THE MATERIAL AND SOCIAL COSTS OF ROMAN WARFARE IN THE THIRD AND SECOND CENTURIES B.C.E.

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ABSTRACT

Bret C. Devereaux: "The Material and Social Costs of Roman Warfare in the Third and Second Centuries B.C.E."
(Under the direction of Richard Talbert)

This dissertation examines the causes of Roman military success and expansion beyond Italy, focusing on the initial period of expansion from the First Punic War (264 B.C.E.) to the defeat of the Cimbri (101 B.C.E.). I argue that, while the current demographic explanation of Roman success in this period, which focuses on seemingly inexhaustible Roman manpower, has validity, it represents only part of a solution which must also include the Roman ability to efficiently mobilize and organize the resources of Italy for warfare. Through the examination and comparison of battlefield equipment recovered archaeologically and described in literary sources, this project investigates the cost of Roman military matériel. This project also seeks to situate that matériel cost in the context of Rome's major rivals in this period in order to show that Rome was able to mobilize comparatively more resources for warfare, both generally and on a per-soldier basis, beyond the established advantage of its manpower. This approach is further extended to include naval warfare, particularly during the First Punic War, by combining the recorded figures for the year-to-year fleet strengths of the Roman and Carthaginian fleets with comparative evidence from the classical Athenian navy to produce rough estimates of the total cost of naval operations. The result of these investigations is to show that Rome's advantage in this period extended beyond manpower to include a superior ability to mobilize a broad range of economic resources. Finally, this project seeks to investigate the sources for this Roman

advantage in resource mobilization. It suggests that the ability of the Roman Republic to marshal such vast reserves was due to the translation of the social institution of *clientela* into a blueprint for the inter-communal system of alliances in Italy, which in turn enabled Rome to efficiently and extensively harness the economic and demographic power of Italy. Rome's rivals were not able to extract revenue and manpower from their own holdings as efficiently, leading to a decisive Roman military advantage.

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LIST OF ABBRIVIATIONS

AAA	Athens Annals of Archaeology
AJA	American Journal of Archaeology
AJP	American Journal of Philology
AW	Ancient World
BCH	Bulletin de Correspondance Hellénique
CA	Classical Antiquity
CAH^2	Cambridge Ancient History, second edition
CB	Classical Bulletin
CJ	Classical Journal
CP	Classical Philology
GRBS	Greek, Roman and Byzantine Studies
Historia	Historia: Zeitschrift für Alte Geschichte
JHS	Journal of Hellenic Studies
JMH	Journal of Military History
JRA	Journal of Roman Archaeology
JRMES	Journal of Roman Military Equipment Studies
JRS	Journal of Roman Studies
Klio	Klio: Beiträge zur alten Geschichte
PBSR	Papers of the British School at Rome
PCPS	Proceedings of the Cambridge Philological Society
TAPA	Transactions of the American Philological Association
ZPE	Zeitschrift für Papyrologie und Epigraphik

MAP 1. PRINCIPLE BATTLES AND THEIR DATES (B.C.E.)

MAP 2. PRINCIPLE ARCHAEOLOGICAL SITES

CHAPTER 1: MATÉRIEL MATTERS

By the end of the year 216 B.C.E., the Roman Republic appeared to be on the verge of collapse. The long conquest of Italy, which had taken nearly three centuries to complete, was unravelling before the stunned eyes of the Roman people. For three years the armies of Rome had been soundly, if not decisively, beaten with Roman losses in excess of 70,000, around one tenth of all of the men, Romans and allies, liable for service in Italy.[1] Lost along with the men were thousands of horses and tens of thousands of sets of armor and weapons. The horses had been slain or run off, but the best of the armor and weapons, now looted, adorned Hannibal's army.[2] Hannibal, like Pyrrhus before him, had shown that Rome's armies were far from invincible on the battlefield.

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[1] The main sources for casualty figures are Polybius and Livy, though their accounting is incomplete and not always in agreement. For the small engagement at Ticinus (218) and the subsequent loss of the Roman sentries to defecting Gauls, neither Livy (21.45-48) nor Polybius (3.65-68) give figures, except for 600 prisoners taken by Hannibal, reported by Livy (21.47). For the Battle of the Trebia (218), Livy gives the Roman army as 38,000 of which only 10,000 arrived at Placentia (21.55-6), a point on which Polybius agrees, but also notes a small number of other survivors (3.74.6-8), suggesting a figure probably quite less than 28,000 losses for the battle, given that routed allies and auxiliaries, mentioned in the battle narrative, are not accounted for. For the Battle of Lake Trasimene (217), Livy gives 15,000 losses (22.7) while Polybius gives 15,000 prisoners taken and an unknown number killed (3.84-65). Livy then also reports the loss of 4,000 cavalry under C. Centenius (22.8), which Polybius also reports but gives no numbers (3.86.4). At the Ager Falernus, Livy reports a skirmish in which the Roman force lost 'a few' (*aliquot*, 22.18); Polybius reports the action and gives 1,000 as the figure for Roman losses (3.93-94). Minucius' army was then roughly handled at Geronium (Livy 22.28-30, Polybius 3.103-105) before rejoining Fabius, but no casualty figures are given. Finally, Cannae, where Livy gives Roman and allied losses at 48,200 (Livy 22.49) while Polybius gives 70,000 casualties as a figure (Polybius 3.117), but his figures here are inconsistent, see J. F. Lazenby, *Hannibal's War : A military history of the Second Punic War* (Warminster: Aris & Philips, 1974), 84. Total manpower following Plb.. 2.23-24. On these figures, see P.A. Brunt, *Italian Manpower: 225 B.C. – A.D. 14* (Oxford: Clarendon Press, 1971), 44-60, 422.

[2] Plb. 3.114.1

And yet the Roman Republic recovered, despite the lost men, the lost allies, the lost prestige, and the tremendous lost wealth in the form of equipment and animals. It recovered not over decades, but almost immediately, fielding 14 legions by the end of 216. Peter Brunt estimates that between 214 and 212 the Romans called up between 225,000 and 240,000 men.[3] It was as if the Romans had never lost the armies at all. Over the following century, Rome would have little rest, careening from one major war to the next while simultaneously dealing with continuous low-intensity warfare in the territories it had won, especially in Spain. For nearly any other state, ancient or modern, such events would be the hubristic prelude to imperial overreach and collapse, but for the Roman Republic this was the road to dominance over the Mediterranean, the path by which Rome would, in Vergil's memorable phrasing, "spare the humbled and war down the proud."[4] But how was it that the Romans were able to defy the odds, despite tremendous setbacks and despite the presence of formidable enemies? How was this tremendous expenditure of men, money and resources possible and why were none of Rome's rivals unable to achieve the same?

This study aims to examine that question by looking at the costs of waging Rome's expansionary warfare during the first phase of Rome's expansion beyond Italy, from the beginnings of the First Punic War (264 B.C.) to the defeat of the last major foreign incursion into Italy under the Republic at the Battle of Vercellae (101 B.C.). This initial phase of overseas expansion marks a crucial turning point in Rome's history; at the beginning of the period, Rome was only one of several powerful states and was by no means the first of that group, but at the end, the Roman Republic suffered no equal in the world that it knew. With the benefit of

[3] Brunt (1971), 418-422.

[4] Vergil, *Aeneid* 6.853, *parcere subiectis et debellare superbos*

hindsight, Rome's expansion seems grandly preordained.[5] But Rome was only one city and the Romans only one people on the Mediterranean with ambition. Thus, the question: why was Rome able to achieve such exceptional success during the third and second centuries B.C.E.?

Militarism and Foreign Policy – the Diplomatic Argument

The diplomatic situation in the Mediterranean, while a promising explanation for Roman expansion at first glance, does not offer an answer to the question of exceptional Roman expansion. This is not to say the Romans were a peaceful people. Rome was, by modern standards, very bellicose and very aggressive, as argued by William Harris in *War and Imperialism in Republican Rome*. Harris posits that Roman society was adapted to warfare, noting that "for a war against some enemy or other, with some 'justification' or other, the Romans expected and intended almost every year."[6] Roman religion and rituals, which might have been checks on Roman bellicosity, became instead legitimization tools for endemic Roman warfare.[7] Accepting this state of affairs as deeply unusual *a priori*, Harris suggests that Roman aggression was fueled by a political structure that strongly incentivized the Roman elite to seek military glory through conquest, reinforced by a citizenry that was at least tacitly supportive of war when not actively motivated "in the hope of gaining land and booty" and by the high value placed on martial excellence in Roman society.[8] Ernst Badian had already made a similar point

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[5] Vergil, of course, suggests as much, *Aeneid* 6.792-807.

[6] W. V. Harris, *War and Imperialism in Republican Rome, 327-70 B.C.* (Oxford: Oxford University Press, 1979), 254.

[7] Harris (1979), 166-175.

[8] Harris (1979), 47.

concerning the imperialism of Late Republic, seeing Roman imperialism as driven by the interests of the ruling class and, in a more limited sense, those of the rising equestrian class as well.[9] As an examination of Roman militarism in isolation, these studies are revealing.

Harris' argument is not comparative, however, and his evidence retains a narrow focus on internal Roman politics. Nevertheless, many of Harris' conclusions carry a comparative flair. Harris notes, for instance, that "the regular harshness of Roman war-methods sprang from an unusually pronounced willingness to use violence against alien peoples."[10] However compared to the picture of brutally realist Athenian imperialism provided by Thucydides or the bloody swath cut by Alexander across the Achaemenid Empire, it is not readily apparent that Roman willingness to use violence against alien peoples really was in fact "unusually pronounced." Likewise, in a clarifying statement in a preface to the 1985 paperback edition, Harris, while admitting that the Romans might not have always been the aggressor, does note that he "finds nothing absurd in the notion that in this period Rome was an exceptionally aggressive state."[11] Kurt Raaflaub, accepting Badian and Harris' vision of an unusually aggressive and rapacious Roman people, attempts to trace this exceptional aggression back to its origins. What he finds is that, "the Romans were not born to be wolves. Rather they turned into imperialists at a certain stage of their communal development," specifically that the Romans were forged into imperialists in a crucible of conflict stretching from the foundation of the Republic until the middle of the fourth century B.C.E., as the fragility of Roman power and even survival in this

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[9] E. Badian, *Roman Imperialism in the Late Republic* (Ithaca: Cornell University Press; 1968).

[10] Harris, (1979), 51.

[11] Harris, (1979), preface.

period necessitated increasing militarism.[12] Thus traumatized, the Roman people then subsequently acted out their trauma on the Mediterranean world as "tough and stubborn warriors to whom warfare had become a normal, if not indispensable, part of their lives…they took on the Samnites–and never looked back."[13] This vision of the Romans as an exceptionally aggressive people, typically presented without substantial use of comparative evidence, exerts a significant influence on the discussion of Roman foreign policy.[14] However, Roman aggression only has explanatory power in as much as the Romans were exceptionally aggressive, such that their unusual behavior conferred an advantage over their neighbors. Despite this need to establish Roman bellicosity as exceptional, most studies of Roman aggression have lacked an explicitly comparative angle.

Some comparative benchmarking is clearly in order, and here arise problems in the thesis that the Romans were an unusually aggressive or bellicose people, because tremendous levels of warfare and violence seem to be common features of pre-modern societies. Far from the peaceful ideal of Rousseau, early humans appear, in as much as evidence survives, to have engaged in remarkably high levels of violence. In *War in Human Civilization*, Azar Gat argues

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[12] K. Raaflaub, "Born to be Wolves? Origins of Roman Imperialism" in *Transitions to Empire: Essays in Greco-Roman History, 360-146 B.C., in honor of E. Badian*, ed. Robert W. Wallace and Edward M. Harris (Norman, OK: University of Oklahoma Press, 1996a), 300.

[13] Raaflaub, (1996a), 300.

[14] See for instance, J. A. North, "The Development of Roman Imperialism," *JRS* 71 (1981): 1-9. R. Rowland, "Rome's Earliest Imperialism," *Latomus* 42 (1983): 749-762. S. Mandall, "The Isthmian Proclamation and the Early Stages of Roman Imperialism in the Near East," *Classical Bulletin* 65 (1989): 89-94. S. Mandell, "Roman Dominion: Desire and Reality" *Ancient World* 22 (1991): 37-42. Harris' view has also been challenged, see for instance: A. N. Sherwin-White, "Rome the Aggressor?" *JRS* 70 (1980): 177-181; A. N. Sherwin-White, *Roman Foreign Policy in the East: 168 B.C. – A.D. 1* (London: Duckworth, 1984); R. M. Kallet-Marx, *Hegemony to Empire: The Development of Roman Imperium in the East from 148 to 62 B.C.* (Berkeley: University of California Press, 1996); J. S. Richardson, *Hispaniae: Spain and the Development of Roman Imperialism: 218 – 82 B.C.* (Cambridge: Cambridge University Press, 2004).

that this endemic warfare was motivated by resource scarcity, combined with the much higher 'returns' to successful warfare than to other activities.[15] Because specialization and productivity in pre-agricultural economies are so low, the greatest gains come from the acquisition through warfare of larger territory and more resources.[16] The level of violence in these early pre-state societies could be truly staggering. Assembling a broad range of studies made of pre-state societies, Gat estimates that the average violent mortality rate of these earliest societies "may have been in the order of 15 per cent (25 per cent for the men)," exceeding even estimated military mortality rates for Rome during the Second Punic War and the century of imperial expansion that followed.[17] Thus Azar Gat suggests that even in the earliest societies, "a fundamental condition of competition and plurality made fighting a norm that very few communities could escape or fail to be prepared for."[18]

Increased production via agriculture, the dominant form of production in the Roman world, paradoxically intensifies rather than ameliorates this violent competition. Production remains closely tied to the amount of land available to a society, but new levels of sophistication

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[15] Azar Gat, *War in Human Civilization* (Oxford: Oxford University Press, 2006), 61-67, 87-113. Likewise, on this topic, but focused more narrowly on pre-state societies, Lawrence H. Keeley, *War Before Civilization: The Myth of the Peaceful Savage* (Oxford: Oxford University Press, 1996).

[16] Gat, (2006), 61-76.

[17] Gat, (2006), 131. Gat notes in comparison Brunt (1971), that Italy may have lost around 20% of its adult male population, but that this burst of mortality was exceptional, even for the Romans. It is worth noting that the estimates for the mortality of this singular exceptional war, typically used to demonstrate the high tolerance of the Romans for violence, only comes close to, but does not exceed, what appears to be the normal state of affairs for pre-state peoples. On military mortality in the Middle Republic, see N. Rosenstein, *Rome at War: Farms, Families and Death in the Middle Republic* (Chapel Hill: University of North Carolina Press, 2004), 107-146. Rosenstein estimates that from 200-168 B.C., Rome's wars produced an excess annual mortality of 3.25% to 3.95% of all soldiers, high in comparison to other pre-modern states, but significantly lower than the estimates Gat presents for pre-state societies.

[18] Gat, (2006), 140.

in organization allow for the labor of conquered populations to be harnessed to the purposes of the conqueror, whether through tribute, slavery or forms of serfdom, which in turn increases potential long-term returns for successful warfare.[19] Greater degrees of social sophistication allowed for more effectively channeled violence and thus more successful warfare, culminating in the emergence of early states.[20] Strategies for successfully coping in a system of militarized anarchy often intensify the violence of the system, a condition which Gat terms the 'security dilemma.'[21] Because power derives from economic and demographic strength, which is in turn dependent on expansion, and because states are forced to seek supremacy in order to render themselves secure (being able to rely only on their own strength), states are forced to expand in order to merely secure their own status quo.[22] Moreover, in order to provide effective security, especially for agriculture which tends to be geographically dispersed, states must not only win battles but also actively keep enemies from raiding their territory. States are thus forced to engage in strategies we might term 'preclusive aggression' by removing threats and often expanding into frontier zones in order to protect their existing holdings, a strategy with ample parallels in Roman foreign policy.[23] The intense pressure of warfare seems to have been a near

[19] See Gat, (2006), 210-230 on high returns from warfare producing social stratification and hierarchy organized around warfare, and Gat, 401-414 more broadly on increasing costs and gains to warfare with the advent of agriculture. This point on the returns to warfare is noted by Harris, see Harris (1979), 56.

[20] Gat, (2006), 231-322.

[21] Gat, (2006), 92-100. Note also A. M. Eckstein, *Mediterranean Anarchy, Interstate War and the Rise of Rome* (Berkeley: University of California Press, 2006), 13-16, on much the same in the Mediterranean world.

[22] Gat refers to this sort of endless escalation as the 'Red Queen effect.'

[23] This is an aspect of security Harris fails to consider in discussing Rome's wars in Italy, considering it a "reason to doubt that defensive thinking was the dominant reason for Rome's Italian wars" that most of those wars were fought outside of Roman territory, Harris (1979) 175-182. But even a state defending itself may well prefer to have the devastation of a defensive war occur on enemy land, especially in an environment where raiding is common.

constant in pre-modern societies. In a perverse irony, societies that failed to victimize their neighbors set themselves up to be victimized in turn, a point which Thucydides places in the mouths of the Corinthian envoys to Sparta.[24]

Thus, we may return to the Mediterranean in order to take a more detailed look at how Rome figures within the diplomatic system it inhabited. Analyzing this problem in two works, Arthur Eckstein concludes that the Mediterranean existed in a system of interstate anarchy in which "the Romans were highly militaristic, bellicose and assertive internationally, but so was every other state."[25] Far from being unique to Rome, Eckstein notes that the bellicose features that Harris identifies, from the prestige accorded to successful commanders to the militarism contained in state religious rituals were a common part of civic life in the ancient Mediterranean state system.[26] Building on the work of Kenneth Waltz, Eckstein explains this state of affairs by arguing that the fearsome pressure of an anarchic interstate environment, one in which "war is normal," produces convergences among competitors such that states rapidly begin to resemble one another in their militarism and bellicosity.[27] Though evidence is limited and obscured by the cultural convergence prompted by Roman expansion, this process appears to be well underway in Italy prior to the unification of the peninsula under Rome.[28]

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[24] Thuc. 1.69.5. Thucydides of course has the Athenians argue that such practices are essentially normal in their own defense, Thuc. 1.76.2. Such sentiments are relatively common, see for instance Xen., *Hell.* 7.5.26; App. 8.53; Thuc. 5.105.2-3; Dem. 3 *Phil* 19-22; on this theme in Thucydides more broadly, see, Eckstein (2006), 48-57.

[25] A. M. Eckstein, *Rome Enters the East: from Anarchy to Hierarchy in the Hellenistic Mediterranean* (Malden: Blackwell Publishing, 2008), 19. On this topic, note also Eckstein (2006).

[26] Eckstein (2006), 181-241.

[27] Eckstein (2008), 16-17. K. N. Waltz, "The Origins of War in Neorealist Theory," *Journal of Interdisciplinary History* 18, no. 4 (1988), 620.

[28] See particularly, P. Kent, "The Roman Army's Emergence from Its Italian Origins" (PhD diss., University of North Carolina, 2012). On the relative similarity of government forms in pre-Roman Italy, note E. T. Salmon, *The Making*

Thus the brutal anarchy in which the Romans were so successful stretches far back before Rome itself, from the calculating and feuding *poleis* of Thucydides through the pages of the *Iliad* to the walls of Mycenae and back before the development of agriculture. This perspective leads to a more nuanced model of the Mediterranean state system, embroiled in opportunistic warfare since the dawn of Mediterranean states, a model which in turn robs Roman bellicosity of its explanatory power and, as Walter Scheidel noted in his review of *Rome Enters the East*, redirects "focus on the problem of unequal outcomes."[29] Thus the riddle of Roman expansion returns: if many of the states and pre-state peoples of the Mediterranean were engaged in the opportunistic pursuit of empire and profit through warfare, why were the Romans so much more successful?

Population and Manpower – the Demographic Argument

That now brings us to what I will term the demographic argument, namely that Rome succeeded because, due to an unusually large or durable manpower base, the Romans were able to field more forces and sustain greater losses than their opponents. This issue was by no means foreign to the ancient sources who seem keenly aware of the need to maintain the population of small, freeholding farmers who made up the bulk of the *assidui*, the citizens liable for military service.[30] Much of the modern scholarship echoes this emphasis on the role of manpower, with Nathan Rosenstein perhaps putting it mostly succinctly, that it was "the massive Italian

of Roman Italy (Ithaca: Cornell University Press, 1982), 1-39, especially the degree to which military leagues become common.

[29] W. Schiedel, review of *Mediterranean Anarchy, Interstate War and the Rise of Rome* by Arthur Eckstein, *Journal of Interdisciplinary History*, 39 no. 1 (2008), 101.

[30] See for instance Polybius 2.24.2-17, 3.89.9, 6.52.11, 18.28-32. Also Plut. *Tiberius Gracchus* 9.4, App.. *Bel Civ.* 1.8-11.

manpower that formed the basis of Rome's military might and imperial success."[31] In his emphasis on manpower, he is hardly alone.[32] The focus on manpower in a relatively narrow demographic sense, that is, manpower as a product primarily of population size rather than administrative or economic factors, is often implicit in the methods and rationale with which the study is approached. Brunt, for instance, justifies writing *Italian Manpower* in part by noting that, "success in war…depended largely on the balance between the forces that Rome and her enemies could mobilize" and proceeds to argue that as a result "an assessment of population is indispensable" for this purpose.[33] Some studies, such as Rosenstein's *Rome at War*, seek to take broader economic and cultural factors into account, but typically focus on those factors as they impact the supply of bodies to the army.[34] Generally missing in these approaches are any treatments of the broader costs of warfare beyond manpower or a strong effort to place Rome in the context of other Mediterranean states. Once again, some comparative benchmarking may be in order.

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[31] Rosenstein, (2004), 107.

[32] For this theme elsewhere in the scholarship, see N. Rosenstein, "Republican Rome" in K.S. Raaflaub and N. S. Rosenstein, eds. *War and Society in the Ancient and Medieval Worlds: Asia, the Mediterranean, Europe and Mesoamerica* (Cambridge, 1999), 193-216; J. E. Lendon, *Soldiers and Ghosts: A History of Battle in Classical Antiquity* (New Haven: Yale University Press, 2005), 166-169; J. P. Roth, *Roman Warfare* (Cambridge: Cambridge University Press, 2009), 43-4, 57, 84-85, P. Erdkamp, "Manpower and Food Supply in the First and Second Punic Wars" in *A Companion to the Punic Wars*, eds. D. Hoyos, (Malden: Wiley-Blackwell, 2011), 58-76, and in general histories, such as C. S. Mackay, *Ancient Rome: A Military and Political History* (Cambridge: Cambridge University Press, 2004), 65. This theme also shows up in broader works of military history, such as Gat (2006), 316-317, citing Brunt (1971). On some of the limits of this theme, see especially J. H. Clark, *Triumph in Defeat: Military Loss and the Roman Republic* (Oxford: Oxford University Press, 2014), 71-75.

[33] Brunt (1971), 3. Brunt also notes, quite correctly, the importance the demographic picture of Italy has on the understanding of Rome's social, economic and political history. My objection to a purely demographic answer to Roman expansion should not be taken as a rejection of demography itself.

[34] Rosenstein (2004). Also in this vein, see K. Hopkins, *Conquerors and Slaves* (Cambridge: Cambridge University Press, 1978), whose thesis is in no small part the target of Rosenstein's revisions.

The Population of Italy in 225 B.C.E.

In order to determine if Roman manpower was truly exceptional, it seems reasonable to begin by asking if the demographic base of Roman manpower was itself exceptionally large. Put more simply, did the Roman state control an unusually large population? Estimating the populations of ancient states is necessarily difficult due to the poor quality to the surviving evidence, and the resulting estimates are by the same necessity only rough approximations. Moreover, in the particular case of Italy, there is significant argument concerning the size and shape of the Italian population. Because establishing a baseline for comparison will be important both here and later in this work, it is worthwhile to discuss, albeit briefly, the debate.[35]

Brunt's *Italian Manpower*, building off of the work of Karl Beloch, remains the starting point for the discussion of the population of Roman Italy. Brunt's conclusion, after an extensive examination of population figures for the second century B.C., provided primarily by Livy, is that the problem facing Tiberius Gracchus was not an absolute population decline, but rather a decline in the number of free-holding farmers who provided the bulk of Rome's armies.[36] This conclusion is bound up with Brunt's estimate of the population of Italy, which provides the basis for what is known as the 'low count.' Brunt concludes that the free population of Italy in 225

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[35] For a more detailed discussion of the debate than what is presented here and the broader implications beyond this study, see L. De Ligt, *Peasants, Citizens and Soldiers: studies in the demographic history of Roman Italy 225 BC – AD 100* (Cambridge: Cambridge University Press, 2012), 1-39 and also W. Scheidel, "Roman Population Size: The Logic of the Debate" in *People, Land and Politics: Demographic Developments and the Transformation of Roman Italy, 300BC – AD 14*, eds. L. De Ligt and S. J. Northwood (Leiden: Brill, 2008), 17-70.. Also note the older, but still quite useful summary of debates on the issue by W. Scheidel, "Progress and problems in Roman demography" in *Debating Roman Demography*, ed. W. Scheidel (Leiden: Brill, 2001a).

[36] Brunt, (1971), 74-81.

B.C., including Cisalpina, was perhaps 4.4 million, with 3 million of those living in Roman controlled peninsular Italy, with perhaps half a million slaves in addition, and that the free population grew very little over the subsequent two centuries.[37] Keith Hopkins, accepting the broad outlines of Brunt's figures, buttressed Brunt's argument by providing a model for both the ruin of the smallholding farming class and the expansion of the slave population implied by Brunt's numbers and his interpretation of the causes of the Gracchan land reform. Hopkins suggested a model of mutually reinforcing developments in which Roman conquest results in long-term deployments that economically ruin the small farmer, while victory at the same time results in an abundant supply of slaves that allows wealthy landholders to purchase the land of ruined smallholders and combine them into large, profitable slave-run estates.[38] If Brunt's analysis was in part to explain the engine that powered the success of the Roman Republic, Hopkins turned that same demographic model, with some expansion, towards the decline of the Republic. Rome's reliance upon rural manpower for its success, in this view, not only gave birth to Roman hegemony in the Mediterranean, it also destroyed the Republic.

Although the 'low count' remains, for now at least, the orthodox position, it has come under attack from multiple angles in recent years. The most direct of these attacks have been the effort of several scholars, most notably Elio Lo Cascio, to revive the 'high count' estimates originally suggested by Tenney Frank, which would posit an Italian population at or above 15

[37] Brunt, (1971), 121.

[38] Hopkins, (1978). Note that Hopkins also moderately revises Brunt's population estimates, suggesting only 4 million free and 2 million slaves for a total population of around 6 million in Italy in 28 B.C.

million in 28 B.C.[39] While the 'high count' argument tends to remain focused on the Augustan census figures, Lo Cascio has also revised population estimates for Italy in 225 B.C. up to between 6 and 8 million, in an effort to show that the 'high count' model does not require an unrealistic level of population growth between 225 B.C. and A.D. 14.[40] Because the 'high count' assumes both a higher population in 225 B.C. and a higher rate of growth in the citizen and allied populations of Italy, it renders the "apprehension of depopulation" surrounding Tiberius Gracchus' reforms very difficult to interpret, with Lo Cascio suggesting that the problem Gracchus was confronting was not demographic at all.[41] Despite Lo Cascio's efforts, however, the low-count remains the orthodox view and is not without its defenders, most notably Walter Scheidel and Luuk De Ligt.[42]

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[39] T. Frank, "Roman census statistics from 225 to 28 BC', *Classical Philology* 19, (1924), 329-41. E. Lo Cascio, 'The size of the Roman population: Beloch and the meaning of the Augustan census figures', *JRS* 84 (1994):23-40. Note also in support of this E. Lo Cascio, "Recruitment and the size of the Roman population from the third to the first century BCE' in *Debating Roman Demography,* ed. W. Scheidel (Leiden: Brill, 2001), 111-37. The key difference between these two counts is how the census figures recorded in the *Res Gestae* are interpreted. The 'low count' relies on the assumption, made by Beloch and Brunt, that the Augustan census figures include not only men but also women and children of citizen status, while the 'high count' estimates assume that Augustus' census followed Republican practice, registering only men.

[40] Elio Lo Cascio and P. Malanima, "Cycles and Stability: Italian population before the demographic transition (225 BC-AD 1900), *Rivista di Storia* 21 (2005): 5-40.

[41] Elio Lo Cascio, "Roman Census Figures in the Second Century BC and the Property Qualifications of the Fifth Class" in *People, Land and Politics: Demographic Developments and the Transformation of Roman Italy, 300 BC-AD 14*, eds. L. De Ligt and S. J. Northwood (Leiden: Brill, 2008), 239-256.

[42] Note for example de Ligt, (2012), and de Ligt, "The population of Cisalpine Gaul in the time of Augustus," in *People, Land and Politics: Demographic Developments and the Transformation of Roman Italy 300 BC – AD 14*, ed. L. De Ligt & S. J. Northwood (Leiden: Brill, 2008), 139-186. For Scheidel, see for instance, W. Scheidel, "Quantifying the Sources of Slaves in the Early Roman Empire" in *JRS* 87 (1997): 156-169; Scheidel, (2001a), 1-82; W. Scheidel, "Human Mobility in Roman Italy I: The Free Population" *JRS* 94 (2004): 1-26; W. Scheidel, "Human Mobility in Roman Italy II: The Slave Population" in *JRS* 95 (2005): 64-79; W. Scheidel, "A Model of Real Income Growth in Roman Italy" in *Historia* 56.3 (2007a): 322-346; W. Scheidel, "Italian Manpower" in *JRA* 26 (2013): 677-688. Scheidel strikes a somewhat more even-handed tone in Scheidel, (2008), 17-70.

While a renewal of the high count' has not caught on generally, Saskia Hin has provided one more option, by arguing for a 'middle count,' where the *civium capita* of the *Res Gestae* refers to individuals *sui iuris*.[43] Hin argues that Polybius' figures for Italy in 225 BC, unlike normal census figures such as those recorded for 234 BC, recorded all men who would be classed as *iuniores* for the purpose of military service, while the records of census figures for Roman citizens record individuals *sui iuris* but, following two passages of Livy, orphans and widows, were excluded.[44] Hin suggests that the reason Livy notes the exclusion of orphans and widows from earlier census records is that in the census of his own day, the ones recorded in the *Res Gestae*, those individuals were counted. Hin does not give a set of final figures for the population of Italy in 225 B.C. However, Alessandro Launaro, applying Hin's method, comes to a count of 4.6 million in all of Italy, including Cisalpine Gaul, with 3.4 million of those living in Roman controlled peninsular Italy.[45]

Perhaps the most meaningful recent development in the argument has been the effort to use archaeological data in an attempt to test the assumptions of each population model. Launaro's *Peasants and Slaves* marshals field survey data to show an overall growth in site numbers which in turn suggests a rising population inconsistent with the stagnant population growth of Brunt's original 'low count' model.[46] Meanwhile, De Ligt in his *Peasants, Citizens*

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[43] S. Hin, "Counting Romans" in *People, Land and Politics: Demographic Developments and the Transformation of Roman Italy, 300 BC-AD 14*, eds. L. De Ligt and S. J. Northwood (Leiden: Brill, 2008), 187-238.

[44] Hin (2008) 202-3.

[45] A. Launaro, *Peasants and Slaves: The Rural Population of Roman Italy (200 BC to AD 100)*, (Cambridge: Cambridge University Press, 2011), 43-4. Launaro subsequently enlarges these figures to account for a 15% undercount, suggesting 4.1 million for peninsular Italy and another 1.2 million for Cisalpina.

[46] Launaro (2011).

and Soldiers proposes a revised ‘low count’ model, suggesting only 2.9 million free persons in peninsular Italy and 4.2 million inhabitants in Italy including Cisalpina and allowing for subsequent population growth to 5.7 million by 28 B.C.[47] De Ligt then tests this new low count model with archaeological data for town numbers and sizes in Italy concluding that the urbanization rates the data reveal cannot be made to support a ‘high count’ estimate.[48] While these works have not settled the debate, Scheidel seems to be correct in suggesting that the area of contention has narrowed to a debate between the revised ‘low’ and ‘middle’ count positions.[49] For the purposes of this study, these two sets of estimates constitute an acceptably small range, implying a population for the Roman Republic in 225 B.C. between 2.9 million (De Ligt’s revised low count) and 3.4 million (Launaro’s interpretation of Hin’s middle count).

The Populations of the Great States of the Mediterranean

Information on the populations of the three major Hellenistic powers, the Seleucid, Ptolemaic and Antigonid kingdoms is far more difficult to come by, as the advantage presented by preserved Roman census figures is not available. Estimating a population for Carthage and its empire is more difficult still. Nevertheless, it is possible to get some sense of where Rome ranked, demographically, compared to the other great powers. Moreover, this exercise is crucial

[47] De Ligt (2012), 71-2, 242-6.

[48] De Ligt (2012), 193-246.

[49] Scheidel, (2013): 677-688.

as a starting point from which to examine the economic basis of these states and their militaries in subsequent chapters.

Without a doubt, the Seleucid Empire held the largest population of any Mediterranean state, as well as the largest total land area by far. Makis Aperghis suggests a population between 14 and 18 million people for the Seleucid Empire at its points of greatest expansion, and his brief regional breakdown suggests a population at the core (Mesopotamia, Syria and the Levant) of the state of between 5.75 and 7.25 million.[50] Walter Scheidel offers a similar estimate, with an upper bound of roughly 15 million.[51] At the low end, Colin McEvedy and Richard Jones' *Atlas of World Population History* suggests a peak population of the Seleucid Empire of around 12.5 million in 200 BC based on regional estimates, although it should be noted that McEvedy and Jones' regional estimates are often substantially lower than estimates of the same regions by specialists.[52] In any case, the population of the Seleucid Empire will have substantially exceeded that of the Roman Republic prior to the end of the Roman-Syrian War. Indeed, for much of the

[50] M. Aperghis, *The Seleukid Royal Economy: The Finances and Financial Administration of the Seleukid Empire* (Cambridge: Cambridge University Press, 2004), 247-8. Aperghis gives regional estimates of 4-5m for Mesopotamia, 1.5-2m for Northern Syria, 0.25m for Judaea. These estimates represent substantial reductions from Aperghis' earlier attempt, M. Aperghis, "Population – Production – Taxation – Coinage" in *Hellenistic Economies*, eds. Zophia H. Archibald, John Davies, Vincent Gabrielsen and G. J. Oliver (London: Routledge, 2001), 77. There, Aperghis suggested a peak around 20-25 million for the Seleucid Empire around c. 280 BCE, and another peak around c. 190 BC, approaching 20 million.

[51] W. Scheidel, "Demography" in *The Cambridge Economic History of the Greco-Roman World*, eds. Walter Scheidel, Ian Morris, Richard P. Saller (Cambridge: Cambridge University Press, 2007b), 45.

[52] C. McEvedy and R. Jones, *Atlas of World Population History* (New York: Puffin, 1978). Breakdown by region in 200 BC: Syria and Lebanon 2m, Palestine and Jordan 0.6m, Iraq 1.25m, Iran 4m, Anatolia 5m. As noted, McEvedy and Jones' population estimates for the ancient world are often surprisingly low. McEvedy and Jones aim to emphasize the impact of modernization on population and thus tend to assume lower populations in ancient and medieval periods compared to the pre-modern. However, note M. H. Hansen, *The Shotgun Method: The Demography of the Ancient Greek City State Culture* (Columbia: University of Missouri Press, 2006), 14 and Walter Scheidel, *Death on the Nile, Disease and the Demography of Roman Egypt* (Leiden: Brill, 2001b), 185-250, on the perils of using 19th century populations as an upper-limit for ancient populations.

third century, the Seleucid Empire's population must have been more than double that of the Roman Republic, even during periods of Seleucid contraction.

More information and thus more estimates are available for the ancient population of Egypt, but most are focused on the population of Egypt as a Roman province, rather than as a Ptolemaic Kingdom. Two ancient figures survive, but neither is trustworthy: 7 million according to Diodorus, amended by Dominic Rathbone to read 3 million, and 7.5 million, excluding Alexandria, according to Josephus.[53] Several estimates converge on a population for Roman Egypt of between 4 and 5 million, including Rathbone and Bruce Frier.[54] At the high end, Peter van Minnen suggests a population of roughly 7.5 million, while Elio Lo Cascio goes further with a population between 8 and 9 million.[55] More recently, Scheidel estimates for Roman Egypt "a deliberately wide range from five to seven million."[56] Estimates for the population in the Hellenistic period tend necessarily to be lower and more speculative. Writing in the *Cambridge Economic History*, Scheidel suggests that the population of Egypt, "fluctuated between perhaps 4

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[53] Diodorus 1.31.6-8. Josephus *Bell. Jud.* 2.385. Note that Rathbone wishes to amend the text of Diodorus to read 3 million. D. W. Rathbone, "Villages, Land and population in Greco-Roman Egypt" *Proceedings of the Cambridge Philological Society* 36 (1990): 103-7. On the weaknesses of these sources, see, Scheidel (2001b), 184-5.

[54] D. W. Rathbone, "Villages, Land and population in Greco-Roman Egypt" *PCPS* 36 (1990): 103-42, gives 5 million for the population of Roman Egypt. Frier and Bagnall largely concur, suggesting a population for Egypt at 4 million under Augustus, rising to 5 million by the high empire. R. Bagnall and B. Frier, *The Demography of Roman Egypt* (Cambridge: Cambridge University Press, 1994) and B. Frier, "Demography" in *CAH*[2], vol 11 eds. A. Bowman, P. Garsney and D. Rathbone, (Cambridge: Cambridge University Press, 2000), 787-816. McEvedy and Jones also give roughly the same estimate, with 4 million in AD1 rising to 5 million in AD 200, McEvedy and Jones (1978), 226-7.

[55] P. van Minnen, *Roman Hermopolis: a study of the social and economic history of an Egyptian town in the first four centuries AD* (Amsterdam: Geiben, 1999). E. Lo Cascio, "La popolazione dell-'Egitto Romano," in *La démographie Historique Antique*, eds. M. Bellancourt-Valdher and J.N. Corvisier (Arras: Artois Presses Université, 1999a).

[56] Scheidel (2001b), 246-7.

and 7 million during the Greco-Roman period," suggesting a lower bound of perhaps 4 million.[57] McEvedy and Jones suggest a peak population in the Hellenistic period of 4 million around 200 BCE.[58] Aperghis gives a lower estimate, suggesting between 3 and 3.5 million for Egypt in the Hellenistic period.[59]

Breaking with the consensus more recently, Willy Clarysse and Dorothy Thompson have estimated, based on a study of the Arsinoite nome, a population of 1.5 million for Egypt in the third century BCE.[60] However Clarysse and Thompson reach this figure by extrapolating from the estimated population density of the Arsinoite nome, which was far from typical, as the authors themselves note, but fail to otherwise account for.[61] As Clarysse and Thompson note, extensive irrigation works under the Ptolemaic dynasty had recently significantly extended and intensified agriculture in the area of the Arsinoite nome, in stark contrast to the Nile proper, which had been settled for millennia and that in the period under examination the process of settlement for the newly arable parts of the Arsinoite nome was not yet complete.[62] Moreover,

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[57] Scheidel, (2007), 45.

[58] McEvedy and Jones (1978), 226-7. McEvedy and Jones' graph suggests a population slightly below 3 million in 300 BCE, rising to 4 million in 200 BCE, before falling again to perhaps 3.5 million in 100 BCE, but the apparent specificity here is false. While the population of Egypt probably was quite volatile, see Scheidel 2001, the evidence does not permit us to speculate on the troughs and ridges of that volatility.

[59] Aperghis (2004), 247.

[60] W. Clarysse and D. J. Thompson, *Counting the People in Hellenistic Egypt* (Cambridge: Cambridge University Press, 2006), 100-102.

[61] Clarysse and Thompson (2006), 101, "The application of the same (low) population density to 20,000 km^2 of cultivable land in Egypt as a whole would result in a total population of 1,200,000 at this early stage of Ptolemaic development. Such a straightforward multiplication is, however, probably unjustified, since the Arsinoite was on most accounts an atypical area." Nevertheless, in order to complete their estimate, Clarysse and Thompson merely add in 300,000 persons to represent the population of Alexandria.

[62] Clarysse and Thompson (2006), 90-1. The authors also note that the region is remarkably atypical for the large number of foundations with Greek names, indicating that Greek settlers made up a large proportion of the population.

Clarysse and Thompson's low population figure requires us to accept an implausibly high rate of growth in order to conform to the estimates for the Roman period population.[63] Given the evidence, Scheidel's higher range for the period seems the most probable, but it will suffice here to note that Ptolemaic Egypt likely had a population somewhere between perhaps 3 million and 4 million, probably on the upper end of that range.

Estimating the population under the control of the Antigonid dynasty is more difficult, in part because of the nature of the estimates available and in part because of the complicated nature of Antigonid control over Greece. No detailed estimate of the population of the Antigonid state has been attempted; however there are estimates for the geographic components of the Antigonid state, particularly during the Classical and Roman periods.[64] The most detailed of these remains Julius Beloch's 1886 study in *Die Bevölkerung Der Griechisch-Roemischen Welt*. Beloch suggests estimates for each of Greece's constituent regions for the Classical period, giving a total population of around 3 million for Greece, including Macedonia and Epirus.[65] While Beloch does not give an estimate for the Antigonid state, it is fairly simple to arrange his

[63] In order to reach even the lower estimate of 4 million in the early Roman period (see n. 46), the population of Egypt would have to grow more than 160% in two centuries, which seems unreasonably high, see Scheidel (2001b), 245 and n. 279. Cf. Estimated growth rates for Italy in the same period ranging from 28% to 71%, Launaro (2011), 165.

[64] Michael Grant, *The Hellenistic Greeks: From Alexander to Cleopatra* (London: Weidenfeld & Nicolson, 1982), 48 suggests estimates for all three successor states, but the figures he gives are implausibly high (30 million for the Seleucids, 7 million for the Lagids, 4 million for the Antigonids) and Grant gives no hints as to where those numbers are derived from.

[65] J. Beloch, *Die Bevölkerung Der Griechisch-Roemischen Welt* (Leipzig: Dunker & Humblot, 1886). While a masterpiece for its time, Beloch's method has flaws. Totals for each region are calculated by taking figures for ancient armies preserved in the sources and, assuming those figures represent all of a region's military-age manpower, multiplying by four (for women and children) and then adding additional numbers of slaves and metics. Such a method is likely to undercount, since it assumes 100% participation by all eligible males in the army, as a result, Beloch's estimates should probably represent a floor on population for the Classical period. On the limitations, see M. H. Hansen (2006), 4-7.

estimates for the purpose, with the result suggesting a little over a million people living in directly controlled territory, and roughly another 1.3 million people in the states of the Symmachy at the beginning of the reign of Philip V.[66]

McEvedy and Jones, using modern borders, suggest a population for Greece of 2.5 million in 400 BC, falling to 2 million by AD 1, a low count that seems implausible given other estimates.[67] Working from population density estimates, Jean-Nicolas Corvisier and Wieslaw Suder suggest 3 million inhabitants for Greece including Macedonia, Epicurs and Thessaly, with 2 million of those south of Thessaly.[68] Corvisier suggests 660,000 in Macedonia and 425,000 in Epirus, both significant increases over Beloch's estimates, but accepts sub-regional estimates which would result in a reduced population for Thessaly.[69] Prior to Chaeronea, Corvisier and Suder suppose Philip II to have ruled approximately 1.6 million subjects.[70] However, Mogens Herman Hansen objects to Corvisier's method of using estimated population density, noting that where our information is more detailed, we find densities significantly in excess of Corvisier and Suder's estimations.[71] Hansen instead tackles the problem through counting *poleis* and estimating their size. He estimates the total population of the Greek world, including Greek

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[66] For the core Antigonid state, Beloch's estimates are: Macedonia 400,000; Thessaly 400,000; Euboea 60,000; and Thrace 600,000, although the interior of Thrace was not controlled by the Antigonids, so only perhaps half this number were under Antigonid rule. For the regions under the Symmachy, Beloch gives Boeotia 150,000; Megara 40,000; Locris and Phocis 60,000; Arcadia 150,000; Argolis 335,000; Achaia 75,000; Epirus: 300,000; Crete: 200,000; Adding together suggests 1,610,000 million in the kingdom proper, with 1,310,000 in the Symmachy.

[67] McEvedy and Jones, (1978), 112-3.

[68] J.-N. Corvisier and W. Suder, *La population de l'Antitiquité classique* (Paris: Presses Universitaires de France, 2000), 32-35. The convergence of Corvisier and Suder's total estimate with that of Beloch's seems intentional.

[69] Corvisier and Suder (2000), 34.

[70] Corvisier and Suder (2000), 44.

[71] Hansen, (2006), 11, n. 39.

colonies throughout the Mediterranean, Macedon and Epirus, to be no less than 7.5 million, a formidable number to be sure.[72] For the Greek mainland, including Akarnania, Thessaly and the Ionian and Aegean Islands, but without Epirus and Macedonia, Hansen suggest 3 to 3.5 million.[73] Richard Billows estimates 1 to 1.5 million Macedonians in the fourth century, a rather high figure, but notes that while Alexander's expedition need not have overly taxed Macedonian manpower, subsequent political chaos and Gallic incursions will have reduced this number somewhat.[74] On the other chronological end, Frier estimates 2.8 million for Greece in the first century AD, with another 2.7 million in the 'Danube Region,' but does not separate Macedonia from the provinces of Moesia and Dalmatia.[75]

The broad range of these estimates, combined with the volatility of Antigonid power in the third century makes any estimate necessarily very tentative. However, it seems reasonable to suggest the population of the Antigonid state proper consisted of perhaps 1 to 1.5 million, including Thessaly and Macedonian possessions in Thrace.[76] To this may be added between 1.3

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[72] Hansen (2006), 27.

[73] Hansen (2006), 32-33. The implication, made explicit on Hansen (2006), 117-118, is that Macedonia and Epirus have a combined population around 400,000 for Epirus and 660,000 for Macedonia in the Classical period.

[74] R. Billows, *Kings and Colonists: Aspects of Macedonian Imperialism* (Leiden: Brill, 1995), 198-203. Billows favorably compares the size of Macedonia in the fourth century (30,000km2) to that of the *ager Romanus* in 230 BC (25,000km2) to support his estimate, noting that the *ager Romanus* supported roughly 1 million citizens at that time. Billows bases his much higher estimate for the region on 19th century population figures, the weaknesses of which are noted above. Note that Billows' estimate does not appear to include the Greeks living in Thessaly, since his concern is ethnically Macedonian manpower.

[75] Frier, (2000), 811-812. The contrast between Frier's figures for Roman Greece and McEvedy and Jones' is instructive.

[76] The lower bound of this estimate is defined by Beloch (1886), see n. 65. The upper bound assumes a more robust population in Macedonia and Thessaly (see M. H. Hansen (2006), 119-20), but still comes in below the numbers suggested by Hansen (2006) or Billows (1995).

and 2 million for the Greek *poleis* of the Symmachy, suggesting a total population under Antigonid control ranging from 2.3 to 3.5 million.[77]

Finally, Carthage. Strabo reports a population of "seventy myriads" (700,000), as the population of the city prior to the Third Punic War, although like all such ancient figures, this one deserves significant skepticism.[78] Beloch suggests a population for the city of Carthage itself between 200,000 and 300,000, but does not estimate a population for all of Carthage's holdings.[79] Ulrich Kahrstedt suggests between 125,000 and 130,000 for the city itself and roughly 2.1 million for the entire empire.[80] Brian Warmington supposes as many as 400,000 people might have lived in the city of Carthage itself, while Gilbert Picard suggests a population of around 100,000 for the city proper, with another 100,000 living in Megara.[81] Walter Ameling has suggested a population within a broad range between 90,000 and 225,000 for the city of Carthage.[82] Dexter Hoyos, assuming roughly 200,000 citizen men, estimates a population of between 700,000 and 800,000 (including around 100,000 resident aliens and slaves) dwelling in

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[77] It seems likely that the Greek states of the Symmachy had a greater population than the core of the Antigonid state, much like the situation in Roman Italy at the time. The lower bound for this estimate is again Beloch (1886). Beloch's figures suggest that we might expect the Antigonids to have controlled through the Symmachy around 60% of the population of Greece excluding Macedonia and Thessaly. Assuming this ratio holds, Hansen (2006) would suggest the states of the Symmachy to have had a combined population between 1.8 and 2.1 million, setting the upper bound on the figure.

[78] Strabo 17.3.15. Note that this figure, while dismissed by D. Hoyos, *Hannibal's Dynasty: Power and Politics in the Western Mediterranean, 247-183 BC* (London: Routledge, 2003), 225, is actually accepted by Werner Huss, *Geschichte der Karthager,* (München: C.H. Beck, 1985).

[79] Beloch, (1886), 467.

[80] U. Kahrstedt, *Geschichte der Karthager von 218-146*, 3 vols. (Berlin, 1913), 133.

[81] G. C. Picard, *Daily Life in Carthage at the Time of Hannibal*, trans. A.E. Foster, (New York: Macmillan, 1961). B. H. Warmington, *Carthage* (Harmondsworth: Penguin, 1964).

[82] W. Ameling, *Karthago: Studien zu Militär, Staat und Gesellschaft* (München: Beck, 1993).

both the city and its territory.[83] Further afield, Hoyos suggests 1.5 to 2 million subject Libyans and Punic allies in North Africa and another 1.5 million in Hasdrubal's Spain, for a total population under Carthaginian control in 221 of 3.7 to 4.3 million.[84] Accepting these estimates as a range, we may tentatively assume Carthage and its empire had a population in the range between 2 and 4 million on the eve of the Second Punic War.

Such an analysis, it must be stressed, is extraordinarily tentative, but serves to establish the point. The Roman Republic, with no more than 4 million people, in terms of population (and thus in terms of raw manpower in the demographic sense) does not appear to have been exceptional in comparison to the great powers of the Mediterranean. Ptolemaic Egypt appears to have had a population of roughly the same size, somewhere between 3 and 4 million, while Antigonid Macedon was probably slightly smaller between 2 and 3.5 million. The Carthaginian Empire is also on the same general order of size and, if Hoyos is correct, could even have a slightly larger population. The clear standout is not Rome but the Seleucid Empire, with a population and land area several times larger than any of its competitors. The third century Mediterranean was thus dominated by five large states of roughly similar size (although the possessions of the Seleucids were the standout) and of a roughly similarly bellicose disposition. From this perspective, Rome's apparent manpower advantage appears at best minimally related to the actual demographics of Roman Italy. Instead, the ability of any ancient state to utilize its own population for war was constrained by social and economic factors far more so than demographic ones, as so we must look elsewhere for the sources of Rome's strength.

[83] Hoyos (2003), 225.

[84] Hoyos (2003), 225-6.

Agriculture and the Organic Economy

Manpower in the ancient world was always constrained by social and economic factors that prevented ancient states from utilizing most of their available manpower reserves. Eligibility for military service was often determined by individual wealth,[85] particularly owing to the need for individual citizens to supply their own equipment in many ancient states. However, this wealth requirement often took on important social significance outside of its immediate economic function. Moreover, certain types of military service might be restricted, either *de facto* or *de jure*, to specific ethnic groups[86] or to individuals of a certain citizenship status.[87] No doubt these limitations will have vexed the rulers of ancient states, who tried, with varying degrees of success, to expand their recruitment bases.[88] However these were often legacy systems deeply entrenched within the social structure that undergirded the state, and were thus often resistant to change.

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[85] Brunt supposes around half of all Romans to have fallen below the property requirement for service at the time of the Second Punic War, Brunt, (1971), 64-66, 417-20, however Rosenstein argues for a much lower figure, perhaps as low as 10%, Rosenstein, (2004), 185-8. In either case, both figures must stand in addition to the number of slaves in Italy (see above) who would also have been ineligible for military service except in absolute emergencies.

[86] Note for instance on the important of ethnic Greeks and Macedonians in the Seleucid army, B. Bar Kochva, *The Seleucid Army: Organization and Tactics in the Great Campaigns* (Cambridge: Cambridge University Press, 1976), 20-48, 56-58. Bar Kochva notes especially that the Seleucids seem to have consciously avoided arming or conscripting Syrians or Mesopotamians, due, Bar Kochva suggests, to internal security concerns, Bar Kochva, (1976), 52. Likewise, though Ptolemy's descendants did make use of native troops, the bulk of the Ptolemaic phalanx remained Macedonian, Christelle Fischer-Bovet, *Army and society in Ptolemaic Egypt* (Cambridge, Cambridge University Press: 2014), 166-191. Ethnically Macedonian manpower also seems to have been a limiting factor for the Antigonids, although they had fewer other ethnic groups to draw upon, Billows (1995), 183-212.

[87] J. Landers, *The Field and the Forge: Population, Production, and Power in the Pre-Industrial West* (Oxford: Oxford University Press, 2003), 285.

[88] On the willingness of certain states to expand political rights in order to gain more access to military strength, see below and in subsequent chapters. Note also reaching for manpower without expansion of political rights, as with the Seleucid 'national contingents,' Bar Kochva, (1976) 48-53, and also with Ptolemaic Egypt, Fischer-Bovet, (2014), 161-166. See also A. Chaniotis, *War in the Hellenistic World* (Malden: Blackwell, 2005), 24-39 on the efforts of Hellenistic states to reach for manpower.

We might expect the relentless pressure of an anarchic interstate system to force states to reach more broadly for manpower, and to a degree they did, but broader economic limits restricted the ability of ancient states to field most of their manpower. As put by John Landers, the problem was "just one more manifestation of the basic question dogging organic economies: how to promote specialization and the division of labour against a background of low productivity."[89] In short, the problem of mobilizing resources for war was primarily an economic problem, but one complicated by added layers of social and institutional constraints. As such, it is useful to discuss in general the economics of the problem of mobilization which will have faced all powers in the Mediterranean world, before moving on to discussing the specific challenges faced and solutions arrived at by Rome and her adversaries.

The roots of all of the economies of the ancient Mediterranean were in agriculture, where the majority of the population labored to produce enough food to feed itself. It is crucial to remember that all of the non-agricultural activities, including not only warfare and the management of the state, but also the production of specialized military equipment, would have to be supported within the relatively small agricultural surplus generated by the countryside. At the same time, economic specialization will necessarily be lower in a society where something on the order of 80% of the population is agricultural. Productivity, rather than the total scale of production, is crucial in this case because military activity requires a surplus, not only to feed the soldiers themselves, but also the workers required to produce and supply essential military supplies: the wood-cutters, shipwrights, blacksmiths, and so on. While it remains a truism that

[89] Landers, (2003), 282.

agricultural productivity in the ancient world was low, it is important to distinguish between different kinds of productivity.

Roman Italy provides a relatively convenient case study for agricultural productivity, as agricultural conditions there are better attested, in no small part due to the focus of ancient agronomists on Italy. Previous scholarship has tended to follow ancient agricultural writers in assessing productivity based on seed yields, but has generally relied on the lowest reported seed yields to generate models of seed productivity at or below 4:1.[90] More recently, Paul Erdkamp has demonstrated that excessively low seed yield figures are the result of an over-selective reading of the sources and an under-appreciation of the range of farming techniques reported by Roman agricultural writers.[91] Instead, Erdkamp argues that ancient seed yields could be as high as 8:1 or even 10:1, with more typical yields as high as 6:1 or 7:1, noting that yields reported in ancient sources are often this high and that ancient methods of agriculture were sophisticated enough to support such yields.[92]

Moreover, even at very low yields, land scarcity hardly seems to explain low agricultural productivity. Put another way, the Malthusian case, that the problem is too many people and not enough land, seems to be untenable, at least in its simplest formation. Pessimistic assessments of the carrying capacity of Italy based on the assumption that about 40 per cent of the land surface

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[90] References for low productivity: D. P. Kehoe, *The Economics of Agriculture on Roman Imperial Estates in North Africa* (Gottingen: Vanderhoeck & Ruprecht, 1988), G. Rickman, *The Corn Supply of Ancient Rome* (Oxford: Clarendon Press, 1980), Rathbone (2000). The very low figures are from Columella, as noted.

[91] P. Erdkamp, *The Grain Market in the Roman Empire: a Social, Political and Economic Study* (Cambridge: Cambridge University Press, 2005). Erdkamp notes in particular a general over-reliance on Columella's overly pessimistic seed yield figures for grain, seed yield figures which are likely selected to serve Columella's argument that there is no profit to be made in cereal farming. On the evidence for relatively high productivity in ancient agriculture, see also G. Kron, "Agriculture" in *A Companion to Food in the Ancient World*, ed. John Wilkins and Robin Nadeau (Malden: Wiley Blackwell, 2015), 160-172.

[92] Erdkamp (2005), 34-38.

was cultivated and using Columella's low seed yield figure of 4:1 suggest that even in this case Roman Italy could have potentially supported a population of 8 million, with more optimistic projections pushing the figures as high as 12.5 million.[93] Such figures would naturally have to be adjusted substantially upwards in the face of Erdkamp's work on seed yields, but they suggest that the population of Italy in the third and second centuries was capable of substantial expansion, a fact increasingly recognized by demographers as noted previously. Yet even if sufficient land to expand production was available and seed yields were not necessarily ruinously low, agricultural productivity remained low. Why?

The problem is not seed productivity or even land productivity, but labor productivity. Large, tightly run estates could potentially be quite productive and allow for substantial surplus. Erdkamp estimates that 50 *iugera* of wheat on an estate cultivated by slaves might produce an annual surplus between 330 and 610 *modii* and that the 'gross agricultural surplus,' defined as production minus seed and labor, might be as high as 70 to 85 per cent on the estates of wealthy landowners.[94] However, large market-oriented estates were not the only form of ancient agriculture, or even the predominant one; rather the countryside was populated in no small part by smallholding households whose production capacity and goals were quite different from the large estates of the wealthy. While bemoaning the fading of the smallholding farmer is a favorite

[93] Willem Jongman, *The Economy and Society of Pompeii* (Amsterdam: J.C. Gieben, 1988), 80-82; Neville Morley, *Metropolis and Hinterland: The city of Rome and the Italian economy 200 B.C. – A.D. 200* (Cambridge: Cambridge University Press, 1996), 46-50; Elio Lo Cascio, "Popolazione e Risorse Agricole Nell 'Italia Del II Secolo A.C." in *Demografia, Sistemi Agrari, Regimi Alimentari Nel Mondo Antico, Atti del Convegno Internazionale di Studi (parma 17-19 ottobre 1997)*, ed. Domenico Vera (Bari: Edipuglia, 1999b), 217-245. Morley's calculations run along the same lines as those of Jongman, but with a smaller assumed fraction of the land in Italy being arable, whereas Lo Cascio arrives at his much higher figure by accounting for yields higher than 1:4 and the use of a short-fallow system. For the limitations of this sort of approach, see de Ligt (2012), 20-39.

[94] Erdkamp, (2005), 46-54.

topos of ancient writers,[95] recent work with survey archaeology has tended to call into question the decline of the Italian smallholder, at least in the period of the Republic.[96] To understand the mobilization of ancient armies it is to these small farmers we must turn.

A 'Typical' Smallholder

Information on smallholders in the ancient world is substantially more limited, so it is necessary to rely on modeling a 'typical' smallholding household in order to approach the problem of agricultural productivity.[97] We may then posit a six member household consisting of a prime-age married couple, an elderly woman (a still living parent), an adult son and two children.[98] Such a family might require something on the order of 4,500,000 calories annually,

[95] See for instance Plut. *Tiberius* 8.1-3, App. *Bel. Civ*. 1.8-9.

[96] See particularly, Launaro (2011) for survey evidence. Likewise, Rosenstein (2004) questions the degree to which the smallholding class will have been depleted in this period. There is more evidence for significance encroachment by large estates during the early empire, see J. R. Patterson, "What Crisis? Rural Change and Urban Development in Imperial Appennine Italy," *PBSR* 55 (1987): 115-146.

[97] Similar, but more extensive and substantial efforts have been made in modeling Roman smallholders by Rosenstein (2004) and Erdkamp (2005). Both models are valuable but have substantial limitations. Erdkamp's model works entirely from ancient units, allowing for a high degree of fidelity to ancient sources, but making some of the calculations (such as the estimated wheat consumption of the household, expressed in *modii*) more speculative. Erdkamp notes the potential importance of wage labor or share-cropping as a strategy for poor Roman smallholders, but does not investigate further. Rosenstein, by contrast, proceeds from modern nutritional estimates, but does probe the potential of adding sharecropped land.

[98] This household is meant to represent merely one plausible arrangement for the purpose of demonstrating the economics constraints on smallholders. The households of Mediterranean small farmers appear in general to have frequently been extended or multi-generational, with a great deal of variation in family size and structure, see Bagnall and Frier, (1994). For the general applicability of the same patterns of family structure in Italy, see, R. P. Saller, *Patriarchy, Property and Death in the Roman Family* (Cambridge: Cambridge University Press, 1994), 43-70. The epigraphic evidence from Italy shows some regional variation, but far more substantial variation in commemoration patterns restrict its use to estimates of minimum family size, see Paul Gallivan and Peter Wilkins, "Familial Structures in Roman Italy: A Regional Approach" in *The Roman Family in Italy: Status, Sentiment, Space* eds. Beryl Rawson and Paul Weaver (Oxford: Clarendon Press, 1997), 239-255.

roughly the equivalent of 200 *modii* of wheat.[99] In practice, our typical farm will likely have produced a range of crops, in part to hedge against the uncertainty of failure in any one type of crop. This strategy will have increased the amount of land the family will have had to keep under cultivation, as other crops, such as barley or legumes have a lower calorie yield per *iugerum*.[100] The average size of a Roman smallholding seems to have been quite small, between 5 and 10 *iugera* and sometimes even smaller.[101] In this case, we may assume a fairly typical farm of perhaps 9 *iugera*, growing a mix of wheat, barley and legumes, in this case beans.[102] As we will see, some quantity of wage labor or sharecropping will have been necessary in most

[99] Efforts to gauge the nutritional requirements of ancient families have proceeded from two methods. The first method, used by L. Foxhall and H. A. Forbes, "Σιτομετρεία: The Role of Grain as a Staple Food in Classical Antiquity" in *Chiron* 12 (1982):40-90 and also used by Rosenstein (2004) has been to proceed from modern calculations of nutritional requirements such as those in the FAO, WHO and UNU, *Energy and Protein Requirements: Report of a Joint FAO/WHO/UNU Expert Consultation*, WHO Technical Report Series, no. 724 (Geneva: WHO, 1985). As Foxhall and Forbes note, however, these figures tend to be extremely high; the report's figures suggest that our typical family would require some 5,692,175 yearly calories (roughly 254 *modii* of wheat). Figures in this report for the needs of adult males substantially exceed the 4 *modii* per month figure ancient sources provide for Roman soldiers and slaves (Plb. 6.39; Cato, *De Agriccultra,* 56) by more than 10%. On the other end, Erdkamp (2005), 49 has attempted to generate subsistence figures using the aforementioned ancient sources; his calculations would suggest our typical family required between 150 and 180 *modii* of wheat, however Erdkamp's figures (which are reduced from the 48 *modii* per year implied by Polybius and Cato) seem excessively low. Here I have opted to split the difference. 200 *modii* of wheat (roughly 1,344kg, using Foxhall and Forbes (1982) for figures for the density of wheat) will contain approximately 4,489,000 calories, or roughly 80% of the 5,692,175 calories required yearly following the FAO report. Following the higher modern figures will increase the family's food requirements (and thus labor requirements) but not enough to push the family into deficit, assuming sufficient opportunities for wage labor or sharecropping are available.

[100] Erdkamp (2005), 48-9, strangely treats a *modius* of wheat, barley or legumes as interchangeable for the purpose of subsistence after harvest. However, a single *modius* of wheat (approximately 6.72kg) will have contained 22,445 calories (3340 calories per kg), while a *modius* of unprocessed barley (approximately 6.465kg) will have contained only 13,951 calories. As noted by Foxhall and Forbes (1982), processing into course barley flour, *alphita*, will have reduced this figure further, to only 12,878 calories per *modius* of barley (measured before sifting and winnowing).

[101] Rosenstein (2004), 75, n.68. Erdkamp, (2005), 47-8.

[102] On legumes available to ancient farmers, see, K. B. Flint-Hamilton, "Legumes in Ancient Greece and Rome: Food, Medicine or Poison" *Hesperia* 68.3 (1999): 371-385.

cases to supplement the output of the farm, so it is important to make an estimate of how much total labor is available to the household for those purposes.

The women of the household will not have been idle, but their labor should probably not be assigned to the pool of available agricultural labor under normal circumstances.[103] Instead the quintessential labor of Roman women was generally textile production, particularly the time intensive spinning of wool.[104] Indeed attentive wool-working was a staple of descriptions of the virtue of Roman women both elite and common, from the commendation of a "tireless attention to wool-working" in the so-called *Laudatio Turiae* and Lucretia's legendary display of virtue spinning by lamplight to Columella's advice that a slave forewoman ought to be attentive to her wool-working and to the famous second century epitaph of a Claudia which declares at the end simply *lanem fecit*: "she spun wool."[105]

Producing enough textiles to provide even a basic level for a Roman household would have been a formidable task, though estimating the scale of that task is necessarily an exercise in

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[103] Note that Rosenstein (2004), 68-69 calculates the labor availability for the Roman family assuming that the women of the household worked full time in the fields.

[104] For a general discussion of the evidence for women involved in textile production, both domestically and commercially, see L. L. Lovén, "Female Work and Identity in Roman Textile Production and Trade: A Methodological Discussion" in *Making Textiles in pre-Roman and Roman Times: People, Places, Identities*, eds. M. Gleba and J. Pásztókai-Szeőke (Oxford: Oxbow Books: 2013), 109-125 and S. Gällnö, "(In)visible Spinners in the Documentary Papyri from Roman Egypt" in *Making Textiles in pre-Roman and Roman Times: People, Places, Identities*, eds. M. Gleba and J. Pásztókai-Szeőke (Oxford: Oxbow Books: 2013), 161-170. Note also M. Gleba, *Textile Production in pre-Roman Italy* (Oxford: Oxbow Books, 2008), 171-8 for evidence for domestic textile production by women in pre-Roman Italy. For similar labor divisions in the Eastern Mediterranean, see E. W. Barber, *Prehistoric Textiles; The Development of Cloth in the Neolithic and Bronze Ages, with Special Reference to the Aegean* (Princeton: Princeton University Press, 1991) and E. W. Barber, *Women's Work: The First 20,000 Years, Women, Cloth and Society in Early Times* (New York: W. W. Norton & Company, 1994).

[105] CIL 6.1527, 31670 (*ILS* 8393), Liv. 1.57.9. Cf. also Suetonius' claim that Livia still wove most of Augustus' clothes, Seut. *Aug*. 73, Col. 12.3.6, CIL 1.2.1211. For an overview of the evidence for textile manufacture in funerary contexts, see L. L. Lovén, *The Imagery of Textile Making: Gender and Status in the Funerary Iconography of Textile Manufacture in Roman Italy and Gaul* (Göteborg, University of Göteburg, 2002), also note Lovén, (2013), 109- 125.

informed guesswork. Cato advises that agricultural slaves be issued a tunic and a cloak (*sagum*) every other year, with the old clothing being made into patchwork.[106] Cato's figures suggest that clothing an agricultural slave required, at minimum, some 43,300cm^2 of cloth every other year.[107] Such an estimate, however, must surely be too low for a free family of the Roman *assidui*, but it is impossible to say how low.[108] If we assume that the family might replace a single complete set of everyday clothing per member per year, then we might estimate our family to need 214,200cm^2 of fabric, at a minimum.[109] In order to produce that much fabric domestically, the women of the family would have to spin approximately 41,500m of thread. If produced in linen fabric, we might assume the entire process would take roughly 2,220 hours merely to spin and weave the fabric, following estimates by Aldrete *et al*.[110] Wool production was more common in Italy, but no detailed estimates of the time intensity of carding, spinning and weaving wool have been published, although given the greater need to process wool prior to

[106] Cato, *de agricultura* 59, *Vestimenta familiae. Tunicam P. III S, saga alternis annis. Quotiens cuique tunicam aut sagum dabis, prius veterem accipito, unde centones fiant.*

[107] This estimate assumes the tunics are made of two panels roughly 1m wide and 1.04m (=3.5 Roman feet, as per Cato) long and that the *sagum* a single panel roughly 1.5m square.

[108] Jinyu Liu supposes perhaps two complete sets of garments per year for Roman soldiers during the Empire, J. Liu, "Clothing Supply for the Military. A look at the Inscriptional Evidence" in *Wearing the Cloak: Dressing the Soldier in Roman Times*, ed. Marie-Louise Nosch, (Oxford: Oxbow Books, 2012), 19-28.

[109] This estimate assumes that for the adult males, everyday wear consists of a tunic and *sagum* as per the previous estimate. Including a toga would dramatically increase the cloth demands, but as a piece of formal wear, it seems unlikely that the toga would be replaced so frequently. For the adult females, this reconstruction assumes the replacement of a somewhat longer tunic of two panels, 0.9m by 1.5m each and a *stola* of roughly the same size. As with the toga, I have left out the *palla*, although as apiece of everyday public wear, it was probably replaced more often. For each of the two children, I have assumed a smaller tunic, perhaps 0.7m by 0.7m. The estimate does not include any of the other myriad uses to which textiles were put to in an ancient household, so it seems likely that any actual number must necessarily be substantially higher.

[110] Time and material estimates for production in linen follow G. S. Aldrete, S. Bartel and A. Aldrete, *Reconstructing Ancient Linen Body Armor: Unraveling the Linothorax Mystery* (Baltimore: John Hopkins University Press, 2013), 149-153.

spinning, it seems likely that woolen textile production would have been even more time intensive than linen.[111] And it should be stressed, such an estimate is necessarily a minimum; it is easy to imagine that a household with the capacity to produce more textiles might either invest that additional time into producing higher quality textiles for the household itself, or in producing materials for sale. Likewise, though wool-working seems to have been one of the primary jobs of free Roman women in the household, this does not preclude specialization between household producers, facilitated by small scale trade or markets.[112]

As a result, female agricultural labor seems only to have been significant at times of peak labor demand, specifically at the harvest.[113] This should come as no surprise; in addition to the demands of wool-working, women performed a range of work in the Roman household which included child-rearing, cleaning and food preparation, all of which was essential to the survival of the smallholding Roman family and could be remarkably time intensive.[114] The same basic

[111] On the technology of textile production, see Gleba, (2008), 37-159; M. Hoffman, *The Warp-Weighted Loom: Studies in the History and Technology of an Ancient Implement* (Oslo: Robin and Russ Handweavers, 1964); M. Gleba and U Mannering, eds. *Textiles and Textile Production in Europe: From Prehistory to AD 400* (Oxford: Oxbow Books, 2012);

[112] Apuleius mentions a poor woman spinning wool for sale in the market, *Metam.* 9.5. For a more recent comparative example from the developing world of how specialization might exist in an environment where household textile production is common, see K. A. Bowie, "Unraveling the Myth of the Subsistence Economy: Textile Production in Nineteenth-Century Northern Thailand" in *Journal of Asian Studies* 51:4 (1992): 797-823. Bowie notes that while most textile production was small-scale and local, not all village women who could spin also wove, or who wove would also spin, with small-scale market interactions being used to exchange production.

[113] For the evidence of women's involvement in agriculture specifically at times of peak labor demand, see Erdkamp (2005), 88-9.

[114] As late as 1900, food preparation and clean-up consumed 44 hours per week of the average American woman's time, with another 14 hours dedicated to laundry and household cleaning, S. Lebergott, *Pursuing Happiness: American Consumers in the Twentieth Century* (Princeton: Princeton University Press, 1993), 50-1. While such modern figures cannot be taken as representative of ancient home life, such tasks were unlikely to be less time intensive in the ancient world.

division of labor appears to have also held for Greek households, albeit with a stronger prohibition against free, citizen women working outside of the home.[115]

This leaves us with the labor of the two adult males, along with potentially some additional labor from the household's children. Columella estimates roughly 290 working days in a year, setting aside 45 days for rain and holidays and another 30 days after the sowing for rest, giving the two adult males in our household a combined total labor of 580 days' worth of labor over the year. Columella gives labor requirements for a variety of crops, suggesting the labor required to cultivate wheat as 10.5 working days for four or five *modii* sown (conveniently the same amount he recommends sowing per *iugerum*).[116] Columella presents barley as less labor intensive than wheat, requiring 6.5 days for 5 *modii* and for beans a total of seven or eight days labor for four to six *modii* sown.[117] Both Michael Spurr and Rosenstein have suggested that Columella has undercounted the labor requirements however, and instead they suggest figures of 14.25 and 19.5 days per *iugerum* respectively for the cultivation of wheat.[118] Assuming that Columella has likewise undercounted the labor requirements of the other crops, we may assume a range between 14.25 and 19.5 working days per *iugerum* of wheat, between 9 and 12 days per *iugerum* of barley and between 10 and 14 days per *iugerum* of beans. Assuming the farm is evenly split between these three crops, the total labor requirement for the farm would be between

[115] S. Blundell *Women in Ancient Greece* (Cambridge: Harvard University Press, 1995), 140-145.

[116] Columella 2.12.1

[117] Columella 2.12.2

[118] Rosenstein (2004), 68. M. S. Spurr, "Agriculture and the *Georgics"* in *Virgil*, ed. Ian McAuslan and Peter Walcot (Oxford: Oxford University Press, 1990), 69-93.

99.75 and 136.5 working days per year, well within the 580 days of labor available to our family's adult males.

The production of such a small farm will, however, not have been generally sufficient to provide for all of the needs of the household, except at exceptionally high yields. At a 4:1 yield ratio, regarded by Erdkamp as the lower end of typical, the total productivity of the farm (with seed for the next crop removed) would amount to 45 *modii* of wheat, 54 *modii* of barley and 36 *modii* of beans.[119] Under these conditions the farm would provide the family with 2,441,708 calories, or 54% of their total requirements.[120] Even a quite robust yield of 6:1 still leaves our typical family short of their total requirements, although only by about 10% of their total needs.[121] A more reasonable moderate yield of 5:1 leaves the family at 72% of their total needs.[122] As Erdkamp notes, the weight of the ancient evidence suggests that most yields will have been between 4:1 and 6:1, with higher yields being possible but fairly rare and probably confined to regions with exceptional productivity.

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[119] Sowing for wheat (sowing 5 *modii* per *iugerum*), barley (6 *modii* per *iugerum*) and beans (4 *modii* per *iugerum*) follows Varro 1.44.1. Columella 2.9 likewise advises sowing 5 *modii* of wheat per *iugerum* on land of medium quality, and 4 *modii* per *iugerum* for beans, but suggests only five *modii* of barley per *iugerum*. It is worth noting that Varro advises sowing less seed on poor group, whereas Columella advises the opposite, suggesting that on rich ground one may sow only 4 *modii* of wheat. Assuming moderate quality land, our family will have sown 15 *modii* of wheat (5 *modii* * 3 *iugera*), 18 *modii* of barley (6 *modii* * 3 *iugera*) and 12 *modii* of beans (4 *modii* * 3 *iugera*).

[120] Following Foxhall and Forbes (1982) for wheat and barley and utilizing FAO, *Food Composition Tables for the Near East* (Rome: Food and Agricultural Organization of the United Nations, 1982) for beans (Table II), 45 *modii* of wheat (approximately 302.4kg) would yield 1,010,016 calories, 54 *modii* of barley (approximately 394.11kg) would yield 753,379 calories, and 36 *modii* of beans (*vicia faba* – approximately 195.48kg) would yield 678,316 calories.

[121] At a 6:1 yield, our family's farm would have produced 75 *modii* of wheat, 90 *modii* of barley and 60 *modii* of beans in excess of seed requirements for the next year, yielding 1,683,360 calories in wheat, 1,255,627 calories in barley and 1,130,526 calories in beans for a total of 4,069,513 annual calories.

[122] At a 5:1 yield, the family farm produces 60 *modii* of wheat, 72 *modii* of barley and 48 *modii* of beans in excess of seed requirements, yielding 3,255,610 total calories.

As a result, the family will have needed, in most years, to supplement the production of their farm with either wage labor or sharecropping. The amount of additional sharecropping the family would require to achieve subsistence varies based on yield. Assuming the sharecropped land produces at the same yield as the family farm and that the sharecropper receives half of the production after seed is removed, it would take an additional 13 *iugera* of wheat to meet subsistence needs at a yield ratio of 4:1, an additional 6 *iugera* of wheat for a yield ratio of 5:1 and only 1.5 *iugera* of wheat at a yield ratio of 6:1.[123] The labor demands of this additional labor, while significant, do not appear likely to have exceeded the labor available to our household; even in the worst case with a 4:1 yield, the additional 13 *iugera* of wheat would require between 185.25 and 253.5 total working days per year, for a total labor demand on the family between 285 and 390 working days out of 580 total days of labor available, leaving the family's available agricultural labor tremendously underutilized.[124]

Wage labor could also have been used in place of sharecropping to make up for the gap between the farm's production and the family's needs. In a fluid labor market, there would have been little difference in returns between labor employed for wages and labor paid in-kind through a portion of the crop. However there is ample reason to doubt that the rural labor market in the ancient world was ever so fluid or well-functioning.[125] Because sharecropping or

[123] On tenancy in the Roman world, see L. Foxhall, "The Dependent Tenant: Land Leasing and Labour in Italy and Greece," *JRS* 80 (1990): 97-114.

[124] This labor demand will have increased greatly during the harvest (see Rosenstein (2004), 69), and at those times employing the labor of the women and children in the family may have been necessary. Most of our evidence for women participating in agricultural labor is in the context of this peak labor demand, see Erdkamp (2005), 88-90.

[125] On the labor market in the Roman world, see P. Temin, *The Roman Market Economy* (Princeton: Princeton University Press, 2013), 114 – 138 and P. Erdkamp (2005), 79-95. Temin is relatively sanguine about how well the Roman labor market functioned, arguing in particular that the slave labor system competed in a single unified market with free labor, but does admit that "the labor market worked better in cities than in the countryside."

agricultural wage labor entailed giving up a significant portion of the harvest to the owner of the land, the marginal cost in labor for additional production beyond the family farm will have been relatively high, that is, it will have taken substantially more labor in sharecropping or wage labor to produce the same amount of food for the family.[126] Such a high marginal cost will have discouraged production beyond the immediate needs of the family, reinforcing a relatively conservative aim for the smallholder's household to produce, as Erdkamp puts it, "subsistence – and a little more" rather than to maximize production.[127] The small surplus produced in this strategy would go to the purchase of the few goods the household did not produce itself, as well as to maintaining the social status of the household and providing for a small reserve against bad times.[128] In either case, even without women laboring in the field through most of the year, a typical Roman smallholding family will have been able to meet this more modest goal of a small surplus over subsistence without using nearly its entire supply of labor.

A Surplus Economy

What our model leaves us with, then, is an economic foundation to any ancient Mediterranean war effort that is long on manpower, but short on the agricultural surplus required

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[126] Foxhall presents a chart of tenancy arrangements in Mexico with tenant's production shares ranging from as low as 9.37% to as high as 81.25%, with the most common arrangement for a tenant that supplied both labor and traction being 50%, Foxhall (1990), 106.

[127] Erdkamp (2005), 96. A similar point is made by Horden and Purcell, who note that the Mediterranean peasantry will have generally aimed to produce more than mere subsistence, partly as security against disaster, P. Horden and N. Purcell, *The Corrupting Sea: A Study of Mediterranean History* (Malden: Blackwell Publishing, 2000), 270-5.

[128] This model of relatively self-sufficient peasants should not be taken to mean that smallholders were entirely disconnected from markets, as smallholders would find themselves sellers of grain in the market in good years and consumers of it in bad years, many smallholders would in fact, be somewhat active in the market economy, Erdkamp (2005), 134-141.

to support activities beyond agriculture. Even under the most difficult circumstances, our model family never used more than 67% of its available agricultural labor, without even needing to employ the women of the household as full-time agricultural workers. Instead the great mass of smallholding families were stingy with their agricultural surplus; what surplus was produced from the land was consumed by families that, as units of labor, were far too large for their farms. Elite estates and larger market oriented farms were more efficient and thus provided a larger surplus, but these were necessarily fewer and in most cases had to rely on the surplus labor of smallholders to thrive. In order to mobilize an army for war, an ancient society would need to extract more surplus from the countryside. This surplus would be required not merely to feed the soldiers, but also to maintain the specialists needed to build and maintain ships, the skilled craftsmen who produced arms and armor, the masses of animals and porters required to keep the army mobile, and also to maintain the elite stratum of society that made war their business and often provided the political and military leadership of the army.

So far, this discussion has avoided discussing these relationships in terms of money. The most obvious reason for this is that not all of the societies on the Mediterranean were fully monetized, so to talk about war economics in these societies in monetary terms is to engage in anachronism. But reducing the discussion of war economics entirely to money also serves to obfuscate key relationships between the nature of the ancient economy and warfare. It was, after all, not precious metals that Rome required for war, but men, equipment, supplies and the will to fight; coinage was merely a means to these ends, not the end in and of itself.[129] While ancient states could briefly surpass their normal limits through debasing their coinage or borrowing

[129] The experience of the Spanish Hapsburgs after the discovery of the New World speaks to the perils of merely expanding the monetary base of a war effort without a concomitant expansion of the overall resource base.

money, both strategies had natural and potentially ruinous limits and neither was sustainable in the long-term with the limited fiscal and monetary tools available to ancient states. Likewise, exploiting precious metal deposits and minting fresh currency could increase the purchasing power of the state, increasing the share of available agricultural surplus at the state's disposal, but only if additional surplus exists to be gathered. All of which returns us to the basic problem, that war required agricultural surplus not only to maintain the soldiers but also the additional economic activities, like the smelting of metal and making of equipment that war required.

The subsequent chapters of this work will go into more detail concerning what is known of the methods for harnessing this basic economic resource, but it is worth briefly covering principles that applied to all ancient societies generally. Ancient societies had four major means for extracting the needed surplus from the countryside: pillaging from the enemy, direct taxes on agriculture, indirect harnessing of the rents of elite landowners, or shifting the costs of warfare onto the larger numbers of small farmers directly. While indirect taxes were certainly available to ancient states as a fifth method, they remained small as a portion of total revenue in most cases.[130] The relatively small agricultural surplus also meant that the amount of economic activity outside of agriculture remained relatively small, leaving significantly less value to be captured with indirect taxes on non-agricultural activity than with taxing agriculture directly. In

[130] Tenney Frank concludes that indirect taxes in Italy were a very small part of Roman revenue even before the establishment of overseas tribute, T. Frank *An Economic Survey of Ancient Rome*, vol. 1 (Baltimore: John Hopkins University Press, 1933), 79. Instead, it was the *tributum*, an direct tax on wealth, that was the primary tax to pay for state military activity in Rome prior to 167 B.C., Claude Nicolet, *Tributum, recherches sur la fiscalité directe sous la républicque romaine* (Bonn, Rudolf Habelt Verlag: 1976), 16-19; Lutz Neesen, *Untersuchungen zu den direkten Staatsabgaben der römischen Kaiserzeit (27 v. Chr. – 284 n. Chr.)* (Bonn: Rudolf Habelt Verlag: 1980), 4-5. On Roman indirect taxes generally, see Sven Gunther, *"Vectigalia nervos esse rei publicae"* in *Die indirekten Steuern in der Römischen Kaiserzeit von Augustus bis Diokletian* (Wiesbaden: Harrasowitz Verlag, 2008). On indirect taxes in the Seleucid Empire, see Aperghis (2004), 152-163, who likewise suggests that the taxes on land were likely more significant than indirect taxes and other sources of revenue, 169.

all cases, it is important to recognize that these methods were often the result of social evolution rather than intentional design, and of course that these methods of resource mobilization were not mutually exclusive. Indeed, most ancient states and pre-state peoples relied on an often *ad hoc* combination of all of these methods, with substantial variation between states and societies.

Pillaging from the enemy is perhaps the most obvious means of sustaining a war effort, but also the least reliable as no ancient army could ensure that it would always operate in the territory of the enemy or that it would always be victorious. Cato's famous declaration that "the war will feed itself" seems to have been rarely fully realized in practice, though looting equipment and subsisting an army off of the countryside of an enemy were frequent strategies to deflect costs.[131] Post-war indemnities or the seizure of state treasuries also fit under the rubric of forcing the enemy to pay for one's own warfare. However such indemnities rarely covered all or even most of the full economic costs of warfare.[132] While the extraction of regular tribute could emerge as the formalization of pillage or indemnity, such relationships lead to the formation of 'military patronage states,' where the conquering state provides security in order to facilitate the production of a surplus to maintain military operations. Such ancient states were, as Fergus Millar noted of the Seleucids, "primarily a system for extracting taxes and forming armies," and their activities in exchanging security for taxes fit better under the rubric of direct taxation than

[131] Livy 34.9.12. On the limits of strategies of fiscal deflection in general, see Landers (2003), 300-308. On the specific limits of obtaining supply locally through compulsion and 'living off the land,' see P. Erdkamp, *Hunger and the Sword: Warfare and Food Supply in Roman Republican Wars (264 – 30 B.C.)* (Amsterdam: J. C. Gieben, 1998), 122-140.

[132] Ironically, the limited administrative power of ancient states made it difficult to do lasting damage to the underlying economy through such indemnities, a feature aptly demonstrated by Carthage's rapid recovery from the heavy indemnities imposed by Rome after the First Punic War, despite continued warfare in Africa: Plb. 1.62.-8-1.63.3. Note a second Roman imposition, Plb. 1.88.12, and subsequent Carthaginian overseas expansion, Plb. 2.1.5-9 and 2.13.1-7. See Dexter Hoyos, *Truceless War: Carthage's fight for survival 241 to 237 B.C.* (Leiden: Brill, 2007). Perhaps an exception to this rule, the wealth gained by the seizure of the Macedonian treasury after Pydna was much greater, some 6000 talents, Plb. 18.35.5.

cost deflection.[133] So strategies of cost deflection, either during war or after, could only take an ancient state so far in covering the costs of endemic warfare and generally not very far at that.

More promising are direct taxes on agriculture. Direct taxes on smallholders forced these farmers to produce more in order to maintain subsistence while still paying the taxes. Such taxes in the ancient world were uncommon in smaller states and generally irregularly collected in either Greek *poleis* or in Italy, although Rome appears here to be an exception.[134] The Roman direct wealth tax in Italy, the *tributum*, was an extraordinary tax tied to the raising of armies and the amount collected seems to have varied year-on-year.[135] Regular direct taxation was more common in larger states which could not rely on either elite civic-mindedness or devolution into a patriotic class of freeholders to subsidize a large portion of the costs of warfare. Aperghis notes that direct taxation, combined with the direct holding of royal lands, seems to have made up the bulk of Seleucid royal revenue, and direct taxes on tributary land may have been as high as 30%.[136] Outside of Italy, in Sicily, the Romans also collected such a tax regularly, the *decuma*, a 10% tax on grain, and such direct taxes formed the bulk of income from the provinces the Romans subsequently acquired.[137] Such direct taxes, of course, could be collected in kind as well as in coin, but direct taxation in either coin or kind also tended to prove onerous for the

[133] Fergus Millar, "The Problem of Hellenistic Syria" in *Hellenism in the East: The interaction of Greek and non-Greek civilizations from Syria to Central Asia after Alexander*, eds. Amélie Kuhrt and Susan Sherwin-White (London: Duckworth, 1987), 129-30. Rolf Strootman, "Kings and Cities in the Hellenistic Age" in *Political Culture in the Greek City after the Classical Age* eds. Onno M. van Nijf and Richard Alston, (Leuven, Peeters, 2011), 144-5. N. di Cosmo, "State Formation and Periodization in Inner Asian History" *Journal of World History* 10.1 (1999): 1-40.

[134] Neesen, (1980), 4.

[135] Nicolet, (1976), 19-26.

[136] Aperghis (2004), 146-7.

[137] Cic. *Ad. Ver.* 2.3.12-15.

farmers and difficult to administer for the state.[138] The cost of maintaining either the bureaucracy to directly administer such taxes would naturally lessen the efficiency of such a tax, as would merely delegating that administration to tax farmers who would, after all, need to extract a profit for their time.

Another way to force the countryside to give up its surplus would be through the extraction of rents. The most direct method would be for the state to claim ownership of the land and lease it out directly, collecting rents for the use of the land, as in the case of some of Rome's *ager publicus*, particularly the *ager censorius*, which was leased out by the censors.[139] Because the labor would be fed out of their portion of the proceeds, any rents so extracted would be purely surplus. Alternately the state could attempt to extract this surplus through elite landowners whose land was worked by slaves, tenants or sharecroppers. In all cases, the agricultural product extracted as rents by the landowner, above what needed to be paid to tenants (or maintain slaves) or to upkeep or improve the land itself, will have been surplus. While much has been said by writers both ancient and modern on the ideal self-sufficiency of elite estates, in practice, the wealthy landowner needed the surplus from his estates to sustain his own status and lifestyle.[140]

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[138] On taxes in kind, see R. Duncan-Jones, *Structure and Scale in the Roman Economy* (Cambridge: Cambridge University Press, 2002). Polybius notes the onerous nature of *tributum* in Italy during the first Punic War, Plb. 1.58.9. On the administration of direct taxes, Aperghis notes that Seleucid direct taxes required extensive and precise assessment, Aperghis (2004), 137-152. Both the Romans and the Seleucids utilized intermediate tax farmers in order to reduce administrative burdens on the state, E. Badian, *Publicans and Sinners: Private Enterprise in the Service of the Roman Republic* (Ithaca: Cornell University Press, 1972).

[139] S. T. Roselaar, *Public Land in the Roman Republic, A Social and Economic History of* Ager Publicus *in Italy, 396-89 B.C.* (Oxford, Oxford University Press, 2010), 119-133.

[140] Erdkamp (2005), 106-120. Morley, (1996), 86-90.

Such concentrated wealth was easier for smaller states to tap into, either with compulsion or through more or less voluntary expressions of civic-mindedness. In classical Athens, these elite contributions tended to find expression through expensive liturgies, most notably the trierarchy, and emergency taxes such as the Athenian *eisphora* of 428/7. *Poleis* in the Hellenistic period increasingly relied on voluntary euergetism, often connected to the holding of public office.[141] Perhaps the most significant advantage of this method, especially for smaller states in the ancient world, was the relatively low administrative overhead required for an arrangement that often merely mandated that the wealthy themselves pay for certain state functions.[142] Because such a mechanism relies heavily on the civic-mindedness of a city's elite, euergetism as a means of state finance scales poorly to larger states. While involved in systems of euergetism, Hellenistic states more often acted as benefactors, through the personal benefactions of their kings, rather than as recipients.[143]

The final option was to shift some of the costs of warfare directly onto the small farmers themselves, effectively privatizing parts of the war effort, although it is worth noting that for many ancient societies which had never had entirely state-run warfare there would be no sense

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[141] The *eisphora*, a direct tax against the property of the wealthy was levied in 428/7, raising 200 talents (Thuc. 3.19.1) but probably abandoned by 425/4. On the scale of elite spending, both voluntary and not, see David M. Pritchard, *Public Spending and Democracy in Classical Athens* (Austin: University of Texas Press, 2015), 42-48, 93-6. On the tension between democratic politics and euergetism in state finance, see Edward Ch. L. van der Vliet, "Pride and Participation. Political Practice, Euergetism, and Oligarchisation in the Hellenistic *Polis*" in *Political Culture in the Greek City after the Classical Age*, eds. Onno M. van Nijf and Richard Alston (Leuven, Peeters, 2011), 155-184.

[142] Elite gifts, especially when in the form of trusts or donations towards specific practices, could entail some administrative overhead in the management of the money once in state hands, see Kaja Harter-Uibopuu, "Money for the *Polis*, Public Administration of Private Donations in Hellenistic Greece" in *Political Culture in the Greek City after the Classical Age*, eds. Onno M. van Nijf and Richard Alston (Leuven: Peeters, 2011), 119-139.

[143] Klaus Bringmann, "The King as Benefactor: Some Remarks on Ideal Kingship in the Age of Hellenism," in *Images and Ideologies, Self Definition in the Hellenistic World*, eds, A. W. Bulloch *et al*. (Berkeley: University of California Press, 1993), 7-24.

that these activities somehow inherently 'belonged' to the public sphere. Such privatization, though a conspicuous feature of the Roman Republic, was not unique to it or to the ancient world.[144] As a method of mobilization, the privatization of some or most of the costs of warfare had the advantage of limiting the necessary administrative overhead, which was a significant benefit for ancient states that often had relatively few administrative officials. In practice, privatizing the costs of warfare worked, much like direct taxes, by forcing smallholders to increase production, either by working more land or by working land more intensively, in order to meet the new costs while maintaining subsistence. This cost shifting could take the form of requiring soldiers to bring their own equipment or pay for their own supplies, or in the form of recruitment by conscription with below-market-value pay for soldiers, all mechanisms used not only by the Roman Republic but also other ancient states.[145] This practice could prove very potent, especially in a context where state resources were often small compared to the total size of the economy. Moreover, for pre-state peoples, where there was even less in the way of administrative structure, some practice of devolution, either onto individuals or onto wealthy grandees was effectively unavoidable.

Mobilization through private expenditure was not without its limitations, however. Most systems of this sort were forced to exchange at least some degree of political involvement, or at least group membership in order to motivate private buy-in in the war effort. It is possible, of course, to conscript unwilling recruits by force, but it is much more difficult to convince them to

[144] Landers, (2003), 285-287, 304-6.

[145] The *stipendium* for Roman soldiers in the period very small and decidedly below market value, Plb. 6.39.12. The rations for Romans (but not allies) was then deducted from that value reducing it further, Plb. 6.39.14.

spend their own money in the process.[146] As a result, this form of mobilization came with political costs. Indeed, military participation was one of the major sources of leverage used during the struggle of the orders in Rome to obtain political concessions from the then-dominant patricians. Livy draws attention to the connection between military service and political voice in his account of Lucius Verginius and the fall of the *decemviri*. Livy has Lucius Icilius predict, correctly, that Verginius, on account of his military service and position as a centurion, could count on the aid of the soldiers.[147] Verginius, for his part uses his military service as his chief argument to obtain legal help and when initially thwarted by a corrupt judge declares "I cannot believe a people will endure this who have arms."[148] As Kurt Raaflaub notes, eligibility for military service was what changed well-off Plebians "from nobodies to somebodies" who could then effect political change.[149]

Such a phenomenon was not unique to the Romans. Political involvement and military service were deeply interconnected in most Greek *poleis*, a point recognized by Aristotle in the *Politics*, who notes that "When, however, states began to increase in size, and infantry forces acquired a greater degree of strength, more persons were admitted to the enjoyment of political rights."[150] Even though serving under a king, Macedonian soldiers in the age of Philip and

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[146] Landers, (2003), 284-5.

[147] Livy 3.45.9. Verginius' successful appeal to the soldiers is what provokes a full crisis and brings down the *decemviri*, Livy 3.50.

[148] Livy 3.47.2-7. *passurine haec isti sint, nescio: non spero esse passuros illos, qui arma habent.*

[149] K. Raaflaub, "From Protection and Defense to Offense and Participation: Stages in the Conflict of the Orders" in *Social Struggles in Archaic Rome: new Perspectives on the Conflict of the Orders*, 2nd Edition, ed. Kurt A. Raaflaub (Malden: Blackwell, 2005), 197.

[150] Aristotle, *Politics* 1296b16-28. αὐξανομένων δὲ τῶν πόλεων καὶ τῶν ἐν τοῖς ὅπλοις ἰσχυσάντων μᾶλλον πλείους μετεῖχον τῆς πολιτείας. On the connection between military service and political involvement in early Greek *poleis* generally, see Kurt A. Raaflaub, "Homer to Solon: the Rise of the Polis, The Written Sources" in *The Ancient Greek City-State: Symposium on the occasion of the 250th Anniversary of the Royal Danish Academy of Sciences and*

Alexander expected to be able to petition their king, and even that their king might have to justify himself to them.[151] Because group membership in these systems was often exclusive, these relationships were difficult to scale up, a problem demonstrated perhaps most notably by the sharp negative reaction to Alexander's effort to include ethnic Persians in roles typically reserved for Macedonians in his army.[152] Thus while effective, devolving costs onto either elite landholders or the smallholding class was generally restricted to an often small group of stakeholders in the community which was difficult to expand effectively.

Prices, Costs and Warfare

Whatever the method of used to acquire and spend the surplus, certain costs will remain regardless. Here it is important to clarify the distinction between costs and price. Price refers to the amount paid for a good or service in a transaction, typically measured in money. An object given away freely may thus rightly be called priceless, as there was no price in the transaction, but such an object is not costless, as the object's production still incurred costs in time, labor and

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letters, July 1-4 1992, ed. M. H. Hansen (Copenhagen, Det Kongelige Danske Videnskabernes Selskab, 1993), 41-105, Kurt A. Raaflaub, "Soldiers, Citizens and the Evolution of the Early Greek *Polis*" in *The Development of the* Polis *in Archaic Greece*, eds. L. G. Mitchell and P. J. Rhodes (London: Routledge, 1997), 49-59, and Walter Donlan, "The Relations of Power in the Pre-State and Early State Polities" in *The Development of the* Polis *in Archaic Greece*, eds. Lynette G. Mitchell and P. J. Rhodes (London: Routledge, 1997), 39-48. On the expansion of political involvement for the lower classes in Athens specifically as a result of a shift to naval warfare, see Kurt A. Raaflaub, "Democracy, Power and Imperialism in Fifth-Century Athens" in *Athenian Political Thought and the Reconstruction of American Democracy,* eds. J. Peter Euben, John R. Wallach, and Josiah Ober (Ithaca, Cornell University Press: 1994), 103-148, and Kurt A. Raaflaub, "Equalities and Inequalities in Athenian Democracy" in *Demokratia: A Conversation on Democracies, Ancient and Modern*, eds. Josiah Ober and Charles Hedrick (Princeton, Princeton University Press, 1996b), 139-174.

[151] Arr. *Anabasis* 5.25.-29, 7.8.1-7.11.9. Cf. also the rebuke of Hermolaus in Curtius Rufus, 8.7.1.

[152] Arr. *Anabasis* 7.6.2-5, 7.8.1-3. The subsequent banquet, Arr. *Anabsis* 7.11.8, served to confirm the central place of the Macedonians in literal fashion, by seating Alexander at the center, with the Macedonians around him, the Persians next, and all others pushed to the fringe.

resources. Discussions of prices in the ancient world are necessarily difficult. Price data in general for the ancient world are scarce and often unreliable. Moreover, a great many economic interactions in all ancient societies were not conducted through market exchange, and thus have no price, monetary or otherwise, to assess. While this study will occasionally refer to some of the few figures we have for prices in the ancient world, or to price *comparanda* from other pre-modern societies, these should be understood not as meaningful on their own, but only as a way to reach the more important piece of information: cost.

In this study, the term cost is taken to mean, more precisely, opportunity cost, that is the cost of forgoing other opportunities in order to perform an activity or produce an object. In technical terms, the opportunity cost of something is the value of the 'next best' option for the use of the same inputs of time, resources and money. For example, the money used to purchase a bronze helmet for a soldier could have gone towards any number of other activities, with the opportunity cost of the bronze helmet being the value of the 'next best' forgone option. At a more basic level, the smith who forged the helmet could have produced a different object with that metal, or if no helmets were required at all, taken up another tradecraft entirely. In this sense, cost encompasses all of the outputs forgone in order to produce or acquire a good, that being in essence the 'true cost' of something, accounting for the resources consumed, the time and expertise spent, and the other options forgone.

These costs can then be divided into two conceptual units, production costs and transaction costs. Production costs are all of the costs directly related to the production of the equipment and supplies required for warfare. These production costs will include not only, for instance, the metal required to forge a sword, but also the cost of setting up production facilities (capital costs) and even the costs of food and necessities needed to maintain not only the craftsman who forges the sword itself, but also the many miners, smelters and strikers required to produce and process the ore to produce the final product.[153] On top of these costs, we must also consider transaction costs; that is the cost required to acquire and move the supplies and equipment. For instance, the grain used to feed an army might have a relatively low production cost, but a high transaction cost if it must be shipped a long distance to reach the army, or if the official in charge of its purchase is corrupt and pockets a portion of the sale. For the purposes of this study, transaction costs include not only the costs associated with the immediate acquisition of equipment and supplies, but also the costs and inefficiency losses associated with acquiring the revenue in the first place. As a result, each step in the chain from levying taxes to the final deployment of the army on the battlefield entails transaction costs and thus reduced efficiency. The total cost of either a fleet or an army would thus be the sum of all relevant production and transaction costs.[154]

At a basic level, production costs are not meaningfully impacted by the method of exchange. A soldier may, for instance, be issued a grain ration at state expense, or the value of that ration may be deducted from his pay (the same thing in all but an accounting sense), or he may be given a small stipend with which to buy the grain, or he may even plunder the grain from the enemy, but the amount of grain he consumes and the amount of labor and resources that went into producing that grain (and that thus cannot be used for other purposes) remains the same. Likewise, a weapon may be purchased individually or at state expense, or be given as a gift or plundered, but it must still be forged nonetheless. This is particularly relevant for non-monetized

[153] Even this understates the full costs of any worked metal object, which would also have to account for the acquisition of large quantities of fuel for both the smelting and forging (or casting) processes.

[154] The cost of warfare in its entirety would be higher still, as it must include the cost of the destruction warfare entails, see Landers (2003), 300-308, 334-354.

or minimally monetized societies (such as those in Spain and Gaul), where few of the costs of warfare would have been expressed in monetary terms. Even without monetary transaction, production costs remain the same. Given that the economic growth rate in the ancient world was very low, at least by modern standards, it follows that differences in overall productivity, at least between the more densely settled and urbanized regions, were also fairly low, meaning that these basic costs of production are likely to have been reasonably similar from one ancient state to the next, although we lack the evidence to be sure on this point.[155] While some areas will have enjoyed some productive advantage over others, these advantages are likely to have been slight.

However, differences in the transaction costs associated with raising armies and navies for warfare could have been significant, and transaction costs, including transportation costs, in some cases will have dwarfed production costs. Over long distance, the cost of transporting supplies, particularly food and water, could often exceed the cost of the supplies themselves.[156]

[155] In order to sustain the prevailing model of significant but relatively low growth, especially in the presence of increasing economic connectivity through trade, differences in productivity between regions would also need to be relatively small (though not necessarily insignificant). If regions had significant differences in productivity as a result of production methods, the diffusion of those methods, which was taking place in this period and especially subsequently, would result in substantial economic growth. Alternately, if large differences in productivity were the result of local factors, the result would be substantial local comparative advantage, which would cause the observed increase in trade over the period to result in more pronounced growth. While there is evidence for both of these processes occurring at some level, the limited scope of those changes, combined with relatively muted evidence for change in overall productivity would suggest, in conformity with the prevailing model of relatively low, if significant, growth, that differences in productivity in the Mediterranean world were relatively small and more dependent on local factors like soil fertility. On the significant but relatively low rate of growth in this period and subsequently under the Roman Empire, see Richard Saller, "Framing the Debate over Growth in the Ancient Economy" in *The Ancient Economy*, eds. Walter Scheidel and Sitta von Reden (New York, 2002), 251-269. On technological diffusion generally, note K. Greene, "Technological innovation and economic progress in the ancient world: M. I. Finley reconsidered," *Economic History Review* 53.1 (2000): 29-59. On technological diffusion in agriculture and the agronomists, see Morley, (1996), 71-82, 115-129. That the scale of trade rose generally over the period has been demonstrated convincingly by archaeology, see A. J. Parker, *Ancient Shipwrecks of the Mediterranean & the Roman Provinces* (Oxford: Tempus Repartum, 1992).

[156] On transportation losses for food supplies, see Roth (199), 156-219, Erdkamp (1998), 15-26, Donald W. Engels, *Alexander the Great and the Logistics of the Macedonian Army* (Berkeley, University of California Press, 1978), 14-22. On water, G. Moss, "Watering the Roman Legion," (master's thesis, University of North Carolina at Chapel Hill, 2015).

In addition to transportation losses, transaction costs also include inefficiency losses at each stage of mobilization. Polybius famously cites a resistance to corruption as a Roman strength, but these inefficiency losses extend beyond simple corruption to include tax and conscription resistance and the cost of the administrative overhead necessary for tax extraction and mobilization.[157] A state that requires large numbers of tax officials in order to gather the revenue necessary to engage in warfare is incurring a transaction cost maintaining those officials as those officials are a large part of the cost of moving resources from the countryside where they originate to the point where they can be used for warfare. These inefficiency losses occur independently of the effectiveness of the actual revenue extraction measure, which is to say that a state may be able to extract a very large portion of the available agricultural surplus of its territory, but find it can only do so at the cost of very high inefficiency losses, such as those through administrative overhead, with the result that the added revenue does not outweigh the increased inefficiency losses.[158] Because transaction costs are heavily dependent on the methods and institutions used to gather resources and mobilize them for warfare, the difference in transaction costs between different societies and states can potentially be quite large.

The fundamental scarcity of resources also forced ancient states and societies into trade-offs between quality and quantity. Significant quality costs, either through training and experience or better equipment meant that fielding better soldiers usually meant fielding less of them.[159] While relatively cheap light infantry still remained important in battle, by the third

[157] Plb. 6.56.12-15.

[158] Perhaps the most obvious example of this phenomenon in action would be cases in which high tax rates triggered revolts.

[159] Landers, (2003), 291-296.

century B.C. the battlefields of Mediterranean were dominated by the more expensive heavy infantry and cavalry, with most armies adopting a combined arms framework (with lighter missile infantry, heavy infantry and cavalry) where the heavy infantry was the primary arm.[160] Where equipment was state issued and training was formalized, the trade-offs between quality and quantity are relatively obvious as more expensive equipment and more extensive training times will have consumed scarce state revenues. Nevertheless these 'quality costs' will have remained in force even when the cost of recruiting soldiers was non-monetary; as noted above, high quality soldiers had a tendency to successfully demand political concessions from their leaders.

In other cases, as with other parts of the mobilization system, the informal systems and formal institutions which controlled the tradeoff between quality and quantity were often legacy systems resistant to change. Even in systems where the acquisition of military equipment was substantially privatized, the quality of equipment would depend significantly on the underlying economic makeup of individual households and on patterns of landholding, since most of the soldier-supplying households would have been smallholders. While a countryside with fewer but better landed and thus wealthier households would produce more expensively equipped soldiers, it would produce fewer of them, given the scarcity of land. Substantially altering those tradeoffs would have been difficult for any ruler as landholding patterns were typically resistant to change, although the creation of Hellenistic military settlements in the east and of Roman

[160] On the size of the cavalry in Antigonid armies, see M. B. Hatzopoulos, *L'organisation de L'armée Macédonienne sous les Antigonides: Problèmes Anciens et Documents Nouveaux* (Athens: Boccard, 2001), 34. On the size of the cavalry in Roman armies, see Plb. 6.20.9 and L. Keppie, *The Making of the Roman Army: From Republic to Empire* (London: BT Batsford, 1984), 33-35. Comparative evidence suggests that an individual cavalryman might have been perhaps a bit more than twice the cost of a heavy infantryman, see Landers (2003), 295-6 and H. Elton, *Warfare in Roman Europe AD 350-425* (Oxford: Clarendon Press, 1996), 122.

colonies in Italy both represent unusual opportunities for shaping these factors.[161] Moreover, where there were opportunities to shape patterns of landholding and settlement, rulers often faced a range of competing political, military and economic objectives.[162] Finally, ethnic and auxiliary contingents often fought in their own cultural styles and with their own equipment that would have been difficult and often counter-productive to change.[163] Whether the compromise between quality soldiers and the quantity of soldiers was struck by the state or imposed on it by socially embedded legacy systems, the result remained that the two values were opposed, given a set amount of available agricultural surplus to be 'spent,' either directly or indirectly, on warfare.

The result of all of these factors is that the question of military power in the ancient world was fundamentally a question of extracting resources from the very limited agricultural surplus and then efficiently deploying those resources for war. However, it was mobilized, it was this extracted surplus that not only fed the army but also fueled the necessary secondary economic activity of building ships and making equipment. Ancient sources still compared military power by the metrics they themselves could observe, such as available manpower,[164] counts of ships,[165] and available funds,[166] but these indicators were merely the visible manifestation of the deeper

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[161] Bar Kochva (1976) 20-47; Fischer-Bovet (2014), 18-37l; E. T. Salmon, *Roman Colonization under the Republic* (Ithaca: Cornell University Press: 1970), 1-94.

[162] Aperghis notes that Seleucid land grants appear to aim to maximize silver revenue, rather than primarily serving political or military purposes, Aperghis (2004), 112-3. Note that Roman colonies in Italy are the exception to this rule, being, as E.T. Salmon notes, principally military in function, Salmon (1970), 15.

[163] Bar Kochva (1976), 48-53. Fischer-Bovet (2014), 138-42, Keppie (1984), 78-9.

[164] Plb. 2.24. Thuc. 2.13.6-8.

[165] Plb. 1.63. Thuc. 2.13.8.

[166] Thuc. 2.13.3-5. Cf. also on the importance of money Thuc. 6.34.2, Cic. *Phil* 5.5.

economic factors that produced them.[167] After all, a large population meant relatively little if sufficient resources could not be mobilized to supply and equip the generally abundant excess laborers in the countryside, while an abundance of money in the absence of a system to convert that money into the resources necessary for warfare was equally unprofitable. Existing in a system of militarized interstate anarchy, ancient states and pre-state peoples were forced to seek to increase this sort of military power in order to remain secure, leading to intense competition over territory, which is to say competition over the regions that could produce the revenue and agricultural surplus that could feed further military activity. In that context, victory belonged to the state that could produce the most efficient system for converting their agricultural surplus into war supplies and matériel, turning their agricultural economy into a war machine. That state was Rome.

The rest of this study then aims to examine the evidence for Roman dominance in this war of resource extraction through an examination of the war matériel of the period, and also to suggest the mechanisms through which the Romans achieved this dominance. Issues of food supply for armies, although important, will receive less focus because they have been discussed amply in other works.[168] Likewise, this study will not focus on the careers of individual generals or the progress of individual campaigns. It took the Roman Republic more than a century to defeat all of its rivals and to secure a durable Roman dominance over the Mediterranean; such

[167] Using a few of the end products, usually highly visible or high prestige end products, of a war economy to gauge the overall economic might of a belligerent is not a method contained to the ancient sources, cf. for instance Richard Overy, *Why the Allies Won* (New York: W. W. Norton & Company: 1995), 180-244, 331-2.

[168] See especially Roth (1999), Erdkamp (1998) and Engels (1978).

conquests cannot be attributed to a single brilliant campaign or military figure. Instead, each of the following chapters will look at a system or set of systems for mobilization.

Chapter two will examine naval warfare, particularly in the context of the First Punic War, in which Rome achieved a level of dominance on the Mediterranean that it would maintain throughout the period. This chapter approaches the problem of the high cost of naval warfare by comparing the naval efforts of Rome and Carthage in what Polybius correctly notes was the largest naval war in the ancient Mediterranean world.[169] This chapter draws into question the narrative presented by Polybius and largely accepted by modern historians of the Romans, inexperienced at sea, overcoming a passive Carthage through sheer willpower and endurance at sea. Instead, a detailed analysis of the naval costs borne by both sides suggests that Carthaginian and Roman expenditures in the naval war were roughly equal in scale. Carthage, far from being passive or feckless, attempted to implement a consistent defensive strategy which had worked in the past against opponents like Pyrrhus, and very nearly worked against the Romans as well. Far from lacking will, Carthage was willing to dedicate tremendous resources to this strategy. Nevertheless, this chapter also establishes the stunning scale of Roman expenditure required to exhaust Carthaginian resources in order to produce a Roman victory against an entrenched opponent.

Chapter three lays the groundwork for the remainder of this study by examining the supply and matériel costs for military activity. While our evidence is often limited, I suggest that the balance of the evidence suggests that Roman expenditures in each element of these costs was likely to be higher, and certainly not likely to be much lower, than Rome's rivals in the

[169] Plb. 1.63.

Mediterranean world. In addition, this chapter presents a more detailed discussion of the costs involved in the production of military equipment, especially arms and armor, and suggests that metal content may serve as an effective proxy for cost in the absence of price data.

Chapter four then looks at the equipment of the armies of Rome. Contrary to the impression presented by modern scholarship of the infinitely expendable Roman soldier, an analysis of the cost of Roman field equipment, especially the quantity of metal used, strongly suggests that Roman soldiers were unusually expensive, despite their vast quantity. Moreover, the equipment that Romans purchased for themselves at such cost created a real qualitative advantage, especially in defensive armaments. Finally, the massive deployments of these uncommonly expensive Roman soldiers suggest that the Roman Republic was able to mobilize the resources of Italy on a very large scale, and furthermore that Roman success was as much a product of economic and institutional factors as demographic ones.

Chapter five then examines Rome's chief land-power rivals, the three largest successor states, Antigonid Macedon, Ptolemaic Egypt and the Seleucid kingdom. While each of these states used the same sort of heavy infantry with comparable equipment to provide the core of their armies, they all functioned under different constraints. The analysis of the equipment of the Macedonian phalanx shows that, despite the large size of these kingdoms and their access to wealthy regions of the Mediterranean, the Macedonian equipment was substantially less metal-intensive and thus less expensive than that of its Roman counterparts. Even with expansive empires, Hellenistic kings found themselves needing to continue using more cost-effective equipment in order to field a strong army. Hellenistic rulers could, to a degree, counteract the disparity in resources by concentrating their own forces to obtain local superiority, but the scale of Roman deployments in the period and the concomitant cost of those deployments suggest that such a strategy was unlikely to be successful in the long-term. Moreover, Roman victories against large royal armies accomplished with only a fraction of Rome's total active legions suggests that concentration of force was insufficient to fully counteract the Roman qualitative advantage.

Chapter six assesses the pre-state peoples or 'barbarians' that Rome fought through the third and second century B.C.E.[170] Pre-state peoples, whether the Numantines in Spain, the Gallic mercenaries in Hannibal's army, or the Cimbri and the Teutones who invaded Italy at the end of the second century, should not be dismissed. Indeed, apart from Hannibal, some of Rome's worst defeats in this period came at the hands of so-called 'barbarians.' An examination of the equipment of these various peoples reveals that they were not simply unsophisticated 'barbarians.' Gallic equipment of the highest quality could be every bit as good as or even better than its Roman counterparts, and the Romans adopted more weapons and armor for use in this period from these groups than from any other. However, literary, archaeological and representation evidence suggests that class distinctions in equipment quality, while also present in Hellenistic, Greek and Roman equipment, were far more strongly felt in the armies of pre-state peoples. Moreover, the limited and relatively less expensive equipment used by the non-elite pre-state warriors speaks to the overall economic weakness of these societies when confronted with the Roman war machine, despite the evidently masterful skill of some Spanish and Gallic artisans.

[170] The term pre-state, used here and following, is admittedly a somewhat imperfect and teleological term. However, by this period many of these peoples were already showing signs of early state formation, especially in Gaul. As such, it seems more fitting to refer to them as pre-state rather than non-state, given that some of the early elements of state organization, particularly the beginnings of the emergence of larger political groupings under kings, were beginning to occur.

Finally, the seventh chapter considers the results of each of these studies together. This apparent paradox of Rome fielding large armies without sacrificing quality to do so is explained by the unique and culturally embedded system of recruitment and resource mobilization used by the Romans, which relied heavily on personal civic engagement to motivate private spending on warfare, both by elites and smallholders. The great strength of the Roman system came from its unique ability, culturally embedded in Italic notions of hierarchical relationships, to scale up this system of civic engagement to include much of Italy, allowing the Roman Republic access to a very large pool of resources at very low administrative overhead. In contrast, the three large successor states were never able to extract the full potential military resources from their territories and had to contend with substantial administrative and military overhead for what resources they were able to gain. Rome's pre-state enemies, on the other hand, 'punched above their weight,' becoming outsized threats to Rome despite their comparatively small resource bases; but they were not able to scale up sufficiently to match Rome's massive and extensively exploited resource base.

Rome's war machine both bequeathed to the Roman Republic an empire and also eventually consumed the Republic it was supposed to safeguard. While history does not follow any pre-determined course, such a feat was not so much the result of luck or chance, but rather an outgrowth of an exceptionally powerful, if improvised, system of mobilization. Rome's ability to marshal tremendous resources for war did not make Roman victory inevitable, and it most certainly did not make Roman armies unbeatable. But it did make Rome's eventual dominance the most likely resolution to the militarized system of interstate anarchy that dominated the Mediterranean after the death of Alexander the Great, because it provided to

Rome the resilience to come back fighting, with fresh troops and fresh equipment, even after disasters like the battles of Drepana, Cannae or Arausio.

CHAPTER 2: NAVAL WARFARE: THE CARTHAGINIANS

Of all of the military operations available to ancient states, naval warfare probably placed the greatest demands on finances and resources. Naval warfare was staggeringly expensive, such that only relatively large states, or confederations of many smaller states, seem to have been able to engage in it on a significant scale. Naval warfare apparently could not be handled through a non-monetary economy in the same way that the costs of a land army could often be devolved directly onto soldier-farmers themselves. Rowers, drawn from the poor, had to be paid, or at least fed, in massive numbers. Shipwrights and the members of the *hyperesia*, the officers of a warship, were skilled and thus could be expensive, needing to be either bought or trained.[1] The resource requirements in timber, cloth and bronze to construct these warships were staggering and would have to be met somehow.

The First Punic War was, as Polybius notes, "the longest, most unintermittent and greatest" naval war fought in the ancient Mediterranean.[2] The consensus view on the war is perhaps best summed up by John Lazenby, "in a slogging match, Rome could simply outslog Carthage."[3] Modern treatments of the war tend to echo Polybius' own emphasis on the virtue of

[1] On the cost of naval expertise, note F. S. Naiden, "Spartan Naval Performance in the Decelean War," *JMH* 73.3 (2009): 729-44. There has been some debate concerning the meaning of the term *hyperesia*. In using *hyperesia* in the sense of the specialists and officers of a warship, I follow J. S. Morrison, "*Hyperesia* in Naval Contexts in the Fifth and Fourth Centuries BC" *JHS* 104 (1984), 48-59.

[2] Plb. 1.63.4. πόλεμος ὧν ἡμεῖς ἴσμεν ἀκοῇ μαθόντες πολυχρονιώτατος καὶ συνεχέστατος καὶ μέγιστος.

[3] J. F. Lazenby, "Rome and Carthage" in *The Cambridge Companion to the Roman Republic*, ed. H. I. Flower (Cambridge: Cambridge University Press, 2004), 270.

Roman willpower, often with the implication that this was the quality that Carthage lacked.[4] Lazenby berates the Carthaginians for their lack of initiate or aggressive strategy, concluding "there can be no doubt that, militarily speaking, Rome deserved to win."[5] John Grainger instead declares it a problem of unequal resources, noting "it was not that Rome and Carthage were generally equal in manpower and resources, still less in military ability. Rome had greater supplies of all of these than Carthage."[6] This, of course, is the story Polybius has chosen to tell: a story about landlubber Romans who, by grit, sheer determination, endless resources and an apparently limitless tolerance for casualties, master a type of warfare with which they were both unfamiliar and temperamentally unsuited. Polybius' work is a cautionary tale, and the place of the First Punic War in that tale is as an omen. Polybius declares at the end of his account "this confirms the assertion I ventured to make at the outset that the progress of the Romans was not due to chance."[7]

Parts of this cautionary tale have already come under some scrutiny. Christa Steinby persuasively argues in *The Roman Republican Navy* that the Romans were hardly as inexperienced as Polybius suggests, and that moreover the Carthaginians had likely only recently adopted the quinquereme or 'five.'[8] The skill gap, then, was not an illusion, but was by no means as wide as Polybius implies. This might have been apparent to a close reader of Polybius,

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[4] Plb. 1.59.1.

[5] J. F. Lazenby, *The First Punic War: A military history*, (Stanford, CA: Stanford University Press, 1996), 170.

[6] J. D. Grainger, *Hellenistic and Roman Naval Wars, 336-31 BC* (Barnsley: Pen and Sword, 2011), 98. Grainger here strikes a similar theme to J. H. Thiel, *A History of Roman Sea-Power Before the Second Punic War* (Amsterdam: North Holland Publishing Company, 1954), 332-337.

[7] Plb. 1.63.9.

[8] Christa Steinby, *The Roman Republican Navy: From the sixth century to 167 B.C.* (Helsinki: Societas Scientiarum Fennica, 2007).

who might note that, for a bunch of landlubbers, the Romans surprisingly win nearly all of the naval battles in the war.

Moreover, this conviction that the Romans won the war in part by a willingness to expend a far greater quantity of resources does not rest on a secure foundation. Many scholars over the years have attempted to work through Polybius' narrative to tease out what we might call an operational history of the naval war, including the naval strength of both sides, but this approach has not translated into an effort to gauge cost in any systematic way; instead it often falls back on Polybius' own report of warships lost to each side. Doubtless this approach is partly due to the evidence, for while Polybius notes that both the Romans and Carthaginians were exhausted by the end of the war, he provides no firm figures for the cost of ships, crews or fleets. This gap in information stands in stark contrast to the narrative of the other great historian of naval wars, Thucydides, who lays great stress on the financial resources of Athens.[9] On the subject of Roman manpower, Polybius is more than helpful, but on Roman finance he is almost totally silent.

This chapter aims to illuminate this gap and, in the process, shed some light on the astounding quantity of resources that Rome expended to become the master of the waters around Sicily, and the equally astounding quantity of resources that Carthage expended in failing to stop the Romans. The chapter will proceed in three main parts, after a brief introduction on the nature of the sources themselves. The first of the main parts aims to lay the groundwork by discussing the basic types of warships available to the Romans and Carthaginians, and the nature of the costs and limitations associated with these oar-powered warships. These limitations are particularly important because ancient oar-powered warships are, in several important ways,

[9] For instance, note Thuc. 1.80.3-4, 1.142.1-9, 2.13.3-6.

quite different from modern warships, or even warships of the age of sail, a fact often significantly underappreciated. Having established the nature of these ships, the chapter then moves to its second main part, a detailed case-study of the evidence for the naval operations of the war, with the aim of constructing a plausible, if speculative, year-by-year reconstruction of fleet strengths and ship construction. Finally, in the third part, this reconstruction provides the basis for a rough estimate of the relative total expenditure of both sides of the war, from which, finally, conclusions may be drawn.

Sources

The principal source for the naval aspects of the First Punic War is Polybius' account in the first book of his histories. Polybius' account is far closer to the original tradition than any other surviving account, such as those of Diodorus or Dio Cassius (via Zonaras), and provides a less confused and more coherent narrative of the war besides. Further evidence does exist outside of Polybius' account in sometimes fragmented and confused chunks in the works of Florus and Orosius, as well as the anonymous *De Viris Illustribus*; all of these sources pale in comparison to the reliability and enduring influence of Polybius. However, his account poses some significant problems for assessing the cost of the naval aspects of the First Punic War that must be addressed. Perhaps the most pressing problem is that he provides no detailed breakdown of materials or costs for the ships in question, preferring instead to use ship-counts as a proxy for his claim that "no forces of such magnitude ever met at sea."[10] Polybius' purpose too, must put us on our guard, for even if we assume that his overall numbers are more or less accurate, an assumption not without risk, we must also be aware that he is likely to suppress details that might

[10] Plb. 1.63.8.

weaken his argument that this war was the "longest, most unintermittent and greatest war we know of."[11] Fortunately, the discussion of Polybius' narrative of the First Punic War has not stood entirely still, with important recent contributions on the topic, most notably by Christa Steinby.[12]

As a result, in revisiting the question of the cost of naval warfare in the First Punic War, it is necessary to reach beyond Polybius, even though he cannot be disregarded. This chapter, then, seeks to combine recent archaeology and scholarship on the costs of warfare to enable a new and more probing look at the tremendous cost of the war at sea that Polybius presents. Perhaps the most valuable *comparanda* for the cost of the First Punic War are the costs associated with the financing of the Athenian navy, a topic with an increasingly useful body of scholarship owing to the larger body of literary and epigraphic evidence surrounding the Athenian navy and Athenian state finance compared to the Roman Republic.[13] While the mechanisms of Roman naval finance were likely quite different, the structure of costs in the Athenian navy can offer us some hints as to what the major expenses were and their rough magnitudes, costs which will have to have been paid by the Romans one way or another. In addition, efforts to reconstruct the Athenian trireme, culminating in the *Olympias*, have also significantly informed our understanding of the heavier ships of the third century, bolstered by the recovery and study of a growing body of waterline warship rams, most notably the Athlit ram and, more recently, the Egadi rams.[14] As a result of this enlarged body of comparative and

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[11] Plb. 1.63.4.

[12] Christa Steinby, (2007).

[13] Note especially V. Gabrielsen, *Financing the Athenian Fleet: Public Taxation and Social Relations* (Baltimore: John Hopkins University Press, 1990), and Pritchard, (2015).

[14] Note especially L. Casson and J. R. Steffy, *The Athlit Ram* (College Station, Texas: Texas A&M University Press, 1991), W. M. Murray, *The Age of the Titans: The Rise and Fall of the Great Hellenistic Navies* (Oxford: Oxford

archaeological evidence, we have ample cause and resources to revisit the question of the costs of naval warfare in this period.

Ships, Costs and Limitations

Starting in the late fifth century, warship design underwent a period of rapid innovation. According to Diodorus, the first 'five' was built by the tyrant Dionysius I of Syracuse and was launched by the spring of 397.[15] The origins of the 'four' are more obscure. The earliest reference, found in Quintus Curtius Rufus, is to the siege of Tyre in 332, but Pliny the Elder quotes Aristotle as claiming the 'four' as a Carthaginian invention.[16] Diodorus has Dionysius I building 'fours' alongside his newly invented 'fives,' suggesting that the build was common by that point.[17] After the death of Alexander and particularly during the career of Demetrius Poliorcetes, the building of larger and larger ships took off, culminating in Ptolemy IV's (r. 221-204) construction of a 'forty.'[18] While the introduction of these larger ship types did serve to diversify the combat roles of warships between different designs, many of the fundamental limitations that had applied to the earlier triremes, being in turn a product of galley warfare, remained unchanged.

University Press, 2012), and most recently S. Tusa and J. Royal, "The landscape of the naval battle at the Egadi Islands (241 B.C.)" *JRA* 25 (2012), 7-48.

[15] Diodorus 14.41.3 - 44.7.

[16] Curtius 4.3.13, Pliny *Nat. Hist.* 7.208.

[17] Diodorus 14.41.3.

[18] Murray, (2012), 171-91. J.S. Morrison and J. F. Coates, *Greek and Roman Oared Warships* (Oxford: Oxbow, 1996), 269-277.

General accounts of naval warfare in this period have tended to argue that the emphasis on building progressively larger ships reflected a shift from a focus on ramming to a focus on boarding. Larger ships, the reasoning went, were valuable as veritable floating fortresses packed with catapults and marines for boarding operations, while classical ramming techniques faded into the background.[19] This view fits well with an assumption that Roman fleets, increasingly dominant in the Mediterranean, prioritized grapple-and-board tactics on account of Roman inexperience with the sea. More recently, Christa Steinby has challenged Polybius' representation of the Romans as novices who were forced to rely on the *corvus* boarding-bridge to make up for slow ships and a lack of skill at ramming.[20] Her argument is reinforced by recent archaeology which has suggested that lighter ships, particularly the trireme, were more common in Roman fleets than Polybius' emphasis on big ships would lead us to believe.[21] As a result, the assumption of ancient navies shifting to more and more boarding-oriented tactics has been called increasingly into question.

Recently, William Murray in *The Age of Titans* has provided a more convincing model for the tactical and strategic uses of the increasingly diverse ship-types in Hellenistic fleets.[22] Drawing on the earlier work of Herman Wallinga, Murray rejects the overly simplistic view that boarding was a viable alternative to ramming strategies rather than a supplement to them.

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[19] Note for instance, W. W. Tarn, *Hellenistic Military & Naval Developments* (Cambridge: Cambridge University Press, 1930), 144-152; Morrison and Coates. (1996), 309-310; Jean Rougé, *Ships and Fleets of the Ancient Mediterranean*, (Middletown: Wesleyan University Press, 1981), 96-104; L. Casson *Ships and Seamanship in the Ancient World* (Princeton: Princeton University Press, 1971), 119-123.

[20] Steinby (2007), 87-104.

[21] Tusa and Royal, (2012), 7-49. Note that Polybius' entire point in his section is reinforced by emphasizing the big ships.

[22] Murray, (2012).

Wallinga noted, in particular, that naval battles would have varied depending on the time of engagement, and he proposed three distinct phases based on the level of exhaustion of the rowers, with boarding largely confined to the final phase.[23] Murray further argues that the emphasis in the sources, particularly Livy and Polybius, on the naval battle as land battle, and the importance of the skill of the marines, often contradicts the stated outcome of the battle, with more ships having been sunk by ramming than captured by boarding. Rather, this focus, Murray argues, had to do with focusing on "a class who mattered to the historians" which is to say, the class of free farmers who comprised Rome's infantry and likely its marines, rather than the poorer rowers of the fleet.[24]

Thus, rejecting the assumption of an increased focus on boarding, Murray's reconstruction of naval tactics attempts to make sense of the continuance of ramming and the survival of the trireme alongside far larger ships in part by stressing the distinction made in ancient authors between larger, heavier ships and smaller, lighter ships.[25] Murray's reconstruction may be summed up by breaking ancient ships into three classes defined by primary function. At the smaller end of Murray's reconstruction are the lighter ships, particularly the trireme, along with *lemboi* and *triemioliai*, which relied on their speed and maneuverability to ram the unprotected sides of enemy ships. These lighter vessels seemed to have featured a somewhat smaller design of ram, were not generally large enough or stout enough to ram frontally as a first resort, but instead functioned in larger fleets as escorts protecting the larger ships. The larger workhorses of navies in this period were the heavier ships,

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[23] H.T. Wallinga, *The Boarding Bridge of the Romans: its Construction and its Function in the Naval Tactics of the First Punic War* (Groningen: J. B. Wolters,1956), 29-50.

[24] Murray (2012), 168-9.

[25] Murray (2012), 3-9, 47-8.

particularly the fours, fives and sixes. The increased size of these vessels, Murray argues, along with prow reinforcement and heavier rams, permitted them to engage in prow-on-prow ramming against smaller ships, a feature of particular value first in harbor battles connected to sieges, but also of use in a crowded naval battle. Finally, the 'titans' of Murray's title, the ships often far larger than a six, appear to have been designed as siege support units. While these ships could function in naval battles, they were designed to specialize in supporting the siege of coastal cities. Neither the Romans nor the Carthaginians appear to have made much use of these super-heavy ships. The Carthaginians did not because, for a power on the strategic defensive, such mega-ships were of limited use, whereas the Romans clearly expected to conduct their sieges primarily by land. Instead the Romans and Carthaginians focused on fleets that consisted primarily of 'fives' and 'threes,' which were classes of ships, in Murray's view, well suited for a focus on ship-to-ship confrontations. Overall, Murray's interpretation of the Hellenistic naval system provides a more effective lens through which to analyze Roman and Carthaginian naval activities than older scholarship.

Limitations

Unlike modern navies which are usually independent service arms and often function thus on the operational level, the navies of the Classical and Hellenistic period were primarily and almost exclusively adjuncts to land forces. Ancient fleets of galleys could not independently achieve complete command of the sea in the Mahanian sense.[26] Mahan's conception of command of the sea consisted of the ability to significantly deny access to the sea in general,

[26] This does not prevent Mahan from indulging in a lengthy digression on the Punic Wars in his introduction, based mostly on a reading of Mommsen; Alfred Thayar Mahan, *The Influence of Sea Power Upon History, 1600-1783* (Boston: Little, Brown and Company, 1890), 13-22.

restricting an enemy force almost entirely to land warfare. Such control required not only the crucial destruction of the enemy fleet but also the control of the strategic positions which dominate lines of trade and communication. Such lines of trade and communication are, for Mahan, as a "great highway" or "a wide common" the "first and most obvious light in which the sea presents itself;" however, apart from engaging other battle fleets, ancient navies had little impact on these lines except at their end points.[27] Apart from direct blockades of individual cities in support of a land-based siege, ancient fleets mostly lacked the capacity to deny access to the sea to an enemy. Fleets instead served as secondary arms to land forces, delivering them to the theatre of operations, supplying them overseas, completing the sieges of coastal cities and attempting to prevent enemy fleets from doing the same. This dependency is born out in the language used to describe the overall commander of a fleet, which typically reused terminology from land armies. Roman fleets were most often led by one of the consuls; the leader of a Greek fleet was typically a *strategos*, while the Carthaginians entrusted leadership in war, on land or at sea, to a general, *rab mahanet* (literally an "army chief").[28]

There are some notable exceptions, but the indecisive nature of independent naval action serves to prove the rule. Piracy and coastal raiding are both well attested as early as Homer and were occasionally used by Classical and Hellenistic navies, although rarely to decisive effects.[29] During the Peloponnesian War, Thucydides notes several attempts at commerce-raiding, *guerre*

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[27] Mahan (1890), 25.

[28] D. Hoyos, *Mastering the West: Rome and Carthage at War* (Oxford: Oxford University Press, 2015), 17. Several *rab mahanets* could be active at once. Occasionally, Greek admirals are called ναύαρχος, especially in the case of Sparta, for instance Thuc. 4.11.2, Xen. *Anabasis* 1.4.2.

[29] On piracy in Homer and during the Archaic, see De Souza, *Piracy in the Graeco-Roman World* (Cambridge: Cambridge University Press, 1999), 17-26.

de course against Athens.[30] Despite Athens' vulnerability to such tactics, Peloponnesian commerce-raiding seems to have had little effect. Rather, it was the Peloponnesian fleet acting in support of a siege of Athens that ended the conflict on favorable terms.[31] Philip de Souza notes "how unclear the distinction between warfare and piracy could be" in subsequent centuries.[32] Although Hellenistic rulers often worked to suppress piracy, they also used pirates as tools against their enemies; but the most notable uses of such 'pirates' were as auxiliaries in conventional fleets operating in support of land-based operations.[33] Despite the frequent use of such auxiliaries, particularly by the Antigonids, there is little sign that these efforts at *guerre de course* were a decisive or even effective use of naval power.

Coastal raiding, also included in the ancient understanding of piracy, came closer to being decisive during the Peloponnesian War after the fortification of Pylos. The subsequent Spartan failure to remove the fort resulted not only in the capture of 220 Spartiates but also opened Messenia to raiding.[34] Subsequent efforts to control Athenian raiding in the following year resulted in a small defeat near Cotyrta; but despite the apparent free-rein of Athenian naval raiding, the war continued for another two years before the brief armistice of 423/2 without producing Spartan capitulation. The Athenians would not employ this strategy successfully in the subsequent phases of the war.[35] Likewise, the Romans were able to defeat a raiding fleet,

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[30] Thuc. 2.69, 5.115, 8.35.2.

[31] Xen. *Hellenica*, 2.3-5.

[32] De Souza (1999), 34.

[33] De Souza (1999), 43-48.

[34] Thuc. 4.41.

[35] Thuc. 4.56, 4.116-119.

probably Syracusan in origin, in 348 with no fleet of their own, merely by denying the fleet the ability to land and thus denying it the ability to operate on the coast of Latium.[36]

The most significant impact of Carthaginian coastal raiding in the First Punic War may have been providing motivation for the Romans to take to the seas themselves, although subsequent operations show the need to complete the sieges of fortified coastal settlements as a more decisive use for these fleets.[37] Polybius briefly mentions Carthaginian raiding at several other points, such as Carthaginian ravaging of the territory of Mylae prior to the battle there and again against the Italian coast by Hamilcar in 247, but he gives little impression that these raids had any lasting impact.[38] Further reports of Carthaginian raiding occur in the accounts of Zonaras and Orosius.[39] As a result, independent naval action was rarely able to be decisive in the ancient world; for that outcome, it had to function as the completion of a land action.[40]

Costs

The structure of the costs of galley fleets also served to weaken the decisiveness of naval action, because the cost of replacing a lost fleet was often not so very much higher than the cost of maintaining a victorious one. Nevertheless, initial construction and mobilization costs could be formidable. Livy gives perhaps the best sense of the vast array of resources demanded for

[36] Livy 7.25-26. Steinby (2007), 51-2.

[37] Plb. 1.20.7.

[38] Plb. 1.23.1, 1.56.1-2.

[39] Raiding by Hannibal: Zonaras 8.10, Orosius 4.7.7. Lazenby (1996), 62, tentatively dates these raids to 261or 260. Raiding by Carthalo: Zonaras 9.16, Orosius 4.10.4. Lazenby (1996), 145, dates these raids between 251 and 248.

[40] These limitations to galley-based naval warfare remain true beyond the chronological limits of the ancient world, see Landers (2003), 190-193.

such a venture when in 205 Scipio Africanus constructs a relatively small fleet using resources from the *socii*. Livy reports that,

> The men of Caere promised grain and supplies of all kinds for the naval allies (*socii navales*), the men of Populonium the iron (*ferrum*), the Tarquinii linen for sails, the Volaterrae the internal woodwork and grain, the Arretini three thousand shields, as many helmets, fifty thousand *pila*, javelins and long spears, with an equal number of each type and also of axes, shovels, sickles, baskets and handmills as many as were needed for forty war-ships, and a hundred and twenty thousand *modii* of wheat also and allowances for the decurions and oarsmen. The Perusini, Clusini and Ruselani promised fir for shipbuilding and a large amount of grain; he also used wood from public forests…[41]

Livy's long list of resources, meant to stress Scipio's resourcefulness, is nevertheless not entirely complete; no mention is made, for instance, of bronze for the ship rams, unless Livy includes this under the rubric of the *ferrum* from Populonium. The reconstruction of the trireme *Olympias* gives a similar impression of the wide range and substantial quantities of resources required to build even a single galley warship, including major items like timber, sailcloth, ropes, oars, caulking and of course the bronze ram.[42]

The largest bulk item for the construction of ships was timber. A number of different kinds of timber could be used for ship construction, with different sorts of wood being used for different functions when available. Theophrastus notes that, "Fir (*elate*), pine (*peuke*) and cedar (*kedros*)" were the most common timbers used for ship construction.[43] Theophrastus further notes that while fir was the preferred timber for warships because of its lightness, pine was

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[41] Livy 28.45.13-18. Caerites frumentum sociis navalibus commeatumque omnis generis, Populonienses ferrum, Tarquinienses lintea in vela, Volaterrani interamenta navium et frumentum, Arretini tria milia scutorum, galeas totidem, pila gaesa hastas longas, milium quinquaginta summam pari cuiusque generis numero expleturos, secures rutra falces alveolos molas, quantum in quadraginta longas naves opus esset, tritici centum et viginti milia modium, et in viaticum decurionibus remigibusque conlaturos; Perusini Clusini Rusellani abietem in fabricandas naves et frumenti magnum numerum; abiete ex publicis silvis est usus.

[42] J. S. Morrison and J. F. Coates, *The Athenian Trireme: The History and Reconstruction of an Ancient Greek Warship* (Cambridge: Cambridge University Press, 1986), 180-191.

[43] Theophrastus, *Enquiry into Plants*, 5.7.1-3. Morrison and Coates (1986), 180-1. Russell Meiggs, *Trees and Timber in the Ancient Mediterranean World* (Oxford: Clarendon Press, 1982), 117-8.

generally used for merchantmen because it resisted decay, and could be used for warships, as could coastal pine (*pitys*) which was used on Cyprus. Specialized timbers were also used for certain parts of warship construction. Theophrastus notes the use of oak for the reinforced keel of a trireme; oars required a more flexible wood, for which Theophrastus recommends a young fir or pine.[44] For the interior-work, Theophrastus suggests "mulberry, ash, elm or plane," but also notes that sometimes coastal pine (*pitys*) is used too, because it is light.[45] Meiggs notes that other timbers could be used, particularly cypress, as by Alexander in his preparations for the planned expedition against Arabia; it is listed later by Vegetius and Pliny as a ship timber.[46]

The variety and quantity of timber required for fleet construction were staggering, but supplies for both Rome and Carthage were likely to have been local. Morrison and Coates note that the basic wooden shell of the reconstructed trireme *Olympias* weighed roughly 15 tonnes, with another 10 tonnes of woodwork for outriggers, seats, decks and so on, some 25 total tonnes of timber, not including the mast, a little more than half the mass of the total ship.[47] The timber requirements of larger ships, particularly the 'fives' that formed the mainstay of Roman and Carthaginian fleets in the First Punic War, will have been significantly higher still. Coates estimates the loaded displacement of a relatively light 'early five' at 90 tonnes fully loaded, and a reconstructed 'five' based on the Isola Tiberina monument at 110 tonnes (compared to roughly 45 tonnes for the *Olympias*).[48] Timber availability would not have been a major problem for the

[44] Theophrastus, *op cit*, 5.7.3-4.

[45] Theophrastus, *op cit.*, 5.7.4. Here I follow Morrison and Coates in reading τορνεία as ἐντερόνεια, Morrison and Coates (1986), 182.

[46] Meiggs (1982), 120. Vegetius 43.4. Pliny *Nat. Hist.* 16.76.

[47] Morrison and Coates (1986), 211.

[48] Morrison and Coates (1996), 285- 303.

Roman Republic. The abundance of good ship timber in Italy was well known and even figures into Alcibiades' recommendation for the Sicilian expedition.[49] Livy's account of the construction of a smaller Roman fleet in 205, quoted above, also attests to the Roman reliance on local timber supplies.[50] Meiggs suggests that the timber required could have come down from Etruria and Umbria via the Tiber and its tributaries for final construction in Rome itself.[51] Carthage too, had significant local timber supplies, and Meiggs notes that Carthaginian failure should not be attributed to "the difficulty of finding adequate supplies of ship-timber."[52] The most plentiful local ship timber for Carthaginian ships would have been Aleppo pine, which seems to be confirmed by the study of what was apparently a Punic warship sunk off the north-western shore of Sicily.[53] It is possible, but by no means certain, that this gave the Romans a small advantage in the qualities of their ships as fir was amply available in Italy and, according to Theophrastus, made for faster warships than pine.[54]

The bronze ram probably represented the single most difficult and expensive part of any ancient oared warship and the largest line item in construction after timber. The manufacture of rams was itself a complicated and difficult procedure, because the final ram needed to be free from flaws and uniform in composition in order to withstand the tremendous forces at play when ramming. The impact of a 50-metric ton trireme traveling at 10 knots would release some 660kJ

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[49] Thucydides 6.90.3. Meiggs, (1982), 124.

[50] Livy 28.45.13-18.

[51] Meiggs, (1982), 141.

[52] Meiggs, (1982), 142.

[53] Meiggs, (1982), 142-3.

[54] Meiggs, (1982), 48, 141. Morrison and Coates (1986), 180-182. Theophrastus *Enquiry into Plants*, 5.7.3-4.

of energy, or the equivalent of 157.7g of TNT, roughly the same energy as a car striking a solid object at highway speeds.[55] Some of this energy would naturally be dispersed as the impact of the ramming pushed the struck ship laterally, but additional forces from the forward momentum of the struck ship would add to the overall stresses on the ram. The forces exerted on the ram of a 'five,' designed to potentially ram another ship head on, would be much higher. Two 110 metric ton 'fives,' each moving at roughly 10 knots would release some 5,800kJ of energy, or the equivalent of 1.38kg of TNT in a head-on impact, representing probably the upper-most bound of the force a ram might be expected to withstand in combat.[56] In order to withstand these forces, a ram would have to be cast as a single piece of bronze at a high level of quality. According to work by Asaf Oron, the recovered Athlit Ram appears to have been cast using a now lost but well-attested wax process technique for the production of hollow bronzes, although producing a bronze of this size and quality would have posed significant technical challenges, as noted by both Oron and Murray.[57] This method of casting also allowed for a ram that would precisely fit the bow of the ship to which it was affixed, which was crucial for effectively transferring the force of impact to the ship without damage.

The material requirements for such a ram, especially for heavier ships, are themselves quite daunting. Because of the demands of durability, size and shape, bronze seems to have been the only available suitable material for the production of waterline ship rams. In addition to the

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[55] Mass and speed after Morrison and Coates (1986), 221. Morrison and Coates present a rather confused computation of the force of impact in 'tonnes of force' instead of a unit of energy.

[56] Mass for the 'fives' after Morrison and Coates (1996), 285-303.

[57] Asaf Oron, "The Athlit ram bronze casting reconsidered: scientific and technical re-examination," *Journal of Archaeological Science* 33 (2006), 63-76. Murray (2012), 35-38.

bronze ram and cowling itself, the rams would also be affixed to the bow with a number of bronze spikes.[58] Not all rams were made to the same size. The available archaeological evidence suggests that the rams of heavier ships were substantially larger and more massive than the rams affixed to triremes.[59] The largest recovered ram, the Athlit ram, which Murray identifies as the ram for a 'four,' is relatively complete and was approximately 465kg when cast.[60] Murray's examination of a marble model ram in Ostia and of the Actian Victory monument further suggests that the ram for a 'five' would be substantially larger than even the Athlit ram, with a substantially higher wale height to accommodate the larger timbers and possibly a greater length.[61]

The rams for triremes, better attested in the archaeological evidence due to the finds off the Egadi islands, seem to have been smaller. Murray supposes that the normal mass of a trireme ram might have been around 100kg, but recent data for the Egadi rams suggest a heavier average mass around 150kg.[62] It seems reasonable to suppose that an increased emphasis on frontal ramming led to the use of heavier rams by the time of the First Punic War, thus explaining the different in mass between the Egadi rams and previous finds such as the Bremerhaven and Piraeus rams. A sense of the tremendous value of the metal being used is fairly easy to gain by through comparison to Roman bronze and brass currency: the Athlit ram would have contained the equivalent bronze of around 2,480 *asses* (on the semi-libral standard in use c. 217) or about

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[58] Tusa and Royal, (2012), 14.

[59] Murray, (2012), 50 – 66.

[60] Murray, (2012), 51. Casson and Steffy, (1991), 3.

[61] Murray, (2012), 59-65.

[62] Murray, (2012), 51. See Table 2.1 for the masses of recovered rams.

16,607 *sestertii* under Augustus.[63] The same amount of bronze could produce a complete set of armor (*lorica hamata*, montefortino-type helmet and pair of greaves) for 58 Roman soldiers. It is thus no surprise that the expenditure in casting a ram was sufficient to require the approval mark of a quaestor or other official.[64] For large fleets, especially those with significant numbers of heavy ships, the amount of bronze required for the rams alone would have thus represented a tremendous expense.

Maintenance Costs

The cost of maintaining a fleet of oar-powered warships could be just as formidable as the costs of building such a fleet. Whereas merchant ships seem to have been built with an eye towards reliability and lower running costs, most oar-powered warships were built for speed over all other considerations, with the already tremendously expensive 'titans' forming a possible exception. But for the ramming ships, from 'threes' to 'sixes,' speed was essential for both offense and defense, and it trumped concerns about reliability. Thus, Theophrastus' advised (as noted above) that warships be built of fir for speed, rather than pine for reliability.[65] Merchant vessels could also shield their hulls from wood-eating ship-worm with lead sheaths, but such protection would slow down a warship and also make it difficult to haul the ship on shore, as was common practice for fleets. As a result, such lead coverings appear not to have been commonly

[63] M.H. Crawford dates the emergence of the semi-libral standard to c.217. M. H. Crawford, *Roman Republican Coinage*, 2 vols. (Cambridge: Cambridge University Press, 1987), 43, 596.

[64] Egadi 1's inscription refers to officials called the *sex viri*, whereas Egadi 4, 6 and 7 refer to quaestors approving the ram. Tusa and Royal, (2012), 42-45

[65] Theophrastus, *Enquiry into Plants*, 5.7.1-3.

used on warships.[66] The myriad costs of maintaining a fleet are diffuse, and as such more difficult to attempt to quantify or assess than the more readily identifiable costs of ship-building. Nevertheless, these costs, both the costs of keeping a fleet in readiness for action and also the costs of ships kept mothballed for future use, were an important part of ancient naval warfare and deserve attention.

[66] Morrison and Coates, (1986), 187.

Table 2.1: Ram Measurements and Tentative Ship-type Assignments[67]

	Belgammel	Bremerhaven	Piraeus	Egadi 1	Egadi 2	Egadi 3	Egadi 4	Egadi 5	Egadi 6	Egadi 7	Athlit
Height of Ramming Head	13.1cm	27.5cm	35cm	22.2cm	19.9cm	21.5cm	21.8cm	21.5cm	24.0cm	24.0cm	41.4cm
Max length	64cm	66.9cm	74cm	84cm	76.5cm	85cm	93.5cm	64.0cm	100.9cm	74.0cm	226cm
Length of driving center	64cm	43.5cm	59cm	58.8cm	66.3cm	74.4cm	83.4cm	59.5cm	85.9cm	69.0cm	168cm
Fin width	12.6cm (upper)	26cm (upper)	36cm (est., upper)	33.3cm (central)	27.7cm (central)	31.6cm (central)	27.2cm (central)	28.5cm (central)	30.6cm (central)	33.6cm (central)	44.2cm (upper)
Mass	19.7kg	53kg	80kg (est.)	167.8(p) 168.0 (r)	75.8 (p)	184.5 (p) 185.6 (r)	130.5 (p) 147 (r)	57.4 (p)	154.0 (p) 154.1 (r)	164.1 (p) 164.2 (r)	465kg
Inscription				Latin		Punic	Latin		Latin	Latin	
Ship Type	Unclear	Three?	Three?	Three	Three	Three	Three	Three	Three	Three	Four

[67] Measurements and type assignments for the Belgammel, Bremerhaven, Piraeus and Athlit rams after Murray, (2012), 49-66 and Casson and Richard, (1991). Size measurements, inscriptions and type assignments for the Egadi rams are after Tusa and Royal (2012). Masses for the Egadi rams kindly provided by Jeffrey Royal, with full publication forthcoming.

The first category of maintenance costs are what might be called ‘trierarchy costs,’ meaning the set of basic fitting, equipping, repair and organization tasks, most of which were entrusted to the trierarch of an Athenian warship. Many of the same tasks and requirements would have held for Roman and Carthaginian warships, although we are not nearly as well informed about how those duties and costs were divided. By contrast, we are relatively well informed about the duties of a trierarch through a number of surviving law court speeches from Athens that touch on the office, most notably Apollodorus’ *Against Polycles*, but also the anonymous *Against Euergus* and Demosthenes’ *On the Trierarchic Crown.*[68] The trierarch was expected to provision the fittings for the ship such as oars, sails and ropes, which in theory could be obtained on loan from the ten publicly appointed dockyard overseers.[69] The trierarch was also expected to enroll the ship’s officers, the *hyperesia* as well as the oarsmen; the latter which were, in theory, paid out of the public coffers by the *strategoi*.[70]

Ships also required continual maintenance when at sea, which in Athens was also the responsibility of the trierarch. Warships would be beached regularly for ‘drying out,’ which probably included applying pitch to the bottom of the hull and caulking any seams, as well as probably applying caulk and a coating of pitch to any holes left by ship-worm.[71] Ship-worm (*teredo navalis* and related species), which the Greeks called *terēdōn*, was a continual threat to warships. As noted, warships were not fitted with metal coverings on their hulls to prevent damage due to speed concerns, and ship-worm damage was thus inevitable. While the damage

[68] On reading these speeches for the duties of a trierarch, see Morrison and Coates, (1986), 120-127.

[69] Morrison and Coates (1986), 122-3.

[70] Morrison and Coates (1986), 123-4.

[71] Morrison and Coates (1986), 152-3, 187. Morrison and Coates (1996), 329, 354-356.

could not be permanently repaired, coating the holes with pitch could reduce the impact to ship performance in the short-term.[72] The negative impact of being unable to dry out warships is noted by Thucydides in the letter of Nicias to the Athenian assembly in 413.[73] Likewise Arrian notes that Nearchos hauled up his fleet for repairs and maintenance on three separate occasions during his voyage from India to the Persian gulf.[74] The labor for these repairs would presumably have been done by the crews of the ships themselves, but the materials (pitch and caulk) would have to be brought with the fleet or, perhaps less likely, acquired locally. Aristophanes alludes to the expense in *Knights* when Cleon threatens a sausage-seller that he will "have you made a trierarch and you will get ruined through it; I will arrange that you are given an old vessel with rotten sails, which you will have to repair constantly and at great cost."[75]

In addition, oared-warships seem to have had relatively short operational lives. To a degree, this fact may explain the tendency of some fleets to seemingly evaporate between wars, one perhaps most notable among the Antigonids. The fleet assembled by Antigonus Gonatus attested in 283/2 and probably involved in the Battles of Cos and Andros is nowhere to be found after Demetrius II dies. Antigonus Doson builds an apparently new fleet, which in turn seems to have evaporated before Philip V's failed efforts to reestablish an Antigonid naval power.[76]

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[72] Morrison and Coates (1986), 187.

[73] Thucydides 7.12.3-4.

[74] Morrison and Coates (1996), 355-6. Arr. *Indica* 25.1, 33.9 and 38.9.

[75] Aristophanes, *Knights* 912-918. Gabrielsen notes that this passage is "overexploited" and misleading in discussions of the role of the *strategoi* in appointing trierarchs, but not as a description of the potentially ruinous costs, Gabrielson (1994), 74.

[76] F. W. Walbank, "Sea-power and the Antigonids" in *Polybius, Rome and the Hellenistic World: Essays and Reflections* (Cambridge: Cambridge University Press, 2002), 123-142.

The average lifespan of a trireme seems to have been around 20 years.[77] The main cause of this limited service life seems to have been the aforementioned ship-worm.[78] Such decay was even true of ships not at sea at all, as memorably implied in Aristophanes' *Knights* by a trireme that is said to have declared she would "rather become an old maid here and be eaten by ship-worm" than be sent on an expedition.[79] There seems no reason to suppose that later, heavier warships would not be similarly affected. As a result, a standing fleet, even when not in military operations, would have to be continuously replacing around 5% of its available ships every year. There is considerable evidence that this was done in Athens. Christa Steinby has argued that prior to the First Punic War, such steady replacement of ships may have been what the *duoviri navales* were expected to undertake at Rome, although information on these officials, elected for the first time in 311, is limited.[80] As a result, maintaining a continuous naval presence, even without an active conflict, required a significant continuous expenditure.

Case Study – Fleet Costs in the First Punic War

The first step, then, in estimating the relative costs of the naval war for Rome and Carthage, is to establish a tentative reconstruction of active and reserve fleet strengths on a year-by-year basis throughout the war. Because ships incurred costs regardless of whether or not there was a battle in a given year, and even ships in reserve had to be maintained and replaced, it is

[77] Steinby (2007), 61. D. Blackman, "The Athenian Navy and Allies Naval Contributions in the Pentecontaetia," *GRBS* 10 (1969): 179-216.

[78] Morrison and Coates (1986), 187.

[79] Aristophanes, *Knights*, 1305-1310. ὑπὸ τερηδόνων σαπεῖσ᾽ ἐνταῦθα καταγηράσομαι.

[80] On Athenian ship replacement see D. Blackman, (1969) and also note M. L. Cook, "Timokrates' 50 Talents and the Cost of Ancient Warfare" *Eranos* 88 (1990): 69-97, and Diodorus 11.43.3. On the *duoviri navales*, see Steinby (2007), 60-63.

necessary to keep track of both the active ships each year, and also what ship reserves each state was likely to have. Athens frequently maintained ships in an inactive state, with no crews or trierarch assigned. As will be outlined below, there is every reason to believe that Carthage, at least at the beginning of the war and again towards its end, did the same.[81] So these ships too must be accounted for.

Any study of ancient fleet activity also has to take into account the seasons. Major repairs and new ship construction are almost always placed by Polybius in the winter months when the sea was closed, and it is only rarely that we hear of military operations during those months. Likewise, there are strong indications that fleets tended, when there was no active blockade or operation, to return to their homeports during the winter months. As a result, I have split every year into two seasons, a 'summer' season covering the 8 months from 11th of March to the 10th of November, when most military activity happens, and a 'winter' season covering the remaining four months of the year (November 11th to March 10th).[82] We are not told that the crews of ships apparently inactive due to winter were demobilized, but for the purpose of calculating crew costs, I have assumed that they were. Fleets are assumed to have returned to a home port and stood down for winter, unless some report of action or operation suggests otherwise as noted below.

It also seems necessary to account for the regular repair and replacement of ships long in service, particularly for the Carthaginian navy, which seems to have maintained a standing fleet. As noted above, the average service life attested for Athenian triremes was 20 years, and this I

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[81] Gabrielsen, (1990), 80-81.

[82] These dates for the *mare clausum* follow Vegetius *Epitoma Rei militaris* 4.39. See also, J. Beresford, *The Ancient Sailing Season* (Leiden: Brill, 2013).

have used as a rough guide. Thus, I have assessed, for each year, in the winter, the cost of replacement for aged hulls and repairs of younger ships at the replacement cost for 5% of each fleet's strength, rounded to the nearest whole ship. This replacement is listed in the charts below as ships 'retired,' which is to say old hulls decommissioned and replaced with fresh construction, or else extensively repaired and refit. Since these regular replacements are assumed to be 'made good' on a rolling basis, they do not impact overall fleet strength, but will impact the final assessment of costs.

It must be noted that what follows is only one plausible reconstruction of the fleet strengths and costs for the war. The sources are such that there are numerous places where different conjectures or interpretations might change the figures one way or the other. As a result, nearly all of the following figures are approximations rather than exact tallies, even though they may not be rounded off and may appear to be rather more precise than they are. As a result of this approach, while I have tried to be as accurate as possible, I have not attempted to make all of the fleet strength figures and loss figures add up perfectly. Such a task appears to be quite beyond the quality of the sources with which we have to work. What follows is not intended as a complete study of the First Punic War either; it neglects entirely numerous elements, including nearly the entire land war. Rather, it is merely an attempt to approach, on a very approximate basis, a comparison of the costs of the naval war to both sides.

2.2 Initial Fleet Strengths

The first object, then, to consider is the starting strength of both fleets at the beginning of the war. Polybius, however, is surprisingly little help on this point, never giving the size of the pre-existing Carthaginian fleet, although he does note its existence, and maintaining that Rome had no navy to speak of. Polybius notes a Carthaginian fleet active from the beginning of the war, initially making raids on the Italian coast (to apparently little effect) and successfully exerting control over the coastal areas of Sicily; but he gives no hint of its size.[83] William Tarn assumes a standing Carthaginian fleet of around 130 ships, raised to 200 at times of "supreme national effort" based on pre-Punic War fleet figures related primarily by Diodorus.[84] Tarn's analysis of fleet figures throughout the war, which forms the basis of Johannes Thiel's subsequent treatment of the war, is firmly rooted in Tarn's conviction that "Rome was not going to challenge Carthage with deliberately inferior numbers."[85] This argument finds little support in Polybius, who tends in most cases to supply or imply slightly larger numbers of Carthaginian ships in most engagements.[86] At the same time, it seems difficult to maintain that Polybius always shifts the numbers *ad maiorem Romae gloriam*, because he does not always do that. The Roman fleet at Hermaeum is clearly substantially larger than the Carthaginian fleet, and Polybius does note situations where the Romans enjoyed the advantage, such as the loaded down Carthaginian ships at the Battle of the Aegates Islands[87] Moreover, while it is certainly possible, it seems unlikely that, through the fog of war, the Romans would have been able to ascertain with any accuracy the size of fleet the Carthaginians would deploy, especially as the Romans would have to guess at Carthaginian deployments for the following year when they began construction. Moreover, Tarn's argument is fundamentally circular; Tarn assumes that the

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[83] Plb. 1.20.6-7.

[84] Tarn, "The Fleets of the First Punic War," *JHS* 27 (1907): 49.

[85] Tarn, (1907), 50.

[86] See, for instance, Polybius' figures for Mylae (Plb. 1.22.10), and Ecnomus (Plb. 1.27-28).

[87] Plb. 1.36, 1.60.1-4.

Romans would not challenge Carthage with inferior numbers, and so he reduces the sizes of fleets to conform to this assumption, before concluding that “the Romans were throughout building to the Carthaginian numbers, not *vice versa*.”[88]

Instead, recent scholarship has tended to converge around a notional strength of around 200 ships for the standing Carthaginian fleet at the start of the First Punic War.[89] Perhaps the most notable testimony is that of Appian, who notes that the dockyards at Carthage in the middle of the second century could fit 220 ships. While that figure is for a later period, it seems rather unlikely that the diminished Carthage of the second century would have maintained a larger fleet or fleet facilities than the naval power of the mid-third century.[90] Moreover, it is not necessary to suppose, as Tarn seems to, that the Carthaginian fleet in battle would always represent the sum total of ships the Carthaginians possessed. Here the Athenian comparison is instructive. Thucydides notes that Athens had some 300 triremes ready in 431 and that between three fleets in service, the Athenians maintained some 250 ships in 428; yet the largest fleets Athens ever put in a single place consistently fall far short of these high figures.[91] The largest Athenian fleet concentrations in the war were the two fleets of the Sicilian expeditions, totaling 207, and the 180 Athenian ships engaged at Aegospotami.[92] We may assume the Carthaginians likely managed their fleet in a similar way, only manning and deploying the number they thought was

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[88] Tarn, (1907), 57.

[89] Dexter Hoyos, *The Carthaginians* (London: Routledge, 2010), 149-153. Serge Lancel, *Carthage* (Paris: Fayard, 1992), 126.

[90] App, *Libyca* 96.

[91] Thuc. 2.13.8, 3.17.

[92] Thuc. 6.43.1, 7.42.1. The initial fleet totals some 134 ships when it arrives, and Demosthenes’ reinforcement group adds 73, for the total of 207. For fleet sizes after 413, see Naiden, (2009), 729 – 744.

necessary at any given time in order to save the crushing expense of manning a very large fleet. Thus it seems prudent to allow for an initial Carthaginian fleet strength of around 200 ships, but with a smaller number of those ships active. Assuming a roughly 20 year service life to match the information concerning Athenian warships detailed above, we should also allow for roughly 5% of the Carthaginian fleet to be replaced yearly, so that Carthage would have to construct 10 replacement ships annually to keep the fleet to strength.

To figure the starting strength of the Romans is likewise quite difficult. Polybius claims that the Roman fleet constructed in 261 was the first fleet built by the Romans, and that the Romans themselves at the opening of the war "had not any decked ships, but no long warships at all, not even a single boat," and were thus forced to borrow the ships for crossing the strait to Sicily.[93] This view was reinforced by Thiel, but the notion that the Romans had no significant naval involvement prior to 261 and were "clumsy beginners" has recently come under attack by Steinby.[94] She notes evidence for a Roman navy, albeit likely a small one, going as far back as the Roman-Carthaginian treaty of 509, which contains conditions for Roman warships.[95] Livy, although he doubts the story, reports Roman ships involved in the siege of Fidenae in 426, which Steinby understands as possibly being riverine transports rather than seagoing warships; but the Romans are also apparently able in 398 and 394 to send a single warship, "*longa una nave*," to transport two embassies to Delphi.[96] Steinby also supposes that, while absent in the sources, an

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[93] Polybius 1.20.9-14.

[94] Thiel, (1954), 3-5. Steinby addresses Thiel's arguments directly, see Steinby, (2007), 29-30.

[95] Steinby, (2007), 36-39.

[96] Liv. 4.34.6-7. Liv 5.15-16, 5.28.1-5. Plutarch, *Cam*. 8.3-4. Steinby, (2007), 44-48.

early Roman naval presence, though small, may have been involved in occupation of Antium in 338 or the occupation of Naples in 326, although this is more speculative.[97]

The evidence for a Roman naval presence is better after 311, where we have definite testimony about two officials, the *duoviri navales* who were in charge of the equipment and refit of the fleet (*classis*).[98] Each of the *duoviri* seems to have been in charge of 10 ships, giving a total strength of 20 ships for the squadron.[99] Steinby suggests that the fleet may have been substantially larger, arguing that we might take a *duovir*'s assignment not as maintaining ten ships, but as refitting or rebuilding ten ships a year, which might be sufficient to maintain a fleet much larger than just 20 ships.[100] However the fleet in 282 that sparked the war with Tarentum was only ten ships, which seems much more consistent with a fleet that consisted of a pair of 10-ship squadrons.[101]

Thiel suggests that by the time of the First Punic War the *duoviri navales* and their squadron had ceased to exist, and that the Romans instead relied entirely on ships contributed by the *socii* from 267 to 264.[102] Tarn, by contrast, assumes that the 20 ships of the *duoviri* are represented by the 20 triremes reported by Polybius in the Roman fleet of 261, though Polybius seems quite clear that these ships too were fresh constructions.[103] Given the service life of ancient warships, it is certainly possible that all of the ships of the flotilla of 282 would have

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[97] Steinby, (2007), 55-60.

[98] Liv 9.30.4.

[99] Thiel, (1954), 9-10. Tarn, (1907), 50.

[100] Steinby, (2007), 61-64.

[101] Steinby, (2007), 65-6.

[102] Thiel, (1954), 31-35.

[103] Plb. 1.20.9. Tarn, (1907), 50.

been unserviceable by 264, but this assumes that the *duoviri* had either been very lax in their duties or their office discontinued. The latter seems unlikely, as Livy notes the existence of the *duoviri* and their squadrons in 181 and 178, though it is possible that the office was only occupied irregularly.[104] Livy notes that in the military preparations of 181, "nor were naval matters forgotten, in this matter the consuls appointed two men (*duoviri*)" seeming to imply that in some years the office might have been left vacant when the consuls thought it unneeded.[105] In that case, it is possible that the squadrons of the *duoviri* had faded from neglect prior to 264.

Adding to the confusion, Polybius does note the existence of a fleet of 'borrowed' ships which enabled the initial Roman crossing to Sicily. He gives no figures for the fleet of "penteconters and triremes" borrowed from the allies at the beginning of the war.[106] The ships ought not to be discounted out of hand merely because they were provided by the *socii* and thus not 'Roman.' As noted in the previous chapter, the mechanism for paying the costs of warfare, in this case initially devolving those costs on to the allies, does not remove the costs. Ships provided on loan from the *socii* still consumed resources, in this case, allied resources, that Rome could not put to other military use. However, the contribution of allied ships was also likely to have been quite small. As Tarn noted, where we do have figures for the contribution of ships by the allies, those figures are invariably small.[107] In 210 D. Quinctius is able to compel Rhegium, Velleia and Paestum to provide ships, and twelve were forthcoming.[108] In 191, the ships

[104] Liv. 40.18, 41.1.

[105] Liv. 40.18.7. nec rei navalis cura omissa. duumviros in eam rem consules creare iussi.

[106] Polybius 1.20.14.

[107] Tarn (1907), 50.

[108] Liv 26.39.

gathered from the Italian allies to bolster the Roman fleet seem to have consisted of only some twenty-five ships, all apparently undecked.[109] Livy notes that Carthage's own contribution at this time was only six decked ships.[110] In 205, Scipio, relying on the resources of the allies rather than on Rome, is able to construct a fleet of thirty ships by drawing very widely for the materials and using volunteers to furnish the crews.[111] It is hard to know how applicable these figures would have been to the Roman naval system in the 260s, but they do seem to suggest that any allied contribution to the Roman fleet would have been relatively small: no more than thirty ships and probably much less.

Returning to the problem of the starting strength of the Roman fleet in the first years of the war, we are left with a quandary. The Romans clearly had access to some ships, as Polybius notes in the crossing to Sicily, but the number, likely assembled from a combination of whatever existed of the squadrons of the *duoviri* with allied contributions, was likely to have been quite small. Any figure for this fleet is no more than an educated guess, but around thirty ships seems a reasonable maximum for its size. It was certainly not large enough to contest the Carthaginian fleet. As with the Carthaginian navy, the short service life of oared warships will mean that a small amount of continuous shipbuilding would have been necessary to maintain the fleet at this strength, roughly three ships every two years. It seems likely, based on the formula Livy reports for their office, "*duumviros navales classis ornandae reficiendaeque causa*," that the *duoviri* would have overseen that process.[112]

[109] Liv. 36.42, App. *Syrian Wars* 22. Tarn, (1907), 50.

[110] Livy 36.42.

[111] Liv. 28.45.

[112] Livy 9.40.4.

Fleet sizes and Shipbuilding in Polybius

Before moving on into the fleets of the war itself, however, it is necessary to address the issues surrounding the reliability of Polybius' account of the war. The size of these fleets and the speed with which they seem to be constructed have raised questions about the reliability of Polybius' figures. Most influential has been Tarn's 1907 article, in which, taking a dim view of Polybius' sources, he extensively 'corrected' the figures for the Roman and Carthaginian fleets, in almost all cases by reducing their size.[113] Tarn's revisions were largely adopted by Thiel and accepted, with some reservations, by Walbank.[114] These 'corrections' aimed to solve the apparent implausibility of the very large fleets at Ecnomus and Hermaeum, to resolve some arithmetical inconsistencies in the account of the Battle of Hermaeum, and to have all the figures conform to Polybius' final totals for ships lost in the entire conflict. While the original figures as reported by Polybius have had their defenders, most notably Tipps and Lazenby,[115] subsequent treatments of the First Punic War, such as by John Grainger and Steinby have tended to avoid taking a strong position on the figures one way or another.[116] Moreover, Michael Pitassi has recently argued, on the basis of Thiel's 'corrected' fleet size figures, for a model of continuous and steady Roman shipbuilding beginning in 267, markedly in contrast to the evidence Polybius

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[113] Tarn, (1907), 48-60.

[114] Thiel, (1954); J. H. Thiel *Studies on the History of Roman Sea-Power in Republican Times* (Amsterdam: North-Holland Publishing Company, 1946); F. W. Walbank, *A Historical Commentary on Polybius* (Oxford: Clarendon Press: 1957), 79, 82-86, 95, 113-5, 117-8, 124-5, 128-9.

[115] G. K. Tipps, "The Battle of Ecnomus" *Historia* 34.4 (1985): 432-465. Lazenby, (1996).

[116] Steinby, (2007).

presents on Roman shipbuilding.[117] As Grainger notes, the dispute over Polybius' numbers is "largely based on incredulity," so we ought first to establish the plausibility of his overall figures and narrative.[118] The particular inconsistencies, such as with the fleet sizes at the Battle of Hermaeum, can then be dealt with in sequence as we establish year-on-year fleet strength estimates.

The first task is to distinguish between the construction of new ships and the refitting or repair of old ships. Even ships that were already built often required preparation or refit prior to being launched. Thus Thucydides notes that in 431 "a hundred ships were fitted out for an expedition against the Peloponnesus," despite noting only a short while before that in the same year the Athenians had three hundred triremes available.[119] He gives some clue as to the nature of these preparations, noting that in 435 the Corycreans manned their ships which "the old ones having been tightened such that they were sea-worthy and the others having been fitted out."[120] Likewise, the full complement of equipment to make a ship battle worthy was not always at hand; Thucydides relates a Peloponnesian plan to raid the Piraeus in 429/8, which required the sailors and marines to bring the oars, rower's cushions and rowlock thongs overland in order to launch ships that were at Nisaea.[121]

Fortunately, Polybius is fairly careful to make clear distinctions between these two activities, building and refitting, although this distinction is sometimes lost in some translations.

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[117] Michael Pitassi, *The Roman Navy: Ships Men and Warfare 350 BC – AD 475* (Barnsley, Seaforth Publishing, 2012). See also M. Pitassi, *The Navies of Rome* (Woodbridge: Boydell Press, 2009).

[118] Grainger, (2011), 89.

[119] Thuc. 2.13.8 and 2.17.4.

[120] Thuc. 1.29.3. ζεύξαντές τε τὰς παλαιὰς ὥστε πλωίμους εἶναι καὶ τὰς ἄλλας ἐπισκευάσαντες.

[121] Thuc. 2.93.2.

The process is described in the most detail for the first Roman fleet of 260, where Polybius notes that the Romans undertake to build ships (ἐπεβάλοντο ναυπηγεῖσθαι σκάφη), then do so with a Carthaginian model (ἐποιοῦντο τὴν τοῦ παντὸς στόλου ναυπηγίαν).[122] Then, while the ships are being fitted out (ἐγίνοντο περὶ τὴν τῶν πλοίων κατασκευήν), the rowers are trained on land so that the fleet could be launched as soon as the ships were entirely finished.[123] When both activities, refitting and building, are happening at once, Polybius is careful to note this, as with the Carthaginian fleet built in late 256, where Polybius notes that the Carthaginians both "refitted [old] ships" (ἐπεσκεύαζον) and "built new ones from scratch" (ἐκ καταβολῆς ἐναυπηγοῦντο).[124] Throughout his narrative of the First Punic War, Polybius uses ναυπηγέω and its noun form ναυπηγία along with the less technical ποιέω to refer only to shipbuilding, and never to the refit or repair of existing ships.[125] By contrast, καταρτίζω is the most common word Polybius uses for ship repair or refit, but he also uses ἐπισκευάζω, παρασκευάζω and its noun παρασκευή for ship refits or pre-launch preparations.[126] None of these words are used for the building of ships from scratch. Polybius also uses κατασκευάζω, but the usage is less clear, and we will return to it in connection to the Battle at Hermaeum.

[122] Plb. 1.20.9-15.

[123] Plb. 1.21.1-3.

[124] Plb. 1.36.8.

[125] For ναυπηγέω and ναυπηγία see for instance Plb. 1.20.9, 1.36.9, 1.38.5, 1.39.15. For ποιέω note Plb. 1.20.15, 1.59.8.

[126] For καταρτίζω note Plb. 1.29.1, 1.36.5, 1.38.6, 1.46.6, 1.47.10, 1.59.7, 1.60.1. For ἐπισκευάζω, 1.36.8. For παρασκευάζω, 1.22.2, 1.25.7, and 1.41.3.

Table 2.2, Shipbuilding Bursts Reported in Polybius Book 1		
Reference:	Year	Roman or Carthaginian
Plb. 1.20.9-1.21.2	261/0	Roman (1)
Plb. 1.25.5-7	257/6	Roman (2) Carthaginian (1)
Plb. 1.36.8-9	256/5	Carthaginian (2)
Plb. 1.38.5-7	255/4	Roman (3)
Plb. 1.39.15	251/0	Roman (4)
Plb. 1.52.4-8	249	Roman (5)
Plb. 1.59.1-8	243/2	Roman (6)

Reading for these distinctions, the picture of both Roman and Carthaginian shipbuilding that emerges is one in which fleets are built in short bursts of production. Continuous shipbuilding would, of course, have been required to replace ships as they aged out of their service life, although given the high rate of losses, this may have posed less of a problem as the war went on. Polybius describes eight such bursts of production in his narrative of the war, six by the Romans and two by the Carthaginians. Most of these bursts of production begin late in the year and probably continued early into the following year, but are often completed in time for major battles and seem chronologically confined to a single winter in the narrative. This method of shipbuilding, focused on the rapid construction of large fleets, often in a single season, does raise the question of plausibility.

Such fast production certainly seemed plausible to the Romans. Polybius reports that the Romans in 255 built some 220 ships in only three months, though he admits such a feat difficult to believe.[127] Livy reports that in 205, the Romans constructed a small fleet of thirty ships from fresh timber in only forty-five days.[128] Pliny the Elder reports that the fleet of Duillius that fought at Mylae was itself completed in only sixty days.[129]

[127] Plb. 1.38.

[128] Liv. 28.45.21.

[129] Pliny, *Nat. hist* 16.192.

In all three cases, we must be on guard against exaggerations, but to be useful, even an exaggeration must remain plausible. Rapid shipbuilding was not new with the Romans, but had been a key part of the later phases of the Peloponnesian War. The Athenians, left with no fleet of note after the loss of the Sicilian expedition, began building in the winter of 413/2 and were able to risk a small engagement the following summer.[130] In the next year, the Athenians both lost a fleet of thirty-six ships at Eretria and still had seventy-six ships the same summer at Cynossema, a rapid recovery indeed.[131] Similarly rapid Spartan recoveries after Cyzicus (410) and Arginusae (406) are also to be noted. Carthage was also able to rapidly build a fleet from scratch while during the Third Punic War; Strabo reports that they constructed 120 warships in merely two months.[132] The same pattern also occurs with renaissance galley-warfare. The arsenal of Venice was famed for being able to produce a galley not so dissimilar from an ancient trireme in only a day and the Ottoman Empire was able to rebuild a fleet of 150 ships and go on the offensive in only eight months after their catastrophic defeat at Lepanto (1571).[133] Rapid production on the scale that Polybius suggests thus seems plausible, even though the examples from the First Punic War may rate as some of the largest bursts of oared-warship production in Mediterranean history.

Nor are the sizes of the fleets reported by Polybius and echoed in later sources inherently beyond reason. In the largest engagement, Polybius reports 350 Carthaginian and 330 Roman

[130] Thuc. 8.8-10.

[131] Thuc. 8.104-6.

[132] Strabo 17.3.15. App. *Pun.* 121. Appian reports the fleet as somewhat smaller, 50 triremes and a collection of smaller ships.

[133] A. C. Hess, "The Battle of Lepanto and its place in Mediterranean History" *Past & Present* 57 (1972): 53-73. On the Ottoman recovery, note also N. Capponi, *Victory of the West: The Great Christian-Muslim Clash at the Battle of Lepanto* (Cambridge: Da Capo Press, 2006), 296-303.

ships at Ecnomus.[134] Part of the incredulity surrounding these numbers relies on the assumption that these fleets consisted almost entirely of quinqueremes, an assumption, as noted, drawn increasingly into question by the discovery of rams from the battle of the Aegates Islands, all of which appear to have belonged to smaller triremes. The fleets reported at Ecnomus are comparable in size to reports of Naulochus and Actium although here, as with Polybius, we should be wary of exaggeration by sources seeking battles of a size to fit their importance.[135] The confused nature of the sources for Actium, in particular, leaves little confidence for establishing fleet strength figures for that battle. Tarn dismissed these examples by noting that the Roman Republic was far smaller and less populous during the First Punic War, but his view seems unconvincing; fleet strength does not necessarily smoothly scale with the size of empire.[136] Athens had, after all, 300 triremes ready at the start of the Peloponnesian War, and later deployed some 180 for the battle at Aegospotami in 405, despite a comparatively tiny empire.[137] Such large fleets were also not confined merely to the ancient world; the Battle of Lepanto in 1571 involved nearly 500 ships.[138] So while we may be on our guard against exaggerations in our sources, the figures Polybius reports, though quite high, are not so high as to be impossible *a priori*. It thus seems prudent to give Polybius' figures the benefit of the doubt; the alternative is more often than not a counsel of despair.

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134 Plb. 1.25.5-9.

135 Naulochus: Ap. *Bel Civ*. 5.188 gives 300 ships to each side. Vel. Pat. 2.79 also provides a narrative, but no figures. Actium: Plut. *Antony* 61.1 gives Antony an incredible 500 warships. Dio 50.16-22 strongly implies that Antony's fleet was larger. Orosius 6.19 gives 230 ships with rams and 30, plus some number of lighter ships for Octavian's fleet at the beginning of the campaign, while Florus 2.21 gives Octavian 400 ships and Antony only 200. On these figures, see Morrison and Coates, (1996), 162-5.

136 Tarn, (1907), 48.

137 Thuc. 2.13.8. Xen. *Hellenica* 2.1.20.

138 Capponi, (2006), 325-331.

The early phase of the war (264 – 255)

For the first three years of the war, the fleets seem little changed from the initial strengths. The Carthaginian fleet seems to have been fairly active in the first years, whereas the small Roman fleet very nearly escapes notice entirely. The presence of the Carthaginian navy seems to have compelled Appius to cross to Sicily in 264 by night, as Polybius notes.[139] The account of this crossing is expanded upon by Dio and in turn by Zonaras, and although the additional details are of questionable veracity, it seems safe to say that the Carthaginian fleet did make some effort to prevent the Romans from crossing initially.[140] Polybius also indicates that Carthaginian naval forces had launched extensive raiding on Italy, which he describes as "frequently plundered," although, as noted above, naval raiding was rarely a decisive strategy.[141]

This state of affairs changes drastically with the construction of the first major Roman fleet in 261. Polybius places this first burst of ship construction seemingly in the winter of 261/260, given that the narrative of the construction of the fleet is placed prior to the appointment of the consul, although Polybius does not make this chronological relationship explicit.[142] It is certainly plausible that fresh naval construction, along with any necessary repairs or refits, would take place during the winter months when warships, less seaworthy than merchant ships, could not sail.[143] As will be seen, subsequent periods of shipbuilding also tend to occur in the narrative immediately before the selection of new consuls, suggesting that

[139] Polybius 1.11.9.

[140] Dio 11, fr. 43. Note also Diodorus 23.2.1. On the usefulness of both passages, see Lazenby (1996), 43-50.

[141] Polybius 1.20.7.

[142] Plb. 1.21.1-4.

[143] Vegetius *Epitoma* 4.39. Beresford, (2013), 14, 134-163.

beginning construction projects for the following year in perhaps November or December was normal. Polybius cites the Roman response to the failure of the fall of Agrigentum in 262 to turn the tide of the war in Italy as the reason for building this first large Roman fleet, suggesting that the Romans resolved to build it as the campaigning season of 261 wound down without positive results.[144] Lazenby suggests that Carthaginian naval raiding in Italy, reported by Zonaras, might also be dated to this period and be a factor in the construction of a Roman fleet, but the dating of these raids is difficult.[145] Lazenby's reckoning would place the raids in early 260, which seems too late to account for the construction of this first fleet.

Operations for the Roman fleet seem to begin early in the sailing season in 260, with a series of minor engagements before the major battle at Mylae. These early engagements are valuable in particular for obtaining a sense of the strength of the Carthaginian fleet and its disposition, presumably representing how it had been deployed in the years prior to 260. Several older scholars, most notably Beloch, Tarn and de Sanctis, have suggested that Polybius' narrative in 260 is actually the result of confusion and that Polybius has reported the Battle of Mylae twice, having confused Philinus' account of the battle with a separate engagement entirely. However this position has been rejected by later scholars, including Thiel, Walbank and Lazenby.[146] Polybius' account of the two fleets trying to come to grips with each other through the fog of war seems perfectly reasonable and cannot be rejected out of hand. While the last of the ships of the fleet were being prepared, the consul in command, Cn. Cornelius Scipio, took

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[144] Plb. 1.20.6-7.

[145] Lazenby, (1996), 62. Zonaras 8.10.

[146] Beloch, *Griechische geschichte*, (Berlin: Walter de Gruyter, 1925), 4:651. De Sanctis, *Storia dei Romani* (Florence: La nuova Italia: 1956), 3:128-9. Tarn, (1907), 51. Against this theory, note Thiel (1954), 122-127, Lazenby (1996), 67. Walbank (1957), 76-7.

seventeen ships out on a scouting mission, with orders for the rest of the fleet to rejoin him when it was ready.[147] The fact of this scouting mission makes it seem even less likely that the Romans would have been able to deliberately build to Carthaginian numbers in anything more than a vague approximation, given the apparent limits of both Roman and Carthaginian intelligence. Scipio is promptly baited into a trap and captured with his seventeen-ship flotilla, again illustrating how little information the Romans possess in terms of Carthaginian strength and disposition.[148] The tables then turn almost immediately, with the Carthaginian commander, Hannibal, blundering into the rest of the Roman fleet with his own scouting flotilla of fifty ships, losing most of them.[149] It is after this that the Romans install the famous *corvus* device, before meeting the main Carthaginian fleet off of Mylae. Polybius gives the Carthaginian fleet strength at 130 ships but gives no strength figure for the Romans.[150] The newly constructed Roman fleet was 120 ships strong, but 17 of these had been captured, leaving 103. At the same time, the Romans may well have captured some of Hannibal's scouting flotilla of 50 ships, and may have received some support from the allies of Southern Italy, as before with the initial crossing to Messana. It seems reasonable, then, to suppose a Roman fleet of roughly equivalent size to the Carthaginian one. Perhaps the most striking element in all of the operations of the year is how little both sides seem to have known about the strength and position of the enemy.

The operations of 260 give us a better sense of Carthaginian fleet strength and disposition. The piecemeal series of engagements suggests that, to some degree, the

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[147] Plb. 1.20.3-5.

[148] Plb. 1.20.5-7.

[149] Plb. 1.20.10-11.

[150] Plb. 1.23.4

Carthaginian fleet was dispersed, possibly because the Carthaginian commander, according to Polybius the same Hannibal that had lost Agrigentum, does not seem initially to have expected the Roman fleet. Hannibal, at Panormus, first detaches another commander, Boödes, with twenty ships to trap Scipio, which nets him the capture of Scipio's seventeen ships.[151] Hannibal's subsequent reconnaissance sortie is with fifty ships, of which he loses "most" (καὶ τὰς μὲν πλείους ἀπέβαλε τῶν νεῶν), perhaps thirty or so off of what Polybius calls the Cape of Italy (τὸ τῆς Ἰταλὶας ἀκρωτήριον, which Walbank tentatively identifies as the Taurianum promontory).[152] Given the 130 Carthaginian ships at Mylae, the entire Carthaginian fleet must have been around 150 ships, assuming that some of Scipio's captured ships were put to use by the Carthaginians.[153] At no other point in the narrative do the Carthaginians break off such a large part of their fleet for reconnaissance as Hannibal does; it seems possible that, at that moment, fifty ships represented the entire squadron that Hannibal had with him, with the remaining fleet dispersed. Having received his bloody nose from the reconnaissance sortie, Hannibal then seems to have concentrated his fleet prior to the engagement at Mylae.

The losses for the subsequent Battle of Mylae are unclear. Polybius gives no figure for Roman losses, and notes Carthaginian losses at fifty ships, with thirty captured. The annalistic tradition also gives figures for Carthaginian losses in the battle, and these are remarkably regular, with Eutropius recording thirty-one captured and fourteen sunk, Orosius thirty-one captured and thirteen sunk, and the anonymous *De Viri Illustribus* giving thirty captured and thirteen sunk.[154]

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[151] Plb. 1.21.5-11.

[152] Plb. 1.21.11. Walbank, (1957), 77.

[153] Plb. 1.23.3.

[154] Plb. 1.23.10. Eutrop. 2.20.2. Orosius 4.7.10. *de vir. Ill.* 38.1.

It seems likely at this point that Polybius' figure may be a rounded one, with the figures from the annalistic tradition deriving from the *columna rostrata* of Duilius, although its surviving text has a lacuna at this point.[155] Polybius also inserts into the narrative here a subsequent defeat suffered by the same Hannibal in 258, which seems to have been at the hands of the consul of that year, Sulpicius Paterculus. Here Hannibal loses many of his ships in Sardinia and is arrested and executed by his own men for his failure.[156] Of his fleet's strength, Polybius only notes that he had the survivors of Mylae, and some additional ships; it seems reasonable to suppose perhaps 100 ships for the venture, while the Roman fleet would include the survivors of Mylae and the 30 captured ships from the battle as well.

The final action of this phase is the Battle of Tyndaris in 257. Polybius gives no sizes for either fleet, although Polyainos reports 200 Roman ships and 80 Carthaginian, which Walbank rejects and Lazenby finds plausible.[157] The battle, in any case, is effectively a draw, with nine Roman ships sunk, against eight Carthaginian ships sunk and ten captured.[158] In both cases, the losses seem to have been a small part of either fleet, and Polybius reports that both sides felt they had fought evenly.[159] Both sides then set to preparing for the larger naval showdown to come, but this is a good moment to pause and take stock of the first phase of the naval war.

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[155] Lazenby, (1996), 72.

[156] Plb. 1.24.6-7. On this passage, note Oskar Leuze, "Die Kämpfe um Sardinien und Korsika im ersten punischen Krieg" *Klio* 10 (1910): 406-44. Walbank, (1957), 80-81. Lazenby, (1996), 76-77.

[157] Plb. 1.25.1-4. Polyainos 8.20. Walbank, (1957), 82. Lazenby, (1996), 78-9. The narrative of the battle is embellished not only by Polyainos, but also by Zonaras (25.4). As Lazenby and Walbank note, Polyainos is in error in assuming both consuls were present at the battle; only Atilius Regulus seems to have been.

[158] Plb. 1.25.4.

[159] Plb. 1.25.5.

Even if Carthage initially possessed some 200 ships as previously suggested, it seems clear from the narrative of 260 that its entire fleet was not active at this point. Given that Hannibal is able to have 130 ships available for the Battle of Mylae after losing 'most' of his fifty-ship flotilla (itself reinforced by the capture of Scipio's seventeen ships), it seems reasonable to suppose that the Carthaginians had roughly 150 ships active at the beginning of the year. Given that the Carthaginian fleet was already engaged in raiding and support operations from the beginning of the war, including the raiding at Mylae that occasioned the battle itself, it seems reasonable to suppose that the Carthaginian fleet had been active at or around this strength more or less from the beginning of hostilities. That would leave the Carthaginian navy with perhaps 50 hulls in reserve. In contrast, the small Roman forces, which may not even have been regularly marshalled year to year once the crossing from Messana was secure, will have remained unchanged until late 261.

The Romans then build 120 ships in the winter of 261/0, as related by Polybius. To this must be added the allied ships used to cross the strait, although these were likely lighter ships. These allied ships numbered perhaps at most around thirty, bringing the total Roman fleet to around 150. Scipio almost immediately loses seventeen of these ships, bringing the total strength of the Roman force down to around 133 for the Battle of Mylae. Carthaginian losses at Mylae were probably less than 50, the round figure Polybius gives, perhaps the forty-three to forty-five given by later sources. No Roman losses are reported, but what losses there were in ships would have been made up by the captured Carthaginian prizes. At the end of the year's sailing season, then, the Carthaginian force might have been reduced to around ninety active ships.[160] On the

[160] This accounts for an initial strength of around 150, with 17 ships gained from Scipio at Lipara, minus around 30 losses at the 'cape of Italy' and another 44 at Mylae, giving a final tally of 93.

Roman end, it is likely that not all of the captured Carthaginian ships could be refitted, but the total Roman fleet might have increased to around 150 ships by season's end.[161] This is probably a conservative estimate as newer ships were faster, and so it stands to reason that losses were more likely to be concentrated among the older ships.

The Carthaginian fleet remains active in the following years, as Lucius Cornelius Scipio apparently encounters and flees from a Carthaginian fleet off of Sardinia, the same fleet commanded by Hannibal which Sulpicius Paterculus, as noted above, defeated in 258, with the loss of many of his ships; but no source gives a number.[162] At Tyndaris, the Romans appear to have a rather large fleet, as a vanguard of ten ships is apparently a trivial component, while the Carthaginian fleet is also apparently large enough to consider giving battle to at least that vanguard. Assuming that Carthage retained the same level of ship production which would have been required to maintain its standing fleet prior to the war (as noted, around ten ships per year), the decreased total fleet size and thus decreased need to replace aged ships would mean that Carthaginian strength would begin to trend slowly upwards, from perhaps 143 seaworthy ships immediately after Mylae to around 150 by the beginning of the sailing season in 258. Polybius indicates that the fleet Hannibal takes to Sardinia consists of the survivors of Mylae, with some additional ships, making perhaps around 100 ships a reasonable guess for the size of his fleet; of this some unknown number, presumably less than half, were lost. Evidently the fleet was large enough to scare off L. Cornelius Scipio. As noted, the Carthaginian fleet at Tyndaris seems to

[161] The newly constructed force of 120, plus the old Roman squadron of ~30, minus Scipio's 17 ships and perhaps 10 losses or so at Mylae, but plus 30 ship captured at Mylae, giving a total of ~153.

[162] Tarn attempts to assign a number of losses to this battle by working back from Polybius' final figure of 500 losses for the war, but this figure must be a round one at best and the method of working back from it is unconvincing. Tarn, (1907), 51. On L. Cornelius Scipio's expedition to Sardinia, note Zonaras 8.11. Lazenby, (1996), 75.

have been around eighty ships; at the very least it was inferior to the Roman fleet in numbers by some margin. Assuming perhaps thirty-five losses at Sardinia, 257 is the first year that Carthage appears to have begun to diminish its existing reserve of ships, in order to field the fleet at Tyndaris. The final Carthaginian strength at the end of 257, then, might have been very roughly sixty-two ships active (the survivors of Tyndaris) with another thirty-eight in reserve, before both sides completed the massive buildup prior to Ecnomus.

While the Roman fleet would have consisted mostly of new ships, it seems reasonable to still assume a replacement rate of 20%, given the continuous operations, which would have required, at the very least, the frequent repair of ships. Although it accomplishes relatively little, the Roman fleet must be active between 260 and 257, and does not appear to be reduced in strength, as at Tyndaris C. Atilius Regulus clearly has the larger fleet.[163] It is not clear if any of the ships Hannibal lost in Sardinia were taken over by the Romans, but it seems relatively unlikely, as the Romans were eventually repulsed from the island in the same year, and moreover would have found it difficult to crew captured ships in hostile territory. Thus, the Roman fleet would have maintained a relatively stable strength, probably around 150, until Tyndaris, when the Roman fleet lost nine ships but captured ten more, leading to a net gain of a single ship, leaving the Romans with an active fleet of just above 150 ships in 257.

The year to year estimates are presented in the table below. As noted above, each year is divided into an eight month 'summer' season when the sea was open and a four month 'winter' season when it was generally closed. Ships 'retired' refers to ships reaching the end of their service life or otherwise requiring substantial repairs, assumed to be roughly 20% of the total

[163] On the continuous Roman activity from 260 to 257, often not reported by Polybius but evident from other sources, see Lazenby, (1996), 72-80.

strength, active and reserve, in any given year. Where that 20% figure produces fractional ships, I have rounded to produce whole numbers.

Table 2.3: Carthaginian Fleet Estimates, 264-257						
Year	Season	Active	Reserve	Built	Lost	Retired
264	Summer	150	50			
264/3	Winter		200			10
263	Summer	150	50			
263/2	Winter		200			10
262	Summer	150	50			
262/1	Winter		200			10
261	Summer	150	50			
261/0	Winter		200			10
260	Summer	150	50		57	
260/59	Winter		143			7
259	Summer	93	50			
259/8	Winter		143			7
258	Summer	93	50		35	
258/7	Winter		114			6
257	Summer	80	24		18	
257/6	Winter		86	See next section		

Table 2.4: Roman Fleet Estimates, 264-257						
Year	Season	Active	Reserve	Built	Lost	Retired
264	Summer	30				
264/3	Winter		30			1
263	Summer	30				
263/2	Winter		30			2
262	Summer	30				
262/1	Winter		30			1
261	Summer	30				
261/0	Winter		30	120		2
260	Summer	150			+3	
260/59	Winter		153			8
259	Summer	153				
259/8	Winter		153			7
258	Summer	153				
258/7	Winter		153			8
257	Summer	153			+1	
257/6	Winter		154	See next section		

The Great Fleets (257-253)

The fleets of 256 and 255 are the subject of much controversy and are sufficiently interrelated to be worth covering together. Polybius relates that, starting in 257, presumably late in the year, both the Romans and Carthaginians significantly increased their naval programs.[164] The following year, in the summer of 256, the Romans launched an expedition to Africa, with a fleet Polybius reports at 330 'covered' (καταφράκτοις) warships, while the Carthaginians opposed this crossing with a fleet of 350 warships.[165] The fleets met at Ecnomus and the Romans won a great victory, with twenty-four Roman and 'more than thirty' Carthaginian ships

[164] Plb. 1.25.5.

[165] Plb. 1.25.7-9.

sunk, and another 64 Carthaginian ships captured.[166] After the capture of Aspis, the Roman fleet deposited M. Atilius Regulus, the expedition, and forty ships at Aspis, while the rest of the Roman fleet returned to Italy.[167]

By the following year Regulus' expedition had fallen into difficulties, and a Roman fleet was sent to retrieve it early in the summer of 255. Polybius gives its strength as 350 ships, presumably the original fleet at Ecnomus enhanced by the captured Carthaginian ships, although it is worth noting that he seems to forget the forty ships supposedly left in Aspis.[168] The Carthaginians, buoyed by their success against Regulus, reconstitute a fleet of 200 ships, with Polybius reporting both an expensive refit, presumably of ships damaged at Ecnomus, and also new construction; this fleet sails to intercept the Roman fleet, which it meets off the Hermaeum.[169] Polybius' narrative of the very lopsided battle is extremely brief, although he reports that some 114 Carthaginian ships were captured. He then reports that the Roman fleet, which he now gives at 364 ships, was caught in a storm off Camarina, with only 80 ships surviving. Clearly something has gone wrong, for we have added 350 to 114 and gotten 364 and misplaced the 40 ships left at Aspis besides. We will return to this problem in a moment, but first it is necessary to advance a bit further in Polybius' narrative, as the events immediately after Hermaeum can serve to shed some light on the possible resolutions of the textual problems.

The Carthaginians, encouraged by the Roman losses, again reconstitute a force of 200 ships, while the Romans construct 220 new ships, bringing their fleet to a full strength of 300,

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[166] Plb. 1.28.14.

[167] Plb. 1.29.8-9.

[168] Plb. 1.36.10.

[169] Plb. 1.36.8-9, 10-12.

with which they capture Panormus in 254.[170] Tarn and Thiel both question the existence of a Carthaginian fleet here, based on its apparent inactivity (Polybius reports no activity for the Carthaginian fleet immediately after being reconstituted), but it is not hard to see why the Carthaginians, after their rough treatment at Hermaeum, would have been reluctant to engage in battle badly outnumbered a second time.[171] Moreover, it is hard to see what the Carthaginian fleet, numerically inferior as it was, was likely to have been able to do in 254 that would have attracted Polybius' attention. The Carthaginian strategy on Sicily was primarily reactive and defensive, aimed at wearing the Romans out rather than running them off the island. That strategy fits fairly well with the indecisive nature of ancient naval warfare and the inability to 'command' the sea, as noted above. Unable to engage the concentrated Roman fleet at Panormus, it is not hard to believe the Carthaginian fleet would have had to busy itself resupplying other Carthaginian holdings, like Lipara and Lilybaeum; a set of actions very likely to have escaped Polybius' notice. This status quo is shaken up, however, when in 253 the Roman fleet is again caught in a storm and the Romans largely abandon large scale naval operations for two years.[172]

The discrepancy at Hermaeum and the storm off of Camarina has occasioned numerous efforts to make sense of Polybius, though perhaps the most enduring attempt to 'correct' him is that of Tarn, who proposed to solve the problem by removing 100 ships from the Roman fleet at Hermaeum and then, in order to keep the relation of the fleets of Hermaeum and Ecnomus correct, to remove 100 ships from the latter battle as well; hence Tarn proposes 230 Roman ships

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[170] Plb. 1.38.

[171] Tarn, (1907), 56. Thiel, (1956), 243.

[172] Plb. 1.39.1-11.

at Ecnomus and 250 at Hermaeum.[173] He accounts for the larger number of Roman ships given by Polybius as mistakenly including the transports among the warships. Moreover, because Tarn was himself convinced that the Romans always built to exceed Carthaginian fleet numbers, he ‘corrects’ the number of Carthaginian ships at Ecnomus to 200. This solution was in turn largely adopted by Thiel and forms the basis for the ship counts recently used by Pitassi.[174] Walbank accepts Tarn’s solution as the “most probable” of a set of options, but he also notes that “Tarn’s scheme is not watertight” and that “no help comes from the Roman tradition” of later sources.[175]

However, there are a number of problems with Tarn’s reconstruction, even beyond the degree to which such an extensive set of ‘corrections’ would seem to cast all of Polybius’ figures into irretrievable doubt. As Lazenby notes, the landing force at Ecnomus seems to have been carried aboard the warships, with the only dedicated transports Polybius reports being horse transports (ἱππηγοὶ); the expedition’s 500 cavalry were nowhere near enough to occasion the 100 transports Tarn envisions.[176] As noted above, the size of the Roman and Carthaginian fleets, while exceptionally large, is not so large as to beggar belief. Polybius also reports Roman fleets of comparable strength in 253 at Panormus, though that fleet too is struck by a storm.[177] As both Lazenby and Tipps note, the Carthaginian fleet, while apparently the largest ever marshalled, is not so large as to be beyond belief, especially given the threat that the Roman expedition to

[173] Tarn, (1907), 52-54.

[174] Thiel, (1954); Thiel. (1946); Michael Pitassi, (2012). See also M. Pitassi, (2009).

[175] Walbank, (1957), 83-95.

[176] Plb. 1.26.14. Lazenby, (1996), 83-4.

[177] Plb. 1.39.1-6. Tarn, bizarrely, dismisses this fleet as “unparalleled,” having already discounted all of the parallels to it in the proceeding passages. Tarn, (1907), 55.

Africa posed to Carthage, nor is it necessarily inconsistent with subsequent reports of Carthaginian building and fleet strength.[178]

Moreover, Polybius' narrative of the battle at Ecnomus seems to confirm that these fleets were of unusually large size, particularly given the Roman division of command. The limitations to command and control in the absence of modern communications made effective command of very large fleets extremely difficult, with the usual response being to delegate command to specific 'wings' of a fleet to subordinates, who then operate with a significant degree of autonomy. At Cynossema, the Athenian fleet of 80 ships was divided primarily between Thrasyllus on the left and Thrasybulus on the right, even though the other *strategoi* were present, as Thucydides notes.[179] At Arginusae, while all eight of the *strategoi* present commanded squadrons, Xenophon's account seems to privilege Aristocrates on the left wing and Protomachus on the right wing as the overall commanders, while Diodorus notes that Callicratidas, the Spartan admiral, entrusted his left wing to Thrasondas the Theban.[180] This tendency to divide command in very large fleets continued into the early modern period and is quite notable at the Battle of Lepanto in 1571. There, the 212 ship Christian Holy League fleet was divided into three main units, a left wing under Agostino Barbarigo, the center under Don John of Austria, and the right under Giovanni Andrea Doria, in addition to a smaller rearguard under Don Alvaro de Bazan. The Ottoman fleet of 272 ships was in turn split into three main

[178] Lazenby, (1996), 83. Tipps, (1985).

[179] Thuc. 9.104.3

[180] Xen., *Hel*. 1.6.29-30. Diodorus 13.98.2-4. Diodorus indicates that the Athenian right wing was in fact under the command of Thrasyllus, to whom Pericles, son of Pericles deferred due to his greater experience. What matters in this instance is the division of command, rather than exactly who commanded which part.

units as well, with the left wing under Uluc Ali reis, the center commanded by Ali Pasha, and the right wing commanded by Mehmed Siroco.[181]

The Roman fleet at Ecnomus, however, was divided, Polybius notes, into four commands, the right and left sides of the wedge, the back of the wedge, and a final warship squadron in the rear called the *triarii* after the back ranks of a legion.[182] It is worth noting that this division did not include the transports, which Polybius treats separately, so we may regard the Roman fleet as having been divided into either four or even potentially five groups. Polybius offers fewer details of the Carthaginian fleet and names no commanders, but Lazenby, in reconstructing the fleet, also notes that it appears to be divided in four parts.[183] Such an extensively divided command strongly argues for both fleets being uncommonly large.

Moreover, Polybius' description of the Roman formation seems consistent with his suggestion that the Roman fleet was somewhat outnumbered, a position presumably worsened by the need to tow and guard the horse transports. As with the fleet numbers, Polybius' formation for the Roman fleet has been questioned, most notably by de Sanctis, Tarn and Thiel, as being impractical to the point of impossibility; but the formation has been defended convincingly by Lazenby and Tipps, and is accepted as plausible by Steinby.[184] Polybius notes that the Roman formation was conceived in part out of a desire to limit the potential damage caused by the faster Carthaginian fleet potentially flanking the Roman formation.[185] But if the Roman fleet had

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[181] Capponi, (2006), 253-286. Both fleets also had small reserves.

[182] Plb. 1.26.13-16.

[183] Lazenby, (1996), 88-91.

[184] Tarn, (1930), 151. Thiel (1954), 119. De Sanctis, (1956), 136-37. Lazenby, (1996), 87-88. Tipps, (1985), 445-454. Steinby, (2007), 94-5.

[185] Plb. 1.26.10-11.

numerical superiority, as Tarn supposes, this compact and essentially defensive formation would hardly seem necessary, as the Roman commanders could have simply extended their line out into open waters and used their superior numbers to envelop the Carthaginian fleet. Instead, it is the Carthaginian fleet that uses this strategy, extending its line out into the open sea and also closer shoreward at a forward angle to aid in encircling the Roman fleet and striking it from behind. Both the Carthaginian formation and the Roman counter-formation suggest a Carthaginian fleet that was at least roughly equal, if not superior, to the Roman fleet in numbers.[186]

No solution to this problem is likely to be completely satisfying, but to cut down all of the figures as Tarn does is clearly unsatisfactory. Tipps suggests that the simplest explanation of the discrepancy at Hermaeum is to assume a mistake of precisely 100 ships in the total for the Roman fleet caught in the storm, bringing it from 364 to 464, noting that this sort of mistake would have been an easy one for a scribe to make.[187] Lazenby, although noting that such a correction would be reasonable, opts instead to assume that the Roman fleet on arrival at Aspis had 504 ships, the original 350, plus the 114 Carthaginian prizes, plus the 40 ships left at Aspis; but departed only with the 364 most seaworthy ships, leaving behind or burning the rest.[188] These proposals by Tipps and Lazenby both have problems, although none so insurmountable as those created by Tarn's solution. The initial difficulty of where the crews for these ships come from is solved by Polybius, who notes that the ships were captured "αὔτανδρους," men and all, which could very well have resolved the need for additional oarsmen.[189] For the purposes of this

[186] Plb. 1.27.1-5.

[187] Tipps, (1985), 438.

[188] Lazenby, (1996), 108.

[189] Plb. 1.36.12.

study, however, the precise number of Roman ships caught in the storm actually matters relatively little. What matters is how many ships set out and how many returned, for both the Romans and the Carthaginians; with the adoption of that narrow focus, many of the questions can be dropped.

What remains, however, is the question of how many ships the Carthaginians lost at Hermaeum, a puzzle which impacts our understanding of the subsequent strength of the Carthaginian fleet. The first possibility is that the battle happened as the preserved text suggests, with 114 prizes, in which case we might follow either Tipps or Lazenby's suggestion in raising the size of the Roman fleet at Camarina. In support of this notion, we might note that we know from Livy that a *columna rostrata* was set up for the two consuls in command, which seems to support a more dramatic victory, although the triumph, over the Carthaginians and the Cossurenses, appears to have been celebrated in January of 253, after their years as proconsuls in Sicily.[190] The triumph alone, however, does not necessarily decisively argue for a large number of ships captured at Hermaeum. Panormus was captured during the following year, and it seems plausible that the triumph was voted to the consuls, not for a single great victory, but for a progression of achievements including the routing of a Carthaginian fleet, some activities on Malta (implied by the triumph including the Cossurenses by name), and perhaps involvement in military operations in Sicily in the year that both consuls seem to have been proconsuls there. This solution of accepting the 114 figure does, however, have the virtue of preserving Polybius' figure.

The second potential option is an emendation to a smaller number of prizes. As Tipps notes, an error of exactly 100 ships would be an easy one to make, and in this case, we might

[190] Walbank, (1957), 95, 99.

point to a single errant ἑκατὸν as the source of the confusion. Diodorus provides a hint in support of this reading, as he gives the total number of prizes at the battle as twenty-four, rather than 114, which perhaps combined with some Roman losses (Orosius reports nine), could put the Roman fleet at roughly the strength Polybius gives.[191]

Further supporting this notion is Polybius' own language about the subsequent Carthaginian recovery. After the storm off Camarina destroys all but eighty of the Roman ships, Polybius reports that the Carthaginians, elated, "got ready [κατεσκευάζοντο] two hundred ships and to make all the other preparations for a naval expedition."[192] As noted above, in Polybius, σκευάζω and its derivatives tend to refer to the refitting of already extant hulls, rather than the construction of new ships. Polybius only uses κατασκευάζω of ship construction at one other point in his Punic War narrative, during the preparation of the initial Roman fleet of 261/0, where he notes that the crews were trained to row on shore "while those to whom the construction of the ships had been committed were busy in getting them ready [κατασκευήν]."[193] The actual construction of the ships, including their derivation from a Carthaginian model, however, seems to have already taken place, leaving the reference ambiguous.[194] It is possible that Polybius here means to include the construction, but it is also possible that, having dispensed with the production of the hulls in the previous section, he understands κατασκευήν here to mean post-construction fitting and finishing.

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191 Diodorus 23.18.1. Orosius 4.9.6.

192 Plb. 1.38.3-4.

193 Plb. 1.21.1.

194 Plb. 1.20.9-16.

Comparative examples for κατασκευάζω in naval contexts are fairly hard to come by. Arrian prefers ἐπισκευάζω, which in the *Indica* always has the sense of repair or refit, and never of construction.[195] Thucydides prefers παρασκευάζω, but it less consistent with its use, typically using it to mean refit, but occasionally including fresh construction.[196] More relevant, a passage from a speech of Apollodorus, *Against Polycles*, uses κατασκευάζω unambiguously to refer to the repair and refit that would be the duty of a trierarch. Apollodorus declares that he "fitted [κατεσκεύασα**]** the ship with equipment all my own, taking nothing from the public stores,"[197] and he later challenges his Polycles to "take over the trireme and furnish [κατασκεύασαι] it yourself, along with sailors and marines and officers."[198] In both cases, the basic ship's hull obviously already exists. If the Carthaginians are mainly refitting ships, then Polybius seems to suggest that the damage to the Carthaginian fleet was less severe than the preserved text implies. Amending the Carthaginian losses from 114 to merely fourteen would neatly solve both the problem of the Roman fleet strength in the storm at Camarina, the brief description of the battle, and the otherwise inexplicable lack of Carthaginian shipbuilding for the fleet of 254.

However, this emendation, changing the losses from 14 to 114, runs afoul of the evidence (such as the *columna rostrata*) that the victory was likely a great one. While Diodorus reports only 24 ships captured, Eutropius and Orosius both give the figure of 104 ships sunk and thirty captured at the battle, suggesting losses higher than Diodorus admits and more in line with the

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[195] Arrian, *Indica* 25.1, 33.9, 38.9.

[196] Παρασκευάζω as purely a refit: Thuc. 1.31.1, 3.3.2, 3.77.1, 4.2.2, 7.22.2, 7.36.2, 8.1.3. Included with fresh construction, Thuc. 8.4.1.

[197] Ps. Dem. 50.7. ἰδίοις τὴν ναῦν ἅπασι κατεσκεύασα, καὶ τῶν δημοσίων ἔλαβον οὐδέν.

[198] Ps. Dem 50.36. παραλαβὼν τὴν τριήρη αὐτὸς σαυτῷ κατασκεύασαι καὶ ναύτας καὶ ἐπιβάτας καὶ ὑπηρεσίαν.

figure in the text.[199] These figures suggests a third possible solution, that many of the ships were in fact sunk rather than captured, leaving the Romans with only perhaps fourteen prizes (or twenty-four prizes with around ten losses), but with the remainder of the 114 sunk or damaged beyond repair. This proposal solves the problem of the Roman fleet size in the storm at Camarina, but not the issue of the lack of Carthaginian building late that year. Possibly that the reason the Carthaginians engage in apparently minimal new ship construction after Hermaeum may be that the Carthaginian navy merely repaired and refitted additional ships still left damaged at Ecnomus, but that begs the question of why this step was not taken in the previous year. This solution also fails to explain why Polybius dismisses in just a few lines what must have been one of the most commanding Roman victories of the war. As is perhaps now readily apparent, no solution to this episode is likely to be entirely satisfactory. What seems the limit of our secure knowledge is that the Romans won a notable victory at Hermaeum, no doubt because of their significant numerical superiority of 350 ships to only 200, but then lost nearly all of their ships, prizes and all, in the subsequent storm. For this analysis, we must at least venture more specific figures, but it should be cautioned at this point that any such figures beyond this basic understanding are necessarily speculative.

Carthage will have had, as noted above, around a hundred ships after the Battle of Tyndaris, so in order to bring its full fleet up to the reported strength of 350 it will have needed to construct some 250 warships plus five more to account for the retirement of old ships as before. A very high number indeed, but not necessarily an unbelievable one, and it is possible that the construction of these ships began well before the winter of 257. To reach their reported strength of 330, the Romans would have needed to build some 178 warships plus eight more to

[199] Eutropius 2.22.1. Orosius 4.9.6

account for normal replacement, and some unknown, but presumably small, number of horse transports. The Carthaginians lose sixty-four ships captured and 'more than thirty' ships sunk, for perhaps a total of 100 losses, leaving 250 ships in the winter, all of which appear to be temporarily mothballed when Carthage turns to fight Regulus on land. The Roman fleet, by contrast, losing twenty-four ships but capturing 64 more, would have been increased to 370, forty of which would be left active at Aspis, and the rest returning to Italy to be retired for the winter. A further twenty Roman ships would need to have been built for the fleet to depart at the 350-ship strength Polybius provides for the following year, plus 19 to account for normal replacement.

The Carthaginian fleet in the summer of 255 was 200 ships strong, but we should also account for the building Polybius describes for Carthage in the winter of 256/5, perhaps eighty ships or so, including the normal replacement of thirteen ships. That would give the Carthaginians 317 total ships, of which only 200 are active for the Battle at Hermaeum. The consensus of the sources seems to be that Carthaginian losses were somewhat over 100, with Polybius giving 114 and Eutropius and Orosius 134, leaving total Carthaginian strength around 200 in the summer of 254, with the remaining ships from Ecnomus being refitted for combat after the reports of the storm off Camarina sinking the bulk of the Roman fleet. The Carthaginian replacement building for the winter of 255/4 would then have stabilized again at 10.

The Roman fleet in 255 would have included the forty-ship squadron at Aspis, as well as the 350-ship relief force. Whatever the solution to the problem of Hermaeum, only eighty of these ships survived to the end of the year. The Romans then build some 220 ships in the winter of 255/4, and go on the offensive with all 300 ships they have in the summer of 254. The

Carthaginian fleet is presumably still at 200 strength. Diodorus indicates that the Carthaginian fleet does shadow the Roman fleet in 253 and possibly prevents it from mooring near Libya, so we should probably assume the Carthaginian fleet stays active, at least when the sea is open.[200] Finally, the Roman fleet is struck by a storm again in 253, losing 150 ships of its total of 300, leading Rome to mothball nearly its entire fleet.

Table 2.5: Carthaginian Fleet Estimates, 257-253						
Year	Season	Active	Reserve	Built	Lost	Retired
257	Summer	62	24		18	
257/6	Winter		86	264		5
256	Summer	350			100	
256/5	Winter		250	80		13
255	Summer	200	130		114	
255/4	Winter		216			11
254	Summer	200				
254/3	Winter		200			10
253	Summer	200				
253/2	Winter		200			10

Table 2.6: Roman Fleet Estimates, 257-253						
Year	Season	Active	Reserve	Built	Lost	Retired
257	Summer	154			+1	
257/6	Winter		154	176		8
256	Summer	330			+50	
256/5	Winter	40	330	20		19
255	Summer	390			310	
255/4	Winter		80	220		4
254	Summer	300				
254/3	Winter		300			15
253	Summer	300			150	
253/2	Winter		150			8

[200] Diodorus 23.19.

Carthaginian Recovery, Dominance and Defeat (253-241 B.C.)

After 253, we see no more monster fleets of 300 or more ships. The shift to smaller fleets can almost certainly be attributed to the economic exhaustion of both sides. Whatever the result of Hermaeum, such exhaustion on the Carthaginian side seems hinted at by the decision to refit only existing hulls in 254. On the Roman side, the decision to temporarily suspend major naval operations after the disaster of 253 would suggest that here too energy was flagging. Given that land-based operations in Sicily continued at a fairly high tempo, it does not seem to be a failure of political will in 253 (or again in 249). Finance seems the more likely cause, although Polybius gives no hint of the state of the Roman treasury until a decade later, noting in 243 that it was empty.[201] There does not seem to be evidence of any sort of currency devaluation in Roman coinage that we might associate with extreme financial distress. However, it is just as likely that the Senate's decision not to raise a large fleet for several years, and instead to rely on land warfare, represented a successful effort to bring income into line with expenditures.[202] Roman soldiers provided their own equipment, could be paid a pittance and would serve for honor and duty, but ships and rowers cost money.

Following the storm in 253, Polybius reports that the Romans opted not to build a new fleet, but instead they revised their strategy to focus exclusively on land forces.[203] Only sixty ships were kept active, Polybius notes, for supply purposes; both Orosius and Eutropius concur

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[201] Plb. 1.59.6.

[202] Crawford (1987), 43, 634. It is worth noting that Crawford here argues for a relatively late date of 217 for the initial devaluation to the semi-libral standard, whereas older works by H. Mattingly and J. G. Milne would have placed that first devaluation during the First Punic War. See J. G. Milne, "The Aes Grave of Central Italy," *JRS* 32 (1942): 27-32 and H. Mattingly, "The First Age of Roman Coinage," *JRS* 35 (1945): 65-77.

[203] Plb. 1.39.7-8.

with this figure.[204] Roman operations in 252 and 251, largely passed over by Polybius but reported in the later sources, seem limited to land-based operations following the capture of Panormus.[205] These operations then culminate in a major land engagement between a Hasdrubal and Roman forces under L. Caecilius Metellus near Panormus, which produced a significant Roman victory.[206] Although land operations do not figure directly into this study, these operations are worth noting to avoid the impression that the war was ever really 'on pause' during this period. The Romans had already begun preparing a new fleet in the winter of 251/0, apparently before the Battle at Panormus.[207] Polybius reports the construction of fifty ships, resulting in a fleet of 200 ships when combined with the 150 ships that had survived the storm of 253.[208] This fleet then supports the subsequent siege of Lilybaeum in 250.[209]

Although Polybius reports the Carthaginian fleet as having been at a strength of 200 ships after 254, he gives few details of their activities until 250. A fifty-ship squadron under the command of Hannibal does run the blockade into and out of Lilybaeum in 250 with relief forces and supplies, before removing his fleet to Drepana.[210] The following year, a Roman fleet of 123 ships under the command of P. Claudius Pulcher was badly mauled by a Carthaginian fleet, the

[204] Plb. 1.39.8. Orosius 4.9.12. Eutropius 2.23. Lazenby, (1996), 118.

[205] Lazenby, (1996), 118-119.

[206] Plb. 1.40. This battle is difficult to date precisely, but it seems to have occurred very late in 250, see Lazenby, (1996), 119-122.

[207] Plb. 1.39.14-15.

[208] Plb. 1.39.15, 41.1-2.

[209] Plb. 1.41.3-6.

[210] Plb. 1.44, 1.46.1-3. This is neither the Hannibal of the first years of the war, nor Hannibal 'the Rhodian.'

size of which Polybius does not provide, at Drepana. The Romans lost all but 30 ships.[211] Following this victory, the Carthaginians sent a small squadron to attack the Roman blockade fleet at Lilybaeum, inflicting limited damage on the fleet.[212] The Romans then sent L. Iunius Pullus with sixty ships and supplies to regroup what was left of the fleet. After he regrouped with the ships at Lilybaeum, Iunius with 120 ships, which according to Polybius was the entire Roman fleet, was caught by a storm off of Cape Pachynus, and the fleet was lost in its entirety.[213] The Romans then gave up completely on the sea, leaving the Carthaginians freedom to again raid Italy.[214]

This status quo, with the Carthaginians having free rein over the sea and the Romans without a fleet, then holds until the construction of a fresh Roman fleet of 200 ships in the winter of 243/2.[215] It seems to have arrived in Sicily in the summer of 242 and invested Drepana. Polybius notes that the Carthaginian fleet was still at Carthage.[216] Despite his suggestion that the Carthaginians readied their fleet "at once" (παραυτίκα), it was only in the following year (Eutropius gives the date as the 10th of March) that the two fleets met off of the Aegadi Islands for what would be the final naval engagement in the war.[217] Polybius reports no size for the

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[211] Plb. 1.51.11-12.

[212] Plb. 1.53.5-7.

[213] Plb. 1.52.7-8.

[214] Plb. 1.55.1-56.3.

[215] Plb. 1.59.7-9.

[216] Plb. 1.59.8-10.

[217] Plb. 1.60.1. Eutropius 2.27.2.

Carthaginian fleet, but notes that it lost fifty ships sunk and seventy captured, with no figures given for Roman losses.[218]

As noted before, both Thiel and Tarn discount Polybius' report of a reconstituted 200 ship Carthaginian fleet in 254 after the storm off of Camarina.[219] Tarn assumes that the 200 ships here mentioned must be transports, reasoning that if Carthage had a fleet of any size in 254 it would have contested the siege of Panormus.[220] Instead Tarn and Thiel both assume that Carthaginians only have perhaps 70 ships available in 254, a number raised to perhaps 170 total ships in 249. However, Carthaginian inaction in 254 and 253 hardly seems sufficient proof for this fairly drastic change to Polybius' narrative. He notes that after the loss of 150 Roman ships (leaving 150 operational) in 253, the Carthaginians were encouraged that they "now controlled the sea without fear, the Romans having withdrawn from it."[221] It is hard to imagine this confidence if Carthage only had a small flotilla of seventy ships, while the Romans were sending only sixty ships to Sicily with another ninety in mothballs in Italy. Moreover, it is hardly a shock that, after the disasters of Ecnomus and Hermaeum, the Carthaginians might have been reluctant to challenge the 300-ship Roman fleet at Panormus. Lazenby offers another solution, noting that Polybius only has the Carthaginians "beginning to prepare" a fleet of 200 ships in 254, and that the fleet may not have been entirely ready right away.[222] It does, however, seem necessary to

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[218] Plb. 1.61.6-8.

[219] Tarn, (1907), 56. Thiel, (1954), 86-7, 244-246.

[220] Tarn, (1907), 56, n. 41.

[221] Plb. 1.39.10. τῆς μὲν γὰρ θαλάττης ἀδεῶς ἐπεκράτουν ἐκκεχωρηκότων τῶν Ῥωμαίων

[222] Lazenby, (1996), 113. Plb. 1.38.3. τοῦτον δ᾽ ἐκπέμψαντες διακοσίας κατεσκευάζοντο ναῦς καὶ τἄλλα τὰ πρὸς τὸν πλοῦν ἡτοίμαζον.

assume that the Carthaginian fleet had reached 200, or at least nearly 200, ships in strength by 253 when the loss of 150 ships gives the Carthaginians untroubled control of the sea.

The events surrounding the Battle of Drepana give some sense of the disposition of the Carthaginian fleet. Polybius gives no figures for the size of the Carthaginian fleet under Adherbal at Drepana, but we know that it was reinforced by seventy ships from Carthage under the command of Carthalo shortly after the battle.[223] If we follow Polybius in assuming the Carthaginians had 200 ships at this point, it suggests a return to the Carthaginian dispositions at the beginning of the war, with 130 ships in the theatre of operations, with the rest (the 70 ships dispatched under Carthalo) in reserve at Carthage.

Roman fleet movements in 250 and 249 also appear to require some explaining. Polybius reports the construction of only fifty ships in 251/0, which combined with the 150 ships that had survived the storm of 253, neatly gives the 200 ship fleet Polybius reports supporting the siege of Lilybaeum in the summer of 250.[224] This fleet, however, appears to have been both augmented and dispersed at the beginning of 249. Following Polybius, P. Claudius Pulcher had with him 123 ships when he sailed against Drepana, of which only thirty returned.[225] In addition, L. Iunius Pullus who Polybius probably incorrectly assigns as the consul of 248, when in fact he was Claudius' colleague in 249, set out from Rome with sixty ships and a supply convoy for the siege.[226] At Messana, Pullus joins up with "those of the ships that had assembled there from the

[223] Plb. 1.53.1-2.

[224] Plb. 1.39.14-15, 1.41.3.

[225] Plb. 1.51.11-12.

[226] Plb. 1.52.4-6. On Pullus' consular year and the dating of Pullus' disaster, see Walbank, (1957), 115-6 and Lazenby, (1996), 137.

army and the rest of Sicily."[227] William Paton, in translating this passage, assumes these ships are from Lilybaeum, a mix presumably of Claudius' survivors and ships left behind to continue the blockade. However, as Walbank notes, if this were true, such ships would have had to have snuck past Carthalo, who is, after this point, positioned between Lilybaeum and Messana.[228] Lazenby instead figures that these ships must be part of the expedition of 250 which had returned to Italy for the winter, and thus that some of Pullus' ships must be new construction in order for the Romans to have had both Pullus' fleet of 120 and Claudius' of 123.[229] This position finds some support from Polybius' language, for although he is clear that Pullus' fleet was a complete loss with "not even the wrecks" being salvageable, he only concludes that the Roman fleets were "disabled" (ἀχρειωθῆναι), rather than completely lost.[230] This statement makes sense if we assume that Claudius' 30 surviving ships were still at Lilybaeum, but badly damaged and effectively useless.

The final question then, is the size of the Carthaginian fleet present at the Aegates Islands. It clearly must have been larger than the 120 losses Polybius reports it sustained, for he also notes the survivors of the battle retreating.[231] The Carthaginians ought to have had something like 293 ships at their disposal: the 200 ships prior to Drepana, plus the ninety-three ships captured from Claudius. However, it seems hardly likely that all of the ships Claudius lost

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[227] Plb. 1.52.6.

[228] Walbank, (1957), 116. W. L. Paton, *Polybius: The Histories, Books 1-2*, rev. F. W. Walbank, and C. Habicht (Cambridge: Harvard University Press, 2010), 159. Walbank and C. Habicht, in revising the new Loeb translation, make no changes to Paton's translation of this passage.

[229] Lazenby, (1996), 123-4.

[230] Plb. 1.54.8. It is worth noting that Diodorus gives a more complicated account of the loss of Pullus' fleet, Diodorus 24.1.7-9. Here, however, Polybius' numbers are, I think, to be preferred, and in any event, Pullus' fleet is a total loss either way.

[231] Plb. 1.61.6-7. Polybius reports 50 ships sunk and 70 captured.

were captured in a serviceable state. In his account of the battle, Polybius notes that many Roman ships were sunk, so it seems likely that a good number of Claudius' lost ships were in fact total losses.[232] There were, evidently, at least some prizes, as Adherbal sends them back to Carthage with the prisoners, before sending Carthalo to raid the remains of the Roman fleet at Lilybaeum.[233] Diodorus reports the Carthaginian fleet at the Aegates Islands to have been 250 warships, which seems reasonable, assuming around fifty of the Roman ships captured at Drepana could be repaired.[234] It is worth noting, with Lazenby, that there are signs that the Carthaginians were at this stage struggling to find adequate crews and especially marines for their ships, which may argue for a smaller fleet, though certainly not much smaller than 200.[235] In the absence of a figure from Polybius, the most reasonable course seems to be to assume that the Carthaginian fleet at the Battle of the Aegates Islands was around 200 ships, roughly the same size as the Roman fleet, not counting transports.

Now we may complete our speculative reconstruction of fleet strengths. Of the 150 Roman ships to survive the storm of 253, sixty are reactivated in the summer of 252, while the remaining ninety are kept in mothballs, with that pattern holding again for 252 and 251. Given our standard formula to account for replacement building, this would have required the Romans to construct eight ships each year. Finally, in the winter of 251/0, the Romans build fifty fresh ships, plus eight more to account for replacement, which are then activated together in the summer of 250 for a total fleet of 200, conforming to Polybius' totals. The following winter,

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[232] Plb. 1.51.7.

[233] Plb 1.53.1-2.

[234] Diodorus 24.11.1. Lazenby, (1996), 155.

[235] Lazenby, (1996), 153.

part of the fleet is left at Lilybaeum to be commanded by Claudius in 249. Polybius reports the presence of the crews at the siegeworks over the winter.[236] The strength of that still active fleet would presumably have been the same as Claudius' strength at Drepana: 123 ships. The remainder, seventy-seven, are mothballed. In order to reach the roughly 240 Roman ships reported active in the following year, the Romans needed to build an additional forty ships, plus ten to account for replacement. Then in 249, the entire Roman fleet is effectively lost, leaving the Romans with no ships, a situation that holds until the construction of a new fleet in the winter of 243/2. This fleet of 200 ships is active in Sicily in the summer of 242 and engages the Carthaginian fleet, following Eutropius, on the 10th of March, 241, thus at the very end of the winter of 242/1.

On the Carthaginian side, we might assume that the entire Carthaginian fleet was active in the summer of 253, given the presence of the large Roman fleet, but that for the summer of 252, only a part of the fleet, perhaps 130 ships, was active, as appears to have been the case in 250 and 249. The arrival of the Roman fleet of 250 causes the Carthaginians to activate their entire force of 200 ships for 249. The Battle of Drepana furnishes them with an abundance of hulls, but it seems plausible, given the evidence of crew shortages, that the they might have merely used this abundance to select the most seaworthy hulls, and then have burned the rest. The slow response to the arrival of a Roman fleet in 242 suggests that the Carthaginians had again gone back to the habit of placing on reserve much of their fleet when the Romans were inactive, although reports of Carthaginian raiding by Hamilcar suggest that at least some of the fleet was kept active.[237] It seems likely, in this case, that the active portion was smaller, given

[236] Plb. 1.49.1-2.

[237] Plb. 1.56.10.

the slow response to the Roman fleet of 242. Here I venture that the ratio of active ships to reserves might have been reversed, with seventy active and 130 mothballed in the summers, but it must be noted that this is mere speculation. In either case, the Carthaginian fleet appears to have been retired back to Carthage in the winters, since the fleet that sails to the Aegates seems to come direct from Carthage, and Polybius does not report it rendezvousing with any squadron based on Sicily.[238]

[238] Plb. 1.60.1.

Table 2.7: Carthaginian Fleet Estimates, 252-241						
Year	Season	Active	Reserve	Built	Lost	Retired
252	Summer	130	70			
252/1	Winter		200			10
251	Summer	130	70			
251/0	Winter		200			10
250	Summer	130	70			
250/49	Winter		200			10
249	Summer	200				
249/8	Winter		200			10
248	Summer	70	130			
248/7	Winter		200			10
247	Summer	70	130			
247/6	Winter		200			10
246	Summer	70	130			
246/5	Winter		200			10
245	Summer	70	130			
245/4	Winter		200			10
244	Summer	70	130			
244/3	Winter		200			10
243	Summer	70	130			
243/2	Winter		200			10
242	Summer	70	130			
242/1	Winter	200			120	10
241	**Final**	80				

Table 2.8: Roman Fleet Estimates, 252-241						
Year	Season	Active	Reserve	Built	Lost	Retired
252	Summer	60	90			
252/1	Winter		150			8
251	Summer	60	90			
251/0	Winter		150	50		8
250	Summer	200				
250/49	Winter	123	77	40		10
249	Summer	240			240	
249/8	Winter					
248	Summer					
248/7	Winter					
247	Summer					
247/6	Winter					
246	Summer					
246/5	Winter					
245	Summer					
245/4	Winter					
244	Summer					
244/3	Winter					
243	Summer					
243/2	Winter			200		
242	Summer	200				
242/1	Winter	200			+70	10
241	**Final**	270				

Case Study Analysis and Conclusions

Polybius reports that in the course of the war Carthage lost some 500 warships and Rome 700. However, these figures must be inexact, and efforts to reconstruct the narratives to verify them have not achieved complete success.[239] Although the human cost implied by those figures

[239] Plb. 1.63.6-7. Polybius refers in this passage to all of the lost ships as quinqueremes (πεντήρεις), although it is increasingly clear that many of the lost ships would have been lighter quadremes and triremes. I take these loss

is immense, it is ironically not lost ships that prove financially ruinous to would-be naval powers. Apart from sunk costs, a sunken ship is, by its loss, rendered no longer a liability on the treasury. Rather it is ships built, maintained, and crewed month after month that drain the treasury.

Carthage, starting with 200 ships, only builds perhaps 350 (344 in the above reconstruction) during the entire war. By contrast, Rome, starting with a very limited fleet of perhaps 30 ships, probably built more than 800 ships (826 in the above reconstruction) over the course of the war. To this new construction should be added the replacement costs as estimated in the tables above, amounting to 219 ships for Carthage and 119 for Rome, narrowing the gap between total ship construction and representing the Carthaginian habit of keeping a standing fleet in the years when Rome made no effort to contest the sea.

To these costs must also be added the basic maintenance of ships at sea, which I will collectively refer to as 'trierarchy costs,' given that they were covered by the duties of a trierarch in Athens, and it is Athens which provides the bulk of our evidence for the nature, extent and scale of these costs. Trierarchy costs should only be assessed on ships that were active for at least some part of the year. As Gabrielsen notes, inactive triremes in Athens were not generally assigned trierarchs for years in which they would be inactive, and we have covered the estimation of the basic maintenance of the hull in storage (for which a trierarch was not, in theory, responsible) above.[240] Thus, for this measure, a ship incurs its full trierarchy cost for any year in which it was activated at all. Following the above tables, Carthage, with a standing fleet

figures to be quite inexact, although it is worth noting that it is an effort to use them as quite precise figures that undergirds Tarn's effort, Tarn, (1907).

[240] Gabrielsen, (1990), 80-84.

and some active ships in every summer of the war, incurred the costs of some 3,378 ship activations. Rome's costs in this regard are somewhat lower, only 2,963 activations.

Finally, crew costs should be accounted for on a seasonal basis, as the 'winter' season in the tables above during the *mare clausum* is only half the length of the summer season. Ships active during summer seasons are thus assumed to have cost 8 months' pay for their crews, while ships in the winter only 4. Because many of the battles of the war cannot be securely dated to the month, it is impossible to pro-rate this figure for ships lost before the end of the season. Given that limitation, adding together the tables above and accounting for the lengths of each season, Carthage paid for some 26,224 crew-months, whereas Rome was slightly less at 25,156 crew-months.

Estimating Cost

Quantifying these various costs poses special challenges. The sources for the First Punic War, unfortunately, are largely uninterested in matters of finance. Although Polybius notes that by the end of the war the Roman treasury was exhausted and the Romans had to privately finance their final fleet, he gives no figures for the cost of any of the fleets of the war, contenting himself only to count ships.[241] Instead it is necessary to turn to Athenian *comparanda* to attempt to estimate at least relative costs. Studies of the cost of the Athenian navy have generally broken costs into three parts: the construction of hulls, the costs assumed by the trierarch, and the cost of paying the crew of the ship. Frank Robbins made probably the most thorough effort to estimate the cost of the Athenian navy in his 1918 article, "The cost to Athens of her Second Empire" though his figures have been subsequently updated by more recent scholars, perhaps most

[241] Plb. 1.59.6-7.

notably Gabrielsen.[242] David Pritchard has revisited Robbins' figures in light of current thinking on Athenian naval costs. He concludes that Robbins' estimate of the cost of a trireme's hull at 2 talents is much too high, concluding that the actual cost of the hull would be very close to the 5,000 *drachmae* penalty imposed on a trierarch for the loss of a warship, with an additional 2,169 or 2,299 *drachmae* for the equipment, as attested in epigraphic sources, bringing the total cost of a new ship to 1 talent, 1,234 *drachmae*.[243] Pritchard reports the average attested cost of holding the trierarchy at 4,436 *drachmae*, and accepts the gross pay for a sailor at 1 *drachma* a day, or 1 talent per ship per month.[244] It is worth repeating that ships not on active duty seem generally not to have been assigned trierarchs.[245]

This rough scheme of cost is, of course, not perfectly applicable to the First Punic War. The main warship of the First Punic War seems to have been the quinquereme, rather than the trireme. As noted above, the quinquereme was a significantly larger and more expensive warship, with a larger crew as well. Moreover, adjusting for the differences between quinqueremes and triremes in the preserved narrative of the war is impossible; Polybius rarely distinguishes between the two, preferring instead to give numbers of ships. The traditional assumption, that both fleets were dominated by quinqueremes and that smaller ships were comparatively rare, has been undermined by recent archaeology which suggests that lighter ships

[242] F. E. Robbins, "The Cost to Athens of Her Second Empire" *CP* 13.4 (1918): 361-388. Gabrielsen (1994). Note also on this topic M Cook, (1990): 69-97; Blackman, (1969): 179-216; and Pritchard (2015), 92-113.

[243] Pritchard (2015), 105.

[244] Pritchard (2015), 97-8, 110-111. On the pay of the sailors, see W. T. Loomis, *Wages, Welfare Costs and Inflation in Classical Athens* (Ann Arbor: University of Michigan Press, 1998), 57-8.

[245] Gabrielsen (1994), 70.

may have been far more common than Polybius indicates.[246] However, for the purposes of a comparison of the costs of the Carthaginian and the Roman exertion at sea, we may make do with an approximate ratio of costs. Pritchard's figures suggest that building and fitting a new ship might have cost some 7,234 *drachmae*, while the maintenance of that hull for a year, roughly equal to the duties of a trierarch, when active, would cost about 4,436 *drachmae*; the crew costs for that year would run some 72,000 *drachmae* (6,000 *drachmae* per month), the costs for a year being in a ratio of roughly 3:2:32.[247] It is perhaps better, however, to express the crew costs on a per-month basis, so that is how I have calculated them, making the ratio of build cost to yearly trierarchy cost to monthly crew cost 3:2:2.6

It must, of course, be noted that the key Athenian warship, the trireme, is rather smaller in both size, crew and ram than the largest ships in use during the First Punic War. With a normal crew of around 200 and a typical mass of around 45 tons, the trireme had two-thirds the crew and 45% of the weight of a quinquereme, which appear to have had a crew of around 300 and mass around 100 tons.[248] Likewise, the ram, almost certainly the single most expensive part of the warship, for a quinquereme would have been as heavy if not heavier than the Athlit Ram (believed to be the ram of a 'four') at 465kg, whereas trireme rams (such as the recovered Egadi rams) tend to mass between 150 and 190kg.[249] As a result, any fleet using a significant number

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[246] For the assumption that quinqueremes dominated the naval landscape, see Tarn (1907), 60, Thiel (1954), 96-100, Lazenby (1996), 64-66. On the archaeological evidence calling this conclusion into question, see Tusa and Royal (2012), 39-42.

[247] This assumes that crews were kept on and paid through the four months when the seas were closed. It seems clear that, at least for the Romans, this was not always the case, as the crews of the fleet participated in the siege of Lilybaeum, Plb. 1.49.1-3.

[248] Morrison and Coates (1986), 107-8. Morrison and Coates (1996), 285-303.

[249] See Table 2.1

of quinqueremes would not only have been much more expensive than an equivalent trireme fleet, but the cost structure of the fleet would also have been more tilted towards construction costs, since the difference in required construction materials is significantly larger than the differences in crew requirements. However, the emphasis on the requirements of the quinquereme too can be overstated, as the Egadi rams seem to suggest quite strongly that Roman and Carthaginian fleets were not so quinquereme heavy as Polybius claims, and in fact still had significant numbers of triremes in them. As imperfect a solution as it is, I will split the difference, assuming that a First Punic War warship would cost about 50% more to build, and 25% more to crew than an Athenian trireme. These calculations would bring our ratio of building, trierarchy and monthly crew costs to 4.5:2:3.3.

Applying that ratio to the figures generated in the case study then allows us to estimate the rough cost structure for both navies for the entire war. Although it is tempting to try to convert these costs to some ancient unit of currency, like the talent, the lack of price evidence from the period of the First Punic War should warn us against this effort, and so the calculations will be presented in 'ship-cost-units,' one unit being roughly equal to the construction cost of a single warship. Thus the construction of a new ship or the replacement of an old one would be valued at a single ship-cost-unit, while the trierarchy costs for an existing active ship would be 4/9ths ($0.\overline{4}4$) a ship-cost unit, and the crew costs for a month would be 11/15ths ($0.7\overline{3}3$) of a ship-cost unit. The results, rounded to the nearest whole number, are shown in the table below:

Table 2.9: Estimated Total Costs of Naval Warfare, 264-241				
	Carthaginian Ship Costs 264-241 B.C.		Roman Ship Costs 264-241 B.C.	
Activity	Total	Ship-Cost-Unit	Total	Ship-Cost-Unit
Building	344	344	826	826
Replacement	219	219	119	119
Maintenance ('Trierarchy Costs')	3,378	1,501	2,963	1,317
Crew Costs	26,224	19,406	25,156	18,448
Total Costs		21,470		20,710

Ship construction and replacement accounts for a shockingly small portion of total costs, only 2.6% of the total cost to Carthage and 4.5% for Rome. While the maintenance costs of the trierarchy exceed shipbuilding, both of these costs are absolutely dwarfed by the staggering cost of crewing so many ships for so many seasons. Crew costs make about 90% of both Roman and Carthaginian total expenses. It should be noted, however, that these figures must represent a ceiling for crew costs, as the sources do not consistently provide the means to pro-rate crew costs for ships and fleets that were lost during any given season; one does not have to pay drowned rowers. However, even with this caveat, it is quite clear that the greatest drain on the resources of both sides was the cost of keeping so many thousands of rowers out at sea, year after year.

This cost structure also reinforces the general indecisiveness of naval warfare, because, paradoxically, fleets were expensive to keep, but cheap to lose. The short service lives of oared-warships meant that any state looking to maintain long-term naval dominance would have to rebuild their entire fleet every 20 years or so, even if the fleet saw little combat. Moreover, in an extended naval conflict, building a fleet and putting it into action for a single season was far less expensive than maintaining a continuous naval presence, year-on-year. Given the proportions of cost discussed above, the running costs of an active, crewed and combat-ready fleet would outstrip the building costs of the same fleet more than 6-fold in a single summer sailing season. Surprisingly, therefore, the best strategic decisions the Roman Senate ever made in the war may be reckoned as those in 253 and again in 249 to temporarily abandon major naval operations. Without those pauses, Rome might well have hit the limit of its resources far earlier in the 240s, while Carthage still had reserves and untouched coastal bases left to fall back upon.

Conclusions

At the end of the war, both Rome and Carthage were clearly financially exhausted. Polybius notes that in the winter of 243/2, there were no funds in the public treasury in Rome to provide for a fleet, and instead the fleet that won the war had to be privately financed.[250] It thus seems likely that, had Rome lost this fleet, there would not have been another for some considerable time. Carthage was, likewise, at the end of its resources. Polybius notes that after the Battle of the Aegates islands, the Carthaginians remained willing to carry out the war, but lacked the means to marshal another fleet to resupply the army in Sicily and, if that army were lost, no means to raise another.[251] The destitution of Carthage becomes all the more clear when, unable to pay the mercenaries it had used in Sicily, it faced a revolt of the army soon reinforced by a revolt of some of Carthage's North African subjects.[252] Hoyos figures that the pay in arrears to the Carthaginian army might have numbered some 4,368 talents, based on evidence for the pay of Greek mercenaries in the period.[253] The Roman state too was likely in debt, as

[250] Plb. 1.59.6-7.

[251] Plb. 1.62.2-3.

[252] Plb. 1.65-88. On the war in general, see Hoyos, (2007).

[253] Hoyos (2007), 31.

Polybius notes that the Romans who financed the fleet of 243 expected to be repaid if all went well; however, this debt was likely covered by the indemnity that Rome placed on Carthage.[254]

What of the insistence that, as Grainger phrases it, "it was not that Rome and Carthage were generally equal in manpower and resources," or that, as Lazenby puts it, "in a slogging match, Rome could simply outslog Carthage?"[255] Of course it must be observed that Rome won this war, and would win the next one, so in a very literal sense Rome did outslog Carthage. But the forgoing analysis lends credence to the argument that in accepting Polybius' vision of dogged and inexperienced Romans bravely striving against an entrenched power all too happy to sit on its laurels, we are underrating the scale at which Carthage directed resources towards the war. Polybius himself, of course, admits that Carthaginian losses were not so short of Roman losses at sea, even accounting for the storms.[256] But beyond losses, Carthage's need to keep at least some fleet active every year, if for no other reason than to supply its armies in Sicily, represented a tremendous expense. The Carthaginians cannot be said to have exerted themselves much less strenuously in their effort to keep their hold on Sicily than the Romans did in their effort to take it. The resources and the 'slogging potential' of these two great states appear not to have been so different after all. What was different was the strategic geography they were forced to contend with.

Moreover, the tremendous scale of Carthaginian expenditure also calls into question the notion that Carthage was passive or complacent in the war. Lazenby, for instance, declares that "it was left to Rome to make the last effort, and to Carthage, as usual, merely to respond…Rome

[254] Plb. 1.59.7, 63.1-3.

[255] Grainger, (2011), 98. Lazenby, (2004), 270.

[256] Plb. 1.63.6-7.

deserved to win."[257] Lazenby goes further in berating the Carthaginians for strategic failure, declaring that "no Carthaginian seems to have had the slightest inkling how to defeat Rome, except in the short term."[258] Lazenby's criticism of Carthaginian inaction echoes Thiel, who attributes "Punic quietism, which manifested itself in a kind of paralysis, in sluggishness, in spoilt opportunities" to the fact that the "Carthaginians were peaceful merchants who tended to avoid wars."[259] But decisive Carthaginian action, perhaps in 249 after the Battle of Drepana and the related disasters, would have required an exertion of resources that by that point in the war, neither Carthage nor Rome had. To, for instance, attack Syracuse, as Thiel suggests, would have certainly required Carthage to activate all of its ships and substantially enlarge its army in Sicily, something that it is worth noting that even the Roman hydra would be incapable of doing for the years following.[260]

Carthage's strategy should also not be so easily dismissed. In fact, it came terribly close to succeeding. Carthage appears to have assumed at the outset that the best it could hope for was a perpetuation of the status quo, which given the events of the Second Punic War, seems practically prescient.[261] Instead, Carthage seems to have employed the same strategy as it had against Syracuse and the other Greek cities in the fifth and fourth century.[262] In these wars, the navy was rarely the decisive arm, but instead merely a necessary tool for maintaining a land

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[257] Lazenby, (1996), 170.

[258] Lazenby, (1996), 167.

[259] Thiel, (1954), 334.

[260] Thiel, (1954), 332-3.

[261] Hoyos, (2015), 29-71.

[262] Hoyos, (2010), 149-77.

presence in Sicily. These wars had often been long and bloody, but indecisive, and Carthage had often adopted a defensive posture with significant success. In the wars of the 480s, Carthage was able to outlast the Greek bloc of Theron and Gelon.[263] Carthage had outlasted Dionysius I and later Agathocles.[264] Throughout this period, Carthage seems to have gained more by defensive fighting in Sicily than by taking the offensive, with the notable exception of the aggressive campaign from 409 to 405 under the command of a Hannibal and Himilco, although this too had left Carthage overextended when, in 397, Dionysius struck back.[265] Finally and most notably, Carthage had outlasted Pyrrhus, who, like the Romans, had captured Panormus and Eryx and left the Carthaginians holed up in Lilybaeum; but then his energy flagged in 276 and he returned to Italy.[266] If in hindsight it is clear that this defensively oriented strategy could not have worked against Rome, it would not have been so clear in Carthage before the fact.

[263] Hoyos, (2010), 165.

[264] Hoyos, (2010), 166-76.

[265] Hoyos (2010), 166-7.

[266] Hoyos (2010), 177.

CHAPTER 3: METHODOLOGY AND METALLURGY

Moving on from naval warfare, the remainder of this dissertation focuses on the costs of land warfare. As discussed in the first chapter, the traditional approach to this topic, emphasizing manpower as the sole or key resource required for land warfare, neglects important economic costs involved in equipment and supply. This chapter addresses those costs in broad strokes, before laying the foundation for more detailed attention to the cost of battlefield equipment. In essence, this chapter aims to confront what might be considered 'confounding variables' for a comparison of battlefield equipment.[1] In order to draw conclusions out of such a comparison, it must first be shown that the other costs of warfare, the confounding variables, while important to understand, are not likely to alter the final conclusions significantly.

In trying to gauge these confounding variables, it is useful to begin by breaking them down by type, which in turn means breaking down the major costs of fielding an army. First, manpower costs, the costs of obtaining and paying the soldiers themselves, have already been discussed in the first chapter. The second major group of costs is for non-durable supplies which the army must regularly consume. For ancient armies, supply concerns were dominated by food and water.[2] In addition to this, animals must be considered, which sit at an uncomfortable juncture between supplies and equipment. Animals have both battlefield and non-battlefield

[1] Confounding or 'third' variables are variables in an experiment that the experimenter has failed to consider or control for, which may alter the results and thus invalidate the study.

[2] Landers, (2003), 205-217. Water supply is a badly understudied facet in ancient military operations, but see G. Moss, (2015).

uses, and while generally durable in and of themselves, also consume substantial amounts of food supplies. Although the division is somewhat arbitrary, this chapter will address the issue of the number of animals required for the baggage train, along with the cost of feeding all of the animals, including warhorses and war-elephants, under the heading of supply costs. The cost of acquiring sufficient warhorses for the cavalry, however will be dealt with in the subsequent chapters as an element of battlefield equipment. Finally, the last major type of costs is equipment costs. Equipment consists of those things which are durable goods, such as tools, weapons, and armor. Equipment may then be further subdivided into non-battlefield or campaigning equipment, such as cooking and entrenching and siege tools, and battlefield equipment, such as a soldier's weapons and armor.

This chapter, then, will proceed first to discuss supply costs, which will be dominated by food and animal costs, and then it will discuss costs of non-battlefield equipment, in order to show that these potentially confounding variables are not likely to throw off the conclusions of subsequent chapters concerning comparisons of the overall level of investment in warfare by Mediterranean societies. Finally, this chapter will introduce and explain the methodology for the following three chapters, which will in turn explore the costs of battlefield equipment.

Supply Costs

Food Supply

The food supply of ancient armies has been the topic of extensive study and so may merit only brief comment here. While the evidence for the logistics of the Roman army is substantial enough to allow for reconstruction, the far more limited evidence for the logistics of Macedonian, much less Carthaginian or pre-state, armies makes direct comparison difficult.

Studies on Roman logistics in both the Republic and the Empire are, for instance, able to reconstruct with some accuracy the Roman military diet.[3] In contrast, Donald Engels in his study of the logistics of the Macedonian army under Alexander, is forced to estimate a figure from comparative evidence and caloric intake, and settles on a ration weighing 3lbs to match the rations carried by Union soldiers in the American Civil War.[4] As a result, without firm figures for both sides of a comparison, a quantitative approach can only give the illusion of certainty.

It is still possible, however, to draw some general conclusions from the literature concerning logistics in this period.[5] The nutritional requirements of soldiers for marching and fighting are likely to vary only within a relatively narrow range, at least in the long-term. However, as Landers notes, soldiers, unlike machines or vehicles, do not simply shut down when not fully supplied. Armies frequently operated in the face of logistical shortages in the short-term.[6] Moreover, within the range of subsistence, there can be considerable variance in how varied and expansive an army's rations are. Roman rations seem to have been unusually ample in this regard. Polybius gives the Roman and Allied grain ration at two-thirds of an Attic *medimnos* of wheat per month, or 2990 calories per day, supplemented by an unknown quantity

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[3] J. Roth, *The Logistics of the Roman Army at War (264 B.C. – A.D. 235)* (Leiden: Brill, 1999). Erdkamp, (1998).

[4] Engels (1978), 125. This despite the ration explicitly including products like coffee which were not available in the Old World until the 15th century.

[5] Logistical studies of other pre-modern armies can provide valuable *comparanda*, but often differences in the logistical systems and capabilities make direct extrapolation impossible, as above with the use of data from the American Civil War. Some pre-modern armies lacked the ability, for instance, to mill grain and bake bread internally (unlike the Romans), e.g. the Spanish army in Flanders, see: G. Parker, *The Army of Flanders and the Spanish Road, 1567 – 1659: The Logistics of Spanish Victory and Defeat in the Low Countries' Wars*, 2nd edition (Cambridge: Cambridge University Press, 2004), 61-64, 75-81. See also: N. Y. Harari, "Strategy and Supply in Fourteenth-century Western European Invasion Campaigns," *JMH* 64:2 (2000): 297-333; J. G. Moore, "Mobility and Strategy in the Civil War," *Military Affairs* 24 (1960): 68-77. For a general overview, note Landers (2003), 205-226.

[6] Landers (2003), 205-6.

of meat.[7] Notably, Roman rations for soldiers seem to have been exclusively in wheat, with barley used for animals, in contrast to Greek rations which regularly included barley even for soldiers.[8] Assessing Macedonian rations, especially in the Hellenistic period is difficult in light of the sources, except to note that Macedonian armies seem to have been substantially more logistically sophisticated than Greek armies of the classical period.[9]

Logistics costs may also be a function of distance and situation, as supplies need to be gathered locally or moved over long distances. Not only do armies need to be supplied as they move from one theater of operation to the next, but supplies then must either be gathered locally or be transported to the army for continued operations. Foraging for supplies locally, it should be noted, does not make those supplies free, rather foraging entails real costs in military activity and reductions in operational mobility.[10] In many cases, maintaining the continued goodwill of the local population required paying for supplies locally.[11] As a result, two armies with the same logistical needs may impose very different costs depending on the distance at which they operate and the availability of local supplies. It is in this context that Paul Erdkamp notes, "the accomplishment of the Romans in military food supply surpassed that of their opponents, especially in the organization of acquisition and distribution."[12] The Roman preference for

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[7] Foxhall and Forbes (1982), 86-7. Erdkamp (1998), 27-45. Note also Roth (1999), 43, who calculates a daily Roman military ration of 3,390 grams, though most of his evidence dates from the imperial period and the precise quantities of non-grain products are speculative.

[8] Foxhall and Forbes (1982): 41-90. Erdkamp (1998), 28.

[9] Engels (1978). Cf. J. W. Lee, *A Greek army on the march: soldiers and survival in Xenophon's* Anabasis (Cambridge: Cambridge University Press, 2008).

[10] Landers (2003), 214-216. Erdkamp (1998), 122-140. Engels (1978), 120-1.

[11] Roth (1999), 141-148.

[12] Erdkamp (1998), 297.

forward deployment meant that Roman armies frequently operated far from Italy, so the Romans were often forced to ship supplies over considerable distances or expend effort to acquire them locally.[13] Roman mastery of this art was not free, but would have involved the efficient mobilization of large amounts of both agricultural resources and transportation. Given the long range of Roman deployments and the Roman reputation for logistical excellence, it thus seems likely that the overall logistics cost of Roman forces was higher on average than that of Rome's rivals, even if the difference in cost is impossible to quantify.

Animal Costs

In addition to food supplies, ancient armies needed to acquire and feed animals, both pack animals and war-horses. Contrary to the popular perception, Roman armies were not unusually short on cavalry. The Roman legion of Polybius, with 4,200 infantry and a 300-strong cavalry detachment was thus 6.7% cavalry.[14] With allied contingents, which Polybius claims come with the same infantry force but three times as much cavalry, the percentage of the total force that was cavalry rises to 12.5%.[15] Michael Dobson notes, in surveying Roman army size figures, that these ratios represent at most a rule of thumb, with the ratio of allied to Roman cavalry ranging from 3:1 to merely 5:3.[16] The size of Roman cavalry detachments will then have varied within the roughly 6% to 12.5% range, but tend towards the upper end of this range. In

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[13] Erdkamp (1998), 155 notes Roman success in this in the East and in Spain on the Mediterranean coast, but also notes the limits of Roman logistics in the western parts of Iberia.

[14] Keppie (1984), 34-5, Plb. 6.20.9.

[15] Plb. 6.26.5-9.

[16] M. Dobson, *The Army of the Roman Republic: The second century BC, Polybius and the camps at Numantia, Spain* (Oxford: Oxbow Books, 2008), 51.

contrast, cavalry ratios for Antigonid forces tended to be somewhat lower, with 2,000 cavalry out of an army of 23,000 at Cynoscephalae in 197 (8.7%), 4,000 cavalry out of an army of 43,000 at the review at Citium in 171 (9.3%).[17] Seleucid armies seem to have been somewhat more cavalry-heavy than Antigonid armies, with 60,000 infantry and 12,000 cavalry at Magnesia in 190 (16.6%), though the smaller army at Thermopylae in 191 had only 500 cavalry and 10,000 infantry (4.8%).[18] The Seleucid force at Raphia in 217 consisted of 6,000 cavalry and 62,000 infantry (8.8%) compared to the Ptolemaic army of 5,000 cavalry and 70,000 infantry (6.7%).[19] Carthaginian armies seem to have been the most cavalry-heavy by a considerable degree. Polybius reports that the Carthaginians had 12,000 infantry and 4,000 cavalry at the Bagradas River in 255 (25%) and 40,000 infantry and 10,000 cavalry (20%) at Cannae.[20] Thus compared to the other major Mediterranean powers, Roman cavalry deployments seem typical, if rather higher than the major Hellenistic states;[21] Carthage is the true standout with a far more cavalry-focused army. It thus seems likely that Roman costs in obtaining, deploying and feeding war-horses were unlikely to have been significantly less (and may have been somewhat more) than other armies, notwithstanding Carthage.

The other war animal of note in this period must also be considered: the elephant. Elephants feature particularly highly in Carthaginian, Ptolemaic and Seleucid armies, although

[17] Liv. 33.4.4-6; 42.51.4-7. Plut. *Aem.* 13.3. On the numbers, see also N. Sekunda, *The Antigonid Army* (Gdansk, Akanthina, 2013), 74-5; Hatzopoulos (2001), 33-34.

[18] Liv. 36.19.11, 37.37.9. App. *Syrian Wars*, 17, 32.

[19] Plb. 5.79.1-13.

[20] Plb. 1.32.9, 3.114.

[21] The amount of cavalry deployed by pre-state peoples, particularly Gauls, Celtiberians and Iberians, is difficult to estimate, due a general lack of reliable army composition figures for them. The cavalry of pre-state peoples will be considered in greater detail in chapter 6.

the Romans too made use of them in smaller numbers during the second century. Carthage deployed nearly a hundred elephants at the Bagradas River in 255, and Hannibal crossed the Rhone with 37 elephants.[22] At Magnesia, the Seleucids had 54 elephants; the Romans uncharacteristically brought 16 of their own smaller African elephants to the battle.[23] At Raphia, the Seleucids fielded 102 elephants against 73 in the Ptolemaic army.[24] Notably, Seleucid elephants tended to be the larger Indian elephant, while Carthaginian, Ptolemaic and occasionally Roman armies employed smaller African elephants. Elephants are estimated to require around 1.5% of their body weight in dry fodder every day, though this can include forage such as tall grasses.[25] Estimates for the food consumption of specific types of elephants vary considerably, but can range from 135-300kg for adult males of the larger Asian elephant.[26] By contrast, the Roman barley ration for a horse was 7 *medimni* of barley, or around 7kg per day, which would have to have been supplemented by an equal amount of green or dry fodder.[27] A single elephant, depending on how much of their feed was forage, would consume as much food as anywhere from 10 to 20 horses.[28] The Seleucid elephants at Raphia might thus have consumed a third as

[22] Plb. 1.32.9. Plb. 3.42.11. On war elephants generally, note J. M. Kisler, *War Elephants* (Westport, CT.: Praeger, 2006).

[23] Livy 37.39.13.

[24] Plb. 5.79.1-13.

[25] R. Sukumar, *The Asian Elephant: ecology and management* (Cambridge: Cambridge University Press, 1989), 78-9.

[26] A review of estimates is set out in P. R. Guy, "The daily food intake of the African elephant, *Loxodonta Africana* Blumenbach, in Rhodesia" *Arnoldia* 7 (1975): 1-8. See also Sukumar (1989), 78-9, who suggests 135-300kg fresh weight as a reasonable range for elephant food consumption. Note also: T. R. Trautmann, *Elephants and Kings: An Environmental History* (Chicago: University of Chicago Press, 2015), 54-5. Trautmann suggests that domesticated elephants require a greater proportion of hard-fodder (grains and rice) compared to wild elephants.

[27] Plb. 6.39.13. Erdkamp (1998), 37-8. Roth (1999), 62-4.

[28] This assumes that roughly half of the elephant's food intake was in the form of green or dry fodder, as with the horses.

much fodder as the entire cavalry corps of the Seleucid army. War elephants thus represented an enormous investment, although likely less overall than maintaining large numbers of traditional cavalry.

In addition, pack animals, consisting primarily of mules, must be considered. No figures from the ancient world survive to provide a firm basis for estimating the number of pack animals which would have accompanied an army, hence there have been a wide range of estimates, often relying on better attested early modern armies for comparative evidence. Engels, assuming that most portage in Alexander's army was done by servants, reckons only 2,421 pack animals for an army of 65,000 men.[29] Paul Erdkamp provides no systematic estimate for pack animals, but suggests a typical example Roman army with 40,000 men, 4,000 horses and 3,500 mules.[30] Jonathan Roth suggests a much higher figure of 1,400 mules for a late Republican legion of 4,800 men.[31] In practice, the number of pack animals will have varied, dictated by the needs of the army. The food consumption of this part of the baggage train would have been considerable. Erdkamp, using statistics from the Peninsular War (1807-1814), estimates each mule might have required 2.27kg of barley and 4.54kg of hay (or straw) per day; the baggage train for his typical Roman army would thus require 7,945kg of barley per day.[32] The cost of feeding these animals, however, is not likely to have varied much between armies. Thus, although the evidence permits little confidence, it seems safe to assume that the Romans would have on the whole required as many, if not generally more, pack animals than other powers, given the greater distance of

[29] Engels (1978), 15-19, 144-5.

[30] Erdkamp (1998), 59.

[31] Roth (1999), 83. Roth notes that scholarly estimates for the number of mules per Roman legion range from as low as 60 to as high as 1,500.

[32] Erdkamp (1999), 38, 45, 55.

Roman deployments and the Roman need to haul greater amounts of equipment, particularly for the construction of fortified camps discussed later in this chapter.[33]

Thus, when it comes to supply costs, all ancient armies will have operated under similar constraints. The cost of food supply, the paramount logistical concern for ancient armies, is likely to have been broadly similar for all of the major states of the Mediterranean. Where Rome stands out was its ability to manage larger deployments at greater distances, even as they remained constrained by the same climatic, technological and geographic realities as their opponents.[34] As Erdkamp notes, "the Romans made full use of the political and economic institutions of the areas under their control to build up a logistical apparatus…in this field they surpassed most of their enemies, which contributed not insignificantly to their success in war."[35] Pushing the limits of logistics meant establishing magazines, using long-distance transport and maintaining larger and more expensive logistics systems.[36] This effort is likely to have incurred greater logistical costs for the Romans, although quantifying those costs is beyond our evidence.

Non-Battlefield Equipment

Much as with supply costs, while the available evidence gives some hints as to the scale of the cost of non-battlefield equipment, a quantitative comparison runs the danger of presenting false precision. Non-battlefield equipment will have consisted, in the main, of cooking tools and

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[33] Erdkamp (1998), 297-8.

[34] Erdkamp (1998), 297-301.

[35] Erdkamp (1998), 297.

[36] Erdkamp (1998), 46-83.

tools for making camps and fortifications.[37] As with supply costs, the evidence permits rather more knowledge of Roman military practice than for other armies in this period, although most reconstructions focus on the post-Marian legion.[38] Vegetius reports that a Roman soldier carried some 60 Roman pounds (20kg) of supplies and gear in addition to his weapons, but it is hard to know how much this will have applied to the pre-Marian period.[39] Plutarch reports that Scipio Aemilianus restricted his soldier's cooking supplies to a pot, a spit and an earthen cup, but permitted metal cups weighing not more than two pounds, presumably for wealthier soldiers; it is hard to know how far to credit this report.[40] Early imperial sites turn up a remarkable array of metal cooking and drinking vessels belonging to soldiers.[41] Some of the heavier cooking equipment, particularly hand-mills, but also possibly a cooking pot, would have been shared by the *contubernium*, the Roman tent-group; Roth supposes these were likely to have been carried by a mule assigned to the *contubernium*.[42] This assumption gains some support from a comment by Plutarch, who notes that during Antony's Parthian campaign, the hand-mills had to be

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[37] Roth (1999), 72.

[38] Efforts to reconstruct the weight of the Roman soldier's pack (or *sarcina*) with rations: 41k (including 22kg of equipment): F. Stolle, *Der römische Legionar und sein Gepack (Mulus Marianus)* (Strassburg: Verlag von Karl J. Trübner, 1914). 30kg: J. Kromayer and G. Veith, *Heerwesen und Kriegsführung der Griechen und Römer* (Munich: C.H. Beck, 1928), 426. G. R. Watson, *The Roman Soldier* (Ithaca: Cornell University Press, 1969), 62-3 suggests Stolle is low by 10-20%. 54.8kg (including 29.4kg of equipment): M. Junkelmann, *Die Legionen des Augustus: Der römische Soldat im archäologischen Experiment* (Mainz am Rhein: Verlag Philipp von Zabern, 1986), 197-8. 40.8kg (including 18kg of equipment): N. Fuentes, "The mule of a soldier" *JRMES* 2 (1991): 65-99. See Roth (1999), 71-77, for an overview. The estimates of Junkelmann and Fuentes, made with the benefits of modern archaeological finds and reconstructed and tested, are to be preferred.

[39] Veg. Epit. 1.19. Roth (1999), 71-2. Marius famously was said to have begun the practice of having his soldiers carry all their own baggage (Plut. *Marius* 13.1), but it is worth noting that similar changes are attributed to other Roman generals somewhat earlier (e.g. Plut. *Moralia* 201C on Scipio Aemilianus).

[40] Plut. *Moralia* 201B-C.

[41] M.C. Bishop and J. C. N Coulston, *Roman Military Equipment: From the Punic Wars to the Fall of Rome*, 2nd ed. (Oxford: Oxbow, 2006), 119-120.

[42] Roth (1999), 77-8.

abandoned after the pack-mules had died.[43] Marcus Junkelmann reconstructed a stone mill at a total weight of 27kg, mostly in stone with some wooden elements.[44]

The second major type of non-combat equipment is for the construction of the camp. First and foremost, the tent (*papilio*), shared by the tent-group, along with tent-stakes.[45] Bishop and Coulston note that Roman tent-stakes were made of wood rather than of metal, which would have made for easier transport; the metal stakes with rings found in Republican era sites are thought to be tethering pegs for animals.[46] Roman soldiers also carried a range of tools for the construction of the camp fortifications. Josephus reports of the Roman army in 69 CE that the soldiers each carried "a saw, a basket, and a pick-axe, a leather strap, a sickle and a hook with three days' provisions" in addition to his weapons, an assemblage Josephus clearly intends to impress.[47] In addition to this, the army carried large stakes, the *pila muralia*, for constructing the camp's palisade; these might have been carried by mule.[48] The Roman *dolabra* or pick-axe is quite well represented in the archaeological evidence for the early imperial period and also appears in Republican sites.[49] It is hard to know exactly how much of this equipment would have been carried by the legion of the third and second centuries; Polybius, though extensive in

[43] Plut. *Ant.* 54.4.

[44] Junkelmann (1986), 210-1.

[45] Roth (1999), 77-8.

[46] Bishop and Coulston (2006), 69-70, 116.

[47] Josephus *BJ* 3.95. πρὸς οἷς πρίονα καὶ κόφινον ἄμην τε καὶ πέλεκυν, πρὸς δὲ ἱμάντα καὶ δρέπανον καὶ ἅλυσιν, ἡμερῶν τε τριῶν ἐφόδιον.

[48] Roth (1999), 74. Fuentes (1991).

[49] Bishop and Coulstson (2006), 69-70, 117-118.

his detail of Roman encamping procedure, does not elaborate on the tools used.[50] However, calculating the precise resource requirements of this equipment is difficult. It seems unlikely that every soldier required one of each of the above tools; more probably they were shared among the *contubernium*.[51] Roman camps of this period, particularly the siege camps at Numantia, have been recovered archaeologically, and their layout and construction follow Polybius' description to a considerable degree.[52]

Comparing Roman practice with Hellenistic or Carthaginian practice is made difficult by the lack of similarly robust descriptions of their equipment. Greek armies of the Classical period do not seem to have carried hand-mills, but Macedonian armies do seem to have carried them, at least in some cases.[53] It is not clear if such portable milling tools were carried by Carthaginian or pre-state armies. Alexander's army carried tools for fortification and construction, a practice likely to be continued by the Successors, although it is not clear how many tools would have been carried.[54]

A related question is if armies regularly fortified their camps, as this would demand a greater quantity of tools and materials to be carried with the army to enable rapid fortification each evening. Fortified camps do not appear to have been unusual for Macedonian armies, but it is hard to tell if camps were fortified all of the time or only in close proximity to the enemy. Engels contends that Alexander regularly fortified his camps, but the instances where this is

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[50] Plb. 6.27-42

[51] Fuentes (1999).

[52] Most notably at Numantia, Dobson (2008), 120-1. Dobson does note some changes in layout, which he attributes to the beginnings of the shift from the manipular to the cohortal legion.

[53] Engels (1978), 12. Front. *Strat*. 4.1.6. Cf. Greek armies, J. Lee (2008).

[54] Engels (1978), 17. E.g. Curtius 5.6.14, 6.5.20, 6.6.28. Arrian, *Alex*. 1.26.1.

mentioned always come under specific circumstances. Arrian reports that Alexander fortified his camp before Gaugamela, but gives the specific reason that Alexander wanted to be able to leave the baggage train behind for the impending battle.[55] Likewise Ptolemy sets up a fortified camp at Aornos Rock before signaling for Alexander, but Ptolemy expects to be attacked once he gives the signal, so this too can hardly be taken as typical practice.[56] Thus while it seems likely Alexander fortified his camps as standard practice, it remains possible that they were only fortified occasionally when there was thought to be a danger.

Assessing later practice poses similar issues. Engels argues, based on Frontinus, that the Romans adopted their fortified camps from the Macedonians by way of Pyrrhus, but Plutarch presents the situation as the other way around, with Pyrrhus amazed by the Roman camp.[57] Livy has Hannibal claim that Pyrrhus was the first "to teach the measuring out of camps," but then also has Philip V stand in amazement at Roman field camps.[58] Such confusion in the sources is hardly cause for confidence. Polybius does mention, in his lead up to the battle of Cynoscephalae, that Macedonian armies carried stakes for entrenching, but compares the Macedonian system unfavorably to the Roman one, noting that Macedonian palisades are more easily broken because the weight of the *sarissa* forces the Macedonians to use less suitable stakes.[59] Most battle narratives with Macedonian armies feature fortified camps. Antigonid

[55] Arr. *Alex*. 3.9.1. Likewise, Curtius 4.12.2, 4.12.17, 4.12.24.

[56] Arr. 4.29.1-3. Likewise, Curtius 5.5.1 notes that Alexander builds a fortified camp only because his way forward was blocked and there was potential for ambush.

[57] Engels (1978), 17, n. 19. Front. *Strat*. 4.1.15. Plut. *Pyrrhus* 16.4.

[58] Hannibal's claim: "castra metari primum docuiise" Livy 35.14.8. Philip's amazement at the Roman camp, Livy 31.34.8.

[59] Plb. 18.18.1-17.

camps feature at the Aous River and Cynoscephalae, although the former camp is incompletely fortified, relying on the terrain to cover some angles and thus vulnerable to Flamininus' eventual flanking maneuver.[60] At Pydna, Perseus pitched camp before the Romans, but no part of his army seems to have attempted to hold out in it; it is possible it was only lightly fortified.[61] Antiochus III's camp at Magnesia was also fortified, and an effort was made to defend it as the Seleucid army collapsed.[62] Carthaginian practice is even more difficult to gauge, but Polybius' narrative of Regulus' expedition seems to suggest that Carthaginian camps were not generally well-fortified. Outside Adys, the Carthaginians are easily dislodged from their camp on a hill, and later Xanthippus' advice to advance the army and camp on level ground (presumably with a palisade, although Polybius does not say) is treated as a bold new strategy.[63]

What is clear is that the sources find the Roman practice exceptional. Polybius presents the Roman habit of building a fortified camp every night as notable and different, going so far as to say that the Romans "pursue a course diametrically opposite to that usual among the Greeks" who "shirk the labor of entrenching."[64] Two centuries later, Josephus likewise presents the Roman camp and the variety of tools carried by the Roman army as exceptional.[65] Without a better archaeological record for Carthaginian or Hellenistic army camps to match that of the Roman army for the republican and the early imperial periods, a firm conclusion does not seem

[60] Plb. 18.24.1. Livy 32.5.11-13.

[61] Plut. *Aem.* 21-22.

[62] Livy 37.38.6-43.10.

[63] Plb. 1.30-34.

[64] Plb. 6.42.1-2.

[65] Josephus *BJ* 3.70-98.

possible. What does seem fair to say is that the cost of Roman non-combat equipment, both for personal use and for entrenching, is not likely to have been less than that of Rome's rivals. Indeed, given the attitude of the sources towards the plethora of Roman equipment and fastidiousness of Roman entrenchment, what seems most likely is that Roman armies required significantly more non-combat equipment than other armies of the period in order to accommodate their style of warfare.

Towards Assessing Battlefield Equipment

Summing up so far: the difference between Roman and non-Roman supply costs and non-battlefield equipment costs are impossible to quantify with any precision given the current state of the evidence. However, the Romans developed a reputation for logistical excellence, and over the third and second centuries, they increasingly deployed armies for extended periods at greater distances, which is likely to have increased Roman supply costs. Moreover, contemporary sources during the Middle Republic and subsequent periods recognized Roman field fortifications and logistical independence as exceptional. These habits came with significant equipment costs in building materials, tools and food preparation equipment such as hand-mills. The weight of the evidence then strongly suggests that Roman costs in these regards were likely somewhat greater than, and certainly not significantly less than, Rome's rivals. That leaves the cost of battlefield equipment to be examined.

Battlefield equipment offers a number of advantages for systematic study. As Erdkamp has noted, ancient sources are often surprisingly uninterested in the quotidian details of logistics or finance; weapons and armor are subjects on which the sources are far more helpful.[66]

[66] Erdkamp (1998), 3-4.

Battlefield equipment is often the subject of extended digressions in the textual sources.[67] as well as of passing mentions such as in Livy's description of the terrible wounds inflicted by the *gladius Hispaniensis* or Varro's description of the construction of the Roman *scutum*.[68] Battlefield equipment is also more commonly depicted in surviving artwork from the period, examples of which will be discussed in the following chapters. Most importantly, while ancient military equipment was rarely uniform, it was generally standardized to a degree, with tactical systems that required soldiers to carry broadly similar equipment, making it possible to extrapolate the likely equipment needs for ancient armies whose strength is often described by listing the number of soldiers of each type. Although such descriptions must be treated with care, as they are often riddled with inaccuracies or anachronisms, nonetheless when combined with representational and archaeological evidence, the documentary evidence is far more substantial than the comparatively scant evidence for logistics or finance, and it can provide a firm basis for reconstruction.

The primary limitation in discussing the cost of battlefield equipment is the lack of preserved price-data from the ancient world. Because of this limitation, it is necessary to begin any discussion of the cost of equipment at the other end, assessing inputs rather than outputs: not with the price of a final product, but with the costs of raw materials and the process of production. Military equipment, as will be demonstrated in subsequent chapters, was composed of four primary materials: metal, wood, textile and leather. It is thus worth discussing the production process for each of these materials, in order to get a sense of the costs in resources and labor that each entails.

[67] E.g. Plb. 3.114., 6.22-23; Liv., 8.8.3-18.

[68] Livy, 31.34.1-4. Varro, *de lingua Latina* 5.115.

Metal Production in the Ancient World

Mining and Smelting

Worked metal will have proved in nearly all cases to have been the most expensive material in a soldier's panoply. Metal equipment, unlike cloth, leather or wooden equipment, could not be produced within the household economy. Instead, its production required specialized facilities and skilled workers. Despite this increased cost, due to the comparative advantage metal presented as a material over other materials, replacing metal equipment with non-metal alternatives typically meant compromising the overall effectiveness of a soldier's equipment, where such replacement was feasible at all. Metal production was remarkably time- and resource-intensive, requiring multiple stages of preparation with specialist labor and facilities. Understanding this process is important for understanding the tremendous mobilization of resources required for the mass of iron and bronze weapons and armor that ancient armies carried into battle.

The process of producing a weapon begins with the mining of ores. Iron, by the Hellenistic period, could be mined and processed out of several ores. Easily the most common of these is hematite, but magnetite and limonite were also used.[69] Mining for iron ores in Italy is attested in Etruria during this period, but the most important iron mines for Italian iron-working in the Republican period seem to be those on the island of Elba, which were worked at Populonia.[70] Bronze and other copper alloys, still used in the second century for certain elements of the panoply such as helmets, required both copper and, typically, tin, although other

[69] J. F. Healy, *Mining and Metallurgy in the Greek and Roman World* (London: Thames and Hudson, 1978), 62-65. P. Craddock, *Early Metal Mining and Production* (Washington D.C.: Smithsonian Institution Press, 1995), 234-5. R. F. Tylecote, *The Early History of Metallurgy in Europe* (London: Longman, 1987), 47-53.

[70] Healy (1978), 63. Livy 28.45 notes Populonian iron being used to equip Scipio's African expedition.

alloys, such as copper-arsenic and copper-zinc (brass), were known.[71] Pliny the Elder notes that copper deposits had been exploited in Italy in Campania and also at Bergamum in the Po Valley, though in his day most copper in Italy was imported.[72] Tin, however, would almost certainly have to be nearly all imported.[73] The mining itself seems to have been done primarily by slaves working under very harsh conditions and was very labor intensive, although systematic estimates of the scale of production for the period of the Republic are probably not possible.[74]

Following mining, the ore undergoes a variety of processes, collectively called 'dressing' in preparation for smelting, with the full preparations being somewhat different depending on the metal to be produced, the ores involved, or even the local ore quality. Ore might require crushing before preparation, either by mortars or mills.[75] Ore could also be washed to remove lighter waste materials, a process attested for precious metals such as gold and silver in the Mediterranean world and possibly used for iron, bronze and tin as well.[76] Sim and Kaminski note that the limited evidence for ore-washing comes mostly from the Near East, but that it is not clear if this process was considered necessary in iron production in Roman Europe.[77]

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[71] Healy (1978), 209-214. Early copper and tin production: Tylecote (1987), 29-40.

[72] Pliny, *Natural History* 34.2. Healy (1978), 58-9.

[73] Healy (1978), 60-61.

[74] R. Shepard, *Ancient Mining* (London: Institution of Mining and Metallurgy, 1993), 59-68. Healy (1978), 132-138. D. Sim and J. Kaminski, *Roman Imperial Armor: The Production of Early Imperial Military Armor* (Oxford: Oxbow Books, 2012), 6-11. D. Sim and I. Ridge, *Iron for the Eagles: The Iron Industry of Roman Britain* (Stroud: Tempus, 2002), 25-34.

[75] Healy (1978), 142-3. Tylecote (1987), 53-64.

[76] Healy (1978), 144-148.

[77] Sim and Kaminski (2012), 13

After any ore dressing, iron ore would then be roasted and finally smelted into a bloom, a sponge-shaped mass of iron metal. The roasting process involves applying heat to the ore to transform the iron-carbonate ore ($FeCO_3$) to smeltable iron-oxide (FeO, Fe_2O_3 or Fe_3O_4), as well as driving out any remaining water in the ore. The exact heats the Romans might have used for this process have not been firmly established, with estimates ranging from 300˚ C to 550˚ C.[78] Sim and Kaminksi, while observing that there is no definitive evidence, suggest that it is likely that dry wood, rather than charcoal, would be used for the roasting of ores, because excessively high temperatures would produce unusable ores.[79] The roasting process is necessary to chemically prepare the ore for reduction in a bloomery, with the application of significantly higher heat, produced by charcoal. The result of this process was a bloom that is a mix of iron and some quantity of mineral impurities called slag.[80] Diodorus describes this process taking place on Elba:

> For the island possesses a great amount of iron-rock, which they quarry in order to melt and cast and thus to secure the iron, and they possess a great abundance of this ore. For those who are engaged in the working of this ore crush the rock and burn the lumps which have thus been broken in certain ingenious furnaces; and in these they smelt the lumps by means of a great fire and form them into pieces of moderate size which are in their appearances like large sponges.[81]

The pieces like “large sponges” Diodorus describe are the blooms themselves, which are relatively brittle sponge-like masses of iron and slag (see fig. 3.1). The iron bloom is still not,

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[78] Sim and Kaminski (2012), 13. Healy (1978), 183-4. On roasting ore generally, Craddock (1995), 167-189.

[79] Sim and Kaminksi (2012), 13.

[80] Sim and Kaminksi (2012), 14-16. Healy (1978), 184-189. Craddock (1995), 235-6. Tylecote (1987), 151-152, 160-161.V. F. Buchwald, *Iron and Steel in ancient times* (Copenhagen: Det Kongelige Danske Videnskabernes Selskab, 2005), 90-94.

[81] Diodorus, 5.13.1. πέτραν γὰρ ἔχει πολλὴν σιδηρῖτιν, ἣν τέμνουσιν ἐπὶ τὴν χωνείαν καὶ κατασκευὴν τοῦ σιδήρου, πολλὴν ἔχοντες τοῦ μετάλλου δαψίλειαν. οἱ γὰρ ταῖς ἐργασίαις προσεδρεύοντες κόπτουσι τὴν πέτραν καὶ τοὺς τμηθέντας λίθους κάουσιν ἔν τισι φιλοτέχνοις καμίνοις: ἐν δὲ ταύταις τῷ πλήθει τοῦ πυρὸς τήκοντες τοὺς λίθους καταμερίζουσιν εἰς μεγέθη σύμμετρα, παραπλήσια ταῖς ἰδέαις μεγάλοις σπόγγοις.

however, in a workable state and requires further refining. The bloom would then need to be heated and hammered into a bar-shape of metallic iron fit for further blacksmithing, called a billet (see fig. 3.2). The process may also have functioned to remove some of the slag impurities which would otherwise weaken the metal.[82]

Bronze (and other copper-alloy) processing was more direct as bronze, unlike iron, could be more easily smelted and even melted and cast with the technology available in the ancient world. Copper ore, particularly malachite, could be reduced to produce copper metal at temperatures of 700-800˚C, although the melting point of fine copper was higher, 1038˚C.[83] That ancient copper furnaces could reach the melting point is demonstrated by Roman 'bun' ingots, although Healy notes that the copper would likely have to be poured quite quickly, given that it would be very close to the melting point and would rapidly harden.[84] Tin ore required washing and roasting because of its quartz matrix, but then could be smelted fairly easily due to tin's low melting point of 231˚C.[85] The main concern, Healy notes, was that too high a heat would cause much of the valuable tin to enter into the slag, requiring precise heat control through the smelting process.[86] The tin and copper could then be melted together; tin content in ancient bronzes generally ranges between 5 and 11%. Healy supposes that quality-control for tin content

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[82] Sim and Kaminksi (2012), 17-18. Healy (1978), 184.

[83] Healy (1978), 159. Tylecote (1987), 125-132.

[84] Healy (1978), 160.

[85] Healy (1978), 176-8.

[86] Healy (1978), 178.

could be achieved by a comparison of color, which he thinks more likely, or, less probably, by hardness tests of the bronze after it had been annealed.[87]

Despite the somewhat simpler production method, bronze and other copper-alloys as materials were generally more expensive than iron. Michael Treister notes that during the Hellenistic period, silver commanded 120 times the value of bronze; although chronological distance makes the comparison fraught, it is worth noting that the early Greek iron *obeloi* traded at 1/2000th the value of silver per unit weight.[88] Vindolanda tablet 183, which records a purchase of 90 Roman pounds (29kg) of iron for 32 *denarii* suggests a silver-iron value ratio of 1:318, substantially higher than the Greek *obeloi*, but still far less than the value of bronze.[89] However, while bronze was generally a more expensive material, it should be noted that the greater ease of producing artefacts in bronze, combined with the greater utility of iron and especially steel artefacts, makes it impossible to propose any general rule for the value of finished goods based merely on the prices of their materials.

In addition to the staggering amount of labor implied by the above process, the consumption of fuel was also very high. Pliny and Theophrastus note that pinewood was considered the best wood for producing the charcoal to smelt iron with, with Theophrastus adding that chestnut is also used for smelting, but fir for smithing.[90] Healy notes that

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[87] Healy (1978), 210-211. Annealing, a process by which the metal is heated and allowed to cool slowly to soften it, is discussed below.

[88] M. Treister, *The Role of Metals in Ancient Greek History* (Leiden: Brill, 1996), 96, 341-2.

[89] L. Bray, "'Horrible, Speculative, Nasty, Dangerous': Assessing the Value of Roman Iron," *Britannia* 41 (2010): 175-185. The calculation assumes a denarius of 3.41g at 83.5% purity, so containing 2.85g of silver each (91.1g total), compared to the 29kg of iron purchased. This value of iron, while higher than the *obeloi*, fits well with the range of iron values Treister notes for the 6th century B.C. Near East, Treister (1996), 96.

[90] Pliny, *NH* 33.30. Theophrastus *HP*, 5.9.1-3. Note also Buchwald (2005), 94-96, who notes pine and birch used in medieval Sweden and Norway.

“experiments have shown that 8 kg. of iron can be produced from 50 kg. of ore” and that a single bloomery-furnace might yield 16kg of iron from 100kg of ore and 80 kg of charcoal a day.[91] That 80 kg of charcoal may have represented the product of about 320kg of raw wood.[92] A more detailed and rather more pessimistic estimate by Sim and Ridge argues that the estimated 5,400 tonnes consumption of Roman Britain in the second century CE would have required 93,650 tonnes of ore and 112,5000 tonnes of charcoal produced from 787,500 tonnes of raw wood.[93] Sim and Ridge estimate, very roughly, that this level of production might have required some 150,000 laborers at all stages of production to maintain.[94]

Putting these bulk figures in the context of a single artefact does much to clarify the tremendous resource cost. Because material is lost at every stage of production, the total resources required can be quite a bit larger than at first consideration. Consider a *gladius Hispaniensis* of moderate (c. 700g) weight. In an experiment, Sim and Kaminksi note 34.27% material loss in the forging and finishing of a gladius; assuming that an ancient smith would have been more practiced, we might assume perhaps 30% material loss.[95] This would mean the sword would have required a billet of at least 1kg of iron. Smelting for such a billet would have required c. 6.25kg of ore and 5kg of charcoal (from 20kg of wood), following Healy’s figures. Sim and Ridge’s rather more pessimistic figures would suggest that the same process might

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[91] Healy (1978), 151, 196.

[92] Healy (1978), 150-1.

[93] Sim and Ridge (2002), 23.

[94] Sim and Ridge (2002), 23-4.

[95] Sim and Kaminksi (2012), 44.

require 12.3kg of ore and 14.56kg of charcoal (from 101.5kg of wood).[96] That tremendous expenditure in labor and fuel would only produce a billet, which would require further labor to shape into usable equipment.

Copper-Alloy, Iron and Steel

Having laid out the mining and smelting process, it is worth discussing the primary metals and alloys used in the production of military equipment. Nearly all of the metal available to ancient armorers and weapon-smiths will have been, to some degree or another, a mixture of multiple metallic elements, as the smelting technology did not permit a higher degree of purification.[97] Defining the term alloy in this absolute way renders it useless; on the other hand, defining alloys narrowly as only the intentional mixture of metals is also perilous, as the ancients sometimes recognized that certain ores produced high quality metals which, unbeknownst to them, were natural alloys. For instance, the credit given to iron from Noricum may in part be because the iron ores of the region had high manganese content, producing a natural alloy with greater hardness.[98] It is also difficult to draw a line based on the total content of alloyed metals; a sample of copper with around 1% tin content is generally classified as impure copper, while iron with only 0.5% carbon content is a mild steel.[99] As a result, the distinction between a 'pure' metal and an alloy depends heavily on the materials involved.

[96] Sim and Ridge (2002), 23.

[97] Healy (1978), 199. As Healy notes, even modern processes do not allow for the production of some metals completely 'pure.'

[98] Sim and Kaminksi (2012), 58. Tylecote (1987), 168-9.

[99] Healy (1978), 199-201, 209-210.

Copper has a wide array of potential alloys and was not generally used in an unalloyed form in this period for the production of military equipment. The most common such alloy for military equipment was bronze, a copper-tin alloy. Bronzes can be defined as having more than 2% tin content, although bronzes used in military equipment generally have a much higher tin content, usually between 5 and 11%.[100] However, it is worth noting that standard bronze (a copper-tin alloy) was not the only copper-alloy produced. Alloys of copper, tin and lead are also common, for instance, in Roman helmets.[101] The primary ore of lead, galena, also contains smaller amounts of silver, with the result that lead production was often a byproduct of silver-smelting, although some ancient mines seemed to have produced lead as a primary product as well.[102] Lead content in alloys intended to be wrought, a category which includes nearly all battlefield equipment in this period, tends to be quite low, typically well under 10%.[103] Some copper-alloy equipment is also made out of copper-zinc (brass) alloy, although this seems to be comparatively rare (e.g. cat. R95).[104] The production of pure metallic zinc would not have been possible in the ancient world because the temperatures required to reduce the ore were already above the boiling point of the metal. However, brass could be produced by mixing zinc carbonate (calamine) with copper heated by charcoal.[105] It is often impossible to tell the exact

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[100] Healy (1978), 209-210. E. Jarva, *Archaiologia on Archaic Greek Body Armour* (Rovaniemi: Pohjois-Suomen Historiallinen Yhdistys, 1995), 134.

[101] J. M. Paddock, "The bronze Italian helmet: the development of the *Cassis* from the last quarter of the sixth century B.C. to the third quarter of the first century A.D." (doctoral thesis, University of London, 1993), 46-7.

[102] Healy (1978), 38-9, 61-2. On the process of smelting galena, Healy (1978), 156-8. On lead and silver smelting generally, Craddock (1995), 221-232. Note also, Tylecote (1987), 192-202.

[103] Paddock (1993), 46.

[104] Healy (1978), 213-214.

[105] Healy (1978), 213.

composition of a copper-alloy artefact without metallurgical tests. For the sake of avoiding false specificity, this study will use the term copper-alloy as a general term, although it may be noted that most copper-alloy military equipment seems generally to have been either standard bronze (i.e. copper-tin) or lead-bronze (i.e. copper-tin-lead) alloys. Catalogue entries presented at the end of this work retain whatever terminology was used in publication or museum catalogue entries.

The primary alloy of iron is with carbon to form steel. As noted, iron can be considered a mild steel at carbon contents as low as 0.5%. Above 2% carbon content, steel becomes pig iron; the high carbon content makes the metal brittle and effectively useless for military equipment.[106] The most likely process for the production of steel in the ancient Mediterranean was case hardening, also called carburization.[107] In this process, iron, when heated between 900 and 950˚C, will absorb carbon if placed in a carbon-rich environment, such as a charcoal fire. Because the carbon is absorbed through the edges of the iron, thicker pieces will take dramatically more time to absorb sufficient carbon. This process could be accomplished in small scale by an individual blacksmith in his own forge. However, case hardening is not a natural process of the forging process; it would have to be done with some intent. During forging, iron is exposed to the carbon-rich forge-fire for only a few minutes at a time. Moreover, the process of forging in an oxidizing environment will actually tend to decarburize the edges of the weapon, and hammer blows will tend to strip off any carburized iron on the surface. A gladius with surfaces apparently decarburized in this way is discussed in the following chapter.

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[106] Sim and Kaminski (2012), 59.

[107] Sim and Kaminski (2012), 59-61. Tylecote (1987), 271-278. On the production of steel in a forge hearth, see D. Wagner, "Ancient Carburization of Iron to Steel: A Comment" *Archeomaterials* 4 (1990): 111-117.

A homogenous, high quality steel can also be produced by the use of a crucible. This was the process used to produce high quality crucible steel, called Wootz, in India and later Persia.[108] In this process, bloomery iron is sealed in a crucible with organic material and heated above 1400˚C. The iron absorbs carbon from the organic material, lowering the melting point until the iron becomes liquid; the impurities and slag in the iron rise to the top and can be removed. The crucible then cools and is broken open, leaving an ingot of high quality steel with fairly high carbon content. Such steel was available as an expensive import good, although the height of the trade came later, during the first and second centuries CE. Pliny the Elder, mistakenly believing this steel was produced in China, refers to it as Seric iron.[109] The peoples of the Mediterranean did not, however, master this production method; any Wootz steel available would have to have been imported.

In both the use of copper-alloy and steel, the third and second centuries represent a period of transition. The transition is mostly a result of the gradual replacement of copper-alloy with iron and steel, as the technology of iron-working improved.[110] Copper-alloy use in this period is restricted mostly to equipment made from sheet metal such as helmets, armor-rings for mail, greaves and some Hellenistic shield-coverings. Some of these uses, such as the thin copper-alloy facing of Hellenistic shields, diminished as the Roman military system steadily supplanted other Mediterranean systems as the result of Roman expansion. At the same time, while copper-alloy does not completely vanish straight-away, Roman mail and helmets are increasingly made of iron, while evidence for the widespread use of greaves continues to decline in the early imperial

[108] Craddock (1995), 275-283. The crucible process was used for non-ferrous metals, but not iron, in Europe, see: Tylecote (1987), 183-189.

[109] Healy (1978), 215; Sim and Kaminski (2012), 58, 61. Plin. *NH* 34.143.

[110] Particularly in the production of iron sheet metal, see Sim and Kaminski (2012), 49-56.

period.[111] Evidence for the use of steel, particularly by the Romans, in this period is very limited. However, it seems that Roman steel working is still in a fairly early stage of development and lacks the full sophistication apparent in the Imperial period.[112]

Forging

The process of reshaping a billet of either iron or copper-alloy into a useful piece of equipment involves a wide range of processes and could include a number of laborers, both skilled and unskilled. Ancient depictions of smiths and workshops generally show multiple laborers engaged in the task. In addition to the skilled smith, such depictions show assistants working the bellows, and engaged in finishing (figure 3.3).[113] Of particular note were strikers (figure 3.4), assistants to the smith who used heavier hammers, typically with both hands. Because the skilled smith typically had to hold the bar being forged in one hand, semi-skilled strikers could provide additional striking power, thus speeding up manufacture without requiring another skilled smith. Unskilled laborers could also assist in tasks like polishing and filing finished products.[114]

Some kinds of equipment, particularly helmets, shield bosses and covers, greaves and some solid armor rings, required the raw metal to be reshaped into sheet metal as an intermediate

[111] Bishop and Coulston (2006), 95-106. M. Feugère, *Les Armes des Romains: de la République à l'Antiquité tardive* (Paris: Editions Errance, 1993), 92. On the progression of Roman helmets to iron, note, H. R. Robinson, *The Armour of Imperial Rome* (London: Arms and Armour Press, 1975), 11-62; however, it is worth noting that Robinson implies rather a too direct and linear development between helmet types. See also M. Feugère, *Les Casques Antiques*: *Visages de la guerre de Mycènes à l'Antiquité tardive* (Paris, Editions Errance, 1994a), 51-97.

[112] See Ch4 at n66

[113] Paddock (1993), 46-49; Sim and Ridge (2002), 53-64.

[114] Sim and Kaminski (2012), 85-6, Sim and Ridge (2002), 56-7, 113-115.

process before the final production of the artefact. We are not well informed about the method of producing sheet metal in this period. Sheet metal could be produced by hammering a billet or ingot flat, either by a single man with a hammer or using a team of strikers; however, this method is difficult and the resultant sheet tends to be substantially thicker in the center than on the edges.[115] In a series of experiments that compared preserved Roman sheet metal (in iron) from the imperial period with a series of proposed methods for the manufacture of sheet metal, Sim and Kaminski concluded that the most likely methods of making sheet metal was the use of heavy rollers; the iron is fed into a pair of rollers and compressed between them, producing a metal sheet of uniform thickness.[116] These experiments, however, focused on producing sheet iron consistent with Roman armor of the first two centuries CE. Close examination of the properties of preserved examples from the Republic has not yet occured. As a result, the applicability of Sim and Kaminski's results to the third and second centuries BCE, especially to work with copper-alloy rather than iron sheets, is unclear. Notably, the equipment that was still produced in copper-alloy in this period (helmets, shield coverings, some mail rings, and greaves) relies on the production of sheet metal. Due to the greater malleability of copper-alloys, producing sheet metal in copper-alloy would be significantly easier than accomplishing the same in iron. As noted, this may explain the continued use of copper-alloy for these products; the improvement in iron sheet metal manufacture may explain the subsequent shift to iron for these components in the imperial period.

It is also worth addressing casting as a method of production, as it is the most apparently direct method of reshaping raw metal. The metal is melted, and the molten metal poured into a

[115] Sim and Kaminksi (2012), 51-52.

[116] Sim and Kaminski (2012), 54-56.

mold to cool and solidify in the desired shape. As noted in the previous chapter in the context of bronze rams, ancient bronze-casting was a sophisticated process by the third century, capable of producing both very large casts of high quality and also complex shapes.[117] Despite this, military equipment made by casting is very rare in this period.[118] This is due in no small part to the shift to iron as the primary material for most military equipment, particularly spear-head, dagger and sword blades which would have lent themselves to casting in bronze.[119] As noted above, ancient furnaces could not achieve the necessary temperatures to melt iron, making casting impossible. Most of the equipment that continued to be produced in copper-alloy in the third and second centuries was worked from sheet metal, such as helmets, Hellenistic shield facings, and greaves. Casting such objects, while not impossible, would have proved more difficult than simply cold-working a bronze sheet into the desired shape. Moreover, the casting process would make the final product very brittle, in both iron and copper-alloy. Due to how thin the metal of such a cast would be, even subsequent annealing and cold-hammering is unlikely to produce a sufficiently durable helmet, and the whole process would have been more

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[117] See Ch. 2 at n. 57.

[118] The only artefacts listed as being cast bronze in this study are several helmets (cat. R80, R81, R82, R83, R84 and R85), identified by Junkelmann as cast bronze without further explanation, M. Junkelmann, *Römische Helme* (Mainz am Rhein: Verlag Philipp von Zabern, 2000), 93-107. Tool marks seem to be visible on at least one helmet in a photo (cat. R80, Junkelmann's AG 441), which would suggest raising, rather than casting. Paddock argues that they were never cast, Paddock (1993), 76. Likewise, P. Craddock, "The Metallurgy and Composition of Etruscan Bronze" *Studi Etruschi* 52 (1984), 232-3, notes that all of the Etruscan helmets and armor in the British Museum were hammered, rather than cast.

[119] For earlier cast copper-alloy weapons, see. P. C. Bol, *Antike Bronzetechnik: Kunst und Handwerk antiker Erzbildner* (Munich: Verlag C.H. Beck, 1985), 41-64. K. Branigan, *Copper and Bronze Working in Early Bronze Age Crete* (Lund: Studies in Mediterranean Archaeology, 1968).

difficult than simply cold-working.[120] One exception to this rule were sling bullets, which were made in lead and could be cast.[121]

Cold-working, as the name implies, is the process of reshaping metal by hammering the metal, as the name implies, 'cold' or at room temperature. Cold-working is the primary method of working copper-alloys like bronze, but can also be used to a limited extent on iron, especially with sheet iron.[122] Cold-working consists of hammering the metal into the desired shape without heating, but it also has an important secondary effect: work-hardening. The process of hammering produces cracks in the individual grains of the metal, which produces a distortion in the crystalline structure of the metal. The result is that, as the metal is hammered, it becomes harder, but also less malleable and ductile and thus, harder to work.[123] Eventually a cold-worked piece of metal would become impossible to shape further without annealing. Annealing is a process where in the metal is heated and then allowed to cool slowly; this process resets the crystalline structure of the metal and thus returns it to its originally malleability.[124] Work-hardening was also a desirable outcome, since both blade-edges and armor generally need to be hardened in order to function. Work-hardening is particularly important on very low-carbon content iron, which will not be hardened by heat-treatment (see below).[125]

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[120] Paddock (1993), 76. Tylecote (1987), 247-8 notes the high quality of work-hardened bronze in Greek and Roman armor.

[121] Bishop and Coulston (2006), 58.

[122] Sim and Kaminski (2012), 31-2. H. Hodges, *Artifacts: An introduction to early materials and technology* (London: Duckworth, 1989),73-76.

[123] Sim and Kaminski (2012), 31-3. Hodges (1989), 73-4.

[124] In bronze-working, the rate of cooling of this process is immaterial, however to anneal iron requires the metal to cool slowly; see heat-treating discussed below. Hodges (1989), 73.

[125] Sim and Kaminski (2012), 27.

Of particular note in the cold-working process is the production of bowl or dome-shapes, such as for the main body of copper-alloy helmets. The bowl of the helmet could be produced from a copper-alloy sheet using the related processes of sinking and raising either by hammering the metal sheet over a dome-shaped tool, or by hammering the metal sheet into a hemispherical depression, a doming-block (figure 3.5).[126] Both raising and sinking will tend to cause the metal to thin at the crest of the helmet, although the weakening of the metal is somewhat compensated for by the work-hardening effect of the hammering.[127] These methods also leave tool-marks on the helmet from the shaping process, and while the tool marks on the outside of the helmet were generally polished off, the tool-marks on the inside of the bowl, which would have been concealed by the helmet liner, were usually left in place. The opposing method is spinning, where the bowl is formed by turning the metal on a lathe and pressing it down against a wooden former.[128] Spinning allows for the mass-production of a larger number of identical objects. Its introduction in the manufacture of Roman helmets at the end of the second century, which coincides with the Marian reforms, is also connected to a general collapse in manufacturing standards in helmets.[129] Spinning leaves no tool marks on the interior of a helmet, making it possible to distinguish spun helmets from raised helmets.

Hot-working is a more fuel intensive, but faster, method of reshaping metal that is all but required for working iron and steel. In this process, the iron is heated to a red heat (typically between 1000-1100˚C), when it is malleable, and then hammered until enough heat is radiated

[126] Hodges (1989), 74. Sim and Kaminski (2012), 34-35.

[127] Sim and Kaminski (2012), 84-5

[128] Hodges (1989), 74-5. Sim and Kaminski (2012), 36.

[129] Bishop and Coulston (2006), 65. Paddock (1993), 802-3. This is discussed further in the subsequent chapter.

away that the iron requires reheating.[130] At higher temperatures, iron objects can also be welded together in a technique known as fire welding to form a single, solid mass.[131] In addition to the fuel and labor required, material loss during this process is significant. Above 700˚C, iron will react with the oxygen in the air of the smithy to produce iron-oxides on the surface of a piece of iron. The resulting coating of oxides is called mill-scale or just scale.[132] This coating is dislodged when the iron is hammered and the iron content of the iron-oxides is lost; welding in particular tends to eject greater amounts of material.[133] In a series of experiments producing Roman armaments from the imperial period, Sim and Kaminski found material losses ranging from 10 to 27.5% in the forging process. Subsequent finishing, including polishing, cleaning and sharpening, raised the final material loss figures to between 14 and 38%, depending on the weapon produced.[134]

For many pieces of equipment in iron and steel, hardening through heat-treatment was also required. In this method, the metal is hardened by being heated to red heat and then rapidly cooled in oil or water, making the metal very hard but also quite brittle. This brittleness can then be removed through tempering, whereby the object is heated to a lower temperature (typically around 300˚C) and then rapidly cooled; the result is the loss of a small amount of hardness, but a significant increase in the malleability of the metal.[135] Different types of equipment will require

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[130] Sim and Kaminski (2012), 25-6. Tylecote (1987), 261-269. A. W. Bealer, *The Art of Blacksmithing* (New York: Funk & Wagnalls, 1969), 122-124.

[131] Sim and Kaminski (2012), 27. Bealer (1969), 125-127, 145-149.

[132] Sim and Kaminski (2012), 27. Bealer (1969), 124.

[133] Sim and Kaminski (2012), 28, 43.

[134] Sim and Kaminski (2012), 44. D. Sim, "Roman Chain-mail: Experiments to Reproduce the Techniques of Manufacture" *Britannia* 28 (1997): 359-371.

[135] Sim and Kaminski (2012), 29-30. Bealer (1969), 151-155.

different balances of hardness and malleability; a sword's edge, for instance, must have considerable hardness in order to hold an edge and cut effectively, but excessive hardness will make the sword too brittle to withstand the considerable strains of use in combat. One solution to this problem was pattern-welding (sometimes called damascening), which involved welding together the blade of a sword from multiple pieces of iron with different levels of carbon content to produce a superior blade. Pattern-welded blades are known in La Tène swords (discussed in chapter 6) and in Roman *gladii* from the imperial period; in both cases the labor required seems to have kept these weapons rare.[136]

The Cost of Metal

Quantifying these costs further is quite difficult, due to the limited nature of ancient price data. The data that does exist, however, tends to reinforce the high cost of worked metal. Because of the limited nature of preserved ancient price data, it is impossible to quantify the high value placed on worked metal, although fragments of such data may offer hints. Perhaps the best evidence is prices recorded in Vindolanda tablets 183 and 186, which record the purchase of 90 Roman pounds of iron (29kg of metal) for 32 *denarii* and 100 hobnails (for use in *caligae*, military sandals) for 12 *asses*.[137] Lee Bray estimates the value added by processing the nails to have represented a 23% increase over the value of the iron, noting that, with a 10% material loss, an experienced smith could produce approximately 180 hobnails from 1kg of iron, with a total value of 1.35 *denarii*.[138] The value added on nails should be taken to represent a relatively low

[136] Sim and Ridge (2002), 92-93. Bishop and Coulston (2006), 130, 156, 241-42. Tylecote (1987), 272-277.

[137] Bray (2010), 175-185.

[138] Bray (2010) 179.

amount of value-added for the final production of metal objects, given that, as Sim and Ridge note, nails of this type could be produced fairly quickly, and often by only semi-skilled labor. Their own experiments yielded manufacture times as short as 3-4 minutes per nail for smaller nails, as compared to a staggering 10.4 hours for the metal elements of a *pilum* and 34 hours for a *gladius*.[139] Much of the value then, of any finished piece of metal military equipment would come from the final stages of forging and finishing.

Nevertheless, even unsmithed iron could command surprising value. Bray compares the price of the unsmithed iron at Vindolanda to a range of other attested prices in the Vindolanda tablets, noting that iron "was significantly more valuable than even exotic, imported foodstuffs such as anise and caraway and more expensive, by a factor of four or five, than the enigmatic 'spices' recorded on Tablet no. 193."[140] Prices for finished goods at Vindolanda compare more favorably to raw iron, with a cloak recorded in tablet no. 596 being worth nearly 5kg of iron when priced at 5.38 *denarii*. No prices, however, for worked iron objects (apart from the nails) are preserved, and the tablets offer few clues as to the quality of the goods discussed.[141]

Comparative evidence from the Middle Ages also supports the high cost of metal equipment.[142] Jan Frans Verbruggen estimates that the cost of heavy infantry equipment, which he figures at around £21 for the heavy infantry militia of Bruges in 1304, would have amounted to more than half a year's wage for the typical artisan. The most expensive item by far, which Verbruggen notes normally cost between £10 to £15, was a tunic of mail, just as in the Roman

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[139] Sim and Ridge (2002), 113-114.

[140] Bray (2010), 180.

[141] Bray (2010), 181.

[142] On this, note Landers (2005), 296.

panopy of 15 centuries earlier.[143] Lighter armed infantry could be much cheaper to outfit. A contemporary Yorkshire village in 1300 paid merely 5 shillings per man to equip a light infantry force required of it, whereas when Edward II demanded even minimally armored infantry, the cost rose four-fold to £1; yet this only covered a padded jack and a metal helmet without any mail body-armor.[144] Non-metal weapons like bows were often far cheaper than metal equipment; Robert Hardy puts the cost of a good quality 14th century longbow at around 1s 6d, which at the longbowman's wage of 2d per day, could be earned back in only 9 days.[145]

The only sort of battlefield equipment whose costs regularly exceeded that of metal arms and armor on a per capita basis, as John Landers notes, was the cost of warhorses.[146] The Frankish Ripuarian Law placed the value of a warhorse at 12 *solidi* in the middle of the eighth century, but valued the horseman's armor, which would have been mail, at 33 *solidi*; the price of warhorses would grow dramatically in subsequent centuries.[147] Comparative evidence from the Late Empire suggests that the cost to equip an armored cavalryman, including acquiring his horse, might about double the cost to equip an armored infantrymen; at such a ratio, the cost of the heavy infantry, far more numerous than the cavalry, would still dominate.[148] Papyri records for land settlments (*cleruchies*) for soldiers in Ptolemaic Egypt tends to support this basic ratio of cost: plots for Greek and Macedonian cavalry in Egypt range from 70 to 100 arouras, while

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[143] J. F. Verbruggen, *The Art of War in Western Europe during the Middle Ages, from the Eight Century to 1340* (Woodbridge: Boydell Press, 1997), 170-1.

[144] M. Prestwich, *Armies and Warfare in the Middle Ages: The English Experience* (New Haven: Yale University Press, 1996), 134, 138-9.

[145] R. Hardy, *Longbow: A Social and Military History* (New York: Bois d'Arc Press, 1992), 44.

[146] Landers (2005), 296.

[147] Landers (2005), 295. Verbruggen (1997), 23.

[148] Elton (1996), 122.

infantry land grants typically range around 25 to 30 arouras.[149] It thus seems almost certain that the largest part of the cost of equipping an infantryman in the ancient world was the production of the metal elements of his equipment, and that the cost of the infantry dominated the total cost of the army.

Other Materials – Wood, Textiles and Leather

Wood

Wood too, was an important material in equipment, and the wooden elements in most sets of equipment will actually outweigh the metal ones. The main uses for wood were in shields and the shafts for spears, javelins, bows and arrows, all applications where wood provided a balance of strength at a low weight and cost premium. As with ship construction, different woods were suited for different purposes and often carefully chosen. For the making of shields, Pliny the Elder suggests poplar for its flexibility and ash for spear-shafts, where he noted the Homeric precedent.[150] The Macedonian *sarisa* is noted as using Cornelian cherry (or cornel) wood by both Theophrastus and Arrian; the latter specifically highlights the advantage offered by cornel's strength as a material.[151] Cornel was also used for javelins.[152] Cornel wood is denser (and thus heavier) than ash, but also quite a bit stronger, making it ideal for applications like the *sarissa* or javelins, where strength is valued over flexibility or low weight.[153] Once chosen, any of these

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[149] Fischer-Bovet (2014), 120-121.

[150] Pliny, *NH*, 16.24, 16.77. Ash (μελία) is used by Homer as synecdoche for a spear, *Il.* 19.390, 22.225; Thus, also in Homer, ἐυμμελίης, comes to mean "well armed with an ashen spear" as *Ody*. 3.400.

[151] Theophrastus, *Historia Plantarum* 3.12.1; Arrian, *Alex*., 1.15.5.

[152] *Homeric Hymn to Hermes*, 460.

[153] M. M. Markle, "The Macedonian Sarissa, Spear and Related Armor." *AJA* 81.3 (1977): 323-339.

woods would have to be first felled and then seasoned to remove the sap and moisture.[154] Shafts for weapons could then be shaped with a lathe.[155] The construction of shields is somewhat more complex, and will be discussed in more detail in subsequent chapters.

Although an important material, wood was also relatively inexpensive. As noted above, comparative evidence from the Middle Ages indicates that wooden equipment often cost only a fraction of the cost of metal. Partly this may be explained with reference to the fuel requirements of metal equipment. A typical *pilum*, for instance might require only 0.3kg of iron for the tip compared to the 1kg wooden haft.[156] However, the fuel requirements merely to smelt the iron for that tip would have been around 43.5kg.[157] Woodworking was a skilled profession in the ancient world, but many wooden elements of military equipment, like spear or javelin hafts, are relatively simple and could have been produced within the household economy with only semi-skilled labor.[158] One of the few items of military equipment explicitly listed in Diocletian's price edict is a finished spear-shaft in cornel wood, for only 30 *denarii*, less than a day's labor for a blacksmith.[159] Unfortunately, bulk iron is not listed in the edict, but if the spear was fitted with a

[154] Hodges (1989), 113-114.

[155] Hodges (1989), 115.

[156] This reconstruction is discussed in the following chapter in more detail, but follows P. Connolly, "Experiments with the Sarissa – the Macedonian pike and cavalry lance – a functional view" *JRMES* 11 (2000a): 103-112.

[157] Sim and Ridge (2002), 23. Sim and Kaminski (2012), 44, notes a material loss during the fashioning of the metal elements of a pilum at 37.91% in addition, when finishing is included.

[158] R. B. Ulrich, *Roman Woodworking* (New Haven: Yale University Press, 2007), 6-12.

[159] *Edict of Dicoletian* 7.11, 14.4-5. Notably, more complex items like wheels and wagons, which would have required a skilled joiner, are far more expensive.

tip and ferrule in bronze, the raw, unworked metal (roughly 300g) alone would cost 50 *denarii*.[160]

Hide Products: Leather, Parchment, Rawhide and Cuir Bouilli

Leather (here and following understood to include rawhide unless specified) has a wide variety of uses in military equipment, although more often as a material used in fittings or secondary elements than as a primary material.[161] Tanned leather (as distinct from rawhide, *cuir boulli*, or parchment) is generally flexible and supple, but of little value as armor. Leather is produced from hides; first the fat layer underneath the hide is scraped away using a paring knife, and any hair and remaining epidermis is removed. The hide may then undergo intermediate treatments, as with oils such as dubbin, or by way of a salt or alum dressing called tawing. The hide is then tanned, that is treated with tannins, to produce tanned leather. Parchment, by contrast, is only tawed and stretched but not tanned, and produces a very thin surface of leather.[162] Very thin hide surfaces could be used for the facings of shields such at the *scutum*.[163] On the other hand, rawhide, which is not tanned but may be soaked in lime, is quite hard and inflexible and may have been used as a primary material in certain armors.[164] Finally, *cuir*

[160] *Edict of Diocletian* 15.66.

[161] On the general details of producing various hides and leathers, see: Hodges (1989), 148-152; M. Kite and R. Thomson, *Conservation of Leather and Related Materials* (London: Routledge, 2005), 1-65; A Michel, "Skin deep: an outline of the structure of different skins and how it influences behavior in use. A practitioner's guide" in *Why Leather? The Material and Cultural Dimensions of Leather* ed. S. Harris, and A. J. Veldmeijer, (Leiden: Sidestone press, 2014), 23-40.

[162] Hodges (1989), 151.

[163] Plb. 6.23.3.

[164] Jarva (1995), 36-3, but note also Aldrete *et al.* (2013), 57-63. The issue of leather as a primary material for various kinds of armor will be discussed in subsequent chapters.

bouilli, sometimes called boiled leather was most likely actually boiled rawhide. It is extremely rigid and hard and can make for quite effective rigid armor.[165]

Confusion between these various types of leather and hide materials has led to leather, often of an unspecified variety, being frequently proposed as a potential primary material for Greek and Roman armor, often as an explanation of last resort. Eero Jarva, for instance, proposes leather as the normal material for the construction of the composite Type IV corselet, generally identified as the *linothorax*; the problems with this reconstruction are discussed in more depth in chapter 5.[166] Raffaele D'Amato also proposes reconstructions in leather for Roman armor, particularly when the representational evidence appears to him to present armor as flexible.[167] The evidence, or lack thereof, for the use leather or textile armor by the Romans is an issue which will be discussed in greater depth in the following chapter. However it should be noted at this juncture that leather which has been treated for use as armor is not, in fact, supple or flexible. For leather to effectively resist weapons it must be hardened (as with rawhide and *cuir bouilli* above); flexible tanned leather will provide little resistance to an arrow or a spear-head.[168] Both rawhide and hardened leather like *cuir bouilli* could provide significant protection, but are far less flexible.

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165 Hodges (1989), 151. L. Davies, "Cuir Bouilli" in *Conservation of Leather and Related Materials*, eds. M. Kite and R. Thomson (London: Routledge, 2005), 94-102. E. Cheshire, "*Cuir Bouilli* armour" in *Why Leather? The Material and Cultural Dimensions of Leather* eds. S. Harris, and A. J. Veldmeijer, (Leiden: Sidestone Press, 2014), 41-76.

166 Jarva (1989), 36-40.

167 R. D'Amato, *Arms and Armour of the Imperial Roman Soldier: From Marius to Commodus 112 BC – AD 192* (London: Frontline Books, 2009), 39-43, 68, 82.

168 Cheshire (2014). L. Davies (2005). This has been well-known among medieval armor specialists for some time, cf. C. Foulkes, *The Armourer and his Craft: From the XIth to the XVIth century* (New York: Benjamin Blom, 1929), 96-103. C. Blair, *European Armour, circa 1066 to circa 1700* (London: B.T. Batsford Ltd, 1958), 37-40.

The leather used in equipment, while important, was not likely to be as expensive as worked metal components. Leather could be produced within the household of a moderately well-off free-holding farmer, who might well tan the hides and skins of his own animals.[169] Beyond the hides, tannins for tanning could be readily obtained from the bark of oak trees.[170] The bulk of leather production in the ancient world appears to have been handled by professional tanners and leatherworkers, who often organized into professional associations. As a class, leatherworkers often faced stigma from the elite, in particular because the occupation was seen as smelly and dirty, but successful individuals and associations also became prominent in their communities.[171] The quantity of leather required for the civilian economy was considerable, with production being perceived as important enough to merit the emperor's attention in the imperial period.[172] Thus as a secondary material for straps and fittings, leather products would have been readily available.

As a primary material in armor, leather would have represented a low-cost alternative to metal, but with reduced battlefield performance, even for hardened leathers like *cuir bouilli*.[173] A sense of the relatively lower cost of leather products is given by Diocletian's price edict, with the price of an untanned ox hide at 500 *denarii*, and the same hide, tanned suitably for fittings, at

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[169] R. D. Higham, "The social position of leatherworkers" in *Conservation of Leather and Related Materials*, eds. M. Kite and R. Thomson (London: Routledge, 2005), 82-7. Small leather items like simple shoes were regularly produced domestically by poor peasants in the Middle Ages, see Q. Mould, "The home-made shoe, a glimpse of a hidden but most 'affordable', craft" in *Everyday Products in the Middle Ages: Crafts, Consumption and the Individual in Northern Europe c. AD 800-1600* eds. G. Hansen, S. P. Ashby and I. Baug (Oxford: Oxbow, 2015), 125-142.

[170] Hodges (1989), 150.

[171] S. Bond, *Trade and Taboo: Disreputable Professions in the Roman Mediterranean* (Ann Arbor: University of Michigan Press, 2016), 97-125. The same tension held in the Middle Ages as well, see Higham (2005).

[172] Bond (2016), 115-118.

[173] J. W. Waterer, *Leather and the Warrior* (Northampton: Museum of Leathercraft, 1981), 34, 36, 46-48, 60-61, 75.

600 *denarii,* which Jarva suggests would provide enough leather to be suitable for two complete corselets.[174] In comparison, a soldier's tunic "of the third quality" (the lowest listed) is priced at 1,000 *denarii*.[175] A blacksmith making wagon fittings, at the listed wage of 50 *denarii* a day, would have been able to afford the tanned ox-hide in just 12 days of labor. The comparison with the cost of a mail shirt in fourteenth-century Bruges, which would amount to more than nine months labor by a skilled artisan, is instructive even at such great chronological distance.[176]

Textiles

Textiles would also make up an important part of any ancient panoply, but as with wooden elements, a relatively small portion of the total resource and labor intensity. Helmets were designed to be used with a lining of wool or linen for absorbing impacts and for increased fit and comfort; without such a liner, the effectiveness of a metal helmet would be drastically reduced. Likewise, most forms of metal body-armor would be worn over a quilted or felt garment where multiple layers of cloth quilted together would serve to absorb impacts against the armor. The evidence for this form of protection in the panoplies of each culture-group are discussed in later chapters. Finally, textiles could be used as the primary material for body-armor, most notably in the Greek and Macedonian *linothorax*. Textiles were thus an important part of the soldier's equipment.

Nevertheless, textiles were not likely to be major drivers of the cost of equipment. Textile production, as noted in the first chapter, could take place within the household economy,

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[174] *Edict of Diocletian*, 8.6-8. Jarva, 153.

[175] *Edict of Diocletian* 26.28-30.

[176] See above at n. 136. *Edict of Diocletian* 7.11.

making use of skills and equipment that individuals in the household already possessed.[177] Moreover, textiles for quilted or felt liners and armor-padding did not need to be of particularly high quality. Diocletian's price edict lists prices for coarse linen ranging as low as 72 *denarii* and basic unwashed wool at only 25 *denarii* per Roman pound, making low-quality raw textiles some of the cheapest goods listed in the edict.[178] In comparison, while a pound of linen or wool was likely to prove more than sufficient for a helmet liner, the 1.5kg of bronze sheet-metal necessary for a helmet would cost 274 *denarii*.[179] The labor time necessary in spinning and weaving in order to turn that raw material into useful textiles was considerable, although still significantly less than the labor requirements of worked metal. Experiments in reproducing the *linothorax* by Aldrete *et. al.* suggests around 170 hours of labor to produce 1kg of woven fabric from raw flax, so the time investment in the production of textiles was not trivial.[180] Despite this, Aldrete *et. al.* note that textile body armor such as the *linothorax* would have been a substantially less expensive alternative to a metal cuirass.[181]

In summary then, the high labor, material and especially fuel costs of worked metal meant that, for most infantrymen in the ancient world, the largest part of the cost of equipment was the production of the metal elements of his panoply. The primary exception to this rule are soldiers who have substituted less expensive equipment, like textile armor, in place of more

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[177] See Ch. 1 at n. 102 and following.

[178] *Edict of Diocletian*, 25.5, 26.10-12.

[179] Based on a price of 60 *denarii* per Roman pound of bronze plate, *Edict of Diocletian* 15.65.

[180] Aldrete, *et al*. (2013), 150-151.

[181] Aldrete, *et al.* (2013), 153-159. Jarva (1995), 153-4 makes much the same point concerning leather.

expensive (but also more effective) metal options. Thus, based on the tremendous resource intensity of worked metal, the following chapters will focus primarily on the metal-content of battlefield equipment, in so far as it can be reconstructed. While other materials (wood, leather and textile) will be considered, worked metal will serve as the primary comparative tool and as a proxy for the production cost of the overall panoply. Each chapter will focus on the reconstruction of the battlefield equipment of a particular army: Chapter 3 on the equipment of the Roman legion of the second century, and Chapter 4 on the armies of the Hellenistic world with a particular emphasis on the Macedonian *sarissa*-phalanx. Finally, Chapter 5 will focus on the armies of the pre-state peoples that came into conflict with Rome through the second century, specifically the Iberians, Celtiberians and Gauls. The final chapter will then draw the results of these investigations into comparison and assess the performance of the underlying mobilization systems of each.

Figure 3.1: Iron bloom[182]

6 *Section through a piece of bloom iron. Magnification approximately x 1.2*

Figure 3.2: Iron Billet[183]

8 *Iron billets found at the legionary fort of Newstead*

[182] Sim and Ridge (2002), pl. 6.

[183] Sim and Ridge (2002), pl. 8.

Figure 3.3: Cherub smiths and assistants[184]

3 *Cherub smiths tending a furnace, from a wall painting in the House of the Vettii, Pompeii*

4 *Cherub smiths from a wall painting in the House of the Vettii, Pompeii*

[184] Sim and Ridge (2002), pl. 3-4.

Figure 3.4: Strikers[185]

11 *Hephaestos in his forge assisted by three strikers*

Figure 3.5: Raising, Sinking and Spinning to create bowls for helmets[186]

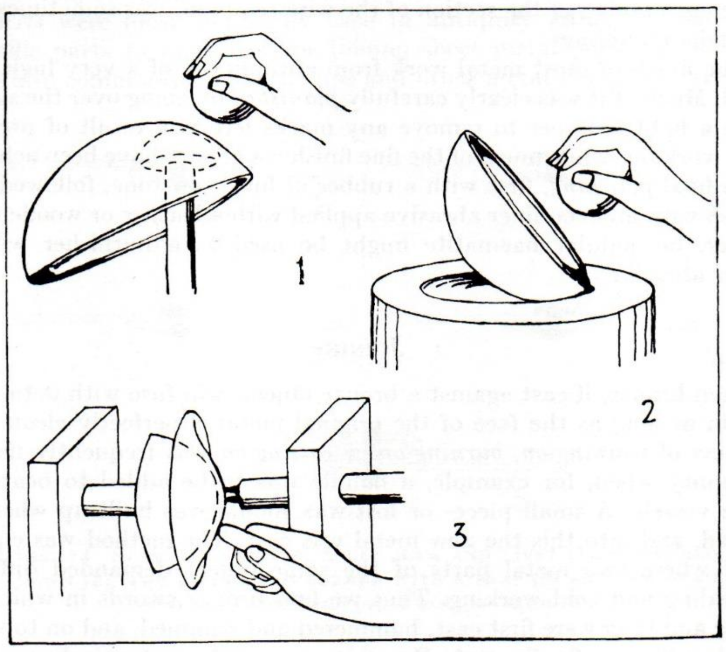

FIG. 12 MAKING SHEET METAL VESSELS BY RAISING (1), SINKING (2), AND SPINNING (3).

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185 Sim and Ridge (2002), 56.

186 Hodges (1989), 75.

CHAPTER 4: THE ROMANS

This chapter discusses the equipment of the Roman army of the third and second centuries, in order to provide a basis for comparison with the equipment of Hellenistic (Chapter 5) and pre-state (Chapter 6) armies of the period. As discussed in the previous chapter, the primary quantitative tool for this comparison will be metal-weights, which are used as a proxy for cost, although in the conclusion non-metal resources will be discussed as well. In this chapter, I first discuss the main sources of evidence on which the reconstructions will be based, before turning to a discussion of the classes of soldiers in the Roman army. After this, the reconstructions themselves, the main body of the chapter, present the evidence for the metal-weights for each equipment type. Finally, preliminary conclusions are from these figures.

Sources

As noted in the previous chapter, military equipment is a subject in which the literary sources do show some interest and provide invaluable information. Two authors in particular, Polybius and Livy, dominate the available information about Roman military equipment in this period. Some general notes, then, about the advantages and pitfalls of these sources are useful at the outset. Polybius was a contemporary and an eyewitness to the army he describes, at least for the latter part of his history.[1] He thus avoids much, though not all, of the danger of anachronism

[1] For background on Polybius' life, see generally Walbank (1957), 1-6. Too much has been written on Polybius to recount all of it here, but see esp. P. Derow, A. Erskine, J. Quinn, *Rome, Polybius and the East* (Oxford: Oxford University Press, 2015), 85-206; A. Erskine, "How to Rule the World: Polybius Book 6 Reconsidered" in *Polybius and his World: Essays in Memory of F. W. Walbank,* eds. B. Gibson and T. Harrison (Oxford: Oxford University

when describing the Roman army, and his outsider's perspective, as a Greek writing about Romans, leads him to describe in detail what might be left unsaid by a Roman source like Livy. However, Polybius' portrait of the Roman army is an idealized one meant to explain Roman success, and his description is a snap-shot rather than a developmental history. In contrast, Livy has a tendency to date changes in military equipment or organization, often with suspicious precision; but he also has a strong tendency towards anachronism, which renders many of these details less reliable. Livy's Roman patriotism also colors his work, and his reliance on Italian sources can lead to distortions in his account of the Roman *socii* in particular.[2] Despite their weaknesses, these two authors must provide the core of any reconstruction of Roman equipment in this period. Later sources, while often providing tantalizing details, must be regarded as less reliable and in some ways inherently suspect, given their greater chronological distance.

For reconstructing military equipment, representational depictions of Roman soldiers and equipment provide valuable evidence and act as a useful check on the descriptions in the literary evidence.[3] The representational evidence for the Roman soldier of the third and second centuries is dominated by two monumental friezes, the Aemilius Paullus Pydna Monument and the so-called Altar of Domitius Ahenobarbus. While other pieces of representational evidence will be dealt with in the reconstructions, in light of the tremendous import and significant difficulties these two monuments pose, it is necessary to discuss both before embarking on the reconstructions.

Press, 2013), 231-245; and A. Erksine, "Polybius among the Romans: Life in the Cyclops' Cave" in *Imperialism, Cultural Politics and Polybius,* eds. C. Smith and L. M. Yarrow (Oxford: Oxford University Press, 2012), 17-32.

[2] On this latter tendency, see: P. Erdkamp, "Polybius and Livy on the Allies in the Roman Army" in *The Impact of the Roman Army (200 BC – AD 476)* eds. L. de Blois and E. Lo Cascio (Leiden: Brill, 2007), 47-74.

[3] On representational evidence generally, see Bishop and Coulston (2006), 1-22.

Aemilius Paullus' Pydna Monument

The dating of the Aemilius Paullus monument is rendered secure by connection to the Battle of Pydna (which it depicts) in 168 B.C.E.; the monument was constructed by Paullus before his return to Rome in the following year.[4] What remains of the monument is a heavily damaged frieze in four panels, which would have served as a base for an equestrian statue of L. Aemilius Paullus, the victor at the Battle of Pydna; the monument was set atop a pillar originally erected by the Macedonian king Perseus and repurposed by Aemilius. The frieze depicts the Roman victory over the Macedonians, although damage to the monument makes identifying the figures and their equipment difficult. Several attempts have been made to evaluate the figures; the recent one by Michael Taylor is perhaps the most successful and persuasive.[5] His interpretation relies heavily on each figure's equipment; he argues that the artists responsible went to some lengths to distinguish between the various sub-units of each army, displaying not only Macedonian infantry and cavalry, but also Gallic mercenaries in Philip's army, as well as drawing a distinction between Romans and Italian allies within the Roman army.[6] I follow Taylor's identifications of the figures on the monument, although it is still necessary to exercise caution, as not all of them are secure.

[4] Plut. *Aem*. 28.4; Polybius 30.10.2; Livy 45.27.7.

[5] M. J. Taylor, "The Battle Scene on Aemilius Paullus's Pydna Monument: A Reevaluation" *Hesperia* 83.3 (2016): 559-576. Previous efforts on the monument, note esp., H. Kähler, *Der Fries vom Reiterdenkmal des Aemilius Paullus in Delphi* (Berlin: Verlag Gebr.Mann, 1965); D. Boschung, "Überlegungen zum Denkmal des Aemilius Paullus in Delphi" in *Rome et ses Provinces: Genèse & diffusion d'une image du pouvoir, hommages à Jean-Charles Balty* eds. C. Evers and A. Tsingarida (Brussels, Le Livre Timperman, 2001), 59-72.

[6] Taylor (2016), 569-70. Gauls in Perseus' army, Plut, *Aem.* 9.6; Livy 42.51.7.

The Altar of Domitius Ahenobarbus

By contrast, the so-called Altar of Domitius Ahenobarbus, really a pair of friezes, one now in Munich and the other now in Paris, presents a greater range of difficulties, encompassing the date of the monument, its context and the identities of the depicted figures. The Paris frieze depicts four Roman infantrymen, a cavalryman and a standing figure dressed as a Roman general. Its excellent preservation makes it extremely valuable for reconstructing Roman military equipment (fig. 4.1). The primary difficulty is dating the frieze, a crucial task for determining the period to which the soldiers depicted belong.[7] Unfortunately, efforts to date the friezes by art historians and by Roman military historians have largely proceeded in isolation from each other. Art historians have favored tying the context of the mythological scenes on the Munich frieze (a scene of the wedding of Poseidon and Amphitrite) to a naval triumph in order to determine the political-religious event (assumed to be a *lustrum*) on the Paris frieze.[8] The dates that emerge from this approach are necessarily tied to the individuals put forward as the sponsor of the monument, originally thought to have been Cn. Domitius Ahenobarbus (cos. 122). Filippo Coarelli and more recently Ann Kuttner propose Marcus Antonius, grandfather of the triumvir, as the sponsor, suggesting a date shortly after his censorship in 97 B.C.E.[9] Others

[7] The friezes, which were probably not part of an altar, but rather a monumental statue base, generally retain the nickname 'the Altar of Domitius Ahenobarbus' in English, although European scholars now generally refer to it as the Paris-Munich reliefs, and Ann Kuttner terms it the 'Marcus Antonius' Base.' Here, I retain the customary English usage and refer to both friezes together as the Altar of Domitius Ahenobarbus. Ann Kuttner, "Some New Grounds for Narrative: Marcus Antonius's Base (The Ara Domitii Ahenobarbi) and Republican Biographies" in *Narrative and Event in Ancient Art*, ed. Peter J. Holliday (Cambridge: Cambridge University Press, 1993), 199-200.

[8] On the long bibliography pertaining to dating the monument, see Florian Stilp, *Mariage et Suovetaurilia: Etude sur le soi-disant "Autel de Domitius Ahenobarbus"* (Roma: Giorgio Bretschneider Editore, 2001), 16-23.

[9] Filippo Coarelli, "L'ara di Domizio Ahenobarbo e la cultura artistica in Roma nel II sec. AC." *Dialoghi di archeologia* 2 (1968): 302-68. Ann Kuttner (1993), 198-229.

suggested as the sponsor are L. Gellius Poplicola (cos. 72) or the younger Domitius Ahenobarbus (cos. 32).[10]

Scholars with a more military focus have generally avoided linking the monument to a specific individual, instead looking to date it by the appearance of the soldiers on it. Lawrence Keppie places it in the latter half of the second century and notes that "the presence of an *eques* by itself could suggest a date before the time of Marius."[11] To Keppie, the presence of this cavalryman, presumably an *eques*, in particular seems to argue strongly against many of the suggested dates in the first century, unless the depictions of the men are intentionally archaizing, as the Roman citizen cavalry is generally thought to have been discontinued in the late second century (fig. 4.2). Florian Stilp, one of the few scholars to consider both the art-historical context of the monument and the equipment and soldiers depicted on it, rejects any linkage to a specific person as impossible, but dates the monument broadly to the second century. In my view, this broad dating to the second century generally is as much precision as can be adopted with confidence.

The identity of the figure standing behind the altar in the *suovetaurilia* scene, one of the central figures there, is another important puzzle, as his armor and weapons are unique on the monument. The figure stands holding a spear upright, resting his arm on a round shield (fig. 4.3). He wears a breastplate with *pteryges* (leather strips protecting the groin and upper thigh), decorated by a band around the waist. His helmet, while damaged on the relief, appears to be in a somewhat different style from those of the infantrymen, as it lacks cheek-guards. Historians

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[10] L. Gellius Poplicola: H. Kähler, *Seethiasos und Census* (Berlin: Verlag Gebr. Mann, 1966); T. P. Wiseman, "Legendary Genealogies in Late-Republican Rome" *Greece & Rome* 21.2 (1974): 153-164. Domitius: S. Lattimore, *The Marine Thiasos in Greek Sculpture* (Los Angeles: Institute of Archaeology, University of California, 1976).

[11] Keppie (1984), 224. Keppie notes that he follows Coarelli in this, but Keppie's pre-Marian date and Coarelli's attribution to Marcus Antonius are incompatible.

of the Roman army, including Keppie, Raffaele D'Amato and Peter Connolly, have tended to identify this figure as a military tribune, with little discussion.[12] In contrast, art historians, such as Heinz Kähler, Steven Lattimore, Kuttner, and Stilp tend to identify the figure as the god Mars, often in an equally cursory manner.[13] Stilp, however, presents the case for an identification with Mars, noting that the position of the figure and his role in the composition fit well within a Greek tradition of showing a human performing a sacrifice and a god accepting it.[14] Dressed as a Roman general, Mars also seems to mirror the sacrificing magistrate on the other side of the altar, perhaps providing an opportunity to show the monument's dedicator in both his civic role (as a magistrate carrying out a *lustrum*) and military role (as a general); the two figures have the same sightline and are a nearly exact match in position, height and posture (fig. 4.4). In my view, the figure should be understood as a representation of Mars, dressed as a Roman general; as such, his equipment should not be considered as typical for the rank-and-file Roman soldiery.

Archaeological Material

Military equipment is also increasingly well-attested in the archaeological record. Archaeological evidence for the Republican period, just as with the representational evidence, has always been more limited compared to later periods, but a steady pace of discoveries has served to fill in many gaps.[15] Moreover, the amount of Hellenistic material available for

[12] Keppie (1984), 224. P. Connolly, *Greece and Rome at War* (London: Macdonald Phoebus, 1981), 214. Bishop and Coulston follow the same identification, but only tentatively, see Bishop and Coulston (2006), 49. Note also D'Amato, (2009), 27. The drawn reconstruction presented by D'Amato, dating from 1883 and presenting the figure in a *linothorax* with a pectoral, is wildly inaccurate.

[13] Kähler (1966), 25. Lattimore (1976), 17. Kuttner (1993), 199. Stilp (2001), 52-3.

[14] Stip (2001), 52-3.

[15] Bishop and Coulston (2006), 48-50.

comparison (see Chapter 5) and our knowledge about it has increased dramatically, while the archaeological evidence for Gallic and Iberian arms and armor (see Chapter 6) is surprisingly extensive. Moreover, battlefield military equipment, particularly the personal arms and armor that the next several chapters will focus on, tends to consist of specialized pieces of equipment with little civilian use, making military objects readily identifiable and distinguishable, with a clear purpose. In the Roman infantry panoply, perhaps the only exception to this pattern is the dagger, although its inclusion in the panoply during the Middle Republic is in doubt.[16]

Archaeological evidence does, however, pose a number of challenges. Most notably, preserved specimens vary widely in how intact they are; some objects come down to the present remarkably well preserved, while others are so heavily damaged as to require extensive reconstruction. Moreover, due to the limited nature of the archaeological evidence, it is often not possible to restrict the evidence base to artefacts with secure recovery contexts or provenance. Where possible, this study aims to use evidence that can be securely tied to the Middle Republic, but for certain kinds of equipment it has been necessary to draw on comparative evidence either from earlier artefacts, as in the case of the pectoral, or later from the early imperial period, as with mail armor rings. In all cases it must be stressed that the state of the archaeological evidence is always evolving. Given the narrow evidence base, it is entirely possible that new discoveries may substantially change our understanding of the material.

Reconstructions

My reconstruction will begin by reviewing the structure of the legion, the classes of soldiers within it, and the equipment attributed to each type, with a focus on the legion in the

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[16] Bishop and Coulston (2006), 56-55.

second century B.C.E. Although the reconstructions will consider the equipment for light infantry (*velites*) and the cavalry (*equites*), emphasis is placed on the heavy infantry (in the Roman case, *hastati, principes* and *triarii*), which formed the largest and most dominant part of not only the Roman army, but also of Hellenistic armies and many pre-state ones. Having established what equipment the soldiers carried and wore, I then discuss and present reconstructions of each item, with a particular eye towards the metal-weight of each piece. Roman equipment was never uniform, particularly in the Republic, so it is necessary in the reconstructions to establish a range of possible metal-weights. Accordingly, each item will be assigned three reconstructed weights: a minimum case figure representing a lower-bound for the likely metal content of each type of equipment, and a maximum case figure representing an upper-bound; in addition, each type of equipment will be assigned a median case figure, representing a 'best guess' estimate at a 'typical' or 'average' piece of equipment. The median-case estimates are necessarily more speculative, but they serve to suggest where in the range between the lightest and heaviest examples the average seems to fall, based on the current evidence. Once all of this is done, reconstructed metal-weights can be produced for all of the potential variants of the Roman panoplies, allowing conclusions about the resource-intensity of Roman warfare to be drawn at the end of the chapter.

Classes of Soldiers

Reconstruction of Roman equipment should begin with an outline of the equipment used by each of several classes of Roman soldier, before proceeding to a detailed item by item discussion of the characteristics and costs of each piece of equipment. As noted earlier in this chapter, Polybius' description of the equipment of the Roman army remains the starting point for any discussion, although the passage is not without its problems.[17] Placement of his description in Book 6 puts it chronologically in the early years of the Second Punic War, but it is not entirely clear to what degree he is attempting to describe the Roman military c. 216 or if he is generalizing from the Roman army as it looked in the latter half of the second century.[18] As a result, an awareness of dating when discussing the development of the Roman 'panoply,' in reality several Roman panoplies, will be necessary.

Modern descriptions of the organization of the Roman army in the third and second centuries generally follow Polybius' description. He breaks the Roman forces into five groups, a front rank of light skirmishers called the *velites*, two middle lines of sword-shield-and-javelin heavy infantry called the *hastati* and the *principes* respectively, a back rank of spear-and-shield heavy infantry called the *triarii*, and finally the citizen cavalry, the *equites*.[19] Polybius presents the normal size of the legion as a whole at 4,200, with 1,200 each of *hastati* and *principes*, 600 *triarii* and the rest (another 1,200 men) being *velites*.[20] The *equites* numbered 300 in addition to this.[21] Polybius has fewer words for the *socii*, but notes that "the total number of allied infantry is usually equal to that of the Romans, while the cavalry are three times as many."[22] Michael Dobson argues, however, that army-size figures reported by both Polybius and Livy show that

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[17] Polybius 6.23.6

[18] E. Rawson, "The literary sources for the Pre-Marian Army" *PBSR* 39 (1971): 13-31, argues the description dates to c. 160s. Dobson, (2008), 55 argues for placing it c. 216. Dobson's case is persuasive, but certainty seems impossible.

[19] Polybius 6.24-25.

[20] Polybius 6.21.7-9. Keppie (1984), 34-5. Dobson (2008), 48-9.

[21] Polybius 6.25.1-2. Keppie (1984), 35. Dobson (2008), 50.

[22] Plb. 6.26.7. τὸ μὲν τῶν πεζῶν πάρισον τοῖς Ῥωμαϊκοῖς στρατοπέδοις ὡς τὸ πολύ, τὸ δὲ τῶν ἱππέων τριπλάσιον.

this correspondence was at most a general rule of thumb, and that there was no fixed ratio of allied to citizen troops.[23]

Livy's description of the organization of Roman and Latin forces in 340 is less reliable. It is largely in accord with the three lines of the heavy infantry that Polybius describes, but the rest of Livy's account is mired in difficulties.[24] Livy omits the *velites*, but adds two new classes of soldier, the *rorarii* and the *accensi*.[25] As Stephen Oakley notes, Livy's description requires multiple emendations in order to make sense of the passage and even then, Oakley argues, "a rational interpretation of his figures is probably impossible."[26] Lawrence Keppie concludes that "it is difficult to suppose that the legion he [Livy] describes ever existed as a reality," and that "solid ground is reached only with Polybius."[27] Livy's omission of the *velites*, may be explained by his later note that the *velites* emerged as a distinct arm during the siege of Capua in 212-211 as a response to Campanian cavalry tactics.[28] Michael Sage doubts this reasoning, instead seeing the *velites* as an effort by the Romans to reach more widely for manpower, while Oakley regards the entire rationale for the introduction of the *velites* as questionable, instead arguing that the *rorarii* and the *velites* are to be seen as different names for the same unit.[29] Polybius notes the

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[23] Dobson (2008), 51-52.

[24] Livy 8.8.3-8.

[25] S. P. Oakley, *A Commentary on Livy: Books VI-X* (Oxford: Clarendon Press, 1998), 469-71, is persuasive in arguing that the *rorarii* are light-armed, but the *accensi* were non-combatants. Keppie (1984), 20, takes the same view.

[26] Oakley (1998), 462-4.

[27] Keppie (1984), 20. Connolly (1981), 126-128, tries heroically to salvage Livy's description, but the result is less than convincing.

[28] Livy 26.4.3-10.

[29] M. Sage, *The Republican Roman Army: A Sourcebook* (New York: Routledge, 2008), 89. Oakley (1998), 469-471.

presence of light-armed troops prior to the Battle of Trebia (218), and Michael Bell reads these as *velites*, pushing the introduction of the unit potentially to this year at the latest.[30] On the balance it is not hard to see the *velites* emerging, as Livy suggests, out of the *hastati*'s attached *leves milites* either gradually or as a response to the pressing need for support troops in the Second Punic War. Functionally they would replace the *rorarii* in that role, but otherwise little confidence can be placed in the details of Livy's description.

My reconstruction, then, will proceed along the lines of Polybius' description, with an army comprising five kinds of common soldier. As with the basic structure of this force, Polybius' description of their weapons remains the starting point for any discussion of the equipment of the Roman army in this period. His description of the heavy infantry is largely uncontroversial. The *hastati* and *principes* carried a sword (the *gladius Hispaniensis*), a large shield (the *scutum*), and two heavy javelins (*pila*); they were armored with a helmet and body armor (either a *pectoral* or the mail *lorica hamata*).[31] Polybius also mentions greaves as part of the armor, but here he is at variance with some of the representational evidence; the issue will be discussed below. The *triarii* were equipped the same, except that they substituted a long thrusting spear (the *hasta*) in place of the pair of *pila*.

Polybius' descriptions of the arms for the *velites* and *equites* require more discussion. He says the *velites* had a sword, javelins (γρόσφους) and a small round shield (πάρμην). Polybius also notes that they wear a "simple headcovering" (λιτῷ περικεφαλαίῳ), sometimes reinforced with a wolf's skin.[32] That the wolf's skin is taken to add significant protective value seems to

[30] M. J. V. Bell, "Tactical Reform in the Roman Republican Army," *Historia* 14.4 (1965): 404-22.

[31] Polybius 6.23.1-14.

[32] Polybius 6.22.3.

imply that the normal helmet of the *velites* was cloth or leather, rather than metal. Following this reasoning, Walbank suggests that the simple headcovering of the *velites* represents the leather or textile *galea* or *galerus*, rather than the metal *cassis*, a distinction mentioned by Propertius and Vergil.[33] Polybius also gives a description of the lighter javelins of the *velites*, identified by Frank Walbank and Connolly with the *hasta velitaris*.[34] Finally, Livy confirms the sword which Polybius notes the *velites* as possessing to have been the *gladius*.[35]

Polybius' description of the equipment of the cavalry of his own day is less detailed, as the description is presented as part of the motif of the Roman adoption of foreign weapons, presenting the Roman cavalry of his day as "armed like that of Greece" in contrast to an older and lighter model of cavalry equipment, which he does not date.[36] Polybius also offers no date for this transformation. Eduard Meyer dated the reform to the second century, and John Eadie argued for the transition being the result of the Roman encounter with eastern cataphract cavalry at Magnesia in 189.[37] Elizabeth Rawson suggested a date during the Second Punic War.[38] Jeremiah McCall has recently taken up the question, siding with Rawson, although he admits the issue can never be settled conclusively.[39] He notes that Roman cavalrymen in the early second

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[33] Walbank (1957), 703. Vergil, *Aeneid* 7.688; Prop. 4.10.20. The distinction is made explicit by Isidore in his 7th century encyclopedia where he notes, "*cassis de lamina est, galea de corio*"; Isidore, *Origines* 18.14.

[34] Walbank (1957), 703. P. Connolly, "The reconstruction and use of Roman weaponry in the second century BC" *JRMES* 11 (2000b): 43-46.

[35] Polybius 6.22.1. Livy 38.21.13. Here and subsequently, *gladius* should be understood as the *gladius Hispaniensis*, unless otherwise specified.

[36] Polybius 6.25.3. ὁ δὲ καθοπλισμὸς τῶν ἱππέων νῦν μέν ἐστι παραπλήσιος τῷ τῶν Ἑλλήνων.

[37] E. Meyer, "Das römische Manipularheer, sine Entwicklung und seine Vorstufen" *Kleine Schriften II* (1924), 193-329. J. W. Eadie, "The Development of Roman Mailed Cavalry" *JRS* 57 (1967): 161-173.

[38] Rawson, (1971): 13-31.

[39] J. B. McCall, *The Cavalry of the Roman Republic* (London: Routledge; 2002), 27-45.

century seems to have already been a match for their Greek opponents, while earlier against Hannibal the cavalry seemed to suffer. McCall also seeks to associate a coin issue in 211, connected with the sack of Syracuse, with the reform of the cavalry, as it features the Dioscuri, long associated with the Roman *equites*, armed as Greek heavy cavalry on the obverse.[40] Such a date would put Roman cavalry reform in almost exactly the same period as the emergence of the *velites* as a distinct arm of the Roman legion, which, as noted, Livy claims was also in response to Roman vulnerability to cavalry. As with the emergence of the *velites*, however, gradual change should not be discounted. It is reasonable to suppose that Roman cavalry became heavier armed and armored over a period of years, as individual cavalrymen altered their own equipment in response to perceived battlefield realities. Whether gradual or sudden, it seems plausible, if not conclusive, to suppose (as McCall does) that the process of Roman cavalry reform described by Polybius was completed well before the end of the Second Punic War. As a result, it is the heavier mailed cavalry that will be presented in this reconstruction.

Weapons

Gladius Hispaniensis – Date and Adoption

The primary weapon of the Roman legionary in the Middle and Late Republic was the *gladius hispaniensis*, a sword, as the name implies, of Spanish origin. The date and circumstances of its adoption are not entirely clear.[41] The only source that explicitly mentions these points is the 10th century Byzantine lexicon, the *Suda*, which places the adoption of the

[40] McCall (2002), 43.

[41] For a complete discussion of the documentary evidence, see: F. Quesada Sanz, "*Gladius hispaniensis*: an archaeological view from Iberia" *JRMES* 8 (1997a): 251-270.

sword in the context of the Second Punic War.[42] Livy, apparently drawing on a passage by Q. Claudius Quadrigarius which survives as a fragment preserved in Aulus Gellius, describes T. Manlius Torquatus as girding on a Spanish sword, *Hispano cingitur gladio*, in the dictatorship of T. Quinctius Pennus in 361; however, it seems likely that the reference to a Spanish sword at this date is an anachronism.[43] Livy later notes that by 200 the Roman cavalry carried the *gladius hispaniensis*, but gives no date for its adoption.[44] At least one of the Roman cavalrymen on the Pydna monument appears to be positioning for a downward strike with a sword, although the weapon itself is lost.[45] Livy notes that the sword was also carried, at least by 189, by the *velites*.[46]

To parse Polybius for a more precise date for the adoption of the sword does not necessarily bring clarity. In his description of the Battle of Telamon c. 225 he notes the effectiveness of Roman swords.[47] Fernando Quesada Sanz has argued that Polybius may not yet mean the *gladius hispaniensis,* because these swords are not specifically referred to as Spanish, although in a later passage Polybius does note the decisive thrusting advantage of the weapon, which was certainly a merit of the *gladius hispaniensis*.[48] In his description of Cannae, Polybius contrasts the effective cut-and-thrust swords of Hannibal's Iberian mercenaries with those of his

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[42] *Suda*: μ 302, *machaira*. The passage appears to be a quotation of a fragment of Polybius, fr. 182 (179) in Polybius, *The Histories, Volume VI: Books 28-39. Fragments*, ed. and trans. S. Douglas Olson, (Cambridge, MA: Harvard University Press, 2012), 582-83.

[43] Livy 7.10.5. Claudius Quadrigarius, Fr. 10b. Aulus Gellius 9.13.

[44] Livy 31.34.

[45] Taylor (2016), 567. Kähler (1965), 26.

[46] Livy 38.21.13.

[47] Plb. 2.30, 2.33.

[48] Quesada Sanz (1997a), 251-270.

Gauls, making a clear distinction between the sword-types, one which is generally supported in the archaeological record (discussed in chapter 6).[49] However, when he describes the Roman panoply, dating the description apparently to the Hannibalic war, Polybius expressly notes that the Roman sword of choice is the Spanish (Ἰβηρικήν) one, seeming to confirm the *Suda*'s placement of its adoption no later than the last two decades of the third century.[50]

Thus, there is no prospect of dating the introduction of the *gladius hispaneisis* precisely without a marked improvement in the archaeological record for the late third century. The *terminus ante quem* must be reckoned as the end of the third century, given Livy's explicit reference to the swords in use in 200 and 187, and the recovery of two *gladii* from Grad near Šmihel, dated to the first half of the second century.[51] It is worth noting, however, that the introduction of a specifically Spanish sword seems not to have occasioned any identifiable revolution in Roman tactics or organization. Polybius' description of Roman fighting against the Gauls in the 220s and Livy's description of the Roman army in 340 suggest that the Romans' fighting methods had emerged before the introduction of the Spanish sword.[52] That the introduction of what became the quintessential Roman weapon should prove less than revolutionary seems at first surprising. However, its design was not a radical departure from the design of other Hellenistic or Iberian weapons, as will become clear in later chapters. It thus seems plausible that the adoption of, at least, a Spanish-style sword might have been a gradual

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[49] Plb. 3.114.2-4.

[50] Plb. 6.23.6

[51] Livy 31.34; 38.21.13. J. Horvat, "Roman Republican weapons from Šmihel in Slovenia," *JRMES* 8 (1997), 105-120; J. Horvat, "The Hoard of Roman Republican Weapons from Grad near Šmihel," *Arheološki Vestnik* 53 (2002), 117-192; D. Kmetič, J. Horvat, and F. Vodopivec, "Metallographic examinations of the Roman Republican weapons from the hoard from Grad near Šmihel," Arheološki Vestnik 55 (2004): 291-312.

[52] Plb. 2.30.8; 2.33.1-9. Livy 8.8.3-8.

process, well underway before the arrival of Hannibal and his mercenaries spurred its universal adoption.

After adoption, the *gladius hispaniensis* seems to have been used by all parts of the Roman army. Polybius explicitly attests the weapon for all three lines of the heavy infantry (*hastati*, *principes*, *triarii*).[53] He also notes the *velites* as carrying a sword, but does not note the type; however, Livy states that the *velites* too carried the *gladius hispaniensis*.[54] Polybius' notes on the equipment of the cavalry are less helpful, as he focuses on the contrast between the lighter "old" (τὸ δὲ παλαιὸν) Roman cavalry and the Roman cavalry of his own day, which he regards as more akin to the Greek model; he makes no mention of swords here.[55] Livy, however, explicitly mentions the *gladius hispaniensis* as the sword of the Roman cavalry in 200.[56] Of the five common soldiers (four infantry, one cavalry) on the Altar of Domitius Ahenobarbus, four can be seen wearing a sword, including the cavalryman, while the remaining infantryman's sword is obscured behind the shield of one of his fellows; the breastplate-wearing central figure, identified as Mars, does not wear a sword.[57] The Pydna Monument, heavily damaged, is less helpful, because weapons and scabbards on the monument appear to have been represented by metal attachments which are now lost, with only the small holes for them remaining.[58]

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[53] Plb. 6.23.

[54] Plb. 6.22.1. Livy 38.21.13.

[55] Plb. 6.25.

[56] Livy 31.34.

[57] Stilp (2001), 83, fig. 46-49.

[58] Taylor (2016), 559-576.

Finally, while my reconstruction will focus on the *hispaniensis* type, as it was both the archetypal Roman weapon of the period and by far the most common, there is strong evidence that individual soldiers still had significant latitude in weapon choices. Other weapon types do show up in Republican contexts. A sword from the Roman camps at Numantia identified by Schulten (cat. G1) as a *gladius hispaniensis* is probably more correctly identified as a Middle La Tène sword.[59] Likewise excavation at Caminreal revealed both a *falcata*, a native Iberian sword type, and a Late La Tène sword from a Roman context.[60] These weapon types will be dealt with in greater detail in subsequent chapters, but it is worth keeping in mind that Roman equipment in this period was never entirely uniform.

Gladius Hispaniensis – Reconstruction

Over the past several decades, an increasing number of examples of Republican-period *gladii* have emerged, in various states of preservation, allowing for a much better understanding of the weapon and making reconstruction possible, if challenging. My reconstruction, because it aims primarily to establish a range for the metal-weight of Roman swords, is most concerned with the metal elements of the *gladius*, namely the blade and the tang; the guard, grip and pommel of Roman swords were generally wooden (see Fig. 4.5). The earliest of the current wave of discoveries and identifications was the 1987 identification of the Delos *gladius* (cat.

[59] A. Schulten, *Numantia: Die Ergebnisse Der Ausgrabungen 1905-1912. Band IV. Die Lager bei Renieblas* (Munich: F. Bruckmann A.-G., 1929), 209, Taf. 25.9. On La Tène sword type chronology, see: J. M. Navarro, *The finds from the Site of La Tène I: Scabbards and the Swords found in them* (Oxford: Oxford University Press, 1972), 360-410; J.-L. Brunaux and B. Lambot, *Armement et Guerre chez les Gaulois* (Paris: Editions Errance, 1987), 120-121; T. Lejars, *La Tène: La Collection Schawb (Bienne, Suisse)* (Lausanne: Cahiers d'archéologie romande, 2013), 149-151.

[60] J.D. Vicente, M. P. Punter and B. Ezquerra, "La catapulta tardo-republicana y otro equipamiento militar de 'La Caridad' (Caminreal, Teruel)," *JRMES* 8 (1997), 167-199.

R1), dated to 69.[61] It is 76cm long and is fairly complete, rusted into the remains of its scabbard.[62] The remains of a charred wooden pommel adorned with rivets were still evident, and serve to connect the weapon-type to the sword depicted on Roman officers' tombstones of the Republic.[63]

The earliest-dated preserved examples are a pair of swords from Grad near Šmihel, Slovenia, as part of a larger hoard of weapons and tools discovered around 1890 but subsequently dispersed. It has recently been more extensively published and analyzed by Jana Horvat, who dates it tentatively the first half of the second century.[64] Of the four swords in the deposit, one has been lost in the intervening time, and a second appears to be of a sword of the Middle La Tène type, but the two remaining fit the pattern of the *gladius Hispaniensis* type.[65] The longer of them, which I term Šmihel-1 (cat. R10), has a blade-length of 66cm and a maximum width on the blade of 4.2cm; the tang is not fully preserved. The shorter of the two, which I term Šmihel-2 (cat. R11), has a blade length of 62.2cm and a maximum width on the blade of 4.5cm; like its fellow, the tang is not fully preserved. Notably, Šmihel-1 underwent metallographic testing, revealing a carbon content in the iron that ranged from 0.01% on the surface to 0.3% in the center of the blade. Horvat suggests that this metal content, indicative of a

[61] G. Siebert, "Quartier de Skardhana: la fouille," *BCH* 112.2 (1987), 629-42. Bishop and Coulston (2006), 56; P. Connolly, "Pilum, Gladius and Pugio in the Late Republic," *JRMES* 8 (1997), 49 and Feugère (1993) mark the Delos gladius as the first recognized *gladius* of the *Hispaniensis* type. The rather precise date offered by Siebert is in connection to the pirate sack of the sanctuary in 69 B.C.E.

[62] Bishop and Coulston (2006), 56. Siebert, (1987), 637-8.

[63] Bishop and Coulston (2006), 56.

[64] Horvat (1997), 105-120. Horvat (2002), 117-192.

[65] On the identification of the swords by type, note: Horvat (1997), 105-120; Connolly (1997), 49-57.

loss of carbon around the edges during forging, points to Šmihel-1 being an inferior product, especially compared to Roman swords of the Augustan period.[66]

A number of other finds allow for the parameters of the weapon-type to be better established, although there is still significant individual variation between the examples. A fairly complete example from Mouriès Bouches-du-Rhône (cat. R3), dated tentatively to c. 100 B.C.E. by Michel Feugère, has a blade length of 63.7cm and a 12.8cm long tang.[67] Another example found in Berry-Bouy à Fontillet (cat. R4), dated by Feugère to the late first century has a blade length of 66.7cm, with an incomplete tang. Another undatable sword (cat. R5) of the same type from Boyer has a blade length of 67.5cm; the tang is incomplete.[68] Assuming a roughly 13cm tang, the latter two swords would have had a total length of 79.7cm and 80.5cm respectively. Another sword discovered in grave 119 at Guibiasco in the Ticino valley in the Swiss Alps (cat. R6) has a blade length of 68cm, a 13cm tang and a total length of 81cm. It has been dated to the early Augustan period, although Connolly suggests an earlier date in the early first or even second century B.C.E. based on the Gallic artefacts present with the sword in the grave deposit.[69] A second sword from Guibiasco (cat. R7), from grave 471 has a blade length of 69cm, an unusually long example.[70]

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[66] Kmetič, Horvat, and Vodopivec, (2004): 291-312.

[67] M. Feugère, "L'équipement militaire d'époque républicaine en Gaule," *JRMES* 5 (1994), 10-11.

[68] Feugère, (1994b), 15. Connolly supposes the sword to date between 58 and 20 BCE, Connolly (1997), 49.

[69] M. Primas, "Grab 119 von Giubiasco und die Romanisiergung der Poebene" in *Festschrift zum 50jähringen Bestehen des Institutes fur Ur- und Frühgeschichte der Leopold-Franzens-Universität Innsbruck* (Bonn: In Komission bei R. Habelt, 1992), 473-83. Connolly, (1997), 49-50. Feugère (1994b), 15.

[70] Connolly (1997), 49.

Thickness and blade-shape also vary within a fairly narrow range. Many examples are waisted, meaning that the blade curves inward at the center then broadens out again, but typically only slightly.[71] This feature is present, but far less pronounced in the *gladius* than it is in the Roman dagger (*pugio*) or the Greek *xiphos* (see Figs. 4.5 and 4.6). Both of the Šmihel examples above show signs of slight waisting, as does the Boyer sword and both Guibiasco swords; however, this design element is missing from the Mouriès, Berry-Bouy and Delos *gladii*. A Caesarian sword from Osuna (cat. R8), broken into two parts, has been reconstructed by Connolly with a width along the blade of between 6 and 5cm and is a more strongly waisted example.[72] Connolly also notes nine badly damaged *gladii* from Gracurris (Alfaro, La Rioja in Spain) dating to the Sertorian war which show a blade width around 5cm at the shoulders of the hilt and narrowing to around 4.5cm in the main part of the blade.[73] Another sword from Es Soumâ, Algeria (cat. R9) dated to 118 shows a blade width of around 4.5cm, although the remains of this sword are broken into fragments and badly damaged.[74] The three remaining fragments suggest a total length of at least 74cm.

Based on the growing number of examples, it is possible to understand the genealogy of the *gladius*. Connolly, assessing a range of swords, suggests a gradual development from a longer, pointed and relatively slim multipurpose cut-and-thrust sword, as in the Šmihel

[71] This is often referred to as the blade being 'leaf shaped;' however here, as with spear-heads, I have opted to generally avoid the term 'leaf-shaped' as it can be unclear. 'Leaf-shaped' swords, for instance, do not share a shape with 'leaf-shaped' spear-heads.

[72] Connolly (1997), 50.

[73] Connolly (1997), 50.

[74] G. Ulbert, "Das Schwert und die eisernen Wurfgeshoßspitzen aus dem Grab von Es Soumâa," in *Die Numider: Reiter und Könige nördlich der Sahara*, eds. H. G. Horn and C. B. Rüger (Köln: Kunst und Altertum am Rhein, 1979), 333-338. The tomb is believed to be that of the Numidian king Micipsa, giving a fixed date for the deposition. Also mentioned Connolly (1997), 50-51, who criticizes Ulbert's reconstruction of the weapon, but accepts the dating.

examples, to a broader, and eventually shorter sword (Fig. 4.7).[75] It, in turn, transitions into the early Imperial gladii types, which tend to be broader and shorter than the Republican examples, probably prioritizing thrusting attacks over cutting, although they maintain a great deal of the weapon's versatility.[76] Looking to the sword's origins, Fernando Quesada Sanz argues that the *gladius* should be understood as a descendant of Iberian-made third and second century La Tène I swords that themselves represented a Gallic design taken over by local smiths in the Meseta (Fig. 4.8).[77]

One recently discovered sword represents a significant outlier to the type and deserves some discussion. This remarkably well preserved and unusually large example, dated to the late first century from Soknopaiou Nesos in El-Fayyum, Egypt (cat. R2), has a blade length of 77.3 and a 17.2cm long tang.[78] The blade is rather strongly waisted, with a width of 5.8cm at the shoulders, narrowing to 4.19cm at the waist and then broadening to 5.68cm before narrowing to the point. The sword is both rather longer and wider than other examples of the type, which tend to have blade lengths between 60 and 70cm, and widths at the thickest point between 4 and 5cm. Unsurprisingly, given the oversized dimensions, the Soknopaiou Nesos sword is quite heavy at 1.3kg, including a large decorated pommel. The unusually large dimensions of the weapon led Paola Davoli and Christian Miks to resist classifying it as a *gladius*, preferring instead to classify it as a *spathe*; but this identification creates more problems than it solves.[79] The terms *spatha*

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[75] Connolly, (1997), 53-6.

[76] Bishop and Coulston (2006), 78-80.

[77] Quesada Sanz, (1997a): 251-70.

[78] P. Davoli and C. Miks, "A new 'Roman' Sword from Soknopaiou Nesos (El-Fayyum, Egypt)" *ISAW Papers* 9 (2015).

[79] Davoli and Miks, (2015).

and σπάθη were descriptions of a shape, rather specifically a weapon, and could be used for a flat wooden weaving instrument,[80] a flat wooden stirring spatula,[81] or the stem of a palm-frond.[82] Hence the traditional identification of the *spatha* with the archaeological type, distinguished by greater length, parallel edges (meaning that it is unwaisted) and a less pronounced point, reflects the meaning of the word.[83] In short, the *spatha,* as a sword, was called such by the Romans because it was *spatha*-shaped, making the identification of a weapon, like the Soknopaiou *gladius,* with a different blade shape, as a *spathe* doubtful. The *spatha* appears to have derived from later La Tène III swords (discussed in chapter 6), rather than from variations on earlier La Tène I swords, making the *spatha* and the *gladius* related, but still very distinct swords. Given the characteristics of the Soknopaiou Nesos sword, with its strongly waisted blade and very pronounced stabbing point, it seems far better to classify it as an unusually large example of the *Hispaniensis* type, rather than as a descendant of the La Tène III swords. As such, it fits into a study of the *gladius Hispaniensis* type.

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[80] Plato, *Lysis* 208d. Aeschylus, *Choephoroi* 232. Seneca *Ep*. 90.20.

[81] Columella, 12.42.3. Pliny *Nat. Hist.* 34.11.26.

[82] Hdt. 7.69. Pliny *Nat. Hist.* 16.26.48

[83] Bishop and Coulston (2006), 82.

Table 4.1: Measurements for Republican *Gladii*						
	Catalogue Number	Date	Total Length	Blade Length	Tang Length	Blade Width
Šmihel-1	R10	Early second century	83 (reconstructed)	66	14 (reconstructed)	4.2 widest
Šmihel-2	R11	Early second century	78 (reconstructed)	62.2	14 (reconstructed)	4.5 widest
Es Soumâ (fragments)	R9	118	Fragmentary, c. 75cm			4.5
Mouriès	R3	c. 100	76.5	63.7	12.8	
Delos	R1	69	76	63.1	12.9	5.7
Soknopaiou Nesos	R2	Late first century	94.5	77.3	17.2	5.8-4.19
Fontillet	R4	c. 20	75.7 (incomplete) c. 80 (est. original)	66.7	9 (incomplete)	
Guibiasco 119	R6	Augustan?	81	68	13	
Guibiasco 471	R7	Augustan?		69	(incomplete)	
Boyer	R5	Undateable	71.5 (incomplete) c. 80 (est. original)	67.5	4 (incomplete)	

It remains to estimate the metal content, measured in mass, that a ‘typical’ *gladius* would have. Unfortunately, most of the swords of this type recovered, as noted, are damaged or badly corroded, often heavily so, making it difficult to determine their original weights. For this purpose, I have reconstructed, the swords digitally in order to accurately estimate the iron required for creating one. The two swords from Šmihel, a notably small example (Šmihel-2), the other a rather typically sized (Šmihel-1), were digitally reconstructed (Fig. 4.9 and 4.10) and analyzed using SolidWorks, producing a reconstructed mass of 680g for the larger Šmihel-1, and

530g for the smaller Šmihel-2.[84] Although this analysis is focused on the metal weight, it is worth noting that the weight of the entire weapon would be higher once the non-metal elements of the grip, guard, and pommel were added, probably bringing Šmihel-1 to c. 800-900g and Šmihel-2 to c. 700g. At the high end of weight, the Soknopaiou Nesos sword, the largest example of the *Hispaniensis* type, is one of the few well enough preserved for the weight to be reliable. The sword was measured at 1.3kg with the large pommel and wrapping; without these, the blade would likely fall just under 1kg. Thus, the minimum case reconstruction for metal-weight can be set at 530g, and the maximum just under 1kg, with the median case suggesting a 'typical' *gladius* around 680g.

Javelins – Pilum, Hasta Velitaris

The other offensive weapon for the bulk of the heavy infantry was the *pilum*, carried in pairs by the *hastati* and *principes*. Polybius describes it at some length, presumably because this weapon would have been unfamiliar to a Greek audience.[85] He notes that *pila* come in two varieties, heavy (παχεῖς) and light (λεπτοί), which, he notes, have the same length of wood haft, but differ in thickness.[86] This distinction is borne out in the archaeological evidence, with the heavy *pilum* generally having a flat-haft or tang connecting it to the wooden haft, while the lighter *pilum* is typically socketed (fig. 4.11a and 4.11b).[87] Although the *pilum* has often been treated as a secondary weapon, according to Alexander Zhmodikov, a closer reading of Roman

[84] Thanks to Christopher Crapuchettes and WASK Engineering for the use of their software and expertise.

[85] Plb. 6.23.8-11.

[86] Plb. 6.23.9-10.

[87] Bishop and Coulston (2006), 52.

battle narratives suggests that battles often involved longer exchanges with missile weapons, in addition to the volley-and-charge assault method.[88]

Fortunately, the number of archaeologically preserved *pila* datable to the Republic is fairly substantial, likely due to their status as disposable weapons, with finds often numerous enough to be published as type-groupings rather than individual pieces. Thus some 59 examples from Grad near Šmihel in Slovenia, likely from the first half of the second century, are broken by Jana Horvat into four groups: tanged *pila* with relatively short 22-30cm tips and two rivet holes (12 examples, cat. R12); tanged *pila* with mid-sized 33-40cm tips and single rivet holes (7 examples, cat. R13); tanged *pila* with long 44-57cm tips and two rivet holes (10 examples, cat. R14); and socketed *pila* (of any length) with a single connecting rivet hole (47 examples, cat. R15), likely the lighter *pila* of Polybius.[89] Although it is tempting to draw conclusions from the rough balance of 31 heavy and 47 light *pila*, it should be remembered that the Šmihel hoard was not kept intact after discovery in 1891. Horvat notes that "it cannot be established how many weapons have been lost."[90]

In addition, there have been a number of smaller finds from Italy and especially Spain which serve to further illustrate the various types and styles of *pilum*. Some 19 *pila*, dated to the second century (cat. R16 and R17), of the same type as the relatively short Šmihel *pila* have been

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[88] *Pilum* as secondary weapon, volley-and-charge see: Sage (2008), 81-2; Roth (2009), 53; P. Connolly, (1981), 128. For extended missile exchanges, see, A. Zhmodikov, "Roman Republican Heavy Infantrymen in Battle (IV-II Centuries B.C.), *Historia* 49.1 (2000): 67-78.

[89] Horvat (1997): 105-120. The lengths of the socketed *pila* were difficult to determine, as most of the points were broken off. Most were between 30 and 38cm, but a single better-preserved example was over 74cm long.

[90] J. Horvat (1997), 106.

found in Talamonaccio, south of Grosseto in Italy.[91] All of the *pila* found there are flat-tanged with two rivet holes, where the tangs are fully preserved. Like the shorter Šmihel *pila*, most of the examples fit between 25-32cm long, although the longest, at 35.3cm total length, may be considered mid-sized. The earliest Republican *pila* finds from Spain are those from the camps at Numantia: 37 *pila*-tips (all missing most of the shank and tang) and 35 more or less complete *pila*, a mix of tanged and socketed types.[92] Schulten attempted to reconstruct one of the tanged types, resulting in a weight of some 2.25kg, almost certainly too heavy, but of the right general shape (see below).[93] Another eight examples of Republican *pila* come from Caminreal, dated between the end of the second century to the first quarter of the first century. Of these *pila*, there are four examples (two of which are incomplete) of the flat-tanged 'heavy' *pilum* (cat. R18), and four of the socketed 'light' *pilum* (cat. R19).[94] The two complete 'heavy' *pila* were 95.1 to 100.2cm in total length; Connolly groups these together with the Renieblas types.[95] The lighter *pila*, which are in fairly good shape, have total lengths of 32.4, 32.9, 41.4 and 50.5cm; one preserves the space for the rivet that would have fixed it to the wooden component of the *pilum*. The Caminreal examples of the socketed *pilum* are mostly the same basic dimensions as the Šmihel examples (cat. R15), which mostly range from 30-38cm in length (although some are shorter).

[91] Martin Luik, "Republikanische Pilumfunde vom 'Talamonaccio'/Italien" *Archäologisches Korrespondenzblatt* 30 (2000): 269-277

[92] Schulten (1929), 205-6.

[93] Schulten (1929), 206; taf. 25c.

[94] Vicente *et al* (1997): 167-99.

[95] Connolly, (2000b), 43.

Due to the relatively robust archaeological evidence, and Polybius' uncommonly extensive description, reconstructions of the various types of *pilum* can be made with a fair degree of confidence. Connolly has published 5 proposed *pila* reconstructions based on different archaeological types.[96] His reconstructions cover four types of heavy *pila*: the short Talamonaccio tanged-type (which corresponds to Šmihel type 1, cat. R12, R16 and R17), the slightly longer tanged single-rivet Šmihel type 2 (cat. R13), the quite long tanged double-riveted Šmihel type 3 (cat. R14), and the largest type, based on the heavy Renieblas *pila*. Connolly also reconstructs the light *pila* based on the longer socketed examples from Šmihel, although he assigns the shortest examples of the socketed type of *pila* to the *hasta velitaris*. Connolly then field-tested all of the reconstructions except for the socketed type, in order to estimate their effective ranges. The weights suggested by Connolly are included in table 4.2 below:

Table 4.2: Reconstructed Roman *pila*

	Mass - Iron	Mass - Wood	Total Mass	Maximum Range	Effective range (est.)
Talamonaccio Type	0.265kg	1.015kg	1.280kg	34m	c. 25m
Smihel type 2	0.340kg	1.040kg	1.380kg	(est. c. 34m)	c. 25m
Smihel type 3	0.250kg	0.960kg	1.110kg	(est. c. 35m)	c. 25m
Renieblas type	0.660kg	1.050kg	1.710kg	33.7m	c. 25m
Socketed *pilum*	0.325kg	0.620kg	0.955kg	Not tested	<30m
Hasta velitaris	0.090kg	0.140kg	0.230kg	54.5m	c. 40m

Connolly's reconstruction reflects the relatively wide range of sizes and lengths for various kinds of *pila*. It should be stressed that, compared to other military equipment in the Roman arsenal, the variety of *pila* is quite wide. Polybius' note that there were generally two types of *pila* has often been taken to mean that each soldier would have carried one of each type,

96 Connolly, (2000b): 43-46.

which is a reasonable suggestion, although Polybius only notes that there are two sorts and mentions differences in their design, not the context of their uses.[97] However, since most of the difference in weight between the lighter socketed *pilum* and the heavier tanged types comes from the wooden elements, nearly any possible combination, excluding the uncommonly heavy Renieblas type, would be likely to lie within a fairly limited range for metal-weight. At the low-end, a soldier carrying, for instance, a Šmihel type-3 and a socketed *pilum* would require 575g of worked iron and carry a total mass (including the wooden haft) of 2.065kg; this may serve as a minimum case. Perhaps more typically, a soldier carrying a Smihel type-2 and a socketed *pilum* would require some 665g of worked iron, and carry a total mass of 2.335kg; this may serve as a reasonable median estimate for a 'typical' soldier. At the top end, combining the very heavy Renieblas type with a socketed *pilum* would require 985g of worked iron and have a total mass of 2.665kg; this may serve as an effective maximum case. It seems unlikely that soldiers would have commonly carried the very heavy Renieblas type in pairs, as this would mean carrying some 3.42kg in *pila*.

Beyond the simple metal-weight of the weapons, the apparent disposability of the *pilum*, both noted in the sources and expressed by the archaeological record, is worth noting. Although Plutarch's statement that *pila* at the time of Marius were fitted with a wooden rivet in order to intentionally break is generally considered a misunderstanding, the tendency of *pila* to bend on impact is well-attested both in literary and archaeological sources.[98] The bending action does not appear to have been the primary goal of the design, but rather was a consequence of the long

[97] Assumption that each infantryman carried a *pilum* of each type, e.g. Keppie (1984), 35. Plb. 6.23.8 notes only that there are type types, one heavy and one light, "τῶν δ᾽ ὑσσῶν εἰσιν οἱ μὲν παχεῖς, οἱ δὲ λεπτοί."

[98] Plut. *Marius* 25. Plb. 6.22.4. *Pila* bending in combat: Caesar *De Bello Gallico* 1.25.1-4.

shank, designed itself to penetrate a target behind a shield. The *pilum* would impact the shield, and the point would be driven through by the weight of the heavy wooden haft, with the long shank permitting the point to travel the distance to the target behind the shield.[99] This penetrative function has been successfully reproduced in field experiments, particularly when used with a bodkin head (fig. 4.12).[100] Of course, bent *pila* could be repaired by being hammered back into shape by a smith, although this would have required the expenditure of labor and, if the metal was to be hammered hot, fuel; many *pila* are found bent, possibly discarded rather than being repaired. The quantity of *pila* finds from the Middle and Late Republic, especially compared to the relative scarcity of other weapons, also serves to demonstrate the expendability of the weapon: some 76 examples from Šmihel, nearly 19 from Talamonaccio, 37 from the camps at Renieblas, and another 8 from Caminreal.[101]

The apparent disposability of the *pilum* is remarkable. A pair of *pila*, as noted above, contain almost as much worked iron as a *gladius*. A *gladius*, however, was hardly expendable, a point demonstrated perhaps most vividly in the famous vignette of M. Porcius Cato Licinianus, son of the Censor, struggling to recover his sword, lost in the confusion at Pydna.[102] Part of the difference must have been the symbolism of the weapon; the *pilum* was meant to be thrown away, after all, but the loss of a sword might suggest some dereliction on the part of the soldier, something Cato clearly feared. Moreover, the amount of labor required to craft the weapons was very different; David Sim's experiments suggest a production time for the *pilum* of around 10

[99] Bishop and Coulston (2006), 50-52.

[100] Junkelman, (1986), 186-9. P. Connolly, (2000b).

[101] Schulten, (1929), 205. Vicente *et al.* (1997): 167-199. For a general review of finds, see Connolly (1997).

[102] Plut. *Aem*. 21.1-5. *Cato the Elder*, 20.7. Lendon, (2005), 208.

hours, whereas for a *gladius*, it took 33.3 hours.[103] Nevertheless, a disposable weapon with so much worked iron and such a long production time is a remarkable statement about both the resources expended in Roman warfare and the willingness of the Romans to devote so much to amassing sufficient weapons for that style of warfare.

Hasta

The thrusting spear, the *hasta*, has received comparably less study, at least for the Republic.[104] As Polybius notes, the *hasta*, which Polybius terms δόρυ, was the weapon of the *triarii*.[105] Bishop and Coulston write that "the spearheads of the period are unremarkable and it is impossible to distinguish Roman from allied or enemy weapons," and that the basic types of Roman spearhead shapes continue into the imperial period.[106] This is true in the main, but there are some important reservations to note before moving onto a reconstruction of the *hasta* of the Republic.

Although a typological system for Roman spear-head shapes has been advanced by William Manning for the imperial period, this typology fits the available Republican period evidence imperfectly.[107] Manning, rejecting earlier efforts to type spear-heads by the quality of construction, instead identifies four main size-groupings based on the length of the spear-blade

[103] Sim (2012), 44. The exact times recorded were 600 minutes for the *pilum* and 2,048 minutes for the *gladius*, but production times would have varied considerably.

[104] Feugère (1993), for instance, has no section on the infantry spear in the Republic.

[105] Plb. 6.23.16.

[106] Bishop and Coulston (2006), 53. Note also M. C. Bishop, "The evolution of certain features" in *Roman Military Equipment: The Accoutrements of War. Proceedings of the Third Roman Military Equipment Research Seminar*, ed. M. Dawson, (Oxford: BAR International Series, 1987), 109-39.

[107] W. H. Manning, *Catalogue of the Romano-British Iron Tools, Fittings and Weapons in the British Museum* (London: British Museum Publications Limited, 1985), 160-168.

(excluding the socket) from the spear-heads, dated to the first century CE, excavated from the Roman fortifications on Hod Hill in Dorset, England. Manning distinguishes between both the length of the spear-heads and also their shape, dividing them into tear-drop or 'leaf' shaped spear-heads (see figure 4.13 for example) and square stiletto or 'bodkin' point spearheads (see fig. 4.16 for an example).[108] Group I in Manning's typology comprises spearheads with blades between 4.5 and 6.5cm (total lengths c.7-12.2cm) and typically has teardrop-shaped blades; Group II blades range between 8-10cm (total lengths c.12-16cm) and have teardrop-shaped blades; Group III blades range between 13 and 15cm (total lengths c. 17-22cm), and have long bodkin-point cross-sections; Group IV blades range between 17 and 25cm (total length c.14-34.9cm) in length and tend to have teardrop-shaped blades. Republican spearheads appear to be substantially larger on average; apart from one incomplete example, the spear-heads from Caminreal published by Jaime Vicenti *et al*. range from 14.6 to 44cm in total length.[109] Spear-heads recovered from Numantia generally conform to this size, ranging between c. 15-30cm in total length.[110] As a result, nearly all of the Republican spears reviewed here would fall into Manning's Group II-IV. Thus, while Republican spear-types do, in fact, continue into the Empire, some of the smaller imperial types do not appear to be heavily represented in the Republic.

[108] Manning uses the terms leaf-shaped and stiletto point; here I have opted instead to use teardrop-shaped (as it is less ambiguous) and bodkin point rather than stiletto (as many stilettos had a rounded, rather than squared cross-section).

[109] Vicenti *et al* (1997).

[110] Schulten (1929). See esp. taf. 25d, 26 and 32. Numantia spearheads as measured from scale drawings, Schulten provides no measurements. Cf. also the significant variation in imperial spearpoints, Bishop and Coulston (2006), 77, fig. 38, compared to Republican spear-points, Bishop and Coulston (2006), 54, fig. 24.

Instead, given the greater diversity of types and sizes in the Republic, a broader typology of Republican spearheads based on blade-shape, with particular reference to cross-section, makes more sense and suggests three major types. Type A (examples Fig. 4.13) consists of a teardrop-shaped blade with a strong central ridge, mounted on a circular socket, typically with a concave section when viewed from above. This type is very common in other cultures, forming the majority of Gallic examples, as well as the Macedonian *sarisa*-point (e.g. cat. H7-H12), and the Greek *dory* (e.g. cat. H13, H14 and H15). This type does not dominate to the same degree in Roman sites, but is still very common, with a number of examples from Numantia (cat. R28, R29, R30, R33) and Cáceres el Viejo (cat. R40). Although no weights were published for the examples from Numantia and Cáceres, weighed spear tips of the same size and type from Gallic contexts tend to mass between 100-300g, with most examples falling between 150g and 250g.

Type B consists of teardrop-shaped blades, but without a strong center mid-ridge, instead with either a lenticular (or biconvex) cross-section, or a rhombic (or diamond shaped) cross-section (Fig. 4.14). The lenticular cross-section does appear in Gallic contexts (cat. G30, G31, G34, G35), but it seems to be a minority type there and examples of it, often quite small, are sometimes identified as javelin heads.[111] Variation in Roman examples within this type is relatively wide, as the cross-sections of the spear-tips range from relatively thicker lenticular sections in some cases to other spear-tips that are nearly flat. On the thicker end of the spectrum, a number of examples from Caminreal have lenticular cross-sections, but are rather larger than Gallic examples, with the specimens of this type from Caminreal ranging from 16.2 to 31.6cm in length.[112] Four of these examples (cat. R20-R23) have been digitally reconstructed (see table 4.3

[111] Identification as Javelins, see Lejars, (2013), 162-3.

[112] Vicente, (1997), 167-99.

and fig. 4.15), with masses of 225g, 337g, 292g and 237g respectively, the greater weight resulting from the thicker cross-section of the blade. Four examples from Es Soumâa (cat. R41-R44) found in what is believed to be the tomb of Micipsa along with Roman style mail armor and a *gladius*, show a thinner rhombic cross-section: the two most complete examples (cat. R41 and R42) mass 77g and 73g, while two more damaged specimens (cat. R43 and R44), mass 68g and 66g.[113] Günter Ulbert interprets these spear tips as throwing weapons (*Wurfgeshoßspitzen*), but it seems more likely, given the general similarity of blade-shape, that they are thrusting spears, as the wide leaf-shaped blades are not typical of javelins and would have limited effectiveness as a thrown weapon. Other examples of this type with relatively thin cross-sections include three spear-tips from Cáceres el Viejo (cat. R37-R39).[114] Of the three, the most complete (cat. R92) has a lenticular cross-section like the Caminreal examples, while the remaining two (cat. R37 and R38) seem to have very flat cross-sections, but are badly damaged.

Finally, Type C comprises a set of long, stiletto or 'bodkin' spear-tips, typically with square or narrow rhombic blade cross-sections, which resemble a long spike and are generally not much wider than their sockets. These correspond to Manning's Group III type for the imperial period. The type occurs in Republican contexts both at Numantia (cat. R26, R32, R35, R36), at Caminreal (cat. R24), and Es Soumâa (cat. R45 and R46, Fig.

Table 4.3: Digitally Reconstructed Spear Points from Caminreal

Cat.	Type	Total Length:	Blade Length:	Max Width:	Reconstructed Mass:
R20	B	21.6cm	11.5cm	3.6cm	c. 225g
R23	B	19.5cm	11.6cm	3.5cm	c.237g
R22	B	27.4cm	18.3cm	4.1cm	c. 292g
R24	C	44cm	34.5cm	2.6cm	c. 318g
R21	B	31.6cm	20.4cm	4cm	c. 337g

[113] Ulbert (1979), 333-338.

[114] G. Ulbert, *Caceres el Viejo: Ein spätrepublikanisches Legionslager in Spanisch-Extremadura* (Mainz am Rhein: Verlag Philipp von Zabern, 1985), 105, 224-5, taf. 24.

4.16). The examples from Numantia and Es Soumâa fit together in a range from 17.4cm to 28.4cm, with the Es Soumâa examples being the smallest. The example from Caminreal is very much an outlier with a length of 44cm. Manning speculates of this type during the imperial period that they are "ideally suited" to serve as cavalry lances; however, a long and narrow pointed weapon might be equally as effective on foot.[115] The shape recalls bodkin point arrow-heads, which seem to have been designed to defeat mail armor; it seems plausible to suggest then that this type had a similar purpose. Some Gallic points seem to show experimentation towards this same goal by extending the square-cross-sectioned mid-ridge out beyond the leaf of the spear-blade. The two Es Soumâa examples both have attested weights of 66g, while the largest example from Caminreal has been digitally reconstructed at a mass of 318.5g (see table 4.3).

The other metal element of the spear is the metal-reinforced butt or ferrule. Republican spear ferrules consist of a simple conical metal socket, with finds from Numantia,[116] Caceres,[117] and Caminreal; another 10 are reported from Grad near Šmihel.[118] This socketed type also occurs in Gallic contexts (e.g. cat. G86), but seems to be less common than a second Gallic ferrule-type driven into the base of the spear like a nail, which does not seem to appear in Roman contexts. Two Roman ferrules from Caminreal (cat. R47 and R48) were also digitally reconstructed, yielding a mass of 81.4g and 69.5g respectively. Two ferrules from Es Soumâa (cat. R49-R50) are rather lighter at 47g and 58g respectively, due mostly to a much narrower

[115] Manning (1985), 166. Indeed, the use of such points on horseback may have posed challenges in recovering the spear after a strike.

[116] Schulten (1929), taf. 21.22, 21.24-26, 21.28-31; taf. 26.7-10; taf 32.20-23; 45.23-25.

[117] Ulbert, (1985), 105, 226-7, taf. 25.

[118] Horvat (1997), 108. 10 spear butts are reported, but not discussed or pictured.

cross-section. The Gallic example (cat. G86), somewhat shorter than the Roman examples, has a published mass of 72g.

Because of the wide range in styles and sizes of spear-points, reconstruction of the metal-weight of the *hasta* is an exercise more in establishing a normal range than in pinpointing exact weights. The lightest spears by far are the examples from Es Soumâa, which feature unusually narrow hafts and relatively light tips and butts. This may be a consequence of the Numidian find-context, although the other weapons in the deposit were of identifiably Roman, rather than Numidian, types. The Es Soumâa tips suggest a lower bound to the reconstruction of c. 130g, assuming roughly 80g for the tip and 50g for the ferrule. At the heavy end, the heaviest examples of spear-tips are the very long stiletto point (cat. R24) and the thick leaf-shaped point (cat. R21) from Caminreal, both just above 300g, putting them in the same range as the heaviest Gallic leaf-shaped mid-ridge types. Assuming a relatively heavy ferrule of c. 80g, in order to balance the weight of the tip, we might suggest a maximum metal weight for the *hasta* of around 420g. More typically, it seems the bulk of Roman spear-points would fall between 150 and 300g; accounting for a ferrule, 300g is perhaps a reasonable median case for the reconstruction of the *hasta*. This must be presented as a more tentative estimate, given the wide variety of sizes and shapes of spear-point. A more secure estimate would require measured weights for a relatively larger and more diverse sample of spear-heads than is currently available. A more thorough and extensive typological study of spear-tips from the Roman Republic is clearly called for, but such an effort is beyond the scope of this work.

Scutum

The *scutum*, the characteristic shield of the Roman heavy infantry, was a large and quite heavy horizontal-center-grip body-shield, with a central boss (*umbo*) made of iron. Livy assigns the *scutum* in the Servian constitution to the second and third classes (the first class was to use a hoplite shield) and notes its full-scale adoption by all of the heavy infantry only in the fourth century; however, as noted above, the reliability of this account is doubtful.[119] Representational evidence seems to confirm that the *scutum* first emerged in Italy in the eighth century.[120] The shield spread from Italy into Gaul in the sixth century and into the East in the second, acquiring both chronological and regional variations.[121] This chapter is concerned with the Roman *scutum*, but subsequent chapters will discuss those regional variants.

Polybius describes the construction of the Roman *scutum* in an unusual amount of detail, presumably because it was still relatively unfamiliar to his audience:

> The Roman panoply consists first of a shield (θυρεός), the curved surface of which measures two and a half feet wide (0.74m) and four feet long (1.18m), the thickness at the rim being a palm's breadth (c. 10cm). It consists of two layers of wood glued together with bull's hide glue; the outer surface is covered first with canvas and then with calf-skin. The upper and lower rims are bound with iron in order to resist the downward cuts of swords and wear when resting on the ground. In the center is fitted an iron shell (κόγχος), which turns aside the heavy impact of stones, sarisae (σαρισῶν) and heavy missiles in general.[122]

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[119] Livy 1.43, 8.8

[120] M Eichberg, *Scutum: Die Entwicklung einer italisch-etruskischen Schildform von den Anfängen bis zur Zeit Caesars* (Frankfurt am Main: Peter Lang, 1987), 171-175. Feugère (1993), 76-77.

[121] Feugère (1993), 76-77. On chronological and regional variations, see P. F. Stary, "Urspung und Ausbreitung der eisenzeitlichen Ovalschilde mit spindelfoӥrmigem Schildbuckel" *Germania* 59 (1981a): 286-307.

[122] Plb. 6.23.2-5. ἔστι δ᾽ ἡ Ῥωμαϊκὴ πανοπλία πρῶτον μὲν θυρεός — οὗ τὸ μὲν πλάτος ἐστὶ τῆς κυρτῆς ἐπιφανείας πένθ᾽ ἡμιποδίων, τὸ δὲ μῆκος ποδῶν τεττάρων, τὸ δ᾽ ἐπ᾽ ἴτυος πάχος ἔτι καὶ παλαιστιαῖον — ἐκ διπλοῦ σανιδώματος ταυροκόλλῃ πεπηγώς, ὀθονίῳ, μετὰ δὲ ταῦτα μοσχείῳ δέρματι περιείληται τὴν ἐκτὸς ἐπιφάνειαν. ἔχει δὲ περὶ τὴν ἴτυν ἐκ τῶν ἄνωθεν καὶ κάτωθεν μερῶν σιδηροῦν σιάλωμα, δι᾽ οὗ τάς τε καταφορὰς τῶν μαχαιρῶν ἀσφαλίζεται καὶ τὰς πρὸς τὴν γῆν ἐξερείσεις. προσήρμοσται δ᾽ αὐτῷ καὶ σιδηρᾶ κόγχος, ἣ τὰς ὁλοσχερεῖς ἀποστέγει πληγὰς λίθων καὶ σαρισῶν καὶ καθόλου βιαίων βελῶν. Measurements follow Bishop and Coulston, 61.

A shield found at Kasr al-Harit, in the Fayyum in Egypt provides a partial parallel for this description (fig. 4.17).[123] It is 1.28m long and 0.635m wide, featuring a large central *spina* like the shields depicted on the Altar of Domitius Ahenobarbus. The shield notably lacks any of the metal reinforcements, such as the boss or reinforced rims described by Polybius, and instead has a wooden 'barleycorn' boss that covers the handgrip. The informative value of the Kasr al-Harit shield, however, is somewhat diminished by the lack of a secure find context, making it impossible to securely associate the shield with Roman, Hellenistic, or even auxiliary use. The basic *scutum* design, with local modifications, was adopted in the East as the *thureos* and it appears frequently in Ptolemaic artwork.[124]

The best piece of representational evidence for the shield of the second century is the Paris Relief on the Altar of Domitius Ahenobarbus, which shows three such shields head on, with a fourth viewed in profile. It has been asserted that the shields on the Altar show no evidence of central bosses, thus matching the Kasr al-Harit shield; however, this is likely due to wear.[125] Close inspection of the two best preserved shields on the monument do show raised detailing above and below the core of the *spina* consistent with a boss (fig. 4.18). It seems likely that only the detailing sheltered by the raised ridge of the *spina* escaped being worn down. The third shield is split by a break in the statue-base which makes it impossible to tell if the shield

[123] W. Kimmig, "Ein Keltenschild aus Ägypten" *Germania* 24 (1940): 106-111. The Kasr al-harit shield has been discussed in a variety of places. Note especially, Bishop and Coulston (2006), 61-62. Feugère (1993), 77-78. Eichberg (1987), 43-47, 157-9.

[124] N Sekunda, *Seleucid and Ptolemaic Reformed Armies 168-145 BC*, 2 vols. (Stockport: Montvert Publications, 1994/1995). N. Sekunda *Hellenistic Infantry Reform in the 160's BC* (Lodz: Oficyna Naukowa MS, 2001a). The Hellenistic *thureos* is classified by Eichberg as a Type D *scutum*, Eichberg (1987), 164-166.

[125] Assertion of shields without *umbones*, D'Amato (2009), 25. Cf. Stilp (2001), 79, who does detect *umbones* on the shields.

originally had an *umbo*. Wear makes it difficult to tell if any of the shields originally had an iron rim, although the shield of the second infantryman from the right seems to preserve some trace of the shield of a rim of some sort on the lower left-hand (from the soldier's perspective) side (fig. 4.18).

Other representational evidence is of mixed value. The Osuna relief shows two soldiers carrying trapezoidal shields with clear rims and bosses. There is no knowing if this shape is meant to represent some of the more angular and less curved Gallic and Iberian shield designs, or if it was merely an artistic choice to ensure that the shields fit the space for the relief.[126] The Aemilius Paullus monument also serves to illustrate the type, although damage makes it difficult to discern fine details. Taylor identifies several *scuta*, one held by infantryman (13) in Taylor's numbering, another by infantryman (20), and the back of *scuta* on infantrymen (6), (7), (24) and (27).[127] Damage to the monument means that, while the central ridge of the *spina* and the general oval shape of the shield are clearly visible, finer details, like the presence or absence of iron *umbones*, seem to have been lost.

Archaeological examples of the iron bosses of Roman shields in this period seem to come in two main types, round 'spindle-shaped' shaped bosses and more angular 'butterfly' bosses (fig. 4.19). Both types also appear in Gallic contexts.[128] The former type completely encloses the central bulge of the *spina* in iron, with only a relatively narrow band of metal running around the edges of the boss for attachment onto the shield. Ronald Bockius has documented this type,

[126] D'Amato (2009), 18, fig. 8a.

[127] Taylor (2016), 562-568.

[128] Brunaux and Lambot, (1987), 130-1.

including a fragment of one example from Numantia.[129] The second type of boss, sometimes referred to as a butterfly boss, serves as a central band of iron running horizontally over the center bulge in the *spina*, with wider flanges or wings on either side of the *spina* serving as the attachment points. Two fairly well-preserved butterfly bosses (cat. R52 and R53), dating to the late second or early first century, were recovered from Caminreal and provide a good example of the type.[130] Using digital reconstruction, as with the Šmihel *gladii* above, I have estimated the mass of the two bosses at c. 280g and c. 265g respectively (fig. 4.20). Some Gallic examples of this type (e.g. cat. G101-G106) could be lighter, with complete examples around c. 200g, although two examples in the British Museum (cat. G99 and G100) are actually heavier, at 298g and 335g respectively. The evolution of types observed in Gaul suggests that the more rounded completely enclosed barleycorn type is in fact a development from the earlier butterfly type.[131]

The other metal elements of the shield are the metal rims described by Polybius, and a metal bar reinforcing the handgrip. Because these elements would have consisted of relatively thin metal plates and rivets, they are difficult to identify, especially as fragments, and no confirmed examples from the period have yet come to light.[132] Examples from the early imperial period offer more insight.[133] Shield rims from the imperial period have been noted from Aislingen, Spettisbury, Carnuntum and Vindonissa; the rims could be both plain edging strips or

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[129] R. Bockius, "Ein Römisches Scutum Aus Urmitz, Kreis Mayen-Koblenz: Zu Herkunft und Verbreitung Spindelförmiger Schildbuckelbeschläge im Gebiet Nördlich der Alpen" *Archäeologisches Korrespondenzblatt* 19 (1989): 269-282. Eichberg also notes this type, Eichberg (1987), 47-49.

[130] Vicenti et al. (1997), 195-6.

[131] Brunaux and Lambot (1987), 130. Feugère likewise associates the round *umbo*, distinct from the 'winged' type, with the imperial period, Feugère (1993), 87.

[132] Manning notes this difficulty, Manning (1985), 147.

[133] Bishop and Coulston (2006), 92. Sim and Kaminski (2012), 148.

have semi-circular tabs for attachment. In either case, they were attached by being bent over the rim and then nailed into place (fig. 4.21).[134] Two broken off examples (cat. R54, R55), both in copper-alloy, in the National Museum of Wales suggest a width for the metal strip of c. 2cm, and a thickness of c. 0.5mm.[135] To cover the entire top or bottom rim of a shield, as Polybius suggests, such a rim would need to be c. 80cm long, suggesting a total weight for a single reinforcing rim of c.60g.[136]

The potential for variation is greater for the handgrip, as the evidence for handgrip reinforcements for the Middle Republic is very limited. Handgrips on imperial period shields often include d-sectioned metal bars of significant size and thickness (fig. 4.22).[137] The handlebars of the imperial period are often quite long as well, running from 60-80cm, in contrast to the much smaller handles that appear on the Aemilius Paullus monument. These seem cover the gap in the main shield structure in turn covered by the *umbo*, although the damage and wear to the monument make it impossible to be certain.[138] Examples of the imperial period type from the National Museum of Wales (cat. R56 and R57) are 16 and 15mm wide, with thicknesses c. 6 and 8mm respectively; the examples are both broken off with preserved lengths of 120 and 220mm.[139] At a length of c. 70cm, such a handlebar, with a D-shaped or half-cylinder cross-

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[134] Bishop and Coulston (2006), 92, 137. Sim and Kaminski (2012), 148.

[135] Evan Chapman, *A Catalogue of Roman Military Equipment in the National Museum of Wales* (Oxford: Archaeopress, 2005), 105-6.

[136] Assuming a rim 80cm long, 2cm wide, 0.5mm thick, in iron with no tabs. Tabs and nails might add significant weight.

[137] Bishop and Coulston (2006), 92-3, 137-8. Manning (1985), 147. Chapman (2005), 105. For a reconstruction of the reinforcement system based on the Dura-Europus shield, see Connolly (1981), 231.

[138] Note especially Taylor (2016), 562, figure (6). On the length of imperial handlebars, note Manning (1985), 147.

[139] Chapman (2005), 105.

section, might mass c. 80g in iron. However, the shields of the early imperial period largely lack the vertical wooden reinforcing central ridge, the *spina*, of the Republican period shields, and it seems possible that the larger and more robust horizontal handlebar served as a compensating structural reinforcement.[140] If this were the case, we should not expect the more robust imperial-style handlebars to be typical during the Republic.

Another alternative is the relatively lighter and smaller handlebar-strips used in Gallic shields (cat. G107-G113), which consist of a thin metal plate 1-3mm thick, 12.5 – 16.3cm long and c. 1cm wide with small wings for the rivets on each end.[141] These far lighter reinforcements range from 6.3 to 24.5g in weight, and seem to be exclusively made in iron. Three metal strips (cat. R58, R59 and R60) found at Numantia and classified as iron fittings of unknown purpose are of the right rough size and shape to be this sort of hand-grip, but such an identification is highly uncertain at best. The handle reinforcement and boss in Gallic shields were often joined elements, with rivets passing through the boss and handle, binding the two together. A fragment of a butterfly boss with the handle still attached in this way from the Nouveau Musée Bienne illustrates the design (Fig. 4.23), with a single rivet passing through the 'wing' of the boss (the rest of the boss is lost) to connect to the handle.[142] The design connection, then, between the 'butterfly' boss and the Gallic style handle would tend to argue against the use of long reinforcing bars in the Republic. Without a robust sample of surviving Republican handlebars, it is impossible to be sure which forms were used or were most common. However, it seems likely, given the depictions of the *scutum* from behind on the Altar of Domitius Ahenobarbus and

[140] Connolly (1981), 231-3. Junkelmann (1986), 175-6.

[141] Lejars (2013), 170.

[142] Lejars (2013), 170.

the Aemilius Paullus Monument, that the handles of this period were typically of the shorter, Gallic variety, paired with the typical Gallic-style 'butterfly' boss.

To reconstruct the metal-weight of the shield, then, requires combining the metal elements. A relatively light, Gallic style handle, a butterfly boss and rims on the upper and lower edges of the shield suggest a median case around 420g of metal.[143] A minimum case, assuming a boss along the lines of some of the lighter Gallic examples, might suggest a minimum around c. 335g. An upper-case, assuming the heavier imperial-style reinforced handle might suggest a maximum of c. 500g metal weight.[144]

Parma – Cavalry and Light Infantry Shields

In Livy's usage, the shield carried by both the cavalry and the *velites* was called *parma*.[145] Notably, for the shield of the cavalry, he does not use *clupeus*, the Latin term corresponding to the Greek *aspis* and denoting the hoplite's traditional double-strap-gripped round shield, although he does use *clupeus* when he means specifically to imply a hoplite shield.[146] However, the description offered by Polybius implies that he saw these shields as clearly distinct; for the shield of the *velites*, he gives a transliteration of the Latin *parma* (πάρμη), whereas the shield of the cavalry he calls *thureos*, connecting the cavalry shield more closely

[143] Assuming 280g of iron for the boss, 60g each for the rims, and c. 20g for the handle.

[144] Minimum case: 120g iron rim as before, c. 14g for the handle (e.g. cat. G108), c. 200g for the boss (e.g. cat. G102 or G103). Maximum case: 120g iron rim, c. 500g for the handle with reinforcing bar, c. 300g for the boss (e.g. cat. G99, G100).

[145] Of the cavalry: Livy 2.6.9, 2.20.10. Of the *velites* Liv 31.35.6. 38.21.12.

[146] Of a Carthaginian shield, Livy 25.39.13. Of early Roman hoplite-armed soldiers, Livy 1.43.2.

with the shield of the heavy infantry, which he also calls *thureos*.[147] The evidence for both shields during the Republic is probably too limited to allow for a confident reconstruction, but some basic design considerations may be noted.

The Roman cavalry shield was probably a center-grip round or oval shield with a metal central boss, more like the *scutum* than the Greek *aspis* (Latin, *clupeus*). Polybius describes the older Roman cavalry shield as shaped like a round boss cake (τοῖς ὀμφαλωτοῖς ποπάνοις), but he then notes that this shield, made of ox-hide, was not very useful and at some point was replaced.[148] Polybius' comment about the adoption of Greek-style cavalry spears has often been taken to mean that he intends the reader to understand that the Romans have adopted Greek style shields as well, but he does not actually say this. Instead he notes, "So too (ὁ δ᾽ αὐτὸς λόγος) concerning the *thureos* (περὶ τῶν θυρεῶν), for being solid and firm are of use both defending and attacking."[149] As noted, *thureos* is the term Polybius uses for the Roman infantry shield, without any direct connection between it and Greek shields, unlike in his previous statement about spears. The ὁ δ᾽ αὐτὸς λόγος could refer to the adoption of Greek fashioned weapons, but also to the adoption merely of stouter and more durable weapons in general.

In practice, the evidence argues strongly against the full-scale adoption of Greek-style cavalry shields. There is some representational evidence of the Greek double-strap-gripped *aspis* in use by Roman cavalry, although it is important to be on guard against overly Hellenized depictions of Roman soldiers, especially in Greek contexts.[150] The Roman cavalryman on the

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[147] Plb. 6.21.1, 6.25.6.

[148] Plb. 6.25.7.

[149] Plb. 6.25.10. ὁ δ᾽ αὐτὸς λόγος καὶ περὶ τῶν θυρεῶν: καὶ γὰρ πρὸς τὰς ἐπιβολὰς καὶ πρὸς τὰς ἐπιθέσεις ἑστηκυῖαν καὶ τεταγμένην ἔχουσι τὴν χρείαν.

[150] D'Amato (2009), 49.

Lacus Curtius relief, however, appears to carry a fairly small round, center-grip shield with a circular boss (fig. 4.24).[151] Most importantly, Roman cavalry shields from the Empire, far better attested than for the Republic, were consistently center-grip shields, usually round or oval (though sometimes hexagonal or rectangular).[152] A copper-alloy round domed boss found at Numantia (cat. R51) may belong to this type, as it roughly matches the shape suggested by the Lacus Curtius monument.[153] No measurements are provided for the boss, but the scale drawing suggests a metal disc of approximately 15cm in diameter, raised in the center. If the boss was made in bronze (copper-tin with 10% tin) at a thickness of 1mm, it would have a mass c. 140g.

The *parma* of the *velites* is even more difficult to suggest a reconstruction for, since the *velites* as a formation did not survive into the better documented imperial period. Livy notes that the shield is three Roman feet (c. 88cm) across.[154] The size matches fairly well with the apparent size of the cavalry *parma* on the Lacus Curtius monument, suggesting that the two shields may, in fact, be functionally the same, as implied by the single word in Latin, *parma,* being used to describe both. It is generally assumed from the term *parma* that the shield is round, yet it is worth noting that the *parmula* of the *thraex* is often depicted as rectangular. At present, however, the evidence permits little in the way of confidence as to the construction and form of the *velites*' *parma*. The most likely case is that the shields of the *velites* and the *equites* were functionally the same, but this is far from certain.

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[151] P. Connolly (1981), 133.

[152] I. P. Stephenson & K. R. Dixon, *Roman Cavalry Equipment* (Stroud: Tempus, 2003), 33-42.

[153] Schulten (1929), 210, taf. 26.22

[154] Livy 38.21.12.

Armor

Body Armor – Types

Unlike Roman weapons, where one or a few types tend to predominate, Roman body armor was varied enough for the differences to be acknowledged in the ancient sources. Polybius notes that the cavalry and the wealthy infantrymen wore mail armor, a θώραξ ἁλυσιδωτός, literally a 'chain cuirass,' which in Latin is generally rendered as the *lorica hamata*, a 'hooked armor,' referring to the individual armor rings hooked into each other.[155] In contrast, the poorer infantry wore what Polybius calls a καρδιοφύλαξ, literally a 'heart-protector' which in Latin was a *pectorale*.[156]

It is also likely that at least some of the Romans and their allies wore the *lorica squamata*, or scale armor, although evidence for this armor from the Republic is very limited. Plutarch reports Lucullus wearing impressive armor of iron scales (θώραξ σιδήρεος φολιδωτός) at Tigranocerta in 69 B.C., although he places some emphasis on its unique and impressive nature, rather than presenting it as typical.[157] A single coat of doubtful origin purported to have been assembled from pieces found at Lake Trasimene is at the Royal Ontario Museum, and is noted by Robinson, although Bishop and Coulston express doubts as to the dating of this armor, which is by no means secure.[158] Although evidence for scale armor from the imperial period is extensive, Bishop and Coulston note that no examples of Republican armor scales from secure contexts have been recognized, and the representational material from the period does not depict

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[155] Plb. 6.23.15.

[156] Plb. 6.23.14.

[157] Plut. *Luc.* 28.1.

[158] Robinson (1975), 153-4. Bishop and Coulston (2006), 64.

it.[159] Although it seems likely that at least some Romans wore the *lorica squamata* during this period, the evidence does not seem sufficient to consider it a common or typical body-armor type.

Somewhat more complicated is the question of the use of textile armor, either of linen or leather, as a primary armor for the heavy infantry. It is important here to make a distinction between body armor where the primary or sole component is textile, such as the Greek *linothorax* (discussed in the following chapter), and situations where metal armor is supplemented by a textile undergarment, such as an arming jacket or the Roman *thoracomachus* or *subarmalis*, which will be discussed later in this chapter.

In a survey of Roman arms and armor, Raffaele D'Amato has recently argued for a far greater prevalence of textile armor than is generally supposed, but the evidence he presents is less than convincing.[160] In a reconstruction, he refers to Roman linen armor as a *thorax linteus*, but in the sources for the Republic this term seems to be used to refer only to non-Roman armors. For instance, the term is used by Livy of the armor of the Etruscan king Lars Tolumnius and by Cornelius Nepos in reference to the reforms of Iphicrates of Athens, suggesting that *thorax linteus* or *lorica linteus* were simply handy translations into Latin of the Greek θώραξ λίνεος or λινοθώραξ, suitable for describing what was, in fact, a foreign armor-type, rather than a home-grown term of art for a common type of armor.[161] D'Amato cites several references from

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[159] For evidence of scale armor from the imperial period, see Bishop and Coulston (2006), 95. Robinson (1975), 153-163. On the lack of evidence from the Republic, see Bishop and Coulston (2006), 64.

[160] D'Amato, (2009).

[161] D'Amato (2009), 8, pl. Ib. Livy, 4.19.2-20.7. Nepos, *Iph*. 1. The phrase is used by Suetonius of an armor worn by Galba (Suet. *Galba* 19), but in the context of armor against assassins rather than battlefield armor. The ancient Greek terminology for the armor is unclear (see following chapter) but both θώραξ λίνεος (Hdt. 2.182; 7.63) and λινοθώραξ (Homer, *Illiad* 2.529; 2.830; Strabo 3.3.6; 13.1.10) seem common enough to form the basis for the natural translation to either *lorica linteus* or *thorax linteus*.

the ancient sources to support the assumption of widespread use of textile armor in the Republic, but all are problematic. In the first, Caesar notes that when his men, engaged in digging defensive works, were continuously harassed by missile troops, they made “tunics and coverings either of felt, quilt or hide.”[162] But this is clearly a reference to *ad hoc* protections rather than battlefield armor, and Caesar refers to these garments as *tunicas aut tegimenta* rather than as *loricae* or *thoraces*. It seems more likely that Caesar’s soldiers were out of their normal, probably mail, armor in order to do the heavy labor of fortification, and were forced to improvise protections that were light enough to allow them to continue to work. D’Amato also points to a passage of *In Pisonem* where Cicero notes L. Calpurnius Piso Caesonius as having collected cattle from his province of Macedonia for leather for a manufactory of arms (*armorum officina*), but no direct connection in the passage is made to armor specifically, and leather would have been useful for a variety of functions beyond leather armor.[163] Finally, D’Amato also notes Plutarch’s description of the battle of Carrhae, in which the Parthians’ arrows pierced armor both “hard and soft” (ἀντιτύπου καὶ μαλακοῦ). However, Plutarch has just made a distinction between Crassus’ light armed (ψιλοὺς, unarmored, bare) troops and his heavy infantry (ὁπλίταις). It is thus presumably the “bare” troops who have the “soft” coverings, contrasted with the heavy infantry who have the “hard” coverings, while Plutarch notes that both are vulnerable to the storm of Parthian arrows, at least once the disordered light infantry disrupt the formation of the legion.[164]

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[162] Caesar, *Bel Civ*. 3.44.6. atque omnes fere milites aut ex coactis aut ex centonibus aut ex coriis tunicas aut tegimenta fecerant, quibus tela vitarent.

[163] D’Amato (2009), 39. Cic. *In Pisonem* 36.87. Leather was used in the facings of shields and in cavalry equipment, for instance.

[164] Plut. *Crass*. 24.4.

The representational evidence for extensive Roman use of textile armor is also problematic, as most of the examples in artwork appear to have heavy Greek influence, and thus may not accurately depict Roman equipment. D'Amato cites the Glanum reliefs from the Julian Mausoleum in Saint-Rémy de Provence as a primary example, but the monument depicts Roman soldiers not only with what may be Hellenistic-style textile armor (although mail over a *thorocomachus* with *pteryges* is also a possible interpretation), but also shows the Roman soldiers with Hellenistic 'Phrygian' type helmets and deeply dished round shields with a *porpax* and *antilabe* grip, rather than the Roman center-grip style (fig. 4.25).[165] In short, the monument shows the Roman soldiers equipped as hoplites or *hippeis*, with Greek armor, helmets and the Greek *aspis* shield, rather than in typical Roman kit, perhaps because of the monument's own location outside of Italy and the close proximity of Massalia. Likewise, a second relief D'Amato presents, "from an unknown monument" showing a supposedly Roman soldier in a *linothorax*, presents the soldiers as wielding what appears to be a shorter Greek *xiphos* (see next chapter) and an *aspis*, rather than a *gladius* and *scutum*.[166] In both cases, the typology of the shield provides a handy barometer as to the reliability of the depiction, because the Roman *scutum* is so distinctive compared to the Greek *aspis*: a sculptor who is not able, or does not care to represent the distinctive Roman shield accurately, is unlikely to be a reliable source for the rest of the military equipment either. It seems likely enough that some Roman soldiers might have adopted forms of textile or leather armor in Hellenistic style. However, as with scale armor, the evidence seems insufficient to support the argument that such armor was widespread among either the cavalry or heavy infantry in the absence of direct attestation by textual sources.

[165] D'Amato (2009), 10-11.

[166] D'Amato (2009), 39.

Body Armor - Prevalence

So the question that remains is the balance between the two more common kinds of armor noted by Polybius, which is to say how many soldiers might normally have worn the Italic pectoral or the *lorica hamata* in battle. Although it is likely that there was a ratio between these armors that was probably fairly consistent between legions, that ratio, at least estimated with any precision, is lost to us. No such figure is preserved in the literary evidence, and there are multiple distortions in the rates of archaeological preservation and discovery. However, it is possible, by examining the evidence that does exist, to ascertain some sense of the range in which such a ratio must have existed, as an exercise more in eliminating wrong answers than arriving at the right one. This section, then, will present a review of the surviving evidence for the prevalence of Roman armor, focused on the common soldiers of the heavy infantry, before suggesting a range of possibilities consistent with that evidence.

Polybius connects the distinction between the *lorica hamata* and the pectoral to census class, which provides a tempting way to extrapolate the prevalence of the armors. He notes that the common soldiers (οἱ πολλοί) wear the pectoral, while only those rated above 10,000 *drachmae* wear the *lorica hamata*.[167] The use of οἱ πολλοί to describe those wearing the pectoral certainly seems to imply they were in the majority even in Polybius' day, but what it less clear is by how much. His figure for 10,000 *drachmae* corresponds suspiciously well, however, with the figures offered by Dionysius of Halicarnassus and Livy for the division between the first class of the *pedites*. Livy gives the 80 centuries of the first class as having a property rating of 100,000

[167] Polybius 6.23.14.

asses, while Dionysus reports the property rating as 100 *minae*.[168] Assuming that a *mina* was worth 100 *drachmae*, Dionysius' valuation for the first classes matches perfectly with Polybius' demarcation of which soldiers wore the *lorica hamata*.[169] Livy's figure of 100,000 *asses* also falls into line, assuming he is using the sextantal *as*.[170] The correspondence makes sense, given that both Livy and Dionysius note that the first class, in contrast to the lower classes, were expected to provide themselves with a full panoply including a cuirass, which was not required of the lower classes.

However, something clearly must be said about the anachronism of the passages and the problems with attempting to compute directly the equipment of a legion on this basis. Both Livy and Dionysius place the establishment of this system in the sixth-century reign of the legendary Servius Tullius; however, the sextantal monetary standard that Livy bases the so-called Servian Constitution on did not exist until 211.[171] As Robert Ogilvie notes, this is a "pious fraud," and both constitutions, in their essential details, must be anachronistic reconstructions.[172] Moreover, the division of centuries appears to have changed by Cicero's day, with *De Re Publica*'s brief and somewhat enigmatic description of the assembly noting only 70 centuries of the first class, compared to 100 centuries of the lower classes of infantry.[173] Finally, the centuries of the *comitia centuriata* did not reflect the balance of the Roman citizen population; indeed, this was

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[168] Dionysius, *RA* 4.16.2. Livy 1.43.1.

[169] *Mina* to *drachma* conversion: Arist. *Ath. Pol*. 10.2.

[170] R. M. Ogilvie, *A Commentary on Livy: Books 1-5* (Oxford: Clarendon press, 1965), 166-7.

[171] Crawford (1974), 43, 596. Ogilvie (1965), 166-7.

[172] Ogilvie, 167-8. A. Lintott, *The Constitution of the Roman Republic* (Oxford: Clarendon Press, 1999), 55-7.

[173] Lintott (1999), 56-7. Cic. *De Re Publica* 2.39.

the entire point, as Cicero notes in *De Re Publica*.[174] Dionysius, somewhat optimistically, claims that soldiers were levied according to centuries such that the wealthy, being split into fewer centuries, were forced to serve more often. Andrew Lintott is skeptical that this system would have still been in force in Rome in the Middle Republic, if it had ever existed at all.[175] Moreover, the property qualifications, especially the 'floor' beneath the fifth class of infantry, may not have been stable during the third and second centuries, although, as John Rich notes, the evidence for potential reductions in the census requirements is deeply uncertain.[176] It is probably impossible to salvage a clear history of the census requirements.

None of this is to say that the evidence provided by Polybius' figure of 10,000 *drachmae* for the requirement to provide a *lorica* is entirely useless, even if it is deeply fraught. Even though it is impossible to reconstruct the exact ratio of infantry equipped with the *lorica hamata*, this sort of evidence can give us a sense of a reasonable range for conjecture. Livy and Dionysius represent the first class as 80 out of the 170 centuries of infantry, or 47%, while Cicero's somewhat different number suggest that only 70 of the 170 centuries, or 41%, would have been of the first class. While not all centuries were of the same size, some weight ought to be given to the ideal expressed by Dionysius that military service was evenly distributed by centuries. Even if this ideal was never fully reached in practice, it seems reasonable to suppose that the army might have, in a very rough way, looked like the balance of the *comitia centuriata*.

Moreover, there is considerable evidence to suggest that the *lorica hamata* was the armor predominantly associated with the Romans by their rivals, particularly in the East. In a fragment

[174] Cic. *De Re Publica* 2.39.

[175] Dionysius *RA* 4.19.2. Lintott (1999), 56.

[176] J. W. Rich, "The Supposed Manpower Shortage of the Later Second Century B.C." *Historia* 32.3 (1983): 287-331.

preserved only partially, but "reasonably completely" by Athenaeus, Polybius describes a Seleucid military parade in which there are five thousand men "trained [or equipped] in the Roman manner, having mail cuirasses."[177] Significantly, mail armor then serves as the signifier to back up Polybius' claim that these five thousand men "in the prime of life" were organized Roman-style, although this unit is clearly an elite one (it leads the parade), and so may have been given access to very high-status armor. But the broader evidence for Roman-style Hellenistic military reform in the 160s seems to reinforce the primacy of mail armor. Nicholas Sekunda supplies a number examples in period artwork from the East of soldiers bearing Roman equipment, many of whom wear mail.[178] For instance, the Stele of Salmas shows the deceased carrying a *thureos*, a shield patterned off of the Roman *scutum*, and wearing mail armor (Fig. 4.26).[179] Likewise the stele of Dioskourides of Balboura, which shows the figure with a *thureos* and possibly a *gladius*, and again in mail armor.[180] By contrast, none of the various forms of the pectoral, either the rectangular anatomical, single or triple-disk styles, seems to appear in Hellenistic contexts as a result of this Roman-style military reform trend. So while Polybius notes that the οἱ πολλοί of his day still wore the cheaper pectoral, it seems that the East strongly associated Roman-style warfare with mail armor.

The surviving representational evidence for the equipment of the Middle and Late Republic, although admittedly very limited, argues very strongly for a relatively high prevalence

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[177] Plb. 30.25.3. Sekunda (2001a), 87. καθηγοῦντό τινες Ῥωμαϊκὸν ἔχοντες καθοπλισμὸν ἐν θώραξιν ἁλυσιδωτοῖς, ἄνδρες ἀκμάζοντες ταῖς ἡλικίαις πεντακισχίλιοι: μεθ᾽ οὓς Μυσοὶ πεντακισχίλιοι. Sekunda takes καθηγοῦντό here to mean "equipped," but it seems like reading it as "trained," "organized," or "led" would be just as probable. It seems likely to me that Polybius intends all of these meanings.

[178] Sekunda, (2001a). Sekunda, (1994/5).

[179] Sekunda (1994) vol 2, 73, fig. 67.

[180] Sekunda (1994), vol 2, 73, fig. 71.

of the *lorica hamata*. Mail appears to have been the standard armor used to depict common Roman soldiers in the Middle and late Republic. All four of the common soldiers on the Altar of Domitius Ahenobarbus, along with the one *eques*, wear the *lorica hamata*. Likewise on the Pydna monument, all of the figures which Taylor identifies as Roman with traces of armor still visible wear the *lorica hamata*.[181] A first century relief from Osuna, Spain, shows two Roman soldiers, one in mail and the other in a tunic which may be a *subarmalis*.[182] In contrast, although the pectoral is absent from artwork of the second century, it is prominent in earlier periods, back to the sixth century warrior of Capestrano statue.[183] Michael Burns notes that the rectangular pectoral described by Polybius first appears in artwork in Campania, Lucania and Apulia during the fourth century, and seems to derive from the Samnite triple-disk cuirass.[184] Burns associates the introduction of this armor to Campania with the Samnite wars.[185] By the third century and second centuries, however, the appearances of the pectoral and related armor-forms in the representational evidence thin to total silence. That said, we should be on guard against overinterpreting this lopsided representation in artwork, as the strong tendency in ancient art is to disproportionately depict high status soldiers and equipment, meaning that the *lorica hamata* is likely to be oversampled in surviving artwork.

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[181] Taylor, (2016): 559-576. Taylor does not several figures apparently on the Roman side wearing breastplates, but concludes these are *socii*.

[182] D'Amato (2009), 18. Robinson (1975), 164.

[183] For the high visibility of the pectoral in earlier periods, see P. Connolly (1981), 91-111.

[184] M. T. Burns, "The Homogenisation of Military Equipment Under the Roman Republic" in *Romanization? Digressus supplement 1* (London: Institute of archaeology, University College London, 2003), 60-85.

[185] Burns (2003), 73.

The archaeological evidence, however, tends to reinforce the impression that the balance between the native Italic pectoral and related armor types and the *lorica hamata* seems to have begun to shift decisively in favor of the *lorica*. Burns notes 19 examples of the rectangular cuirass and 38 examples of the triple-disk cuirass dating to the fifth or fourth century, with examples of the rectangular cuirass dated as late as the 330s and 320s.[186] After this, however, the evidence of the armor begins to dry up, although Polybius' testimony confirms that it was still in common use in his own day.[187] In contrast, as noted below, the number of armor ring finds likely from fragments of the *lorica hamata* increases over time, with a relatively small number of such finds from the Middle and Late Republic. These nevertheless outnumber finds of pectorals from the same period, even though we might expect, based on the reparability and reusability of mail, the armor to be preserved at a lower rate. The preserved examples of fragments of the *lorica hamata* increase greatly in the Early Empire, while, by that point, the pectoral has vanished completely from the archaeological record. Thus, the archaeological evidence seems to confirm the picture suggested by the representational evidence that the prevalence of Italic pectorals and related armor types markedly declined in the second century. By the era of the civil wars these Italic armor-types were no longer major components of the kit of Roman heavy infantry.

The question then remains as to how to incorporate this evidence into a reconstruction that is concerned with the resource intensity of the legion as a whole. To incorporate the distinction between those infantrymen who were *loricatus*, and those who were not, into the maximum and minimum case framework so far established could have the unwelcome side

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[186] Burns (2003), 72.

[187] Plb. 6.23.14.

effect of overwhelming more subtle variations in equipment weights, since the gap between the metal-weight of a high-quality *lorica hamata* and a basic pectoral is quite large. Instead, a range of potential prevalence for body armor will be accounted for as a separate variable in the reconstruction, thereby generating, maximum, minimum and median cases for a range of assumptions about how common the *lorica hamata* and the pectoral were. In this case, four potential cases will be computed in the qualitative analysis section. The first will assume, somewhat pessimistically, that only one-third of all Roman heavy infantrymen wore the *lorica hamata*. This figure seems like a prudent lower-extreme; it is well below what the census figure and representational data would lead us to expect, but it fits with Polybius' statement that the *hoi polloi* still wore the pectoral. The second will follow the implications of Polybius' assigned wealth classification, matching the balance of centuries in the *comitia centuriata*, and assuming that 41% of Roman heavy infantrymen wore the pectoral. The final two cases will be set at an even one-half distribution, and finally at a distribution where two-thirds of Roman heavy infantry wore the *lorica hamata*. These latter two cases should be taken to represent likely stages, perhaps in the mid-to-late second century, in the process by which the armor of the legion was standardized around mail armor.

Lorica Hamata – Reconstruction

No complete Roman *lorica hamata* survives from any period, but the nature of mail armor makes confident reconstruction possible if we combine the shape of the armor in representational evidence with the armor rings which do survive. It is particularly important in this case to reconstruct carefully from ancient evidence, as weights for body armor of all types suggested in scholarship are often far too high, based perhaps on outdated assumptions about the weight of body-armor in the ancient world. Connolly suggests between 12 and 15kg for the weight of the *lorica hamata*, a figure subsequently repeated by Feugère, which as will be shown, is far too heavy.[188] This tendency is not limited to mail armor; Eero Jarva's figures for the weight of Greek breastplates at between 4kg and 8kg are also likely far too heavy.[189] As a result, especially with body-armor, it is important to root all reconstructions solidly in the ancient evidence, in order to avoid grossly inaccurate 'estimates' of weight.

The best source of representational evidence for the *lorica hamata* remains the Paris frieze of the Altar of Domitius Ahenobarbus, which shows five soldiers, four heavy infantry and one *eques*, wearing variations of the armor. In all of the figures on the monument, the armor is represented as what would have been known in the Middle Ages as a hauberk, a tunic of mail extending to just above the knees, with little or no sleeves. All four of the infantrymen's armor shows the distinctive pattern of 'shoulder doubling,' where a second layer of mail covers the shoulders, which would otherwise have been particularly vulnerable to downward strokes from La Tène swords or the Iberian falcata (see chapter 6). It is clear, to judge by the second soldier from the left on the frieze, that the shoulder doubling is in addition to the mail shirt, rather than being a pull-over clasp in the fashion of the *linothorax* (see chapter 5), meaning that areas covered by shoulder-doubling would, in fact, be covered by two overlapping layers of mail armor (fig. 4.27). This can be seen even more clearly from the statue of the Vacheres warrior, where a relatively short sleeve protrudes from beneath the shoulder-doubling (fig. 4.28).[190] Hilary and John Travis note two distinct styles of shoulder doubling. In the former, which they

188 Connolly, (1981), 231. Feugère (1993), 74.

189 Jarva (1995), 135. For reconstructions of Greek styles of breastplates, see the following chapter.

190 Connolly (1981), 123. Robinson (1975), 165. H. Travis and J. Travis, *Roman Body Armour* (Stroud: Amberley Publishing, 2011), 69.

term the ‘Gaulish-style,’ the doubling is provided by a ‘cape’ of mail which extends over the shoulders and is fashioned in front. In the latter, which they term the ‘Greek’ style, more popular in the Late Republic and early Empire, the shoulder protectors are a pair of separate mail coverings, tied down to the body of the mail.[191] A badly corroded iron-age British mail shirt from Kirkburn suggests that the shoulder attachments on some mail shirts did function in the fashion of the shoulder-guards of the Greek *linothorax*; however, this method does not seem to have been common in Roman armor.[192]

In addition to the basic shape of the *lorica hamata*, reconstruction requires a sense of the range of sizes for the armor rings used. The fabric of Roman mail armor is produced by joining metal rings, either of iron or copper-alloy, in a four-in-one pattern, where each ring is joined to four others.[193] The rings are closed by one of three methods: they are either solid (stamped as a single ring or fire-welded together from a wire), closed with a rivet, or have the ends simply abutted without any closure device.[194] Abutted or riveted rings could be alternated in rows with solid rings, since only one of the two rings in any join needs to be opened and closed during construction. The combination, in alternating rows, of riveted and solid rings is likely to produce the strongest armor and is generally the most common type in Roman examples.[195] In contrast, abutted mail is markedly inferior, and uncommon in Roman examples from any period, but easier to make (and consequently common in modern reproductions). Rings with smaller

[191] Travis and Travis (2011), 71.

[192] I. M. Stead, *Iron Age Cemeteries in East Yorkshire: Excavations at Burton Fleming, Rudston, Garton-on-the-Wolds, and Kirkburn,* (London: English Heritage, 1991), 54-6.

[193] Sim (1997), 359-371. Sim & Kaminski (2012), 124.

[194] Types of ring-closure: Sim & Kaminski (2012), 123.

[195] On the strength of riveted mail, Sim (1997), 359.

diameters and thicker wires would lead to the creation of higher quality armor with a greater degree of resistance to penetration, but smaller rings would also require the use of more rings to create a complete coat. The potential difference in protective quality is greater than it may at first appear, as smaller high-quality rings will not sit perfectly flat against each other, but end up at an angle due to the ratio between their thickness and diameter; hence the mail presents more material to resist an incoming strike. The smaller internal diameters of smaller rings also makes it more difficult for weapons to wedge into the gap and split the ring open. As noted below, the use of smaller rings increases the total weight and metal requirements of a single *lorica*.

Preserved examples of armor rings from any period are generally scarce, as mail was relatively easy to repair and reuse, making preservation in the archaeological record infrequent.[196] Still, a handful of ring finds are known from the Republic. A scrap of mail with 123 joined copper-alloy armor rings was found in Lager III at Numantia (cat. R61), between 0.8 and 1.1cm in diameter, with the metal wire comprising them approximately 1mm thick.[197] A second set of 48 rings, also in copper-alloy, unmeasured but of roughly the same size in scale drawings, were found loose in the same context by Schulten.[198] A fragment of mail is also reported from the Tomb of the Scipiones in Rome, but the measurements for those rings have not been published.[199]

Because of the relative scarceness of preserved examples of Republican rings, it is worth also considering the evidence from the imperial period in order to gauge the normal size and

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[196] Bishop and Coulston (2006), 63.

[197] Schulten (1929), 210, taf. 26.20

[198] Schulten (1929), 209, taf. 24.20.

[199] A. M. Liberati, "L'esercito di Roma nell'età delle guerre puniche. Riconstruzioni e plastici del Museo della Civiltà Romana di Roma" *JRMES* 8 (1997): 25-40.

construction of armor rings. David Sim notes a set of six gilded copper-alloy armor rings from Ouddorp, Leiden (cat. R62). These are some of the smallest armor rings, with an outside diameter range of 3.062 to 3.197mm, inside diameters from 2.123 to 2.268mm, and a wire-thickness ranging from 0.51 to 0.63mm.[200] Sim also presents another set of ten rings, otherwise unpublished, dating to the second century C.E. from Caerleon, with outside diameters from 6.6-7.8mm, inside diameters from 4.4-5.4mm, and wire thickness from 0.8-1.4mm.[201] Another set of iron rings from Thorsberg dates between 150 and 250 C.E.. Two of the rings, pictured by Sim and Jamie Kaminski, appear to be between 3.8 and 4.2mm in diameter, based on the scale image (fig. 4.29).[202] Sim and Kaminski also picture in the same volume a concretion of rings from Arbeia with an outside diameter of 7.5mm, and a thickness of 1.3mm, closer to the measurements of the Numantia rings (fig. 4.30).[203] In addition, a large number of ring finds from a legionary fortress in Usk, Wales, currently housed in the National Museum of Wales, have been measured and catalogued by Evan Chapman; some of these are also listed in the table below.[204] Eight fragments catalogued by Chapman as Ma07, thought to be from two different pieces of armor, are split here; two of the fragments with no intact rings surviving are omitted.

[200] Sim (1997): 361. Robinson (1975), 172-3.

[201] Sim (1997), 361.

[202] Sim and Kaminski (2012), 125, fig. 88.

[203] Sim and Kaminski (2012), pl 4.b.

[204] Chapman (2005), 86-88.

Table 4.4: Roman Armor Rings:

	Cat. Number	No. of Rings	Material	Date/Period	Outside Diameter (mm)	Thickness (mm)
Numantia, Lager III	R61	123	Copper-Alloy	153 or 137 B.C.	8-11	c. 1
Leiden	R62	6	Copper-Alloy	Imperial	3.062-3.197	0.51-0.63
Caerleon	R63	10	Iron	Second century CE	6.6-7.8	0.8-1.4
Thorsberg	R64	2	Iron	150-250 CE	c. 3.8-4.2	
Arbeia	R65		Iron	Imperial	7.5	1.3
Usk – Ma03	R66		Iron	Pre-Flavian	4.3 (±0.3)	c. 1
Usk – Ma04	R67		Iron	Pre-Flavian	5.4(±0.8)	c.1.1
Usk – Ma05	R68	6 fragments	Iron	Pre-Flavian	2.1-3.0	0.6-0.8
Usk – Ma06	R69		Iron	Pre-Flavian	8.0(±0.4)	c. 1.6
Usk – Ma07(a)	R70	3 fragments	Iron	Pre-Flavian	2.6(±0.2)	c. 0.5
Usk – Ma07(b)	R71	3 fragments	Iron	Pre-Flavian	c. 4.6-6.9	c. 1.0-1.2

Sim and Kaminski note, and the Table confirms, that the rings within any particular *lorica* tend to be made to fairly tight tolerances.[205] However, there is wide variation between different pieces in terms of the quality of the armor as expressed by the size of the rings. As noted above, smaller rings generally mean a higher quality armor, but would also substantially increase the cost, as more rings would be required. The *loricae hamatae* shown on the Altar of Domitius Ahenobarbus and the Aemilius Paullus monument show a core armor comprised of a mail shirt with little or no sleeves, extending down to just above the knees; a mail shirt of this size might, with significant variation for the size of the wearer, require around $0.9m^2$ of joined rings. The distinctive shoulder-doubling might add an additional $0.1\text{-}0.15m^2$ of joined rings, although certain styles of shoulder doubling, such as the long shoulder armor of the Vacheres

[205] Sim and Kaminski (2012), 114.

warrior, would require more. It seems reasonable, then, to suppose roughly $1m^2$ of joined rings to reconstruct the Republican era *lorica hamata*.

The total ring counts, and thus metal-weight, of such a reconstruction would vary significantly based on the size of the rings used, however. At the low end, the rings (cat. R61) found at Lager III at Numantia represent some of the largest recovered, at between 8-11mm of diameter. Taking the average at c. 10mm, it might require roughly 19,000 rings to produce the square meter of mail required for the *lorica hamata*. With each ring consisting of roughly 3.1cm of wire 1mm thick, the volume of metal for each ring would be $0.024cm^3$, with a mass, if made out of bronze of c. 0.2g, and if made out of iron c. 0.19g.[206] A *lorica hamata* made of such rings might thus weigh around 3.8kg in bronze and 3.6kg in iron. A fairly typical *lorica*, following the Caerleon rings (cat. R63), with an average outer diameter of around 7mm, might take some 29,000 rings. Each ring would have consisted of 2.2cm of wire an average of 1.10mm thick, giving a volume per ring of $0.021cm^3$ and a mass per ring in iron of c. 0.165g. The full *lorica hamata* would then weigh around 4.8kg total.

Relatively small differences in the size of the rings could substantially increase the ring-count and thus the weight of the *lorica*. For instance, a finer, but still fairly typical *lorica* with rings at an average outer diameter of 6mm and a thickness of 1.2mm, might require around 35,500 rings, with a volume per ring of $0.02131cm^3$ and so a mass per ring of 0.168g.[207] The entire *lorica* then would weigh around 5.95kg. Ring-counts increase rapidly as rings grow smaller, although the overall weight of the armor relates more to the ratio of wire-thickness to

[206] Mass in bronze assumes around 10% tin content and thus a density of around $8.5g/cm^3$.

[207] Sim and Kaminski (2012), 132, figure a *lorica* of this size to require around 40,000 rings. The discrepancy is between the later imperial *lorica hamata*, which incorporated sleeves, and the *lorica hamata* of the Republic, which generally does not.

ring-size. A very fine *lorica* with rings like the copper-alloy Leiden (cat. R62) or Usk Ma07(a) (cat. R70) rings would have required a staggering number of them. Assuming a 3mm diameter ring 0.6mm thick, it might take nearly 200,000 rings. The wire for each ring would only have a volume of 0.00266cm^3 and a mass of 0.0209g, but the coat overall would still weigh around 4.2kg. For the purpose of the reconstruction, it seems reasonable to assign the reconstructed copper-alloy Numantia *lorica*, at 3.8kg, as the lower bound of the reconstruction, and the much heavier 5.95kg reconstructed *lorica* as an upper bound, at least for common soldiers. The 4.8kg *lorica* based roughly on the Caerleon rings probably represents more closely a 'typical' *lorica hamata*, and will serve as my median case.

Pectoral – Types, Origins, Reconstruction

Polybius describes the pectoral as a breastplate one span square, or roughly 23cm^2, but recovered pectorals show a wider range of shapes and style, including not only the square (or rectangular) armor plate described by Polybius, but also small disks covering only the center of the chest and larger triple-disk plates.[208] Because no representational evidence of any of these types of armor is preserved from the third or second centuries, it is necessary to make extensive use of older examples in order to gain a sense of the range of defensive options available to poorer Roman soldiers. Fortunately, various kinds of pectoral armors are well documented in the archaeological and representational evidence from Italy from the eighth to the fourth centuries. So we may divide pectoral armors by shape: circular pectorals, the rectangular or square pectoral described by Polybius, and the common Samnite triple-disk pectoral.

[208] Polybius 6.23.14.

Circular or round pectorals begin to appear in Etruscan contexts starting in the seventh century, with finds extending south into Latium and east into Umbria.[209] The armor is also prominent in the archaeological record for the Oscans in the sixth and fifth centuries.[210] Such pectorals are perhaps most famously depicted on the sixth century statue of the warrior of Capestrano (fig. 4.31), although recovered examples tend to be larger than this, typically between 20 and 24cm wide as noted by Connolly.[211] There could be included a matching back plate, as with both the Capestrano warrior and a fairly well preserved example from the necropolis at Alfedena.[212] P. F. Stary terms this armor a "Herzpanzer (kardiophylakes)," suggesting an association with the armor described by Polybius, although this may not be secure.[213] In particular, the armor-type seems to have become scarce by the fourth century, especially in Central and Southern Italy. No examples have emerged from the tombs at Paestum, nor does Helle Horsnaes note any examples in a study on North-Western Lucania from 600 to 273, although rectangular and triple-disc cuirasses are common there.[214] Instead, by the fourth

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[209] P. F. Stary, *Zur eisenzeitlichen Bewaffnung und Kampfesweise in Mittelitalien: (ca. 9. bis 6. Jh. v. Chr.)* (Mainz am Rhein: Philip von Zabern, 1981b), 67, 236, karte 15. Connolly (1981), 97-8.

[210] Connolly, 101.

[211] Connolly, 101-2. Additional single-disc armors, note P. Connolly, "Notes on the development of breastplates in southern Italy" in *Italian Iron-Age objects in the British Museum* (London: British Museum Publications ltd, 1986), 117-125. See also V. Cianfarani, *Antiche civilta d'Abruzzo* (Rome: De Luca Editore, 1969), 17-20, 45-47 tav. a, b, I-VII.

[212] Connolly, 101.

[213] Stary (1981b), 67.

[214] On Paestum, see A.Pontrandolfo and A. Rouveret, *Le Tombe Dipinte Di Paestum* (Modena, Franco Cosimo Panini, 1992). On Lucania, note H. W. Horsnaes, *The Cultural Development in North Western Lucania c. 600-273 BC* (Rome: L'Erma di Bretschneider, 2002), 80-81.

century, as Horsnaes notes, the triple-disk and rectangular pectorals dominate, while the older circular type appears to have fallen out of use.[215]

However, a circular disk armor (cat. I24), 17cm across with perforations around the edges, found by Adolf Schulten in the Roman camps near Numantia, has been identified as part of this older type.[216] Even so, this find could also easily be representative of a native Celt-Iberian armor-type, which consisted of armor-discs mounted in a harness. A complete harness, discovered in the Necropolis de El Altillo and now in the Museo Arqueológico Nacional in Madrid (cat. I28), is of similar size and type, dating to the fourth or third century, and having a main plate 18cm across with perforations around the edges. The main pectoral disk and the smaller shoulder disks on the harness show similar geometric circle patterns as the Numantia pectoral. Likewise a set of front and back plates (cat. I25 and I26) from the Necropolis de la Osera near Chamartín, Spain, dated to the fourth century are each somewhat larger at 26cm in diameter, but maintain the same shape and pattern with perforations around the edges. Given the similarities between these types, it is not clear that the Numantia pectoral can be securely tied to a Roman or Italian origin. Of particular note, the concentric circle decoration with a central raised knob or bulb of the Numantia pectoral does not seem to appear on previous Italic single-disc pectorals (which more often feature scenes or animal motifs); but it does closely resemble the decoration of some Iberian pectorals (such as cat. I28), which are decorated by a series of overlapping sets of concentric rings with a central bulb (fig. 4.32). Unless further examples of

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[215] Feugère (1993), 87, also notes that the small circular pectoral survives into the fourth century, but not, apparently, beyond it.

[216] A. Schulten, *Numantia: Die Ergebnisse der Ausgrabungen 1905-1912. Band III. Die Lager des Scipio* (München, F. Bruckmann A.-G., 1927), taf. 44,19; 50. Bishop and Coulston (2006), 63-64.

this type of armor appear in Roman contexts, it seems more likely that the Numantia pectoral is representative of Iberian, rather than Italian, armor styles.

Rectangular pectoral plates have perhaps the longest history in Italy, with examples dating from the eighth century in Etruria and Latium.[217] Connolly notes, however, that the pectoral of Polybius corresponds to the later rectangular anatomical cuirasses, so named because the rectangular plate is frequently decorated with chest muscles, much like the Greek muscle cuirass. The rectangular anatomical cuirass seems to share an origin with the Samnite triple-disc cuirass, rather than earlier central Italian rectangular types.[218] All of the examples of the type are made of copper-alloy. The British Museum has a remarkably well-preserved example of the type (cat. R72), dated to the fourth century (fig. 4.33). Comprising both a breastplate and a back plate, the armor is 27.94cm high and 30.48cm wide, making it somewhat larger than Polybius' description, and approximately 2mm thick. The front plate weighs 877g, the back plate 707g, although Connolly notes that the side and shoulder plates are missing, so the original metal-weight would have been somewhat higher. Other examples in the British Museum (cat. R73, R74, R75), identified as examples of the type by Connolly, are too damaged to make a weight measurement useful, but they serve to outline the type, each just over 30cm high and about as wide.[219] Another example, from Tomb 2 at Paestum (cat. R76), which includes a front plate (30cm by 28cm), a back plate (32cm by 28cm) and one of the side plates (10.4cm by 7.9cm). Another example of this type in the Paestum Museo Archeologico Nazionale and cited by Giovanni Carratelli (cat. R77) is of a similar size, with both a front plate (37 by 27.6cm) and a

[217] P. F. Stary, (1981b), 25, 141. P. Connolly (1981), 92-3.

[218] Connolly (1986), 117-125.

[219] Connolly (1986).

back plate (29.5 by 29.5cm) along with two connecting plates (8.6 by 11.6 and 8.9 by 12.6cm).[220] Although no weight is given for the piece, the thickness is 1.5mm, which would suggest a mass around 2.5kg for the entire armor.[221] At the lower end, Polybius' suggested size for the pectoral is a single span (c. 23cm) square; at a fairly typical thickness of 1.5mm it would result in a front plate weighing only c. 650g in bronze.[222]

The triple-disk pectoral, developed in the central Apennine region and generally associated with the Samnites, may be the direct predecessor of the Roman armor Polybius describes. It was no doubt still used by many Roman *socii* during the second century.[223] The armor, like the rectangular pectoral, was a harness, consisting of at least a front plate, and potentially a back plate and shoulder plates, held together by shoulder and side straps.[224] The armor is frequently depicted in artwork from Campania, such as on a warrior on a *lekythos* in the British Museum (Fig. 4.34) and also on a fresco dated to the fourth century from Paestum in Lucania.[225] A heavily damaged example in copper-alloy (fig. 4.35) dating to the fourth century in the British Museum lacks a back plate or shoulder harness, but shows the basic shape. The preserved thickness of the plate is c. 1mm, and the plate itself in its current state weighs 352g,

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[220] G. Carratelli, *The Western Greeks* (Milan: Bompiani, 1996), 649.

[221] Assuming a mean thickness of 1.5mm over the surface area of the front plate (1021.2cm^2) back plate (870.25cm^2), and side plates (99.76 and 112.14cm^2), gives a volume of 315.5025cm^3. Assuming a density of bronze around 8g/cm^3, that suggests a mass of c. 2,520g.

[222] Assuming a square shape 23cm^2 on each side with a thickness of 1.5mm would give a volume in bronze of 79.35cm^3. This assumes true bronze (copper-tin) with 10% tin content.

[223] The exact developmental relationship between the single-disc, triple-disc and rectangular armors is unclear. Feugère suggests that the triple-disc cuirass is an extrapolation from the single-disc, Feugère (1993) 87-88. Connolly, however, argues that the triple-disc form is a stylized version of the rectangular anatomical cuirass, P. Connolly, "Notes on the development of breastplates" (1986), 118.

[224] Burns, (2003), 71-2.

[225] Connolly (1981), 105.

although it would have doubtless been heavier at the time of construction, perhaps around 0.8-1kg, once side-plates, shoulder-plates and the back plate are accounted for. Another example from Alfedena (cat. R79), has a front plate 28 by 26.5cm, a back plate 27.5 by 27cm, two side plates each 19cm long, and a single preserved shoulder plate 10cm long; the second shoulder-plate is missing.

Reconstructing metal-weights for 'typical' examples of this kind of armor is necessarily speculative. As the armor of poorer Romans, it seems likely that the size and quality of pectorals in the third and second centuries would have varied widely. This variation is compounded by the modular nature of both the triple-disc and rectangular cuirasses, which could include metal plates protecting the sides, back and shoulders, but could also conceivably be worn simply as a single front plate. Such an arrangement does not seem to occur in the archaeological or representational evidence, but it cannot be ruled out, especially as the evidence is likely to favor the armor of elite individuals. Thus, although no such example appears in the representational evidence, it seems prudent to assign as the minimum case a metal-weight of c. 650g, corresponding to Polybius' description and assuming a relatively small single plate with no attachments. For the median case, the British Museum rectangular anatomical cuirass (cat. R72) seems the most typical at 1.584kg, although this is a conservative estimate as the cuirass is missing side and shoulder plates. The estimate for the rectangular Paestum cuirass (cat. R77) at 2.5kg can serve as a maximum case.

Helmets – Types, Origins and Reconstruction

The Montefortino-type helmet, sometimes mistakenly referred to as a 'jockey-cap' helmet (along with the Coolus type), first appears in Gallic contexts in France and Austria in the late fifth century, before arriving in Cisalpine Gaul towards the end of the fifth and the beginning of the fourth century.[226] Although in Gallic contexts this helmet type was often made of iron, Roman examples were exclusively produced in copper-alloy during the period of the Republic. Widespread adoption in Roman sites begins in the late fourth and early third centuries, such that the Gallic-inspired Roman Monteforinto type eclipsed all other helmet-types in use by the mid-third century.[227]

The speed with which the Montefortino helmet was adopted throughout Roman Italy is remarkable in a context where other helmet-types (*pilos*, Samno-Attic types, etc) provided sound alternatives. Burns has suggested that this speed was the result either of the need for a "neutral form of helmet, which did not carry any ethnic or political overtones," or of a "need, or a trend, to associate certain types of equipment with all forces serving the Roman Republic."[228] However, it should also be noted that this helmet, close-fitting with hinged-cheek plates, provides excellent protection. Moreover, the shape is economical to produce (although decorated rims and crest-knobs are typical embellishments) while not inhibiting vision or breath; so it seems plausible that the Montefortino-type dominated because it was perceived, correctly, as a superior helmet. As a result of its ubiquity among Roman soldiers, it tends to surface in the archaeological record wherever they went. John Paddock notes, "the spread of the Montefortino

[226] Paddock (1993), 482. Montefortino helmet referenced as a "jockey-cap:" Robinson (1975), 13-41; Feugère (1993), 70-71.

[227] Paddock (1993), 482. Burns (2003), 73.

[228] Burns (2003), 74-75.

helmet therefore acts almost as barometer of Roman troop movements and the expansion of the Roman Empire."[229]

The form of the Montefortino helmet shows some variation over the long period of its use. Although Paddock identified 12 distinct types from the fourth century B.C.E. to the first century C.E., the basic form of the helmet remains fairly consistent.[230] It is typified by a round conical bowl shape with a pronounced crest-knob, a thickened rim and attachment points for hinged cheek-guards. The rim often, but not always, has a cable design on the thickened portion (see fig. 4.36).[231] The design is a remarkably effective one for its simplicity, particularly for use in close-combat. The thickened rim provides strong structural support against overhand blows, such as might be expected from the classic Middle and Late La Tène type swords; much the same function is performed by the brow-ridges which begin to appear on Hellenistic helmets, apparently in response to Gallic threats (discussed in chapter 5). Moreover, the cabled brim serves to deflect away from the face a sword-strike that is gliding down the face of the helmet. The open face may have made the wearer more vulnerable to missile weapons, but the ability of a Roman soldier to hunker down behind his large *scutum* probably mitigated this risk. The unrestricted breathing that the helmet allows has been an underappreciated feature, but would have been invaluable under actual combat conditions. Finally, the helmet would have been worn with a textile (probably felt) liner, which may have reduced the concussive force of blows.[232]

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[229] Paddock (1993), 484, 803. It must be confessed that this logic can be somewhat circular. As noted in Chapter 6, helmets of this type also found use among non-Romans in Spain and Gaul.

[230] Paddock (1993), 510-520.

[231] Paddock (1993), 470-472.

[232] Paddock (1993), 67-68.

During the third and second centuries, Montefortino helmets were produced by a process called raising, where a metal sheet is gradually hammered out over a wooden block with a hemispherical depression, called a doming block. This process often leaves the crest of the helmet somewhat thinner than the lower portions, a tendency accentuated by the Montefortino type's characteristic thickened rim.[233] Manufacturing standards, and thus weight, steadily declined during the second and first centuries. This trend culminated in the introduction of spinning as a form of mass production, where the helmet bowl is formed by being rotated and pressed against a wooden former.[234] Paddock suggests that the initial decline in weight from some of the very heavy early examples may have been motivated by a desire to produce a more effective and comfortable helmet, but subsequent weight reductions, especially towards the end of the second century, are connected with a more general collapse in manufacturing quality.[235] In Paddock's view, this collapse in standards may be related to the rapid increase in the size of Roman armies in the Late Republic, but that hardly seems likely when the tremendous military exertions of the third century produced no matching collapse in apparent quality.[236] Paddock also links the decline in quality with the so-called Marian reforms, a position which Bishop and Coulston share, representing a shift from individually supplied arms and armor to state supply or subsidy.[237]

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[233] Paddock (1993), 490-1. On manufacture, see Paddock (1993), 44-77, Sim and Kaminski (2012), 34, 82-86.

[234] Paddock (1993), 66. Sim and Kaminski (2013), 35-6.

[235] Paddock (1993), 801-2.

[236] Paddock (1993), 66.

[237] Bishop and Coulston (2006), 65. Paddock (1993), 802-3.

As implied by its rapid adoption and wide dissemination, this piece of armor represents the single best-attested type of armor from the Republican period. In 1993, Paddock noted 143 examples; more have since come to light and so the parameters of the type are well established, although weight data is often omitted when helmets are published.[238] My objective in presenting examples is not to provide a comprehensive list of all, or even most, preserved examples, but merely a sufficient sense of the type to allow for reconstruction. A table of weighed examples (Table 4.5) is presented below, with the tendency towards lighter and thinner helmets over time clearly visible.

Table 4.5: Montefortino-type Helmets by Date

Cat. No.	Date	Height	Width	Weight	Metal Thickness	Cheekguards?
R80	Mid-4th to mid-3rd cent.	180mm	160-215mm	2010g	2-3mm	Intact
R81	Mid-4th to mid-3rd cent.	200mm	170x205mm	1895g	2-3mm	Intact
R82	Mid-4th to mid-3rd cent.	183mm	165x210mm	2204g	2-3mm	Intact
R83	late-4th to early-3rd cent.	185mm	170-200mm	1180g	1-3mm	Lost
R84	Late-4th to mid-3rd cent.		164x205mm	868g	1-1.15mm, rim 3.5mm	Lost
R85	3rd cent.	220mm	185mm-206mm	1315g	2.5mm; rim 5mm.	Lost
R86	Mid-to-Late 3rd cent.	255mm	170-227mm	1180g	1-2mm; rim 4.5mm	Lost
R87	Mid-2nd to early-1st cent.	227mm	194x212mm	984g	1-2mm	Lost
R88	Late 2nd – 1st cent.	168mm	210-216mm	680g	1-1.5mm	Lost
R89	Late 2nd – first half of 1st cent.	193mm	183-210mm	960	1.5-3mm	Lost
R90	300 – 100	203.2mm	228.6mm	1,180g		Lost
R91	250 - 150	203.2mm		1,270g	c. 3-6mm	Lost
R92	220 – 170	192mm	217mm	1,090g	2-3.5mm	Lost

238 Paddock (1993), 471-481.

Although most of these helmets do not retain cheek-guards, all of them had attachment points and would have originally included cheek-guards. So the examples without their cheek-guards still extant would have been significantly heavier than their listed weights. The thickness, and thus weight, of cheek-guards seems to have declined in step with the helmet bowl itself, beginning to fall in the late second century. Marcus Junkelmann has published a very well-preserved pair of cheek-guards (cat. R94, fig. 4.37), dated to between the middle of the third and the beginning of the second century.[239] They range between 2 and 2.5mm thick and weigh 350g each. Another right cheek-guard (without the matching left piece) dated from the late first century B.C.E. to the first half of the first century C.E. (cat. R95) was only 0.8 to 1.4mm thick, and massed only 92g.[240]

The relatively wide variation over time makes it a challenge to establish weights for the purpose of reconstructing the Roman heavy infantry panoply. Given my study's reliance on Polybius, I focus my reconstruction on the period for which his description is most likely to apply, namely the end of the third century and the first half of the second century. A reconstruction focused on the earlier third century would likely suggest a significantly heavier weight for the Montefortino-type helmet, while a reconstruction focused on the post-Marian army would, in turn, posit a substantially lighter weight. Of note here is the effect that this chronological choice has on the other Gallic type, the Coolus helmet, which is to exclude it. This type of helmet was in use by the Gauls starting in the fourth century. However, as Paddock notes, it was only adopted by the Romans in the mid-first century, placing its use by them

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239 Junkelmann (2000), 163.

240 Junkelmann (2000), 164.

outside of this period.[241] The Coolus type will, however, be discussed in more depth as a Gallic helmet in chapter 6.

Given this chronological focus, reconstruction of some of the heavier late third century examples (eg. cat. R83, R85 and R86), with a pair of cheek-guards of around 350g each (consistent with cat. R94), would suggest a maximum case around 2kg. At the low end, some of the lightest helmets (e.g. cat. R88, R89) from the end of the period with a pair of cheek-guards around 100g each (consistent with cat. R95), would suggest a minimum case of around 0.9-1.2kg. Because this study is mostly focused on the earlier second century, the median case is likely to fall closer to the heavier examples, with a helmet bowl probably around 1.2kg and cheek-guards at c. 200g each, suggesting a median case c. 1.6kg.

Greaves – Prevalence and Reconstruction

Polybius notes that, in addition to body armor and a helmet, the Romans wore προκνημίς, or leg protection, generally translated as greaves, although the word here is singular.[242] Greaves also figure into the panoplies of the first and second class described by Livy and Dionysius for the reign of Servius Tullius; the difficulties with those accounts have already been discussed.[243] The apparently uncomplicated picture presented by the textual evidence is, however, complicated by the representational evidence. Only the figure of Mars on the Paris relief of the Altar of Domitius Ahenobarbus wears greaves; neither the infantrymen nor the cavalryman

[241] Paddock (1993), 805-806.

[242] Plb. 6.23.8.

[243] Liv. 1.43. Dionysius *RA* 4.16.2-3.

does.[244] Although damage makes firm identification difficult, none of the figures on the Aemilius Paullus monument appears to have had greaves either. Taylor, in reconstructing the monument, does not supply any.[245] The Macedonian figures on the monument also lack greaves, despite an inscription from Amphipolis, discussed in more depth in the following chapter, which seems to suggest quite strongly that greaves were a mandatory piece of equipment in the Antigonid army.[246] Thus the possibility must be admitted that greaves might have been omitted in sculpture even when they were present on the battlefield, perhaps out of a desire to display the musculature of the leg. At the same time, the possibility that many soldiers simply went without greaves should not be discounted. Greaves were the least essential part of the Roman panoply, as the legs could be protected from missiles with the *scutum*, and actually striking the lower leg in combat is difficult with most melee weapons.

Greaves are not, however, entirely absent from artwork of the period. The two figures of the Osuna relief both wear a single greave on their left legs (fig. 4.38).[247] As Bishop and Coulston note, this was a sensible arrangement, as the soldier's stance would present the (shielded) left side of the body with the right leg back so that he could step forward while striking with his own weapon; the left leg was thus more vulnerable than the right.[248] With a greave on the left leg, the soldier could present a solid front of armor when on the defensive. Walbank suggests that the use of a singular greave may explain Polybius' use of προκνημίς in

[244] Stilp (2001), 79.

[245] Taylor (2016), 568.

[246] SEG 40.524. Hatzopoulos (2001), 153-156.

[247] Shown in D'Amato (2009), 18-19.

[248] Bishop and Coulston (2006), 64-5.

the singular.[249] Two ivory reliefs from Palestrina show greaves, this time in pairs, but the figures, in muscle-cuirasses and carrying spears, although without swords, do not seem to be equipped in Roman fashion, and so these reliefs cannot be securely tied to the Roman military (fig. 4.39).[250] A wall painting in Paestum dated to the early fourth century shows two foot-soldiers, each wearing a pair of greaves.[251] Likewise, greaves commonly occur in combination with the triple-disc cuirass, as with a bronze figurine in the Louvre depicting a warrior, possibly a Samnite, and a warrior wearing a triple-disc cuirass on a squat lekythos now in the British Museum; both wear full pairs of greaves.[252]

Because of the contradictory evidence, the presence or absence of greaves in reconstructions of Roman soldiers in the Republic varies significantly, and there is no consensus in the scholarship. Feugère suggests that greaves were probably the preserve of centurions and officers before being phased out during the first century CE.[253] Connolly presents soldiers in all three possible states, with greaves, without them, and with only a single greave, but suggests that the wearing of one greave was the Roman style.[254] D'Amato presents a late Republican centurion

[249] Walbank (1957), 705.

[250] Feugère (1993), 62-3.

[251] P. Connolly (1981), 105.

[252] P. Connolly (1981), 108. The *lekythos* is British Museum number 1986,0403.4.

[253] Feugère (1993), 76. Oddly, Feugère cites Vegetius, I.20 attributing a single iron greave to the infantry (*pedites*) in general for the period of the Republic; Vegetius can hardly be reliable on this point for the period of the Republic.

[254] P. Connolly (1981), 133. Reconstructions presented with: two greaves: Connolly (1981), 134, 138; one greave, 123; no greaves, 138. Connolly's comment that wearing one greave was the Roman style is supported by a quotation from Arrian, *Tact.* 3.5 "… or as with the Romans, one greave to protect the leg which is advanced in fighting" (ἢ ὡς Ῥωμαίοις κνημὶς μία πρὸ τῆς κνήμης τῆς ἐν ταῖς μάχαις προβαλλομένης), where Arrian contrasts this with the Greek style of wearing greaves on both legs. As with Vegetius, Arrian can hardly be reliable on this point for the period of the Republic, though both of them together may suggest something that was commonplace knowledge.

in greaves, but otherwise omits greaves from his reconstruction, despite presenting them as part of the standard equipment in his text.[255] In practice, the evidence permits no certainty as to how common or uncommon greaves were in the Middle Republic, except to say that some soldiers wore them and some did not. It may perhaps be added that they must have been fairly common at least early in the second century for Polybius to include them, but beyond this, the evidence permits little confidence.

Reconstructing the likely metal-weight of greaves is also difficult. None have yet been found from the period in a Roman context, although a set of metal fittings from Cáceres el Viejo in Spain are thought to have been presses for them.[256] So it is necessary to rely on comparative evidence in assessing the likely metal-weight of Roman greaves. Three sets of greaves found in Italy or thought likely to have originated there, now in the British Museum, are presented in Table 4.6. Unfortunately, one pair of copper-alloy greaves (cat. H48) could not be removed from their mounting in order to measure their mass, as they were bolted in; although displayed together, they do not appear to have originally been paired.[257] These measurements fit with weights suggested by Eero Jarva for greaves in the Archaic period in Greece, which ranged from 0.5 to 1.1kg, growing generally lighter over time.[258]

[255] D'Amato (2009), 8, 30, 41, pl. I, II.

[256] A. Mutz, "Die Deutung eines Eisenfundes aus dem spätrepublikanischen Legionslager Cáceres el Viejo (Spanien)" *Jahresberichte aus Augst und Kaiseraugst* 7 (1987): 323-30.

[257] Pers. Correspondence with Ben Harridge, Assistant Collections Manager, British Museum.

[258] Jarva (1995), 137.

Table 4.6: Greaves in the British Museum					
Cat. No.	Date	Length	Mass	Thickness	Notes:
H50	500-450	45.72cm	759g	2.2mm	Pair w/ H51
H51	500-450	45.72cm	773g	2.4-4mm	Pair w/ H50
H48a	6-5th cent.	46.9cm		1.9mm	
H48b	6-5th cent.	46.2cm		2.5-4mm	
H49a	550-500	43cm	580g	1.6-2.5mm	Pair w/ H49b
H49b	550-500	42cm	623g	2.1-3mm	Pair w/ H49a

Because the prevalence of the use of greaves is so unclear, the metal-weight reconstruction, as a matter of assessing the 'typical' soldier, will be more tentative than has been the case with other kinds of equipment. The minimum case must clearly be set at the complete omission of greaves, strongly attested in the representational evidence. As a maximum case, a full pair of greaves at c. 1.5kg (following cat. H50 and H51) in copper-alloy seem a reasonable supposition. For the median or 'typical' case, we may assume a single greave worn on the left leg, following the Osuna relief, of perhaps 650g in copper-alloy, although it must be stressed how tentative this median case is.

Quantitative Analysis

Metal-Weights for the Heavy Infantry

Table 4.7 presents the estimated metal-weights for each piece of the Roman heavy infantry panoply. Taking these into account, Table 4.8 then presents the resulting metal-weights for the Roman heavy infantry in the minimum, maximum and median cases:

Table 4.7: Reconstructed Metal-Weights for Roman Heavy Infantry by Equipment Type			
	Minimum	Median	Maximum
Gladius	530g	680g	1,000g
Pila (as a pair)	575g	665g	985g
Hasta	130g	300g	420g
Scutum	335g	420g	500g
Lorica Hamata	3,800g	4,800g	5,900g
Pectoral	650g	1,580g	2,500g
Helmet	1,000g	1,600g	2,000g
Greaves	0g (none worn)	650g (single greave)	1,500g (pair)

The infantrymen are divided between the front two lines (*hastati* and *principes*) and the *triarii*, and between those who are *loricatus* (wearing the *lorica hamata*) and those wearing the pectoral. The extreme measurements implied by the maximum and minimum cases are meant to serve only as the outer bounds for reconstruction; few soldiers would have been equipped in all of the heaviest or all of the lightest gear. The median case, again, represents a 'best guess' based on the available evidence of what the 'average' or 'typical' soldier might have carried.

Table 4.8: Reconstructed Metal-Weights for Roman Heavy Infantry by Soldier Type:

	Minimum	Median	Maximum
Hastatus/Princeps	3,090g	5,595g	8,485g
Hastatus/Princeps, loricatus	6,240g	8,815g	11,885g
Triarius	2,645g	5,230g	7,920g
Triarius loricatus	5,795g	8,450g	11,320g

It is then necessary to aggregate these figures to represent the larger units in which Romans fought. This calculation requires computing an average of the above metal-weights based on the ratios of each class of soldier. The ratio between the three lines of heavy infantry is given by Polybius. There were 1200 *hastati*, 1200 *principes* and 600 *triarii* in a legion generally.[259] How many men would have worn the *lorica hamata* is not known, but the evidence does permit a range of reasonable estimates to be tested. Average values for the heavy infantry of the legion (excluding *velites* and *equites*) are presented below in table 4.9:

Table 4.9: Reconstructed Average Per-Soldier Metal-Weights for the Roman Heavy Infantry:

Prevalence of the *lorica hamata*	Minimum Case Reconstructions	Median Case Reconstructions	Maximum Case Reconstructions
1/3 *loricatus*	4,051g	6,595g	9,505g
40% *loricatus*	4,279g	6,810g	9,732g
1/2 *loricatus*	4,576g	7,132g	10,072g
2/3 *loricatus*	5,101g	7,668g	10,638g

[259] See above at n. 21.

Non-Metal Equipment Requirements – Wood and Textiles

Although worked metal will have represented the most expensive element of the Roman heavy infantry panoply, wooden elements actually make up the majority of the weight of the panoply. Reconstructed *scuta* generally have wooden elements at or just under 10kg.[260] Connolly's reconstruction of the *pilum*, detailed above, suggest around 2kg of wood for a pair, bringing the total weight of wooden equipment to c. 12kg for a *hastatus* or *princeps*.[261] While this figure exceeds by weight the total metal-weight of any projection, it probably represented a relatively smaller portion of the total cost of the equipment. It is important to keep in mind the tremendous fuel costs underlying the much smaller metal-weight figures. The lowest metal-weight figure for a non-*loricatus hastatus* or *princeps*, 3.09kg, would require c. 430kg of raw wood for fuel in the smelting process alone, with more required for forging.[262] While finished wood products, particularly the *scutum*, would certainly require more labor than an equivalent mass of wood turned into charcoal, the tremendous fuel and labor demands of worked metal vastly exceed those of wooden equipment.

Textiles would also make an important part of the Roman panoply, but, as with wooden elements, a relatively small portion of the total resource and labor intensity. Roman helmets were designed to be used with a lining of wool or linen both for absorbing impacts and for increased fit and comfort.[263] Likewise, it is generally assumed that the *lorica hamata* was worn

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[260] Junkelmann (1986), 174-179. Connolly (1981), 131, 233.

[261] Connolly (2000), 43-46.

[262] Sim and Ridge (2002), 23. Using J. F. Healy's figures would result in a much lower consumption of fuel wood around c. 86kg, but still well in excess of the requirements for wooden equipment. As a matter of accuracy, Sim and Ridge's larger fuel consumption number is probably to be preferred. Healy (1978), 151, 196.

[263] Paddock (1993), 67-71.

over a quilted or felt garment, called a *thoracomachus* or a *subarmalis*.[264] Attestation for padding worn under mail armor, however, comes only in later sources, such as the fourth century C.E. anonymous *De Rebus Bellici*s.[265] While we cannot be certain that such a padded garment was used during the period of the Republic, it seems very likely. Clear examples of the *subarmalis* from the Republic are rare, although a sculpture from Volterra may depict a quilted variant, and the second soldier in the Osuna relief appears to be wearing some kind of padded textile garment.[266] Without effective padding, the defensive value of the *lorica hamata* would have been significantly reduced. As Paddock notes, we have ample evidence for the use of felt or linen padding worn beneath helmets.[267] The potential defensive properties of felt or quilted textiles were also clearly known, exemplified by Caesar's soldiers' use of such garments while constructing siege works at Dyrrachium.[268] Thus, despite the lack of clear evidence for a padded or quilted garment beneath the *lorica hamata* during the Republic, it seems very likely that such garments were worn.

To accurately reconstruct the resource and labor requirements for any additional padding worn under the *lorica hamata* is impossible. We lack a sense of the number of quilted layers or the thickness of felt and the method by which the garment was assembled, for instance with thick felt, or by quilting multiple layers of fabric. A comparison with the reconstruction of the Greek and Macedonian *linothorax*, discussed in more depth in the next chapter, however, is instructive.

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[264] Bishop and Coulston (2006), 63. D'Amato (2009), 38. Note also G. Sumner, *Roman Military Dress* (Stroud: The History Press, 2009), 170-175 and Junkelmann (1986), 154-157.

[265] *De rebus Bellicis* 15. Note also *SHA Severus* 6.11.

[266] Volterra: Sumner (2009), 100, fig. 4. Osuna: D'Amato (2009), 18-19.

[267] Paddock (1993), 61-71.

[268] Caesar, *B.C.* 3.44.6.

An order for a soldier's clothing preserved on papyrus in Egypt dating to c. 138 C.E. gives a weight of c 1.6kg for a rather large and surprisingly thick soldier's tunic, possibly indicating a *subarmalis*.[269] In contrast, the *linothorax* has been reconstructed at around 3.5 to 4kg of textiles, or around 2-2.5 times as much fabric, with an estimated production time, including spinning and weaving, of some 715 hours.[270] The comparison suggests that the spinning, weaving and construction time for a *subarmalis* might have been in the range of 280-350 hours, requiring labor skills that were already readily available within a normal Roman household. In comparison, Sim estimates that to produce a *lorica hamata* of around 40,000 rings would require around 2,300 hours, not including mining, smelting, or bar-smithing, with finer coats of mail requiring dramatically more time.[271] This manufacture time encompasses not only work by semi-skilled apprentices making the wire, but also skilled labor assembling the final coat. As a result, while the addition of a *subarmalis* beneath the *lorica hamata* would have significantly improved the protective qualities of the armor, it was unlikely to be a major driver of cost, as the labor and resource intensity of the metal components of the panoply would have been much higher.

Light Infantry and Cavalry

Reconstructions for the *velites* and *equites* in the legion of the Roman Republic are necessarily more speculative, as there is far

Table 4.10: Reconstructed per-soldier Metal-weights for the *equites* and *velites*

	Minimum	Median	Maximum
Equites	5,620g	8,190g	10,980g
Velites	1,320g	1,470g	1,790g

[269] Sumner (2009), 23.

[270] Aldrete, *et al*. (2013), 146, 152.

[271] Sim and Kaminski (2012), 132. Mail with higher ring-counts: Sim (1997), 370-371.

less evidence of their equipment. However, some conclusions, albeit tentative ones, may be suggested. The personal battlefield equipment of the Roman *equites* would have included a helmet of either the Montefortino or, as on the Altar of Domitius Ahenobarbus, a Boeotian type (discussed in more detail in chapter 5), the *lorica hamata*, a *hasta*, a *gladius*, and a *parma*.[272] Fittings and tack for the cavalryman's horse would also have included some metal elements, but the reconstruction of equestrian equipment, although its importance is not to be overlooked, is outside of the scope of this project. For the *velites*, Livy notes the use of the *parma*, the *gladius*, and seven lighter javelins, the *hasta velitaris*.[273] Polybius notes that the *velites* supplemented their helmets, "sometimes with a wolf's skin or something like it, both to protect and to act as a distinguishing mark."[274] Based on that statement, it has generally been supposed that the helmet of the *velites* was probably a textile helmet (a *galea*), rather than a metal one (a *cassis*), as a wolf's hide would have little reinforcement to offer a copper-alloy helmet.[275] The metal-weights in table 4.10 and subsequently follow this conclusion. However, the idea that some *velites* might have used a metal helmet, likely to have been of the Montefortino type, cannot be ruled out. The addition of a metal helmet would have effectively doubled the metal requirements of an individual *veles*, meaning that the adoption of a metal helmet by even a relatively small number of *velites* would have had a large impact on the average metal requirements of the *velites* as a collective group.

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[272] McCall (2002).

[273] Shield and *gladius*: Livy 38.21.12-13. Number of javelins: Livy 26.4.

[274] Plb. 6.22.3, προσεπικοσμεῖται δὲ καὶ λιτῷ περικεφαλαίῳ: ποτὲ δὲ λυκείαν ἤ τι τῶν τοιούτων ἐπιτίθεται, σκέπης ἅμα καὶ σημείου χάριν.

[275] Walbank (1957), 703, likewise concludes that Polybius is expressing the distinction between leather or textile *galea* or *galerus* and metal *cassis*, a distinction also made in Propertius (Prop 4.10.20) and Vergil (Verg. *Aeneid* 7.688) and made explicit by Isidore (Isidore, *Origines* 18.14): "*cassis de lamina est, galea de corio*."

Reconstructions of the metal-weight requirements for the *velites* and the *equites* based on these assumptions are presented in the table 4.10. For the *parma*, in both cases, a boss is assumed following the circular boss found at Numantia (cat. R51) and a small handgrip reinforcement of c. 20g. The *hasta velitaris* follows Connolly's reconstruction presented above, assuming c. 90g per *hasta velitaris*.[276] The much smaller amount of metal required to equip a *veles* is consistent with their recruitment from relatively poor citizens. In contrast, while the *equites* do require somewhat less worked metal than their *loricati* infantry counterparts, this difference would be more than compensated for by the cost of the cavalryman's horse. Comparative evidence from the Late Empire suggests that the cost to equip an armored cavalryman, including acquiring his horse, might be about double the cost to equip an armored infantryman.[277]

Metal Requirements for a Legion

The legion was fundamentally a combined-arms unit composed of cavalry, light infantry and heavy infantry. While this analysis is focused on the latter, it is worthwhile to consider the material requirements of the entire legion. It was typically composed of 1200 each of *hastati*, *principes*, and *velites*, 600 *triarii* and 300 *equites*.[278] Assuming 40% of the heavy infantry wore the *lorica hamata*, equipping an entire legion would require (following the median cases) some 20,565kg (22.6 tons) of worked metal in iron and copper-alloy. Higher prevalence-rates for the *lorica hamata*, likely reached later in the second century, would result in higher figures; with

[276] Connolly, (1997), 43-46.

[277] Elton (1996), 122.

[278] Plb. 6.21.6-9; 6.25.1-3. Keppie (1984), 34-5.

two-thirds of the legion's heavy infantry *loricatus*, the total rises to 22,626kg (25 tons). Each Roman legion thus represented a truly astounding investment in labor and resource-intensive metal equipment. The vast majority of this investment went into the heavy infantry. Even if we assume, as suggested above, that because of the cost in horses and feed, an *eques* cost roughly twice as much to field and equip as a heavy infantryman, the *equites* collectively would still only represent some 18% of the total equipping cost of the legion.[279] As subsequent chapters will show, Roman soldiers, especially in the heavy infantry, were more heavily and expensively equipped than their Mediterranean rivals. This result is quite startling, because the Roman Republic's commitment to maintaining larger military deployments, as well as its willingness to suffer larger casualties than the other major states of the Mediterranean, are well established.

Conclusions

The matériel intensity of Roman troops, especially the heavy infantry, likely contributed to the Roman qualitative edge. Recent scholars have sometimes been hesitant to attribute clear advantages to specific combinations of armor and weapons in the ancient world, instead noting that, in a general sense, it is not typically possible to demonstrate a meaningful technological edge in warfare.[280] Mail armor, however, probably did represent a genuine technological advance that gave the Romans, as early adopters, a real advantage. Mail armor would continue

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[279] Assuming an average *eques* cost twice as much as the average infantryman would suggest a total cost to field an *eques* as being equivalent to the cost of around 13.62kg of worked metal. Thus the 300 *equites* of a legion, with a combined 'all included' cost equivalent to roughly 4,000kg of worked metal would represent around 18% of the total cost of equipping a legion.

[280] On this, particularly on charges of 'technological determinism,' note for instance F. Rey, "Weapons, Technological Determinism and Ancient Warfare" in *New Perspectives on Ancient Warfare* edited by G. G. Fagan and M. Trundle (Leiden: Brill. 2010), 21-56. In practice, Rey's argument, which fails to recognize meaningful distinctions within weapon and armor classes, is reductive to the point of uselessness.

to serve as the ‘gold standard’ of body-armor in Europe and the Middle East until the late Middle Ages, because it offered an excellent mix of protection and mobility, albeit at a very high cost premium. Other elements of the panoply, particularly the *pilum*, provided an advantage that was economic in origin rather than technological; the *pilum* was not a particularly advanced weapon, but it demanded a willingness to invest significant time and resources into producing large numbers of disposable weapons with large metal components. Ultimately, Roman soldiers may have rightly drawn a measure of confidence from the greater protection and offensive potential afforded by their equipment.

The advantages of the Roman panoply were certainly not lost on Rome’s rivals. Polybius notes that Hannibal, after his early victories, used the spoils to equip his African troops entirely in Roman fashion.[281] Likewise, Nicholas Sekunda has assembled an impressive body of evidence suggesting that the Ptolemaic and Seleucid kingdoms attempted to reform their armies along Roman lines beginning in the 160s, and to adopt Roman equipment, at least for elite units.[282] Roman equipment also shows significant diffusion in the western Mediterranean, with the appearance of Roman-style weapons and armor in the Tomb of Micipsa in Numidia, as well as the appearance of Montefortino-type helmets that seem to have been manufactured in Spain.[283] This diffusion comes in spite of the resource intensity of Roman equipment. This high resource intensity meant that to adopt Roman equipment would have been an expensive choice

[281] Plb. 3.114.1.

[282] Sekunda, (2001a); Sekunda, (1994/5).

[283] Roman-style mail armor and weapons in Numidia: G. Waurick, “Die Schutzwaffen im numidischen Grab von Es Soumâa” in *Die Numider: Reiter und Könige nördlich der Sahara*, eds. H. G. Horn and C. B. Rüger, (Köln: Kunst und Altertum am Rhein, 1979), 305-35; Ulbert (1979). Montefortino helmets from Iberia: F. Quesada Sanz, “Montefortino-type and related helmets in the Iberian Peninsula: a study in archaeological context” *JRMES* 8 (1997b), 151-166.

for both the individual or the state. Thus, adopting Roman arms suggests that the qualitative edge they provided was perceived as significant, perhaps even decisive, by Rome's rivals.

The Roman military system, then, invested as much in quality as it did in quantity. Roman equipment was very effective, but also very expensive in both labor and materials. Roman soldiers also show themselves to be highly motivated and capable on the battlefield. The Roman army was thus one composed of high quality soldiers, equipped with high quality gear. This observation demands fresh examination of the Roman system for mobilizing men and resources for war. How is it possible that Rome fielded not only such high quality heavy infantry, but also so much of it?

Figure 4.1: Paris Frieze from the so-called Altar of Domitius Ahenobarbus

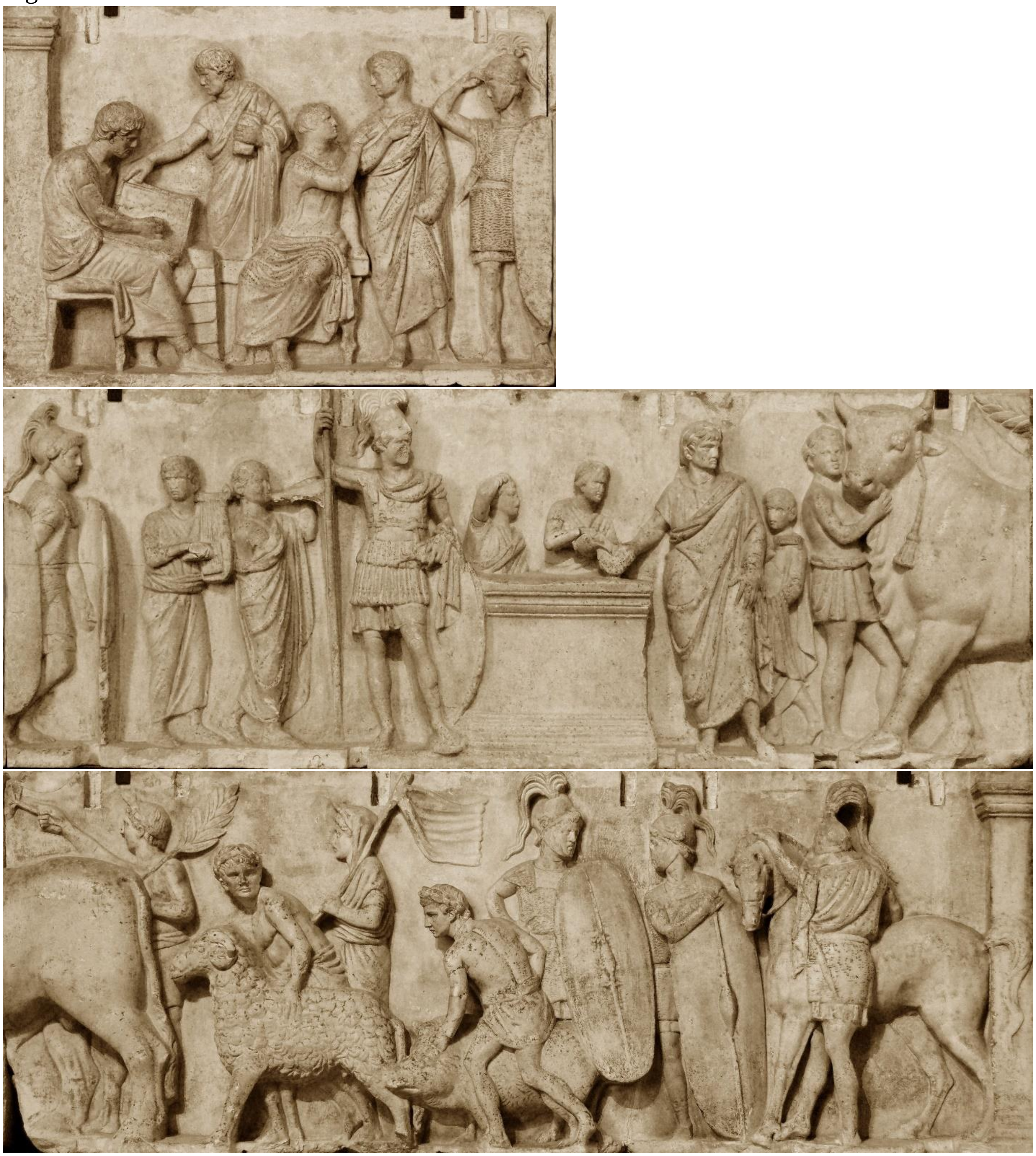


Figure 4.2: Detail of *eques* on the Paris frieze:

Figure 4.3: Detail of Mars on the Paris frieze:

Figure 4.4: Mars and magistrate from the Paris frieze

Figure 4.5: Elements of a Roman *gladius*

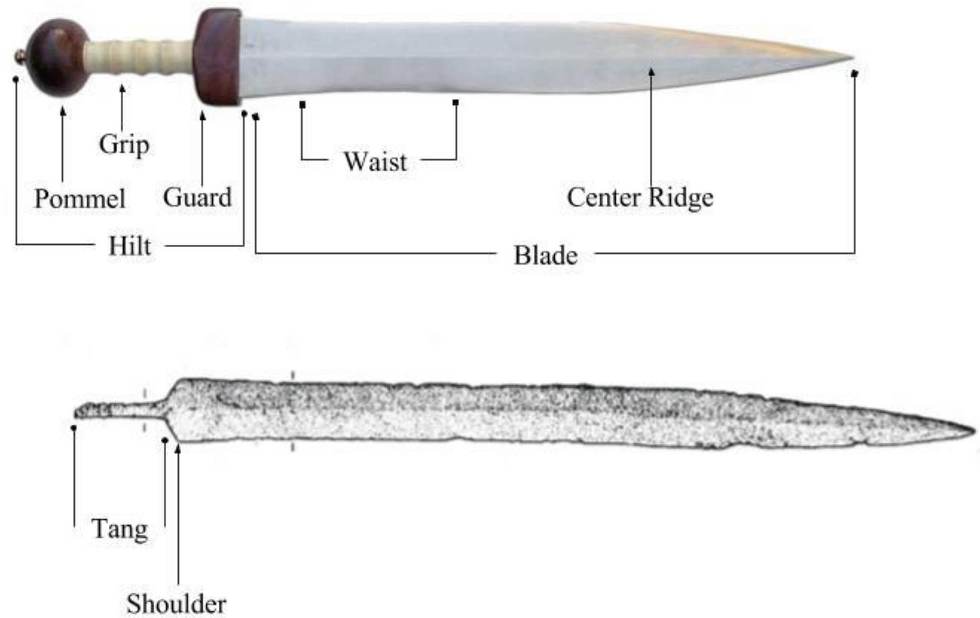
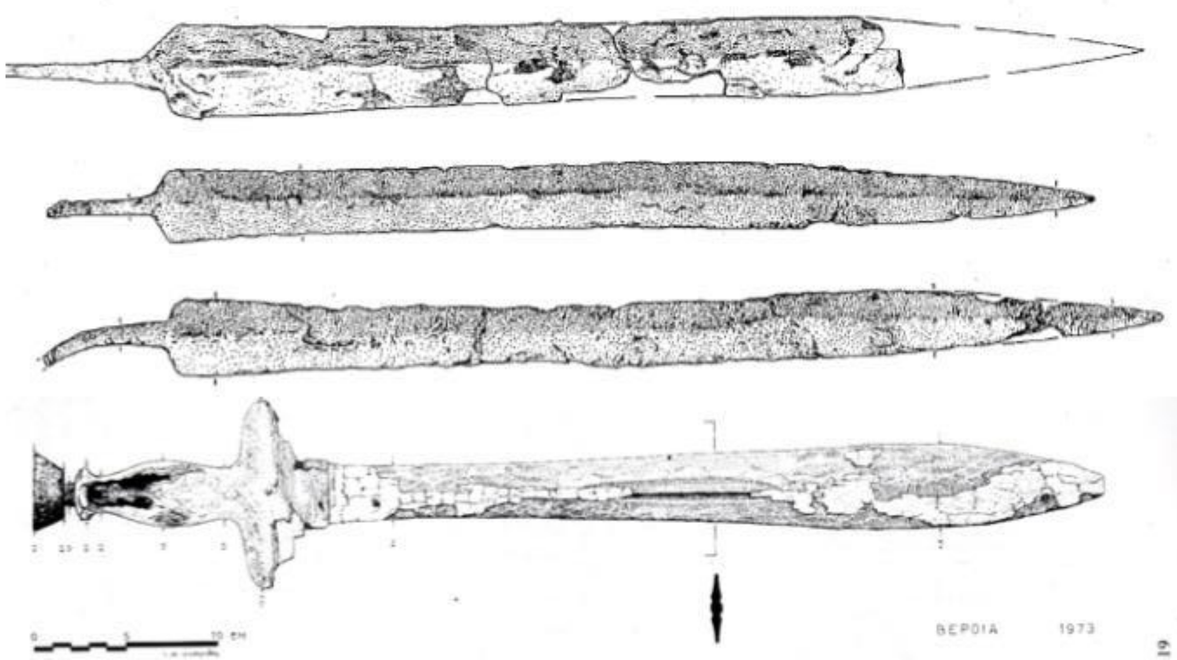


Fig. 4.6: Waisting in Roman *gladii*. From top to bottom, *gladius* from Osuna, Spain; Šmihel-2; Šmihel-1; *Xiphos*, the 'Sword of Beroia' with more strongly pronounced 'waisting.'[284]



[284] Scale drawings: P. Connolly (1997), 52. L. Touratsoglou, "Τὸ ξῖφος τῆς Βεροιας: Συμβολὴ στὴ Μακεδονικὴ ὁπλοποιία τῶν ὕστερων Κλασσικῶν Χρὸνων,"*Ancient Macedonia IV* (Thessaloniki, Institute for Balkan Studies, 1968), 617.

Fig. 4.7: Development of the *gladius Hispaniensis*.[285]

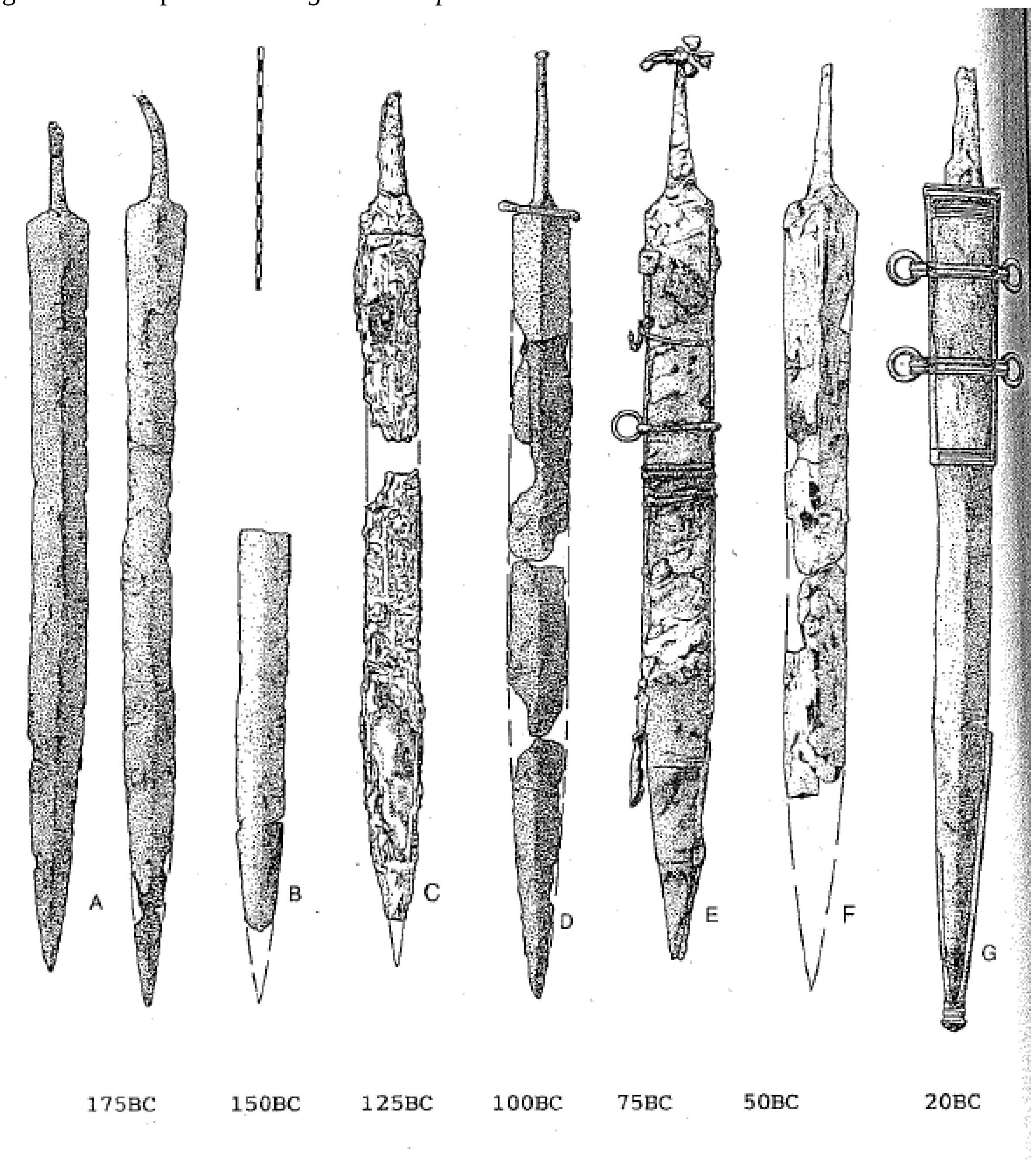
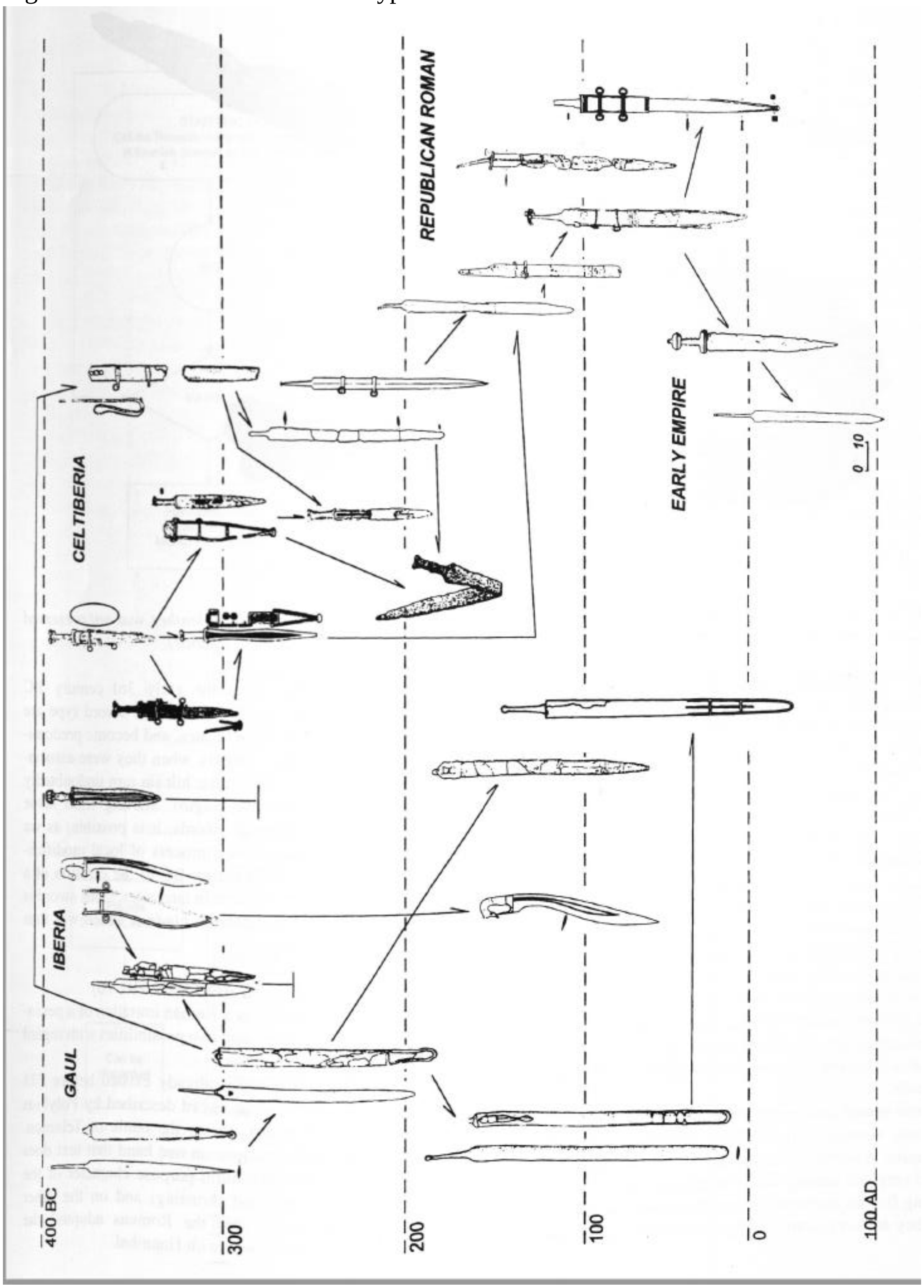


Fig. 11: *The development of the Gladius Hispaniensis: A, from Šmihel, Slovenia. B. from Renieblas III, Spain. C. from Es Soumâ, Algeria. D. from Mouriàs, France. E. from Delos, Greece. F. from Osuna, Spain G. from Berry-Bouy, France.*

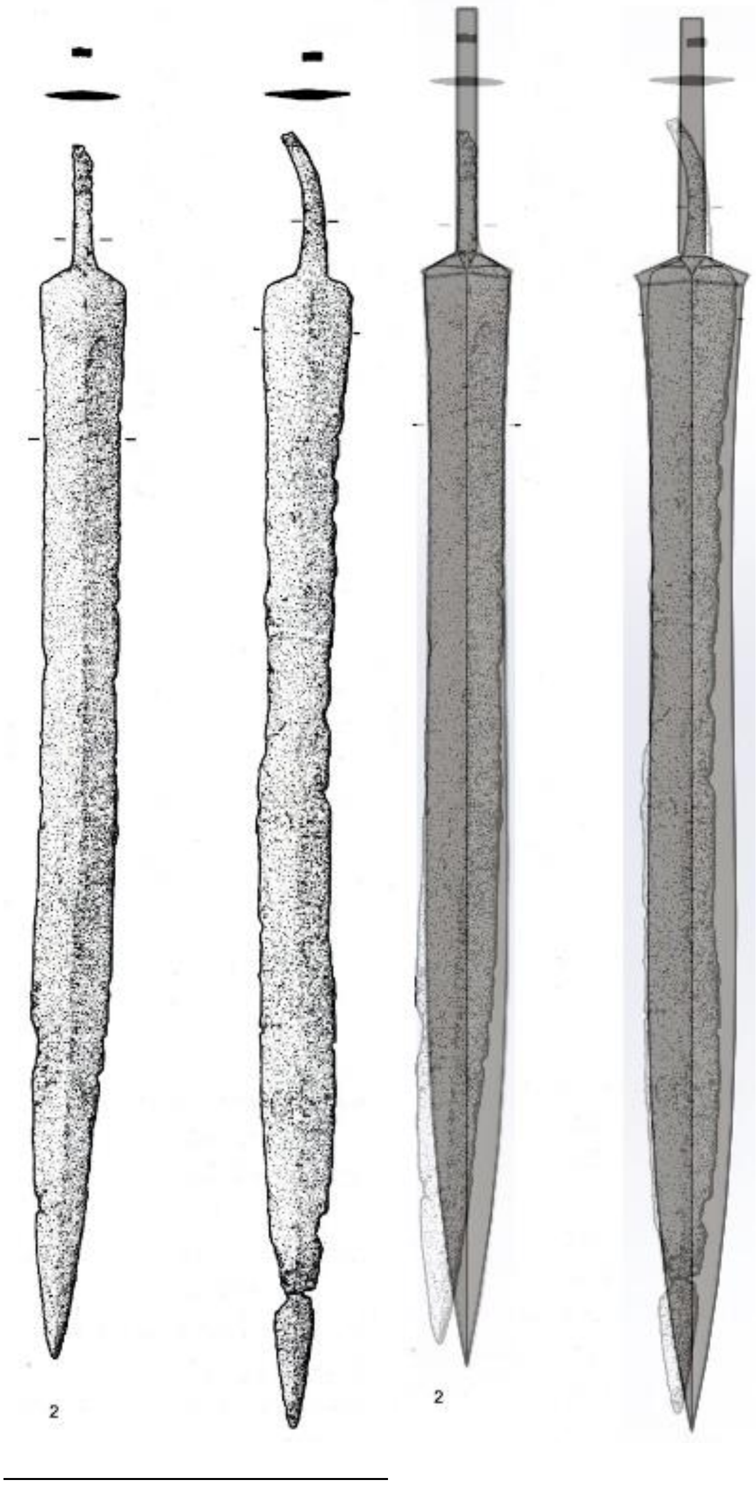
[285] Connolly (1997), 54, Fig. 11.

Fig. 4.8: Evolution of the *Gladius* type.[286]



[286] F. Quesada Sanz, (1997a), 265.

Fig. 4.9: Digital Reconstructions of two *gladii* from Grad near Šmihel[287]



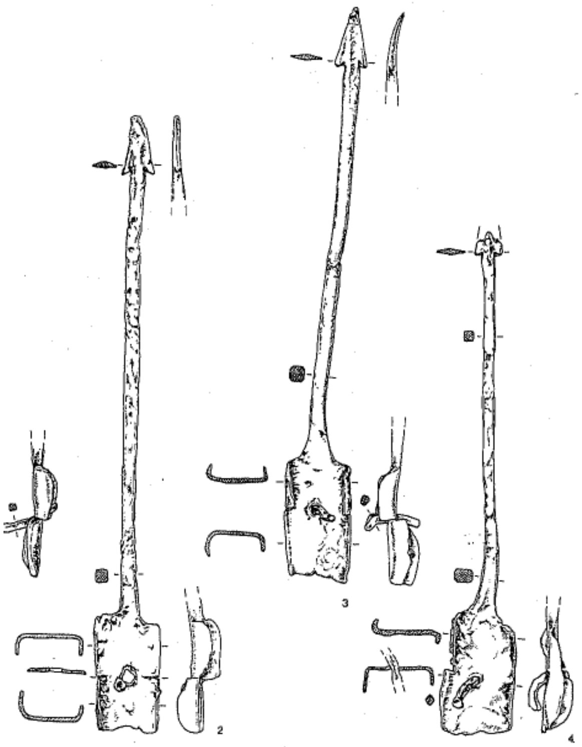
[287] Scale drawing of the swords from Bishop and Coulston (2006), 55.

Fig. 4.10: Three-Dimensional Projections of the reconstructed *gladii* from Grad near Šmihel

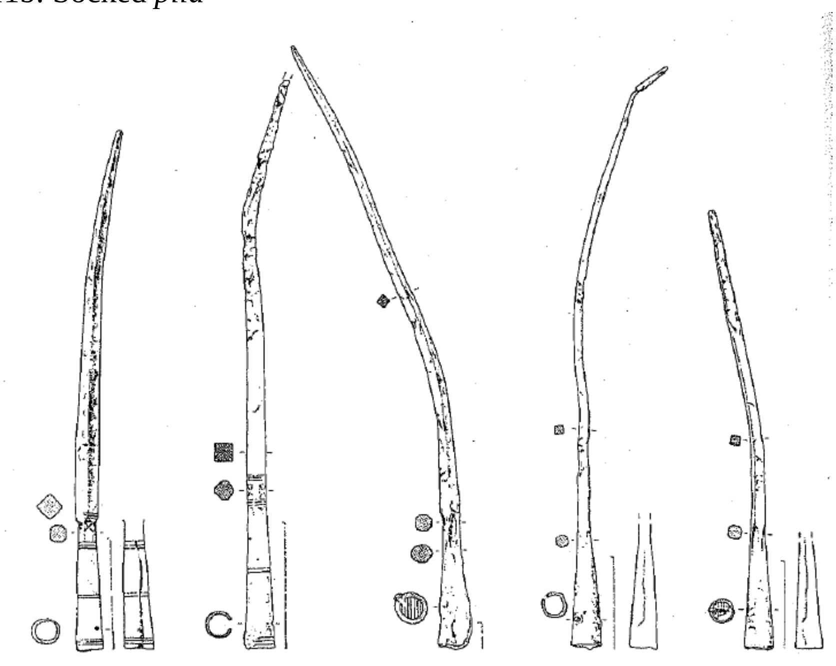
Šmihel-1 (680g)

Šmihel-2 (530g)

Figure 4.11: *Pila* from Grad near Šmihel [288]
4.11a: Flat Tanged *pila*

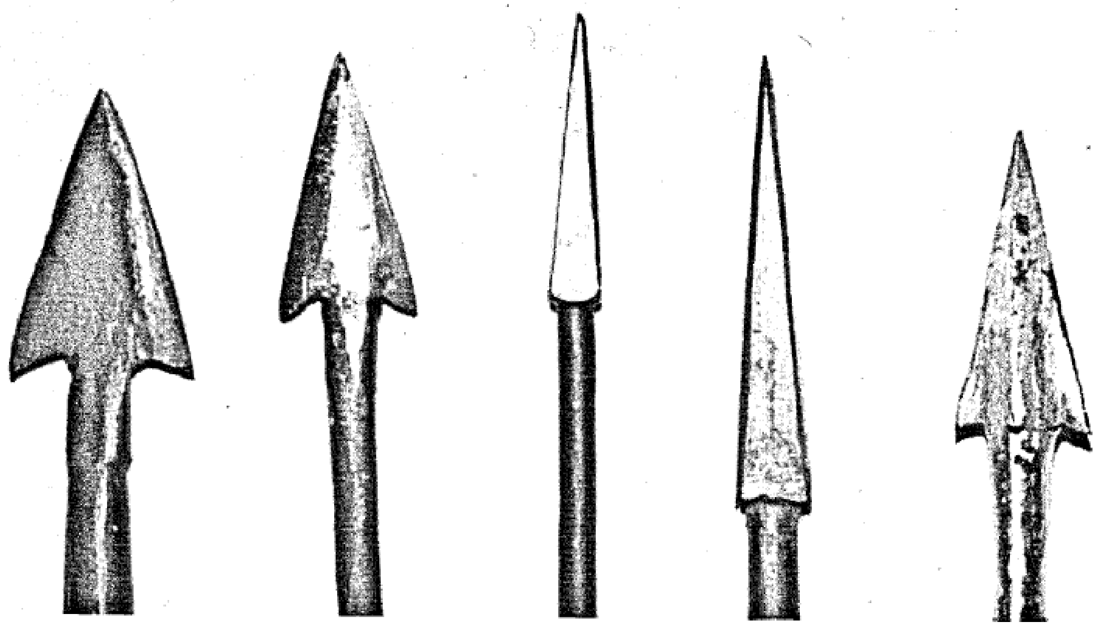


4.11b: Socked *pila*



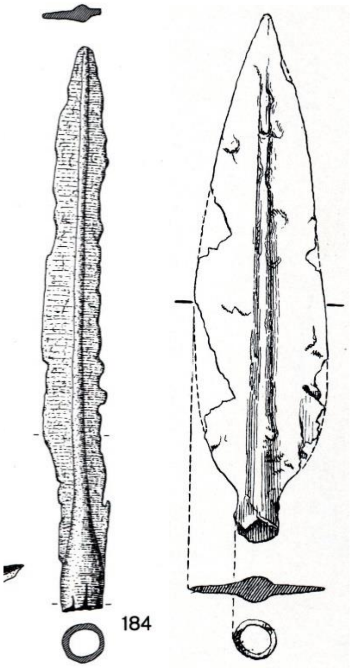
[288] Horvat (1997).

Figure 4.12: *Pila* tips reconstructed by Connolly; 3 and 4 are squared off 'bodkin' type points.



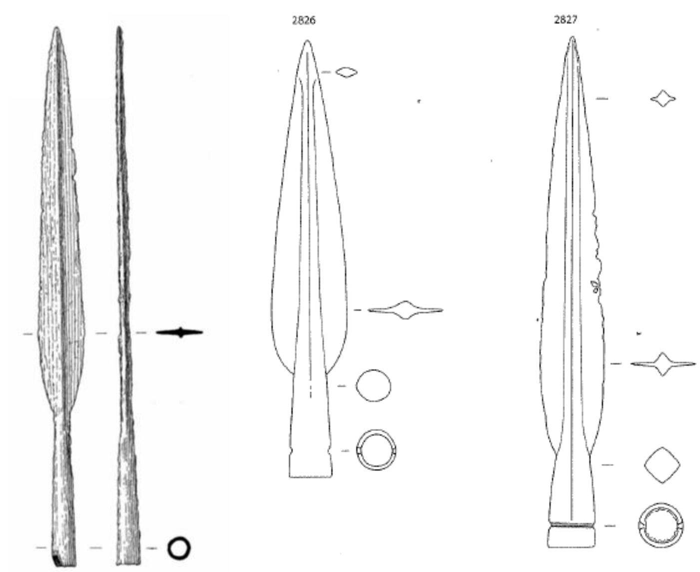
The five pilum points tested for piercing capability from left to right: 1 Telemonaccio type. 2 Smihel type 3 3 Hasta velitaris 4 Elongated pyramidal type 5 Barbed fin pyramidal type

Fig. 4.13: Type A (Mid-Ridge) Spear-Heads (not to scale):



Left to right: cat. R40 from Cáceres El Viejo, cat. R33 from Numantia.[289]

Gallic Examples (not to scale):



From left to right: cat. G75 (British Museum ML 2403), cat. G55-G56.[290]

[289] Images: Ulbert (1985), taf. 24. Schulten, (1929), taf. 45.5.

[290] Images: Left: British Museum ML.2403. Right: Thierry Lejars, (2013).

Fig. 4.14: Type B spearheads from Es Soumâa with rhombic cross-sections[291]

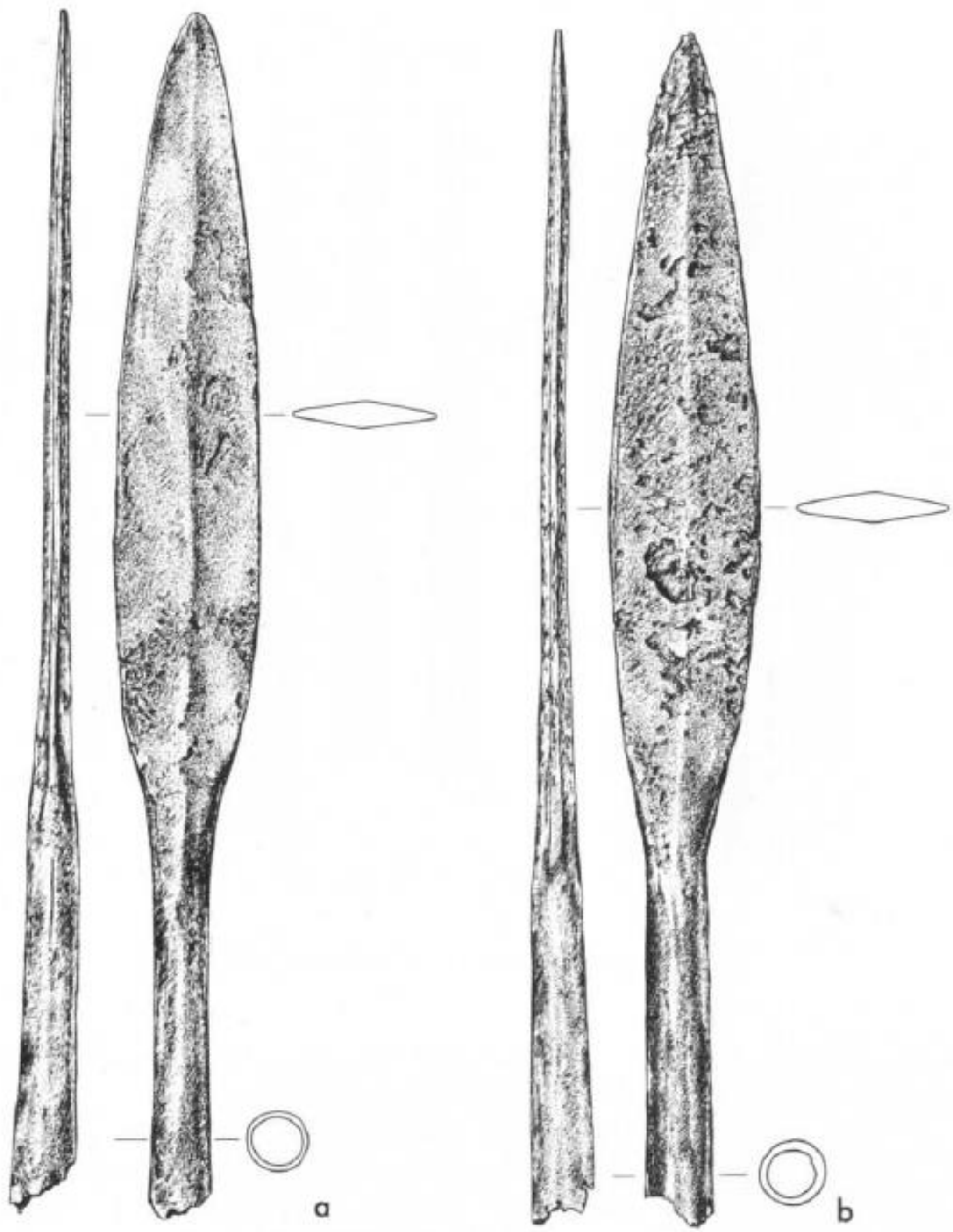
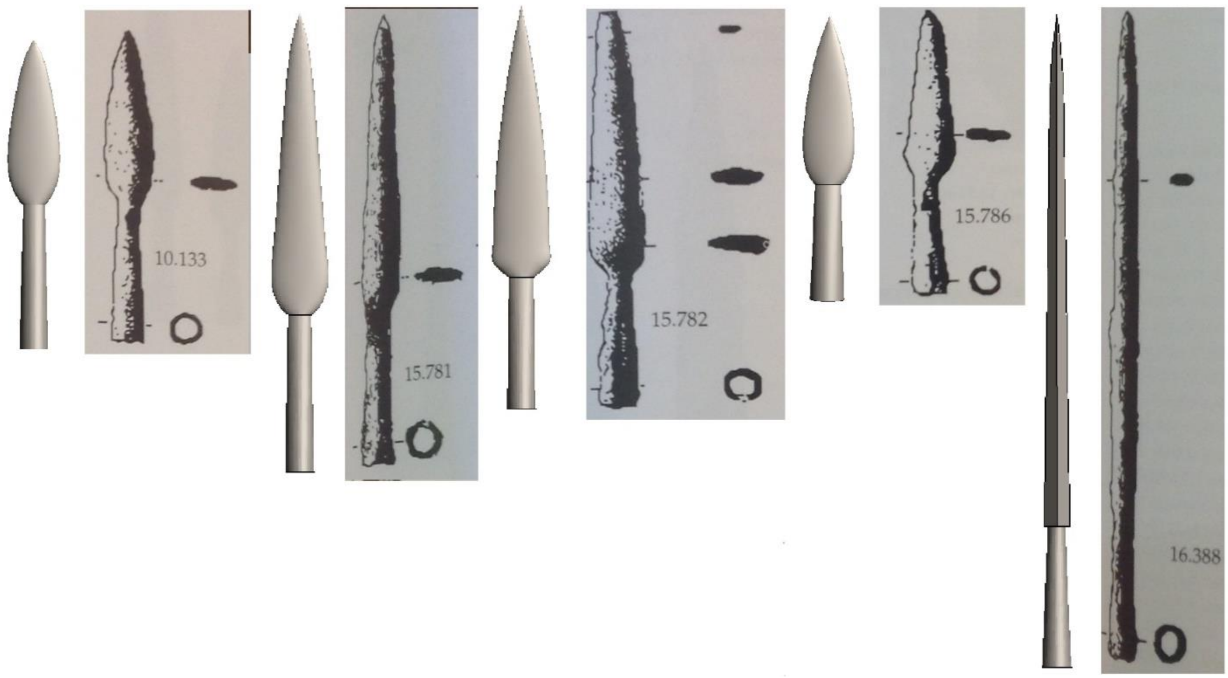


Abb. 201 Lanzenspitzen aus dem Grab von Es Soumáa. Maßstab 1 : 2.

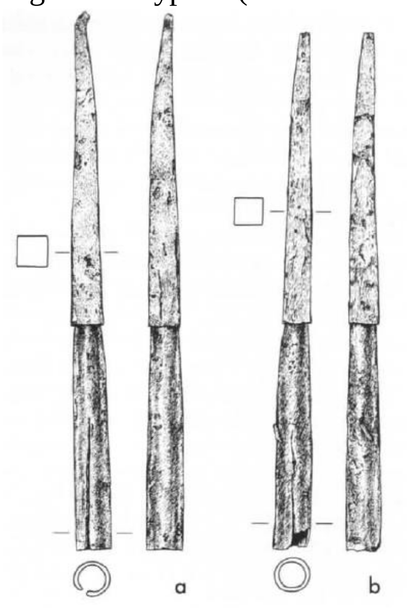
[291] Ulbert (1985), 355

Fig. 4.15: Digitally Reconstructed Spear Points from Caminreal (to scale):



Left to Right: cat. R20-R24.[292]

Fig. 4.16: Type C (Bodkin Point) Spear-Heads from Es Soumâa:

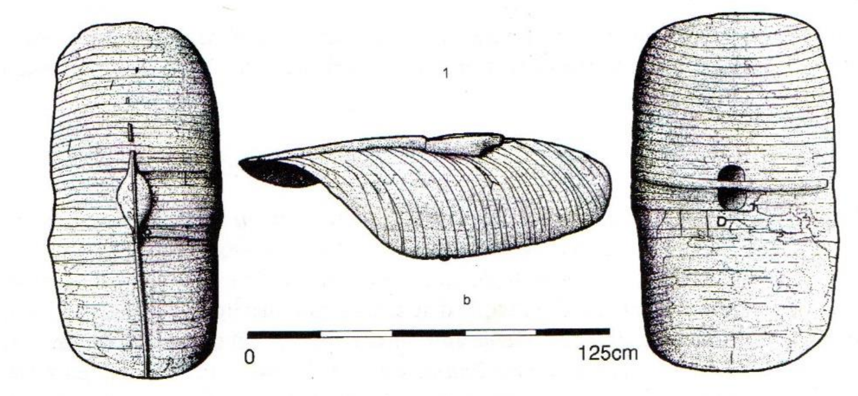


Left: cat. R45, Right: cat. R46.[293]

[292] Scale drawings from Vicente, *et al*., (1997), 167-99.

[293] Image: Ulbert, (1979), 337..

Fig. 4.17: Kasr al-Harit shield, from the Fayyum, Egypt[294]



294 Bishop and Coulston (2006), 62.

Fig. 4.18: Detail for the Paris Frieze. Red arrows point to raised detailing consistent with a boss; green circle marks traces of what may have been detailing for a metal rim.

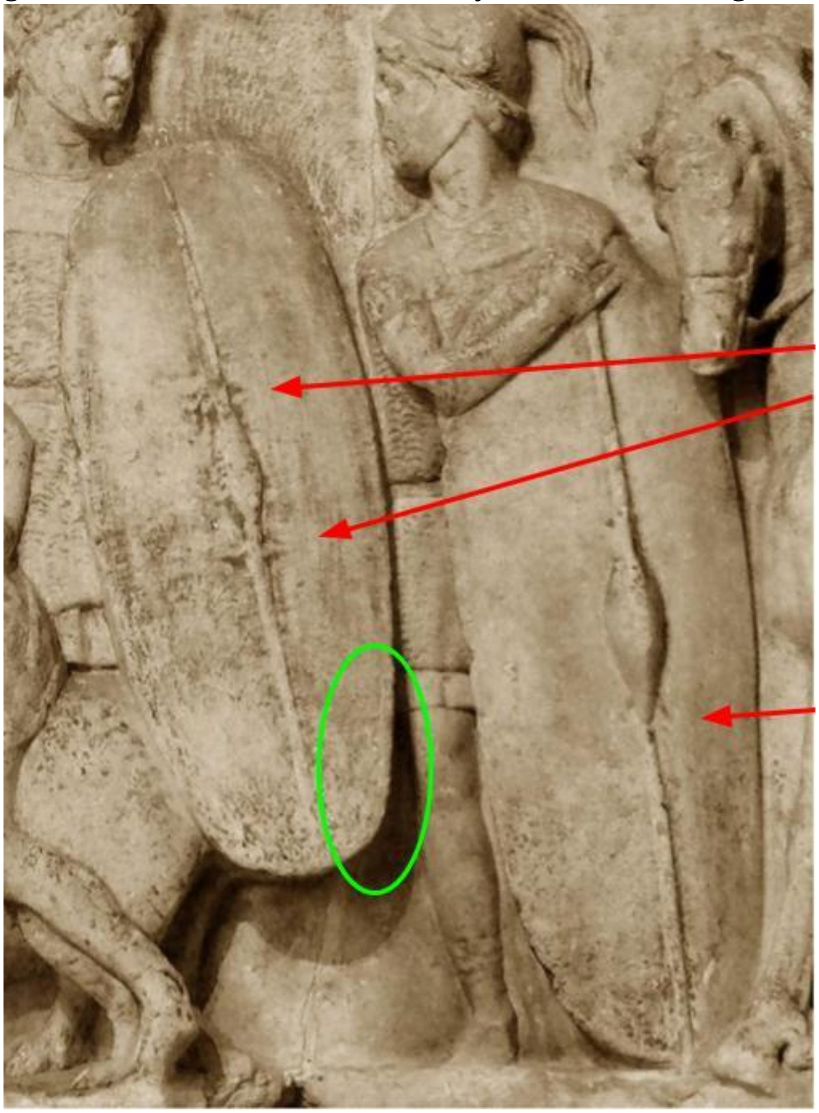
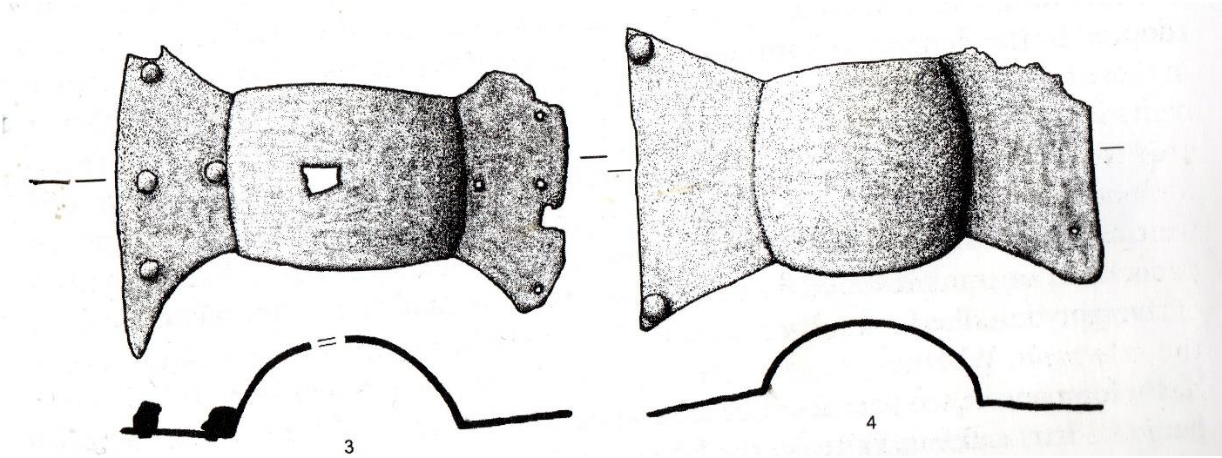


Fig. 4.19. Roman shield bosses (*umbones*) Top: Butterfly bosses from Caminreal; Bottom: spindle-shaped bosses, including a fragment from Lager III at Numantia. Images not to scale with each other.[295]

[295] Bishop and Coulston (2006), 62; Bockius (1989), 272.



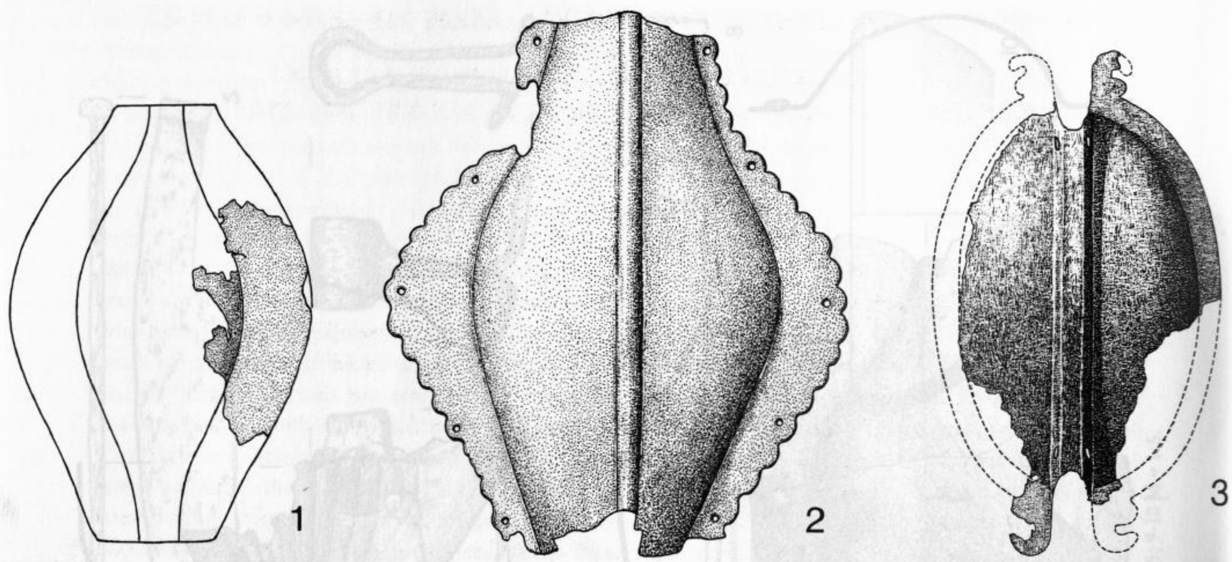
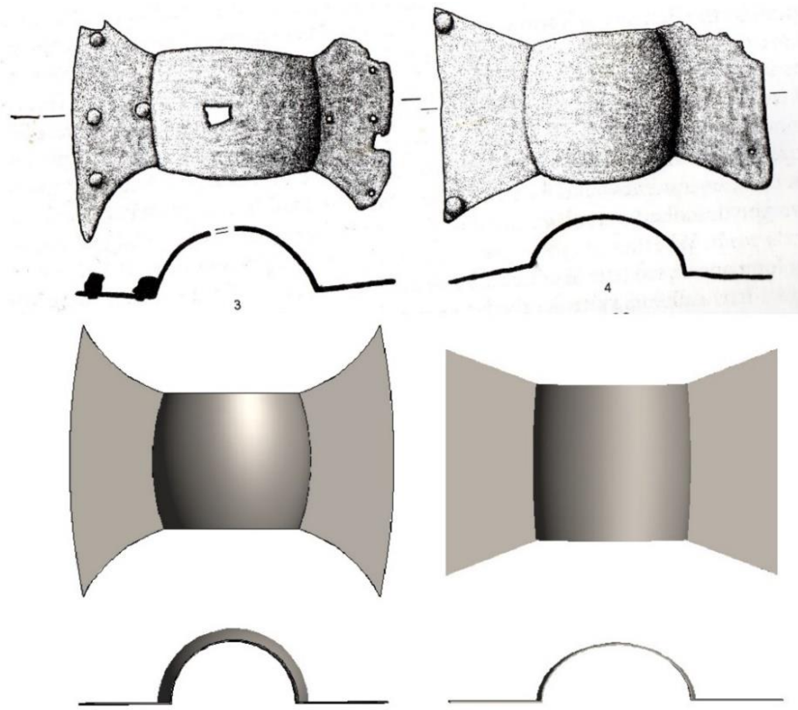


Abb. 3 1 Lager III von Renieblas bei Numantia, Prov. Soria. – 2 Gualdo Tadino, Prov. Perugia, aus Körpergrab 12. – 3 Ste.-Anastasie, Dép. Gard, aus Grab. – M = 1:3 (1 Umzeichnung nach Schulten, 2 nach Klindt-Jensen und Eichberg, 3 nach de Saint-Venant).

Fig. 4.20: Digital Reconstruction of the Caminreal *umbones*:



Left: cat. R52, Right: cat. R53.[296]

Fig. 4.21: Early Imperial shield rims from Aislingen and Spettisbury[297]

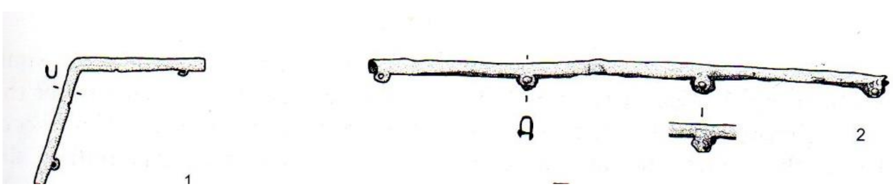
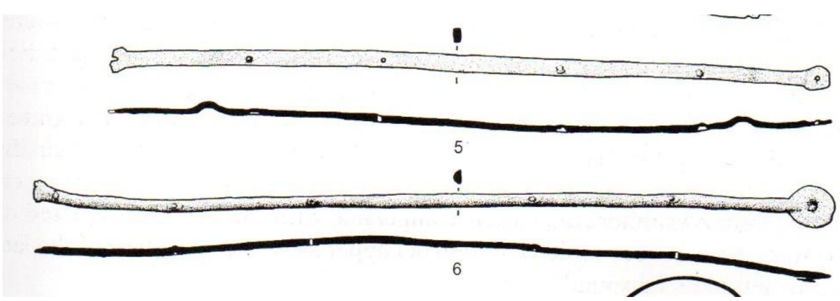


Fig. 4.22: Early Imperial handgrips from Newstead:[298]



[296] Scale drawing from Vicente, *et al*. (1997).

[297] Bishop and Coulston (2006), 93.

[298] Biship and Coulston (2006), 93.

Fig. 4.23: Shield Boss with Attached Maniple (NMB2902)[299]

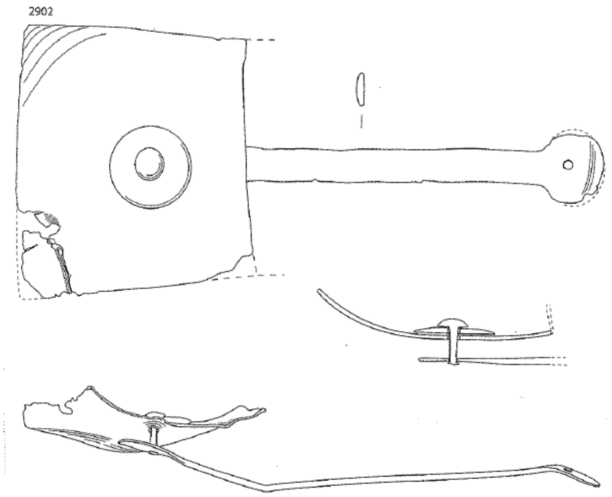
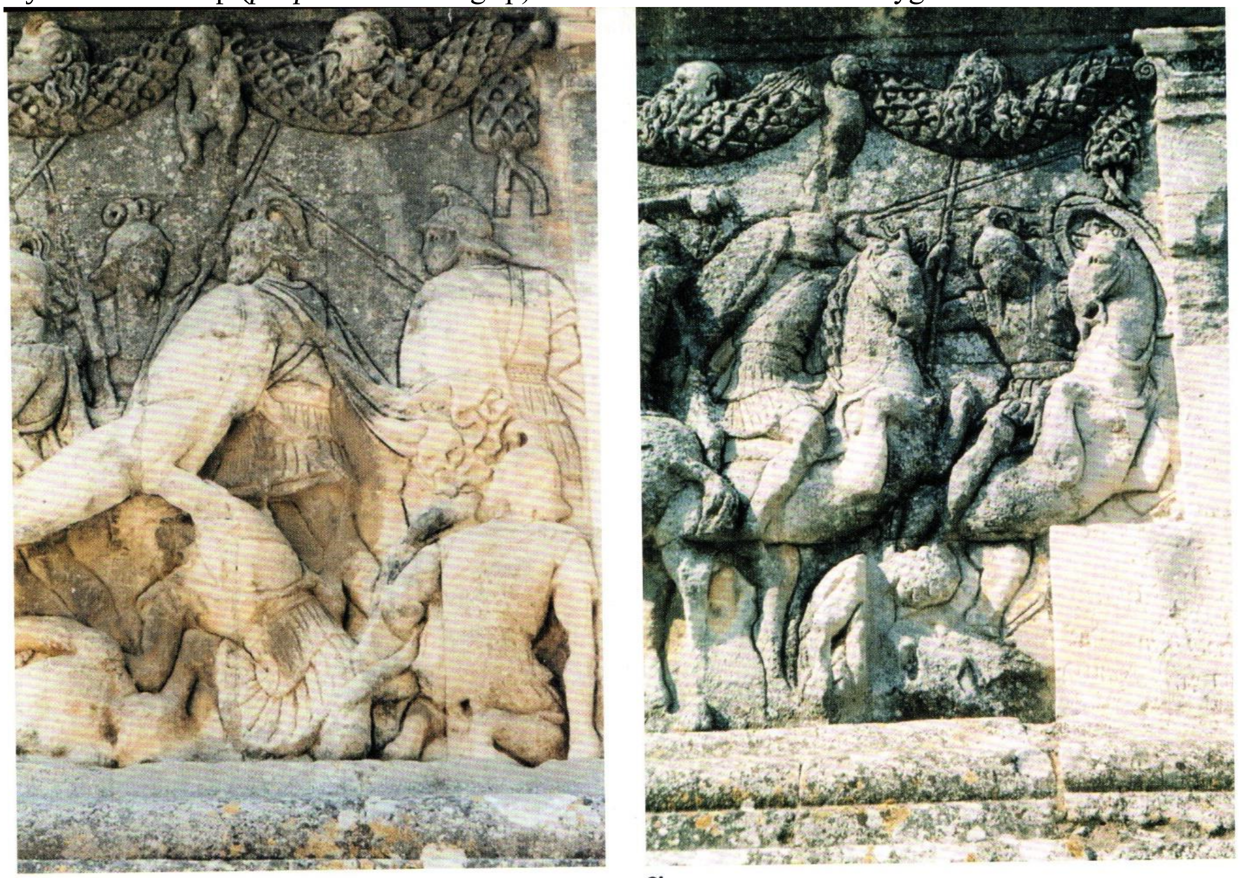


Fig. 4.24: Horseman for the Lacus Curtius, showing the cavalry *parma* as a round, center-bossed shield:[300]

[299] Scale drawing: Lejars, (2013).

[300] Connolly (1981), 133.

Fig. 4.25: Details from the Glanum relief, showing 'Roman' infantry and cavalry with Greek-style double-strap (*porpax-antelabe* grip) shields and Hellenistic 'Phrygian' helmets.[301]



301 D'Amato (2009), 12.

Fig. 4.26: Hellenistic soldier in Roman-style equipment with a Hellenistic variant of the *scutum* (the *thureos*) and mail armor. From the stele of Salmas in Sidon.[302]

67 Sidon Stele [3] and detail

[302] Sekunda (1994) vol 2, 73, fig. 67.

Fig. 4.27: Detail from the Paris Frieze. Note especially that the soldier's shoulder-doubling appears clearly as an extra-layer of mail over the main mail shirt of the *lorica hamata* when viewed from the side.

Fig. 4.28: Statue of the Vacheres warrior. Note especially that his mail sleeve protrudes beyond the second layer of mail provided by the shoulder-protection.

Fig. 4.29: Armor rings from Thorsberg (150-250 C.E.):[303]

Figure 88: Two rings from Thorsberg showing facets on the outside diameter

Fig. 4.30: Imperial period armor rings from Arbeia and Leiden. Top-left image shows a rusted-together concretion of rings, which is a common find-condition for many iron armor rings.[304]

Plate 4:
a. A concretion of Roman ring mail from Arbeia showing corrosion
b. Ring mail rings from Arbeia. Outside diameter of rings 7.50mm, thickness 1.3mm.
c. Solid and riveted rings from Leiden

[303] Sim and Kaminski (2012), 125.

[304] Sim and Kaminski (2012), Plate 4.

Fig. 4.31: Capestrano Warrior statue.[305]

[305] Drawing from Connolly (1981), 101.

Figure 4.32: Iberian pectoral harness with circular-ring motifs in the Museo Arqueológico Nacional, Madrid (cat. I28)

Fig. 4.33: Italic Rectangular Anatomical Cuirass (front plate and back plate) in the British Museum (cat. R72):

Figure 4.34: Warrior on squat lekythos, 350-330 B.C.E. (British Museum 1986,0403.4)

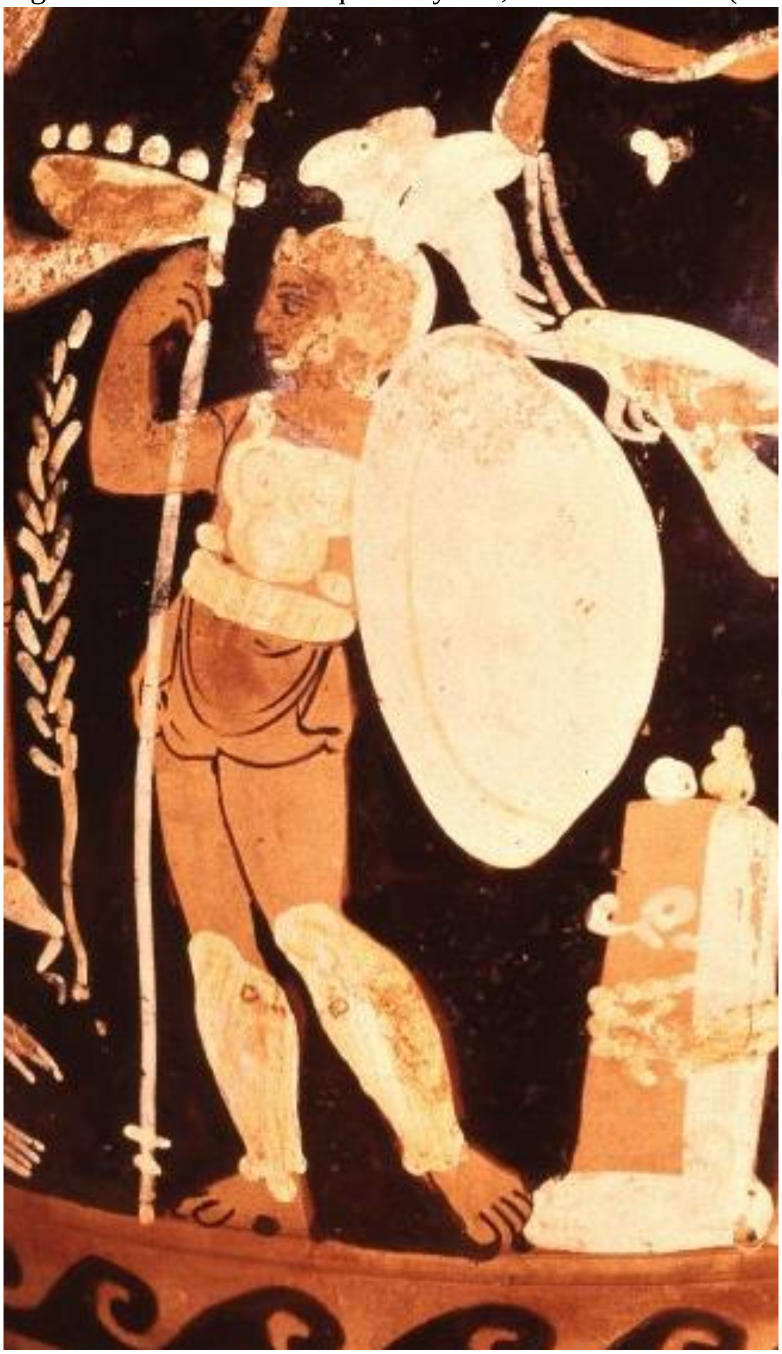


Fig. 4.35: Remains of a triple-disc pectoral in the British Museum (cat. R78):

Fig. 4.36: Montefortino helmet, basic features.[306]

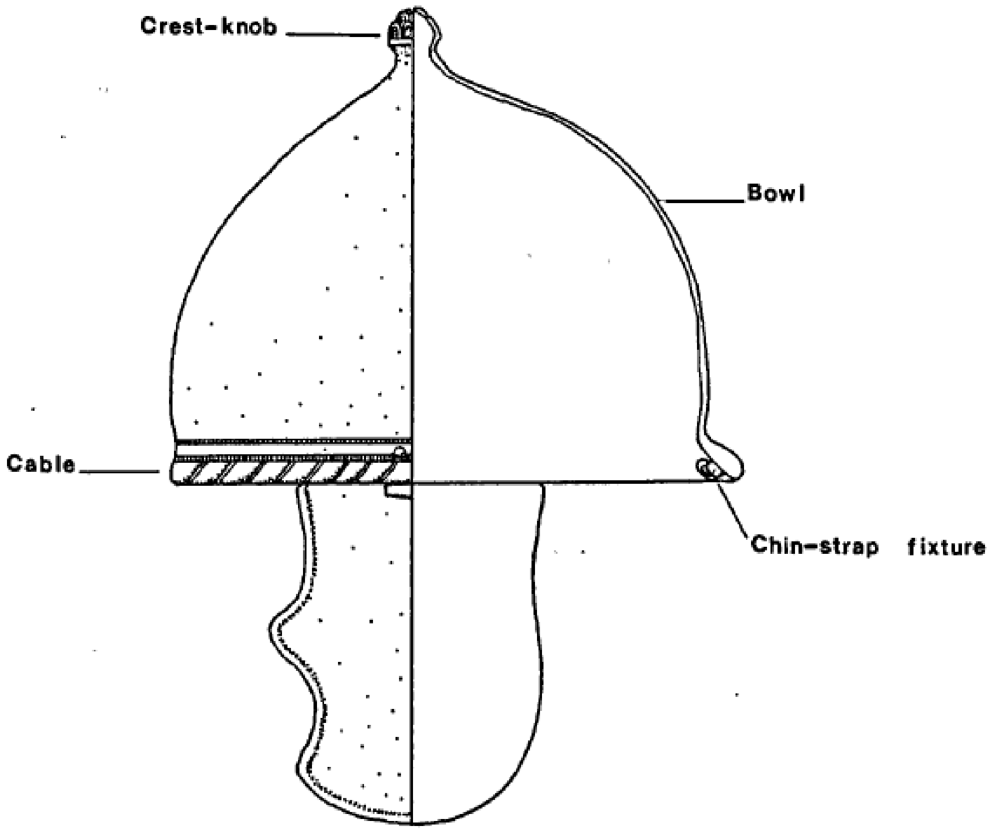
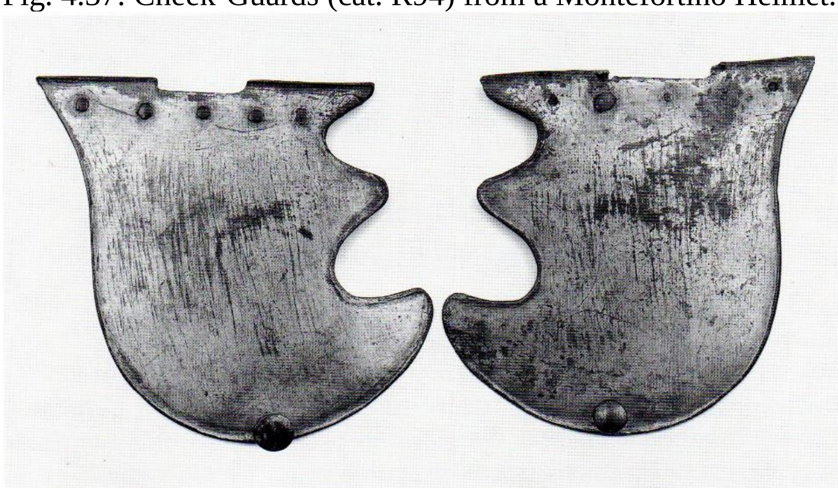


Fig. 4.37: Cheek-Guards (cat. R94) from a Montefortino Helmet.[307]



[306] From Paddock (1993), 472, fig. 123.

[307] Junkelmann (2000), 163.

Figure 4.38: Osuna Relief, showing greaves worn on the left legs.[308]

[308] D'Amato (2009), 18.

Fig. 4.39: Reliefs from Palestrina.[309]

[309] Feugère (1993), 4.

CHAPTER 5: THE MACEDONIANS

This chapter presents resource-intensity reconstructions for the equipment of the major Hellenistic states, in the same manner as the previous chapter did for the Roman Republic. As with the reconstructions of both Roman equipment (Chapter 4) and that of pre-state peoples (Chapter 6), the primary quantitative tool for this comparison is metal-weights, used as a proxy for cost, although non-metal equipment factors into this reconstruction and analysis of it rather more than in the previous chapter. Part of the core purpose of this chapter is to provide a comparative benchmark against which to measure the Roman evidence. Thus the comparison focuses on Hellenistic armies as organized and deployed during the period of open conflict with Rome, which is to say the last quarter of the third century and the first half of the second century. This does mean that certain trends in the composition and organization of Hellenistic armies after c. 160 BCE (such as 'Romanizing' organizational or tactical reform, or further changes in the ethnic composition of these armies) fall outside of this limited chronological scope and are not discussed in depth here.

This chapter, then, first discusses the main sources of evidence on which the reconstruction is based, before identifying the many types of regular, mercenary and auxiliary soldiers available to Hellenistic kings. The core 'Macedonian' elements of these armies, which make up the heaviest and most resource intensive parts, are the focus of this chapter and are reconstructed in detail. After the reconstructions, preliminary conclusions are drawn from the final figures for the resource requirements of these soldiers, especially as compared to the figures for the Roman army generated in the previous chapter. The evidence for the Hellenistic armies of this period poses significantly greater difficulties than the Roman evidence. This chapter thus also endeavors to clarify which conclusions are to be considered more secure, and which are necessarily more speculative.

Sources

While the main problem in reconstructing the equipment of the Roman legion was reconciling the many, often unclear or conflicting, sources, the problem for major Hellenistic powers is the opposite: to assemble a complete reconstruction out of the fragmentary and often patchwork descriptions that survive. No outsider's full description of Hellenistic armies, of the sort that Polybius composed for the Roman legion, survives. Instead, descriptions of Hellenistic military equipment in the sources tend to be dispersed and often frustratingly lacunose.

The main contemporary description of the Hellenistic phalanx is that of Polybius, who offers a comparison of the Roman and Macedonian fighting styles.[1] He does disclose a number of key details for the phalanx, such as the spacing of individual soldiers, and the length of the *sarisa*, but he does not discuss the organizational structure of the formation or the other equipment used.[2] Moreover, his comparison poses an interpretive problem, given his argument that the Hellenistic *sarisa*-phalanx was an altogether inferior formation to the Roman legion. As a result, we should hesitate to credit some of what he claims. Polybius' insistence, for instance on the inflexibility and vulnerability of the phalanx seems to run counter to the Seleucid phalanx's ability to form a defensive square successfully when pressed.[3] Polybius himself

[1] Plb. 18.28-32.

[2] Plb. 18.29.1-5.

[3] Plb. 18.31.7-12. Cf. App. *Syr*. 35, where the Seleucid phalanx "nevertheless put forth their close-packed *sarisae* at all four angles" ὅμως δὲ τὰς σαρίσσας ἐκ τετραγώνου προβαλλόμενοι πυκνὰς.

admits that Pyrrhus' formation, combining a Hellenistic phalanx with Italic heavy infantry, was more flexible and effective than the unalloyed form he criticizes; it had been a match for third century Roman legion in the field.[4] Thus Polybius' criticisms, while valuable, must be treated with some care. However, his primary limitation as a source for these purposes is that he assumes a reader already familiar with Hellenistic warfare, and perceives no need to explain exactly what is entailed in equipping soldiers 'in a Macedonian manner.'

For a more complete rendering of Hellenistic equipment and tactics, we are thus often forced to rely on later sources. The most valuable of these is Asclepiodotus' *Tactics*, which provides a complete organizational summary of a model Hellenistic phalanx, and occasional brief descriptions of the expected armaments of the traditional parts of a Hellenistic army. Asclepiodotus, however, was no commander himself, but a philosopher, and the phalanx he presents, along with its equipment, is idealized. The date of composition is uncertain, but it likely to be during the first century B.C.E., when the phalanx outlined was very nearly a defunct formation.[5] Perhaps the most valuable evidence Asclepiodotus provides is his detailed organizational summary of the normal divisions of a Hellenistic phalanx, which seem generally to map well onto the inscriptional evidence for the Antigonid army, though this sometimes uses different terminology.[6] Further information on the formations and equipment of the period is

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[4] Plb. 18.28.10-11.

[5] Connolly (1981), 76. K. K. Müller, "Asklepiodotus" *RE* ii col. 1637-1641. Note also the useful introduction and discussion of the author in the Loeb edition, *Aeneas Tacticus, Asclepiodotus, and Onasander*, trans. Illinois Greek Club (Cambridge: Harvard University Press, 1928), 230-243. On the reliability of Asclepiodotus and the genre of philosophical military manuals in general, note esp. G. Wrightson, "To Use or Not to Use: The Practical and Historical Reliability of Asclepiodotus's 'Philosophical' Tactical Manual" in *Ancient Warfare: Introducing Current Research* eds. G. Lee, H. Whittaker and G. Wrightson (Newcastle on Tyne: Cambridge Scholars Publishing, 2015), 64-93.

[6] Asclepiodotus 2.1-10. Sekunda (2013), 88-98. Hatzopoulos (2001), 76-80.

occasionally preserved in Plutarch's *Parallel Lives*, most notably in the *Life of Philopoemen*, where Plutarch contrasts the equipment and fighting style of the Greek *thureophoros* with heavy infantry equipped in Macedonian style.[7] Plutarch, too, must be treated with significant care, however, as he is writing at even greater chronological distance than Asclepiodotus and, like him, is no soldier.

Another major type of literary evidence for Hellenistic armies is figures preserved for specific battles and deployments by the major Hellenistic powers. Polybius presents figures for a number of important events, most notably for the Battle of Sellasia (222), the Battle of Raphia (217), and a Seleucid military parade at Daphne (166).[8] Livy provides figures for the Macedonian army raised for the Third Macedonian War when it formed up at Citium (171), as well as providing, along with Appian, figures for the Battle of Magnesia (190).[9] These orders of battle are particularly important given the lack of a full organization summary of actual (rather than idealized) Hellenistic armies, since they offer a sense of the scale of particular units, and the types of auxiliary troops typically present. These orders of battle can be of limited use insofar as the equipment of each component of the battle is often not specified and must instead be inferred from other evidence.[10] Moreover, many units are simply described with ethnic markers; it can be unclear if these classifications indicate ethnic origin, or equipment style, or both.[11]

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[7] Plut. *Philop*. 9.1-5.

[8] Sellasia: Plb. 2.65.2-4. Raphia: Plb. 5.65, 79-87. Daphne: Plb. 30.25.

[9] Liv. 42.51, 37.40. App. *Syr*. 32. Appian and Livy are clearly working from the same source, likely Polybius.

[10] Sekunda (2013), 108-127 does this for the Antigonid armies at Sellasia and Citium, but is compelled by the limited evidence to allow for a great deal of uncertainty, especially in the 'ethnic' contingents.

[11] Fischer-Bovet (2014), 169-195.

Given the weaknesses and lacunas of the literary evidence, we are forced to rely even more heavily on the representational evidence to correlate weapons and armor mentioned by our sources with the surviving archaeological evidence. One important source is Hellenistic funerary artwork. A number of painted tombs and funeral stelae, most notably the painted tomb of Lyson and Kallikles, provide valuable representational evidence for the equipment of the Macedonian soldiery.[12] In addition, state artwork of equipment provides a valuable resource, especially as it is often datable. The depiction, for instance, of helmets and shields as common motifs on Hellenistic coins provides the basis for understanding chronological change and variation in both equipment types, given the limited archaeological evidence.[13]

One representational artwork of particular note is the Alexander Mosaic from the House of the Faun in Pompeii, now in the Naples Archaeological Museum (fig. 5.1a). Though damaged, the surviving image depicts not only Alexander fighting on horseback, but also the Macedonian cavalry behind him, as well as the row of *sarisae* from his infantry which loom over Darius in the composition. The mosaic itself likely dates to the early first century BCE, but it is thought to be a copy of a third century original.[14] Although the mosaic is damaged, elements of it, in particular the horse equipment, which is of accurate, late fourth century style, strongly

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[12] S. Miller, *The Tomb of Lyson and Kallikles: A Painted Macedonian Tomb* (Mainz am Rhein: Philipp von Zabern, 1993).   Sekunda also discusses this tomb at length, though some of his conclusions seem questionable, Sekunda (2013), 9-20. Painted funeral stele, note esp. Sekunda (1995).

[13] P. Dintsis, *Hellenistiche Helme* (Rome: Giorgio Bretschneider Editore, 1986). K. Liampi, *Makedonische Schild* (Bonn: R. Habelt, 1998).

[14] A. Cohen, *The Alexander Mosaic: stories of victory and defeat* (Cambridge: Cambridge University Press, 1997). J. K. Anderson notes the accuracy of the horse equipment for the late fourth century depicted in the mosaic, J. K. Anderson, *Ancient Greek Horsemanship* (Berkeley: University of California Press, 1961), 75. Palo Moreno argues for the Alexander Mosaic's lost original to be attributed to Apelles, which would make the original contemporary with Alexander, P. Moreno, *Apelles: The Alexander Mosaic*, trans. D. Stanton (Milan: Skira editore, 2001).

On the use of the mosaic for reconstruction, note also Connolly (2000a), 106-7.

suggest that the original composition was produced with well-informed attention to late fourth century Macedonian equipment. As a result, despite the late date of the actual mosaic, it remains a uniquely valuable representational source.

Finally, epigraphic evidence can be an important element for the study of Hellenistic armies. Militiades Hatzopoulos' study of the Antigonid army rightly puts the inscribed evidence, his *documents nouveaux*, up front in the title.[15] Of particular importance for this study is the inscribed Antigonid military regulations from Amphipolis, dated to the reign of Philip V (r. 221-179), which list the fines for failure to appear at muster with each piece of equipment required for both officers and regular soldiers.[16] The inscription is not without difficulties, as some terms for equipment used in it are of uncertain meaning. However, it provides the only official listing of equipment for a Hellenistic army to survive, and as such is of tremendous value.

One bias in the distribution of these sources must be mentioned: they come disproportionately from Macedonia proper or the Aegean, rather than from the larger Hellenistic states in the Greek East. This limitation is present to one degree or another in nearly all of the evidence types, and is intensified by the outsized impact and preservation of material from the reigns of Philip II and Alexander III, which tend to further bias the material towards practice in Macedonia proper and away from the successor states of the Near East. The literary sources, focused on Roman expansion, give far more attention to the Antigonid armies than they do to the Seleucid or Ptolemaic ones. At the same time, the balance of representational evidence heavily favors the Antigonid kingdom, with no ready Ptolemaic or Seleucid match for the tomb paintings

[15] Hatzopoulos (2001).

[16] The inscription is SEG 40.524. M. Hatzopoulos, *Macedonian Institutions Under the Kings*, vol. 2 (Paris: De Boccard, 1996), 32-36. Hatzopoulos (2001), 161-4.

at Lefkadia, the tomb of Lyson and Kallikles, the royal tombs at Vergina/Aigai, or the Amphipolis military regulations.[17] The archaeological evidence likewise tends to come from Greece, Macedon and Southern Italy. Southern Italy in particular provides an outsized proportion of preserved Greek military equipment for the third century, as the custom of burying warriors in armor remained common there long after it had fallen out of favor in Greece. It is not always clear how typical the equipment from Southern Italy would have been; heavier armor and equipment seems to have consistently survived longer and remained more popular in Southern Italy than in Greece proper.[18]

The consequence of this westward skew in the evidence is that many of our assumptions about Hellenistic armies in general derive almost exclusively from evidence about the Antigonid army in particular. While we are comparatively better informed about the organization of the Seleucid and Ptolemaic armies, any regional variations in their equipment remain obscure to us. Using the Antigonid army as a basis for understanding the equipment and tactics of the other major Hellenistic states is not an entirely foolhardy approach. Polybius is willing, as noted below, to use Antigonid unit terminology to describe Ptolemaic and Seleucid formations, which implies a great deal of similarity between them. Likewise, nearly all of the literary sources describe *sarisa*-phalanx units using some variation of the phrase “armed in the Macedonian manner,” suggesting that the equipment of these units varied little and that they were broadly interchangeable.[19] That assumption is not implausible *a priori*; all of these systems not only had

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[17] However, Sekunda does note a number of painted grave stelae from the Ptolemaic Levant featuring *thureophoroi* which are quite valuable for this troop type, Sekunda (1995).

[18] T. Everson, *Warfare in Ancient Greece: Arms and Armour from the Heroes of Homer to Alexander the Great* (Stroud: Sutton Publishing, 2004), 112, 144. A. M. Snodgrass, *Arms and Armour of the Greeks* (Ithaca: Cornell University Press, 1967), 128.

[19] Polybius uses variations of εἰς τὸν Μακεδονικὸν τρόπον to mean *sarisa*-phalanx troops, e.g. of Ptolemaic troops Plb. 5.65.8, of Seleucid troops Plb. 5.79.4-5. Plut. *Philop*. 9.2 contrasts Greek fighting techniques with the *sarisa*-

common descent from Alexander's army, but also seem to have changed and evolved relatively little since then. It is thus not unreasonable to suppose they would have remained broadly comparable in terms of equipment, even as regional variations in organization and recruitment became increasingly entrenched. That said, this basic limitation to the source material, and thus the need to frequently extrapolate from only one of the major Hellenistic states, and the smallest one at that, should be noted at the outset. It remains entirely possible that future archaeological discoveries could show more substantial regional variation than the current limited state of the evidence indicates.

Composition of Hellenistic Armies

Even more so than Roman armies in this period, Hellenistic armies tended to be composite forces, with troops representing the full reach of each king's influence. In consequence it is necessary to discuss the composition of these armies on campaign in greater depth. Despite their differences, elaborated on below, the armies of the three Hellenistic great powers functioned similarly in that they consisted of a core phalanx, generally the heaviest part of the army, usually composed of ethnic Greeks and Macedonians (often simply called 'the Macedonians' as a collective group in the sources), supported by a diverse array of 'ethnic' and mercenary contingents, fighting in local style. Reconstructing the full panoplies for all of these ethnic contingents is beyond the scope of this work, and in many cases beyond the strength of the surviving evidence. The section following this one will attempt, however, to give an overview of

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phalanx which he terms 'Macedonian.' App. *Syr*. 32 refers to the core Seleucid phalanx as ἡ φάλαγξ ἡ Μακεδόνων and describes it as "arrayed after the manner of Alexander and Philip" (ἐς τὸν Ἀλεξάνδρου καὶ Φιλίππου τρόπον), suggesting little tactical change. Livy 37.40.1 note the men of the Seleucid phalanx "were armed after the manner of the Macedonians" (*more Macedonum armati fuere*).

such contingents and what is known of their equipment. However, it is the ‘Macedonian’ portions of these armies, which typically composed the heaviest infantry as well as the heavy cavalry, which will be fully reconstructed in the pattern of the previous chapter. This section will proceed first to lay out the organization of the main units of the common Macedonian core of these armies (their equipment will be reconstructed later in the chapter) and then of the various special contingents of each.

The Macedonian Core

By the third century, the heavy infantry component of Hellenistic armies, the *sarisa*-armed phalanx, had become the dominant force in the army; the role of the cavalry, while still important, was much diminished from the days of Alexander.[20] In the Antigonid army, the phalanx was recruited from the local Macedonian population, although the territorial regiments of Alexander’s day seem to have been done away with.[21] The phalanx itself consisted of two types of soldiers: the common phalangites, called *chalkaspides*, and the elite peltasts (*peltastai*), of which the elite was the *agema*. The peltasts (called *caetrati* by Livy), named for their smaller shield (the *pelte*), were not the light skirmishing infantry of the classical period, but rather a force of phalangites, only somewhat lighter than the regular heavy infantry, who could fight in the phalanx with the *sarisa*.[22] The *chalkasipides* were named for their use of a larger, bronze-faced

[20] This trend is widely noted, see Connolly (1981), 80; Hatzopoulos (2001), 33-35, Sekunda (2013), 67; Fischer-Bovet (2014), 125.

[21] Sekunda (2013), 102.

[22] Hatzopoulos (2001), 71. Sekunda (2013), 95. On the origin of these troops, and their possible connection to the reformed peltasts of Iphicrates, see N. Sekunda “Land Forces” in *The Cambridge History of Greek and Roman Warfare* eds. P. Sabin, H. van Wees, M. Whitby (Cambridge: Cambridge University Press, 2007), 327-8. Livy’s term ‘*caetrati’* is effectively a direct translation of *peltastai;* the *caetra* was a round shield smaller than the *clupeus* (that is, the Greek *aspis*) common in Spain.

shield, and made up the bulk of the heavy infantry of the Antigonid armies.[23] The Antigonid cavalry were divided between standard regiments of cavalry (which Livy calls *alae* for the Greek *ἴλη*) and an elite royal guard consisting of what Livy calls the 'sacred squadrons' (*equitumque sacrae alae*); both of these units seem to have had similar equipment and battlefield function.[24]

The Seleucid army likewise featured a core of ethnically Macedonian *sarisa*-armed infantry, often simply called 'the phalanx' or 'the Macedonians' in the sources.[25] These troops were recruited from the military settlements composed of Greek and Macedonian military settlers.[26] At the Daphne parade, Polybius divides the phalanx into three groups: *chalkaspides*, *chrysaspides* and *argyraspides*; of these, the first two seem to be the traditional core of the phalanx and the organizational equivalent of the Antigonid *chalkaspides*.[27] The *argyraspides* were an elite guard, corresponding to Alexander's royal *hypaspists* or the Antigonid *peltastai*, and were in fact the organizational continuation of the *hypaspists.*[28] Bar-Kochva argues that this body of troops, maintained at roughly 10,000 men, represented a standing force organized around the king, and that the Seleucid *hypaspists* sometimes mentioned in the sources were an

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[23] Hatzopoulos (2001), 73-76; Sekunda (2013), 78-87.

[24] Liv. 42.66.5, 44.42.3. Sekunda (2013), 76-7. Hatzopoulos (2001), 36-38.

[25] Bar-Kochva (1976), 56-7.

[26] Bar-Kochva (1976), 20-48. S. Sherwin-White & A. Kuhrt, *From Samarkhand to Sardis: A new approach to the Seleucid Empire* (Berkeley: University of California Press, 1993), 53-6, argues that the Seleucids did in fact make fuller use of Syrian and Mesopotamian troops than Bar-Kochva's simplification allows for. Aperghis (2004), 195-7, suggests that these troops would have served in the phalanx, and questions if any ethnic Greek or Macedonian settlers were required to serve, as Bar-Kochva envisages. Aperghis instead suggests that the phalanx was primarily a standing force of 'regulars.' The precise ethnic makeup of this force does not matter for the present study, whereas the question of their pay is discussed in the final chapter.

[27] Plb. 30.25.

[28] Bar-Kochva (1976), 58-67.

elite force within the *argyraspides*.[29] In any case, on the battlefield the *argyraspides* served in the *sarisa*-phalanx.

The Seleucid cavalry, like the Antigonid, was organized into both regular and elite units, but with added ethnic distinctions. Of the elite units, there was a cavalry *agema* (in contrast to the infantry *agema* formations in the Antogonid and Ptolemaic armies) and a regiment of Companions, both typically 1,000 strong.[30] Livy notes, with Polybius as his likely source, that the *agema* "were Medes, select men, and a mixture of the many other nations from that region," while the companions were "many Syrians, with Phrygians and Lydians mixed in."[31] Bar-Kochva takes this to mean that the *agema* was made up of Iranian peoples, whereas the companions were composed of Greek and Macedonian military settlers from settlements in Syria and Asia Minor.[32] Livy contrasts both of these elite cavalry units with the heavier cataphract cavalry at Magnesia, which was deployed in two formations of 3,000 each. Bar-Kochva supposes these to have been recruited from military, settlers and so that they formed part of the regular army rather than an auxiliary unit, which does seem the most likely solution.[33] Seleucid cataphract cavalry will thus be treated as part of the regular cavalry, albeit with different equipment, for the purposes of this reconstruction.

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[29] Bar-Kochva (1976), 60-67. Bar-Kochva envisages the *argyraspides* as a standing force that promising young soldiers would be processed through, making the rest of the phalanx a sort of reserve force; this suggestion is plausible, but the evidence to support it is limited.

[30] Liv. 37.40. Bar-Kochva (1976), 68-72.

[31] Liv. 37.40.5-11. "addita his ala mille ferme equitum; agema eam vocabant; Medi erant, lecti viri, et eiusdem regionis mixti multarum gentium equites…regia ala levioribus tegumentis suis equorumque, alio haud dissimili habitu; Syri plerique erant Phrygibus et Lydis immixti."

[32] Bar-Kochva (1976), 69. Mariusz Mielczarek makes the same judgment, noting the lack of ethnic names attached to the Seleucid cataphracts, M. Mielzcarek, *Cataphracti and Clibanarii: Studies on the Heavy Armoured Cavalry of the Ancient World* (Lodz: Oficyna Naukowa, 1993), 69.

[33] Liv. 37.40.5-11. Bar-Kochva (1976), 74.

The Ptolemaic phalanx is unusual in that it began to include native Egyptians alongside Macedonian and Greek soldiers; the Antigonid and Seleucid phalanxes seem to have largely kept their ethnic character. Polybius seems to have applied Antigonid organizational terminology to the Seleucid and especially Ptolemaic armies, leaving us in the dark as to any internal regimental names (like *chalkaspides* and such above) that the Ptolemaic kingdom may have had.[34] Polybius refers to the Ptolemaic *sarisa*-phalanx as 'the phalanx' and its members as phalangites, but the terms phalanx and phalangite are never used in Egyptian documentary sources in this way, which tend instead to use generic terms such as *pezoi* ("infantrymen") or *stratiotes* ("soldiers").[35] Nevertheless, for the purpose of assessing battlefield role and equipment, these equivalences are useful; Polybius divides the *sarisa*-infantry of the Ptolemaies into the phalanx (meaning the *chalkaspides*) and the peltasts, the same as with the Antigonid army.[36] Much of these forces, especially prior to c. 220, would have consisted of Greek or Macedonian military settlers (*cleruchs*) or mercenaries. There is evidence for the recruitment of native Egyptian troops from the beginning of Ptolemaic rule, but the trend towards local recruiting increases dramatically in the second century, when Egyptian troops paid in land grants, called *machimoi*, begin to make up a larger and larger portion of the infantry.[37] Polybius's narrative focuses on the Raphia campaign (217 BCE) as the catalyst for this process, but the Egyptian evidence suggests a longer process spurred to completion by the military strain of the late third century.[38]

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[34] Bar-Kochva (1976), 63. Fischer-Bovet (2014), 134-138.

[35] E.g. Plb. 5.65. Fischer-Bovet (2014), 134.

[36] Fischer-Bovet (2014), 133-138.

[37] Fischer-Bovet (2014), 121.

[38] Plb. 5.63-64.

We are less well informed about the divisions of cavalry in the Ptolemaic army. Polybius' description of them at the Battle of Raphia is the only source for upper-level organization, and it is unclear how typical this arrangement was, as the army was substantially reorganized prior to the Raphia campaign.[39] As with the Seleucid army, disentangling Macedonian and native cavalry proves difficult. At Raphia, Polybius divides the cavalry between the cavalry of the court (ἱππεῖς περὶ τὴν αὐλήν), 700 strong, and the native Libyan and Egyptian cavalry, 2,300 strong.[40] These were deployed in a single formation and had been trained together, suggesting that they may normally have been a composite unit.[41] Another 2,000 cavalry were Greek mercenaries, a mix of both mercenaries hired from Greece and *misthophoroi hippeis*, professional cavalry living in Egypt.[42] Somewhat strangely, at Raphia Ptolemy IV fought initially on the left with the former group, while the Greek mercenaries were stationed on the right.[43] Such an arrangement keeps the normal order of placing the Greek and Macedonian cavalry on the right and allied or native cavalry on the left, but inverts the position of the king, placing him with his native troops rather than on the right in the position of honor. It is not clear from the evidence how typical that arrangement would have been for the Ptolemaic army.

Finally, all three armies employed a common type of Hellenistic mercenary, the *thureophoros*, which although not part of the regular army, is worth discussing in general before moving on to the special units of each state. These soldiers were named for the shield they

[39] Fischer-Bovet (2014), 132.

[40] Plb. 5.65.4-6.

[41] Plb. 5.65.5.

[42] Plb. 6.65.6; Fischer-Bovet (2014), 132.

[43] Plb. 5.84.1.

carried, the *thureos*, a Hellenistic variant from the same family of center-grip shields as the Roman *scutum* and the Gallic shield.[44] In the third century *thureophoroi* seem to have replaced the peltast as the common type of Greek mercenary soldier, as well as the common soldiers of many of the smaller Greek states and leagues.[45] These soldiers were what we may call 'medium' infantry, capable of both skirmishing and fixed formation fighting, although they tended to fare poorly against heavy infantry at close-quarters.[46] The Hellenistic *thureos* is substantially smaller than the Roman *scutum*, and Plutarch comments on how light it was.[47] While several of the Greek states in the late third century reformed their armies away from the *thureophoros* towards the sarisa-phalanx armed in Macedonian fashion, *thureophoroi* as allied or mercenary troops remained common in Hellenistic armies.[48] Such soldiers appear frequently on grave paintings in the Hellenistic world.[49]

The equipment of these types of soldiers, who made up the 'core' of these Hellenistic armies, will be discussed in greater depth in the following section. However, it is first necessary to consider the many other mercenary and ethnic special contingents found in Hellenistic armies.

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[44] Eichberg (1987), 164-6. Stary, (1981), 286-307.

[45] *Thureophoroi* were the common infantry of Sparta before the reforms of Cleomenes (Plut. *Cleom.* 11.2 notes Cleomenes replacing a shield carried by a handle (the *thureos*) with one carried by a strap (the *aspis*)), in the Achaean league prior to the reforms of Philopoemen (Plut. *Philop* 9.1-3), as well as the Aetolian League. J. K. Anderson, "Philopoemen's Reform of the Achaean Army" *CP* 62.2. (1967): 104-106. The Boeotians too used *thureophoroi*, but also *peltophoroi*, Liv. 33.14.5. See also on this Sekunda (2013), 112. *Thureoi* feature frequently on third century Boeotian tombstones, P. M. Fraser, T. Rönne, *Boeotian and West Greek Tombstones* (Lund: C. W. K. Gleerup, 1957), 69-70. As light-infantry mercenaries, Everson (2004), 196.

[46] Plut. *Philop*. 9.1-6.

[47] Plut. *Philopoemen* 9.1.

[48] Military reform to the *sarisa*-phalanx: Sparta: Plut. *Cleom* 11.2; Megalopolis: Plb. 2.65.3; Achaean League: Plut: *Philop*. 9.1-3. *Thureophoroi* in Antigonid armies, Sekunda (2013), 108-127.

[49] Sekunda (1994/5).

Often, the evidence for these contingents does not permit confident reconstruction. However, an overview of these troops is sufficient to show that they were generally lighter-armed than the core Macedonian forces, with the exception of troops organized 'in Macedonian fashion.'

Antigonids

The army of the Antigonids is perhaps the easiest of the three great powers to assess, insofar as the Antigonids had access to a relatively more limited array of non-Macedonian specialist troops; also as noted previously, of the three great powers, the Antigonids are the best documented. Nicholas Sekunda, in attempting to discern the nature of the *leukaspides* (a question I consider below), presents a detailed breakdown of these troops as reported in the invasion of Laconia during the Cleomenean War (222 BCE), the review at Citium (171 BCE) and at Pydna (168 BCE), along with their likely battlefield role.[50] Many of the mercenaries present in these armies would have been armed as *thureophoroi*. For the Cleomenean war, the regular troops of the Achaeans were still armed this way *and* would be until Philopoemen's reforms in 207 BC.[51] Likewise, Livy describes Boeotians, Thessalians and Acarnanians in a Macedonian force defeated near Corinth in 197 as *scutati omnes*, suggesting they fought as *thureophoroi* at that date.[52] A force of 3,000 Cretans is also reported at Citium; Cretan mercenaries were the mercenary archer force *par excellence*, in use by all of the major Hellenistic powers. "Cretan" in the context of mercenary light infantry could be as much a type

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[50] Sekunda (2013), 108-127.

[51] Plut. *Philop*. 9.1.

[52] Livy 33.14.5. Sekunda (2013), 112.

of soldier as an ethnic origin, although Perseus' archers at Citium do appear to have been from Crete, given the demonyms of their commanders.[53] Some Greek allies in Antigonid armies, such as the 1,000 Megalopolitans at Sellasia, were armed "in the Macedonian fashion" (εἰς τὸν Μακεδονικὸν τρόπον) meaning as *sarisa*-bearing phalangites, although such forces seem uncommon.[54]

Gallic infantry appears frequently. A significant force of Gauls also features in the army of Antigonus Gonatas. There were 1,000 Gauls in 227/6, 2,000 at Citium, and a Gallic mercenary also appears on the Aemilius Paullus monument, attesting to the presence of Gallic troops at Pydna.[55] Gallic military equipment is discussed in greater depth in the next chapter, but it is useful to note here that the average Gallic warrior, lacking metal body-armor, would have required far less worked metal than either a Roman legionary or a Macedonian phalangite.[56] Connolly labels Gallic mercenaries (among others) as 'medium infantry' in a diagram of the battle of Raphia, and this term is useful as a classification for troops that, although not missile

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[53] Sosos of Phalassarna and Syllos of Knossos. Liv. 42.51.7. Sekunda (2013), 116-117 supposes these troops to have been supplied from the Cretan *koinon*. Everson (2004), 197. G. T. Griffith, *The Mercenaries of the Hellenistic World* (1935), 144, 241. These archers are sometimes also noted in the sources as being 'Neo-Cretans' the meaning of which is not entirely clear, but seems to indicate newly recruited or younger Cretan archers. On this, see N. Sekunda, "Neocretans" in *Pratiques et identités culturelles des armées hellénistiques du monde méditerranéen* eds. J-C. Couvenhes, S. Crouzet and S. Péré-Noguès (Bordeaux: de Boccard, 2011), 75-85.

[54] Plb. 2.65.3. Sekunda (2013), 112. Possibly also the Paionians at Citium (Livy 42.51.6), Sekunda (2013), 118-9.

[55] Plb. 2.65.2. Liv. 42.51.7. Taylor (2016), 564. On Gauls in Antigonus Gonatas' army, see A. N. Borel, "Mercenaires galates d'Antigonos Gonatas: problèmes de numismatique et de démographie" in *Pratiques et identités culturelles des armées hellénistiques du monde méditerranéen* eds. J-C. Couvenhes, S. Crouzet and S. Péré-Noguès (Bordeaux: de Boccard, 2011),193-202.

[56] The evidence for the military equipment of Gallic mercenaries in the Greek east specifically is discussed briefly by A.-M Adam and S. Fichtl, "Les Celtes dans les guerres hellénistiques: le cas de la Méditerranée orientale" in *Pratiques et identités culturelles des armées hellénistiques du monde méditerranéen* eds. J-C. Couvenhes, S. Crouzet and S. Péré-Noguès (Bordeaux: de Boccard, 2011), 117-128, who note the distinctive Gallic sword (and its equally distinctive suspension) and shield in art and funerary deposits.

troops, are relatively lightly armored and equipped, but are nevertheless expected to fight hand-to-hand.[57]

At Citium the Antigonid army also had 3,000 Thracian troops fighting under their own commander, left unnamed by Livy; some of these Thracians are reported in the skirmish that begins the Battle of Pydna.[58] Plutarch relates a description from Scipio Nasica that the Thracians were "clad in tunics which showed black beneath the white and gleaming armor of their shields (θυρεοί) and leg-coverings (περικνημίδες), holding their heavy iron *rhomphaiai* (ῥομφαῖαι βαρυσιδήροι) high on their right shoulders."[59] The *rhomphaia* was a heavy two-handed iron polearm which continued in use well into the Roman period.[60] Aside from this weapon, however, the implication is that the equipment of the Thacians is fairly light. Sekunda connects Plutarch's description with a tomb-painting from Kazanluk (fig. 5.2**)**, which serves to help evaluate it.[61] Plutarch's description implies a lack of any kind of body-armor, the lack of which is also apparent in the Kazanluk tomb. The "white and gleaming" part of the shields must be the hide front-facing painted white; the *thureos* has the same basic construction as the Roman *scutum*. It also seems plausible that the leg protections that Plutarch describes were textile,

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[57] Connolly (1981), 82.

[58] Liv. 42.51.7. Sekunda (2013), 114-5, Plut. *Aem*. 18.1-5. Liv. 44.40.2. On Thracian mercenaries and ethnic auxiliaries in the Hellenistic world and their relative integration into Hellenistic states, note D. Dana, "Les Thraces dans les armées hellénistiques: essai d'histoire par le noms" in *Pratiques et identités culturelles des armées hellénistiques du monde méditerranéen* eds. J-C. Couvenhes, S. Crouzet and S. Péré-Noguès (Bordeaux: de Boccard, 2011), 87-115.

[59] Plut. *Aem*. 18.5. λευκῷ καὶ περιλάμποντι θυρεῶν καὶ περικνημίδων ὁπλισμῷ μέλανας ὑπενδεδυμένοι χιτῶνας, ὀρθὰς δὲ ῥομφαίας βαρυσιδήρους ἀπὸ τῶν δεξιῶν ὤμων ἐπισείοντες. Cf. a very similar description, Xen. *Cyrop*. 6.2.10.

[60] M. Kostoglou, *Iron and Steel in Ancient Greece* (Oxford: John and Erica Hedges Ltd, 2008), 27-8. Sekunda (2013), 120-121. Everson (2004), 197.

[61] Sekunda (2013), 121.

rather than metal if they were the same color as the shield-facing; the Kazanluk tomb painting shows no leg protections at all.[62] Thracians then, fighting in native style, can be classified as medium infantry comparable to Gallic warriors: close combat troops nevertheless lacking significant body-armor. If the Thracians at Pydna lacked metal helmets (Plutarch does not describe them as having any) as do the figures in the Kazanluk tomb, they would likely be even more lightly armored than the average Gallic warrior.

Illyrians also made up a common auxiliary force in Antigonid armies. Illyrian troops were present in Antigonus' invasion of Laconia, and Livy reports a force of 2,000 Illyrians from Penestia as part of the garrison at Cassandrea in 168 BC.[63] A complete Illyrian panoply is not described in the sources, but the archaeological evidence suggests the Illyrians fought as a 'medium' infantry. The distinctive Illyrian weapon was a curved sword, the *sica*, but Illyrian grave deposits also include a range of weapons including spears, battle-axes, swords, bows, and light shields with bronze bosses.[64] In terms of armor, John Wilkes notes that breastplates and greaves are present in Illyrian burials, but seem to be the preserve of the elite; metal helmets are more common.[65] The Illyrians troops at Sellasia were placed in alternating formations with the phalanx of the *chalkaspides*. Sekunda takes this to suggest they might have been equipped as *thureophoroi*, providing a more mobile covering force for the phalanx. However, it seems equally likely that the Illyrians would have fought in their native equipment and style, which

[62] Sekunda (2013), 121.

[63] Plb. 2.65.4.; Liv. 44.11.7.

[64] J. Wilkes, *The Illyrians* (Malden: Blackwell, 1992), 239.

[65] Wilkes (1992), 240-1.

seems to have filled much the same role.[66] Polybius notes that in the assault on the Spartan position, set on a hill and occupied by the *perioeci* and allied troops, it was the Illyrians who were decisive, being able to fight effectively in the rough terrain and constricted space at the top of the hill; the Spartan formation, "because of their heavy equipment and stiff formation," was forced to retreat, making it clear that the Illyrians were relatively lighter-armed.[67]

Seleucids

The Seleucids employed the most diverse array of special troops of any of the Hellenistic powers, though as Bar-Kochva notes, most of these are auxiliaries from regions under the control or influence of the Seleucids, rather than mercenaries in the strict sense.[68] Many of the troop-types discussed above in the Antigonid army were also put to use by the Seleucids. Thracian mercenaries are attested at the battle of Raphia and the Daphne military parade; the Galatians, presumably armed as Gallic warriors, are present at Magnesia and at Daphne.[69] At Magnesia, Antiochus also had Cappadocian troops that Livy reports were "similarly armed" (*similiter his armati*) to the Galatian infantry.[70] Cretan archers are also present in Seleucid armies at both Raphia and Magnesia, though after 188 Seleucid access to these mercenaries seems to have been limited.[71]

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[66] Sekunda (2013), 113.

[67] Plb. 2.67.1-10. τῷ βάρει τοῦ καθοπλισμοῦ καὶ τῆς συντάξεως

[68] II. Macc. 8.9; Liv. 37.40.1. Bar-Kochva (1976), 53; Griffith (1935), 168-70.

[69] Thracians at Raphia, Plb. 5.79.6; Galatians (called *gallograeci* by Livy) at Magnesia Liv. 37.40.5-10. At the Daphne parade, Plb. 30.25.

[70] Livy 37.40.10.

[71] Plb. 5.79.10; Liv. 37.40.8. Griffith (1935), 165.

Seleucid armies are also reported with a number of ethnic infantry contingents not seen in the other Hellenistic armies, nearly all of them light troops. At Raphia, Polybius notes the presence of 5,000 mixed Dahae, Carmanian and Cilician light-armed troops, 2,000 Agrianian and Persian bowmen and slingers, 500 Lydian javelin troops (*akontistai*) and 1,000 Cardaces, which Bar-Kochva considers likely to be Kurds; that these Cardaces are also javelin troops is made clear when Polybius details the army's deployment.[72] Polybius also notes a mixed ethnic contingent of 5,000 "Medes, Cissians, Cadusians and Carmanians," which were likely also archers.[73] Antiochus also had 10,000 Arab troops, obtained previously in the campaign as a result of a series of early successes.[74] Polybius does not detail their equipment, but the force is almost certainly of light troops; they are, in any event, routed almost immediately by Ptolemy's Greek mercenaries.[75] At Magnesia, Livy reports 2,500 Mysian archers, 8,000 Cyrtaean slingers and Elymaean archers (in two detachments), Cretan archers along with Carians and Cilicians armed the same way (2,500 total), 3,000 Trallian light infantry (*levis armatura*, per Livy).[76] Finally 4,500 Pisidians, Pamphylians and Lycians, which Livy terms *caetrati*; Appian makes clear that these are skirmishers, not the heavier Macedonian-style peltasts.[77]

The Seleucids also deployed significant forces of mercenary and auxiliary cavalry. Polybius does not distinguish between the types of cavalry present at Raphia, but Livy and

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[72] Plb. 5.79.3-6, 82.11. As Bar-Kochva notes, the Carmanians are listed twice, both with the other light infantry (5.79.3) and with the other auxiliaries from within the empire (5.79.7), Bar Kochva (1976), 50.

[73] Plb. 5.79.7. Cissian bowmen: Strabo 16.744. Walbank (1957), 608-9. M. Launey, *Recherches sur les Armées Hellénistiques* (Paris: De Boccard, 1949), 567.

[74] Plb. 5.71.1, 79.8.

[75] Plb. 5.85.4. Walbank (1957), 609.

[76] Livy 37.40.5-14.

[77] Livy 37.40.14; App. *Syr.* 32.

Appian do so distinguish for the Seleucid army at Magnesia. Livy notes that the army included 2,500 Galatian cavalry.[78] Appian adds that these cavalrymen were armored (κατάφρακτοι), which probably means mail armor as we might expect from Gallic cavalry composed of local elites (discussed in the next chapter), though it is possible that Appian has confused the regular cataphract cavalry and the Galatians set next to them; Livy makes clear that these were separate formations.[79] The Galatian cavalry seems to have been mailed Gallic heavy cavalry. Appian describes them as mailed (κατάφρακτος), like the cavalry of the *agema*; in contrast, he describes the Companion cavalry on the opposite wing as armored (κατάφρακτος), but also lightly armed (ὡπλισμένη κούφως).[80] Livy echoes this distinction in equipment, noting that the royal cohort (meaning the Companions) had "lighter coverings for themselves and their horses, but not altogether dissimilar from the rest."[81] These descriptions would seem to suggest the Galatian cavalry was heavier than the Macedonian Companion cavalry, but lighter than the heavy Seleucid cataphracts, which in turn suggests mailed Gallic cavalry.

In addition to the Galatians, the Seleucids used light missile cavalry. Livy and Appian both report Arab mounted camel-archers at Magnesia, though neither gives a number to this formation.[82] Though not mentioned by Polybius, it seems fairly likely that similar Arab camel-cavalry would have been present at Raphia, given the reported presence of a very large body of Arab infantry in the Seleucid formation there. Livy also reports 200 Dahae horse archers;

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[78] Liv. 37.40.13.

[79] Livy 37.40.5-10; App. *Syr.* 32.

[80] App. *Syr.* 32.

[81] Livy 37.40.11. regia ala levioribus tegumentis suis equorumque, alio haud dissimili habitu.

[82] Livy 37.40.11; App. *Syr.* 32.

Appian reports the formation without the ethnic signifier. Appian also notes the presence of "other mounted archers from the Dahae, Mysia, and Elymais" on the left of the army; Livy does not mention these cavalrymen, although he does mention Elymaean and Cyrtaean infantry.[83] The Dahae horse-archers may also have been present at Raphia although they are omitted from Polybius' order of battle; Dahae infantry are reported by Polybius as part of the light troops.[84] This sort of light missile cavalry would have represented a tremendous investment in human capital, as the skills required of mounted archers are considerable, although the equipment required for them, beyond the mounts themselves, would have been minimal.[85]

Ptolemies

Evidence for special and ethnic units in the Ptolemaic army benefits tremendously from the epigraphic and papyrological evidence from Egypt, which serves to supplement Polybius' otherwise somewhat brief and schematic description of the Ptolemaic army at Raphia. He reports a force of 4,000 Thracians and Gauls there, some of whom were actually military settlers in Egypt (called *katoikoi*).[86] Likewise, Polybius notes the presence of 3,000 Cretan archers in the Ptolemaic army.[87] The documentary sources from Egypt tend to confirm the presence of these soldiers in the Ptolemaic army, but also provide evidence of other groups, particularly Jewish

[83] Livy 37.40.13; App. *Syr*. 32. ἱπποτοξόται τε ἐπὶ τοῖσδε ἕτεροι, Δᾶαι καὶ Μυσοὶ καὶ Ἐλυμαῖοι.

[84] Plb. 5.79.3.

[85] See Chapter 3 at n. 145 for a comparison of bow-cost to metal armor-cost.

[86] Plb. 5.65.8; Fischer-Bovet (2014), 176.

[87] Plb. 5.65.7. 1,000 of these are noted as being 'Neo-Cretans.'

military settlers in the Fayyum.[88] Fischer-Bovet presents a study of ethnic designations; more than half of the men bearing the ethnic designations for Galatian, Libyan, Thracian, Thessalian, Macedonian, Cyrenian and Cretan were soldiers, which conforms generally to the picture provided by Polybius.[89]

The Ptolemaic army is unusual, however, in that some of these units were incorporated into the heavy infantry phalanx directly. Polybius notes for the Battle of Raphia that not only the native Egyptian infantry, but also 3,000 Libyans and the Greek mercenary infantry were armed in the Macedonian fashion and incorporated into the phalanx.[90] Equipped as phalangites, these units are therefore covered in my reconstruction below as part of the regular army. The Ptolemaic cavalry at Raphia has already been discussed above as part of the regular army. The documentary sources also preserve evidence for a number of ethnic hipparchies within the Ptolemaic cavalry, starting around 235 BCE.[91] Hipparchies are attested for Thracians, Mysians, Persians, Thessalians, and Macedonians; they likely originally consisted of a core of cavalrymen from that ethnic designation, using equipment associated with it.[92] At some point in the first half of the second century, these ethnic hipparchies were discontinued. Fischer-Bovet suggests that by that time the ethnic designations had probably lost their connection to specific kinds of fighting or equipment.[93]

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[88] Fischer-Bovet (2014), 176.

[89] Fischer-Bovet (2014), 187.

[90] Plb. 5.64.1-3; 5.65.4-9.

[91] Fischer-Bovet (2014), 126-7.

[92] Fischer-Bovet (2014), 127.

[93] Fischer-Bovet (2014), 133.

To sum up, the effect of the many special, ethnic or mercenary units in Hellenistic armies would have been to lower the average per-man resource intensity of the army, as these additional non-regular units were almost all substantially less heavily equipped than the regular army. Such light troops may have been more cost-effective as garrison forces, especially in the far-flung Seleucid empire.[94] Restricting the heavy infantry to a closed and ethnically distinct class tied directly to the ruler also served to maintain royal escalation dominance and thus to secure royal Macedonian power.[95] Nevertheless this cost-economizing use of light-troops had negative battlefield effects, vividly illustrated by the collapse of the Seleucid light troops at both Raphia and Magnesia. Moreover, when discussing the resource intensity of the regular Macedonian army, as I will below, it must be kept in mind that the regular Macedonian forces are by far the heaviest part of a Hellenistic army; the outer layer of auxiliary and mercenary troops were far more lightly equipped and consequently significantly less expensive.

Reconstructions

The next step towards a reconstruction of the resource intensity of the regular Macedonian and Greek portions of Hellenistic armies is to outline the equipment expected of each type of soldier. The following section, building off of the previous discussion of the Macedonian core of Hellenistic armies, outlines the equipment for the basic troop-types within

[94] Bar-Kochva (1976), 53.

[95] 'Escalation dominance' here refers to the ability of the core military force to prevail in a high intensity conflict, cf. the same concept applied to the Roman army of the early empire, E. Luttwak, *The Grand Strategy of the Roman Empire* (Baltimore: John Hopkins University Press, 1976), 41-2. Polybius notes this interaction explicitly, Plb. 5.107.1-3; Bar-Kochva (1976), 52-3 also notes this as an organizing principle. Contra this view for Egypt, note Fischer-Bovet (2014), 86-102, who contends that the Great Revolt was more a general military *coup d'état* of both Greek and Egyptian soldiers than an ethnically Egyptian uprising.

that framework. Subsequent sections next discuss the evidence for each piece of that equipment one by one. A full reconstruction, paralleling the reconstruction of the Roman legion in the previous chapter, is then presented in the conclusion.

The most numerous soldiers in any Hellenistic army were the regular *sarisa*-bearing infantry, the phalangites. The best evidence for their equipment comes from an Antigonid inscription from Amphipolis dating to the reign of Philip V, which specifies fines for the loss of various pieces of equipment.[96] The decree lists the equipment for the regular infantry as a *kottybos*, helmet (*konos*), *sarisa*, sword (*machaira*), greaves (*knemides*) and shield (*aspis*); for the officers (*hegemon*), a *thorax* or *hemithorakion* is also specified. *Hegemon* in this context signifies a file-leader, a *lochagos* or *dilochites*, who occupied the front rank in combat and was evidently more heavily armored than the regular phalangite.[97] While most of the items listed here are relatively straightforward to identify, the terms for body-armor, particularly *kottybos* and *hemithorakion*, pose interpretative problems which will be discussed below.

The elite *sarisa*-bearing peltasts of the Antigonid and Ptolemaic armies seem to be somewhat lighter than the regular phalangites. Ascelpiodotus, in describing an ideal Macedonian-style army, notes that the peltasts are heavier than the light troops (*psiloi*) but lighter than the phalangites.[98] He notes specifically that the *sarisa* of the peltasts is much shorter than that of the main phalanx, and they use a smaller, lighter shield (*pelte*). The distinction between the *pelte* and the *aspis* in this context is a fraught one, and will be discussed below. Beyond this, Asclepiodotus' description leaves the impression (but does not specifically state)

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[96] SEG 40.524; Hatzopoulos (2001), 161-4.

[97] Sekunda (2013), 89. Hatzopoulos (2001), 76-7, 80-1. Connolly (1981), 76-7.

[98] Asclepiodotus 1.2.

that the peltasts are otherwise equipped like the phalangites, with cuirasses, greaves and helmets. Sekunda, however, notes that descriptions of the Antigonid peltasts in the Macedonian wars do not mention cuirasses, and reconstructs the peltasts as having no body-armor or greaves.[99] As with the phalangites, this issue will be considered in the section on body armor.

The regular cavalry of Hellenistic armies were essentially heavy lancers: typically armored and using a spear as their primary weapon.[100] The standard cavalry lance was the *xyston*, a cornel wood spear.[101] From Arrian's description of Aretas fighting with the broken end of a *xyston* at Granicus, it seems that the spear had a pointed metal butt; this confirms the impression from Polybius that Greek cavalry spears of his period (unlike earlier Roman spears) had that feature.[102] During the third century, Hellenistic cavalry adopted shields, which they do not seem to have used previously, possibly from contact with Gallic cavalry.[103] Representational evidence generally reflects Hellenistic cavalry as armored.[104] This impression is reinforced by Livy's comment that the Macedonian cavalry at Magnesia, although "with lighter coverings" (*levioribus tegumentis*) than the cataphracts, was otherwise similar.[105] The probable distinction being made here would be between the textile type-IV armor of the regular Macedonian cavalry compared to the heavier metal armor of the cataphracts. The Boeotian helmet seems to have

[99] Sekunda (2012), 33-4.

[100] Hatzopoulos (2001), 49-54. Everson (2004), 193.

[101] Hatzopoulos (2001), 51. Sekunda (2013), 68-9. Everson (2004), 197-8.

[102] Arr. *Anab.* 1.15.5-8. Plb. 6.25.8.

[103] Hatzopoulos (2001), 53-4. Sekunda (2013), 69. Everson (2004), 198-9.

[104] Everson (2004), 199.

[105] Liv. 37.40.11. et tria milia cataphractorum equitum et mille alii equites, regia ala levioribus tegumentis suis equorumque, alio haud dissimili habitu.

remained popular with the cavalry, alongside the Attic and 'Phrygian' or 'Thracian' types, recognizable in artwork from their distinctive metal crests.[106] The standard side-arm of the cavalry seems to have remained the *machaira* as advised by Xenophon.[107]

The equipment of the Seleucid cataphract cavalry is less clear. These units appear only infrequently in the sources; besides the battle of Magnesia, they appear only once more in Livy at Aigion in 192, and twice in Polybius at Panium in 200 and at the Daphne parade in 166.[108] The state of the evidence makes it difficult to assess if Seleucid cataphracts were as heavily armored as later Parthian and Sassanid cataphracts, but they seem not to have been.[109] Armor made of segmented metal plates, found at Ai Khanum in Afghanistan, is thought to have been armor for a cataphract (fig. 5.3**)**, though the plates were unfortunately published without thickness data.[110] This armor consisted of thin metal plates attached to a leather or textile backing, which would have covered the shoulders, arms and possibly legs of the rider; chest protection could have been provided by a traditional Greek cuirass. This armor appears to match a set of Seleucid armor to be seen on a frieze (fig. 5.4) over the entryway to the Temple of Athena at Pergamum, showing the arms and armor of enemies defeated by the Attalids.

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[106] Xenophon recommends the Boeotian helmet for the cavalry, Xen. *Peri Hippikes* 12.3. Everson (2004), 199-200. Hatzopoulos (2001), 50-51. Sekunda (2013), 71-2.

[107] Xen. *Peri Hippikes* 12.11. Arr. *Anab.* 1.15.8. Hatzopoulos (2001), 51. Everson (2004), 197-8. A. Choremis, "Μετάλλινος ὁπλισμὸς ἀπὸ τὸν τάφο στό Προδρόμι Θεσπρτίας," *Athens Annals of Archaeology* 13 (1980): 3-21.

[108] Magnesia: Liv. 37.40.5. Cf. App. *Syr.* 32 and Florus 1.24, which make no mention of cataphract cavalry. Aigion: Liv. 35.48. Panium: Plb. 16.18.8. Daphne Parade: Plb. 30.25. Mielczarek (1993), 68.

[109] Mielczarek (1993), 70-1. Bar-Kochva (1976), 75.

[110] P. Bernard, *et al.* "Campagne de Fouille 1978, à Aï Khanoum (Afghanistan)" *Bulletin de L'École Française D'Extrême Orient* 68 (1980): 5-116.

The same frieze also shows horse armor in the form of a face guard (*chamfron*) and chest guard (*plastron*).[111] A small terracotta relief dating to the fourth or third century BCE from southern Khwarezm (fig. 5.5), shows part of a horse armored on the front legs and chest with what appears to be a segmented metal plate armor, but without the full covering of later Parthian cataphracts.[112] The armor for the horse may have been much thinner than that for the rider; one of the sets of plates from Ai Khanum, thought to be possibly a *plastron* for the horse, though made in iron, was thin enough to be flexible.[113] A reconstruction of this armor with metal-weights is impossible given the current state of the evidence. Evidently, such cavalry was somewhat more heavily armored than normal Macedonian cavalry; Livy says as much.[114] The conclusion to this chapter will suggest some tentative estimates to account for the Seleucid cataphracts, but without more evidence, any such estimate is little more than informed guesswork.

The last soldier-type to be reconstructed in detail here is the *thureophoros* 'medium' infantryman. He carried the *thureos* for which he was named, a Hellenic and Hellenistic variant of the center-bossed Gallic *scutum* shield-type.[115] Plutarch's description of the differences between *thureophoroi* and *sarisa*-infantry makes clear that the former did not generally wear cuirasses or greaves.[116] This impression is reinforced by their appearance on funerary artwork in

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[111] Everson (2001), 200-202. Mielczarek (1993), 71-2.

[112] Sekunda (1994), figs 29-30.

[113] Bernard, *et al* (1980), 61. No report is made of the thickness of the metal as an absolute measurement.

[114] Liv. 37.40.11.

[115] Eichberg (1987), 164-6. Stary (1981).

[116] Plut. *Philop.* 9.2.

the Hellenistic world, which frequently shows these soldiers with combat equipment: helmets, swords, spears and the *thureos* are almost always all present, but body-armor is rare and greaves do not appear (fig. 5.6a-b).[117] Some *thureophoroi* were armored, but in Polybius' narrative these soldiers are indicated by a different term, *thorakites* (θωρακίτης); the implication must be that such armor was unusual enough to render the man wearing it essentially a soldier of a different type.[118] At the battle of Caphyae, the Achaean *thorakites* are deployed in separate formations from the main body of *thureophoroi*.[119] When describing the division of lighter troops during Antiochus III's eastern expeditions, Polybius explicitly separates the *thorakites* from the *thureophoroi*, although they are both assigned to the same commander.[120] For offensive weapons, Plutarch makes clear that the *thureophoroi* generally carried the shorter thrusting spear, the *dory*; the representational evidence discussed above confirms this, but also consistently shows that they carried a sword, typically straight-edged rather than curved.[121] *Thureophoroi* could also engage at range with javelins, though these weapons make few appearances in artwork.[122]

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[117] Sekunda (1995), figs 65-73.

[118] Plb. 4.12.3-7; Plb. 10.29.6.

[119] Plb. 4.12.3.

[120] Plb. 10.29.6. τελευταίους δὲ θωρακίτας καὶ θυρεοφόρους, ὧν εἶχον τὴν ἡγεμονίαν Νικομήδης Κῷος καὶ Νικόλαος Αἰτωλός.

[121] Plut. *Philop*. 9.1.

[122] Plut. *Philop*. 9.1.

Weapons

Sarisa[123]

The primary weapon of the main body of Macedonian infantry was, as noted, the *sarisa*, a long pike wielded in two hands. However, nearly everything about the normal form of the weapon has been the subject of significant scholarly debate. When assessing the evidence and arguments, it is worth keeping in mind that the *sarisa* certainly did work. Any reconstruction must produce a functional weapon which could perform in combat in the formations described by the ancient sources. Clever arguments that nevertheless result in non-functional weapons, or ones which cannot function in a Macedonian pike-phalanx, must be rejected.

Various ancient sources give figures for the length of the *sarisa*. Of these, the most reliable are Theophrastus who states that the *sarisa* was 12 cubits long, and Polybius who gives 14 cubits.[124] Asclepiodotus states that the shortest *sarisa* was 10 cubits, while Polyaenus states the length of the *sarisa* at 16 cubits at the time of Cleonymus of Sparta; Leo VI and Aelian also provide lengths for the weapon, but they seem to be merely quoting Polybius on the topic.[125] Converting from Athenian cubits, the *sarisa* of Theophrastus would thus be 18 feet (c 5.5m), while Polybius' measurement suggests one 21 feet (c. 6.4m) in length. Polybius further specifies that each man in the formation occupies three feet (c. 1m) and that the grip of the *sarisa* occupies

[123] Here and following, I spell the weapon *sarisa* after the more common Greek spelling (σάρισα), rather than the more common *sarissa* in English; both spellings, σάρισα and σάρισσα, appear in the sources.

[124] Theophrastus *HP* 3.12.2. Plb. 18.29.2. Connolly (2000a), 105.

[125] Asclepiodotus *Tact*. 5.1; Polyaenus *Strat*. 2.29.2; Leo *Tact.* 6.39; Aelian *Tact*. 14.2. On these passages and their use, note J. R. Mixter, "The length of the Macedonian Sarisa during the Reigns of Philip II and Alexander the Great" *AW* 23 (1992): 21-29.

the rear 4 cubits (c. 1.6m), such that the *sarisae* of the first five ranks project beyond the first rank.[126]

The discovery of a set of spear components from the royal tombs at Vergina (Aigai), believed to be elements of a *sarisa*, prompted a number of competing reconstructions of the weapon. Manolis Andronicos published three *sarisa* components (cat. H7, H8, H12) in 1970, followed by Minor Markle's publication in 1982 of two more spear-points (cat. H10, H11) from the same site (fig. 5.7).[127] The weights and suggested function of these items are shown in table 5.1. A *sarisa*-butt found at Isthmia seems to be of the same size and type as cat. H8, but was pictured without measurements.[128] The first set of reconstructions proposed for the Vergina finds were produced by Markle, who accepted Theophrastus' figure for the length of the *sarisa* at 18 feet, comprising two pieces of cornel wood joined by a metal sleeve at the center; he used the large flanged spear-butt (cat. H8) and the very large element (cat. H12) which had been identified by Andronicos as a spear-tip for the metal elements.[129] At 14.5lbs (6.57kg), Markle's reconstruction was extremely heavy.[130]

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[126] Plb. 18.29.1-5.

[127] M. Andronicos, "Sarissa" *BCH* 94 (1970): 91-107. M. Markle, "Macedonian Arms and Tactics under Alexander the Great" in *Macedonia and Greece in Late Classical and Early Hellenistic Times* eds. B. Barr-Sharrar and E. N. Borza (Washington D.C.: National Gallery of Art, 1982), 87-112.

[128] W. Rostoker and E. R. Gebhard, "The Sanctuary of Poseidon at Isthmia: Techniques of Metal Manufacture" *Hesperia* 49.4 (1980): 347-363, pl. 108d.

[129] Markle (1977), 323-339. Markle defends and qualifies this reconstruction in a number of subsequent publications, notably: M. Markle, "Use of the Sarissa by Philip and Alexander of Macedon" *AJA* 84.4 (1978): 483-497; Markle (1982), 88-92.

[130] Markle (1977), 324.

Table 5.1: *Sarisa* and spear elements from Vergina/Aigai					
Cat. No.	Length	Width	Socket Diameter	Mass	Function
H7	27.3cm	3cm	1.9cm	97g	*Sarisa* point
H8	45cm	4cm	3.4cm	1070g	*Sarisa* butt
H10	47cm		2.5cm	235g	*Xyston/Dory* point?
H11	50cm		2.0cm	297g	*Xyston/Dory* point?
407	51cm	6.7cm	3.6cm	1235g	*Xyston* butt

Markle does not discuss the handling characteristics of his reconstruction of the weapon, apart from noting its limited utility outside of the phalanx, but they would have been very poor even in formation. Handling characteristics are an often-neglected element of ancient weapons, but proper weight distribution is essential, especially in the case of heavier weapons. In order to provide effective tip control, and to avoid fatiguing the wielder, the point of balance for the *sarisa* needs to fall either on the position of the leading hand, or between the leading hand and the trailing hand to provide satisfactory leverage. Markle's reconstruction would balance very near the midpoint (the shaft is not tapered, and the head and butt are near the same weight), while the phalangite's leading arm would grip the weapon (as per Polybius) four cubits (c. 1.6m) from the rear, which in turn would place the grip more than a meter behind the point of balance.[131] With both hands behind the point of balance, the phalangite must exert torque on the weapon merely to keep the tip level with the ground; the effect may be compared to attempting to hold a long staff at the base with a single hand, compared to holding the same at the point of balance (or with two hands, one on each side of the point of balance). Such a poorly balanced weapon would have rapidly fatigued the wielder, especially given the very heavy weight Markle

[131] Plb. 18.29.1-4.

assumes. His reconstruction must then be rejected, because it cannot function as the weapon is described.

Peter Manti attempted to correct Markle's reconstruction by revisiting a suggestion by Tarn that there was a Macedonian cubit measuring three-fourths of the traditional Attic cubit, and that the measurements given for the *sarisa* used this, otherwise unattested, measurement.[132] The result would reduce Theophratus' *sarisa* to 4.12m and Polybius' to 4.8m. Such a change does nothing to fix the balance problems raised by Markle's reconstruction, save that by making the weapon much shorter, it also renders it lighter. However, even small weapons need to balance for ease of use. The more pressing problem is that, by sharply shortening the length of the *sarisa*, Manti's solution renders the formation suggested by Polybius, with five *sarisa*-points projecting out from the first rank, impossible.[133] The *sarisa* would project forward from each man only 3.4m (accounting for the grip), whereas the four ranks in front of the fifth would occupy 3.7m (145.5 inches; 12 attic feet). Reducing the space allowed to each man in order to make Manti's short *sarisa* function as Polybius says it should would result in too little space for each man. If we account for two cubits (c. 0.8m) of projection, as Polybius says the fifth rank's *sarisa* should project beyond the first, Manti's reconstruction would only allow each man about half a meter to occupy when in combat, far too little for a workable formation.[134] Manti's reconstruction thus introduces more problems than it solves, and must also be rejected.

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[132] P.A. Manti, "The sarissa of the Macedonian Infantry" *AW* 23 (1992): 31-42. Note also P.A. Manti, "The cavalry sarissa" *AW* 8 (1983): 73-80; P. A. Manti, "The Macedonian Sarissa Again" *AW* 25 (1994): 79-86. Tarn's original hypothesis, Tarn (1930), 15-6.

[133] Plb. 18.29.5. Connolly (2000a), 105-106.

[134] Assuming a 4.8m long *sarisa*, 2/7ths of which, as per Polybius, is occupied by the grip and that the weapon must project past the first rank 2 cubits (even using Manti's 'short' cubit).

More recent articles by Peter Connolly and Nicholas Sekunda have suggested more workable reconstructions of the *sarisa*. Sekunda argues persuasively that the evidence strongly points to the lighter ash wood, rather than the heavier cornel wood, as the material used for the shaft of the *sarisa*. Cornel remained the material of choice for shorter spears, cavalry lances and javelins, but the cornelian cherry tree does not grow tall enough to provide the shaft of the *sarisa* (a point which Theophrastus makes).[135] Both Sekunda and Connolly note that the resort to a Macedonian 'short' cubit is unnecessary, as pikes of comparable length to the *sarisa* are known from early modern Europe.[136] Most importantly, Connolly correctly identifies what Andronicos, Markle and Manti thought of as a *sarisa*-head (cat. H12) as the butt of a cavalry lance, and three smaller and far lighter spear-points (cat. H7, H10 and H11) as actual *sarisa*-points. With this configuration (without the overheavy tip), the flanged spear-butt can perform its role, in balancing the weight of the wooden shaft which projects beyond the leading arm of the phalangite. Connolly then reproduced the proposed weapon along these lines and demonstrated its handling characteristics, noting that with cornel wood the point of balance was within 3cm of the leading hand, and that a coordinated group could wield the weapon and even charge with it.[137] The shaft of Connolly's *sarisa* tapers over the length of the weapon (as the socket of his tip, cat. H7 is much smaller than that of the butt, cat. H8), resulting in a much lower weight of only 4.05kg.[138] Changing the wood of the shaft from cornel to ash, as Sekunda suggests, would

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[135] N. Sekunda, "The Sarissa" *Acta Universitatis Lodziensis* 23 (2001b): 13-41. Sekunda (2013), 78-81. Sekunda here revives the opinion of Lammert and Snodgrass; Lammert, "Sarissa" *RE s.v.* 2515-30. Snodgrass (1967), 119.

[136] Sekunda (2001b), 40-41; Connolly (2000), 105.

[137] Connolly (2000).

[138] Connolly (2000), 109-10. Connolly notes that a tapered shaft also clearly conforms to representational evidence of the weapon.

likely bring the point of balance back further and substantially reduce the overall weight of the weapon, thus further improving its handling characteristics.

Further complicating any reconstruction is the suggestion, first advanced by Andronicos and Markle, that the *sarisa* would normally have been made of two shorter wooden hafts joined together at the center by a metal connecting tube.[139] A hollow metal sleeve, 17cm long, supposed by Andronicos to be for those purpose, was found at Vergina, but unlike the other *sarisa* pieces, no weight was published for this find.[140] Notably, none of the forgoing reconstructions includes such a tube when calculating length or weight. Christopher Matthew recently suggests a weight of roughly 200g for the sleeve and reconstructs the *sarisa* on this basis.[141] However, the evidence for the normal use of such a connecting tube is practically nonexistent. No ancient source mentions such a connecting tube, and it is not depicted in any ancient artwork of the weapon. Most notably, none of the *sarisae* on the Alexander mosaic (fig. 5.1c) show metal connecting tubes, although many of them have the mid-section of their hafts, where such a tube would be found, in view. On that basis, I have assumed a single long wooden haft, with no metal connecting tube.

Matthew's recent reconstruction of the *sarisa* and related formation must also be rejected. Matthew proposes a *sarisa* held two cubits from the rear, rather than four. Matthew follows Asclepiodotus and Aelian rather than Polybius; it is hard to see how either of the former is more credible than Polybius, who would have actually had an opportunity to see the *sarisa*-phalanx in

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[139] Andronicos (1970), 106. Markle (1977), 323-4. C. A. Matthew, *An Invincible Beast: Understanding the Hellenistic Pike-phalanx at War* (Barnsley: Pen & Sword, 2016), 55-62.

[140] Andronicos (1970), 98.

[141] Matthew (2016), 91.

action.[142] Matthew argues that Polybius' figure of four cubits behind the leading hand is in error, but Polybius is quite deliberate in noting that part of the *sarisa* extends behind the area of the grip "to balance the weight in front [of the grip]."[143] The two cubits behind the trailing hand in Polybius' description are furthermore necessary for understanding his explanation of the projection of the *sarisa*; they cannot be a careless error. Finally, Matthew's argument that a formation holding the *sarisa* as Polybius describes could not function is refuted by Connolly's success in doing exactly that with a re-enactment pike group; Connolly expressly notes that, the extension of the rear of the pike into the next file caused no issues in the practical test. The group was even able to charge in the formation at a run without difficulties.[144]

Consequently, a reconstruction involving a hybrid of Connolly and Sekunda's efforts, produces not only the most functional weapon, but also one most consistent with the ancient evidence concerning length, use and handling. The limited nature of the evidence for this weapon makes reconstructing maximum and minimum cases difficult. While actual weapons almost certainly varied, the published examples of these pieces provide only one reconstruction (combining cat. H8 and H7), for a total metal content of 1.167kg. Connolly allows for the other two spear tips (cat. H10 and H11) to have been *sarisa*-heads, but it seems more likely, as discussed below, that these belong to cavalry spears, or perhaps the smaller *dory*.[145] Smaller and lighter variants of the weapon may have existed, particularly for the peltasts: Asclepiodotus notes

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[142] Matthew (2016), 81-90. It seems far more likely, on the balance, that both Ascleiodotus and Aelian have misunderstood their source, which may very well be Polybius.

[143] Plb. 18.29.3. τούτων δὲ τοὺς τέτταρας ἀφαιρεῖ τὸ μεταξὺ τοῖν χεροῖν διάστημα καὶ τὸ κατόπιν σήκωμα τῆς προβολῆς.

[144] Connolly (2000), 111.

[145] Connolly (2000), 109-110. Connolly notes that the heavier spear-tips caused notable degradation in the handling of the weapon.

that the peltasts use a much shorter *sarisa* than the phalangites.[146] Another butt-spike, noted by Sekunda and Matthew, now in the Great North Museum in Newcastle (cat. H9), is of uncertain date and provenance, but has the letters "MAK" inscribed on the side. It is 38cm long and has a mass of 876g.[147] It is plausible, but by no means certain, that this bronze butt could have belonged to one of the shorter *sarisae* of the peltasts. A shorter *sarisa* will have required a lighter butt-spike, because less material on the rear of the weapon will have been required in order to bring the point of balance back to the grip. However, without further evidence, it is impossible to distinguish different lengths of *sarisa* for elite units with certainty; for the purpose of this reconstruction, I assume that all *sarisa*-bearing infantry use the heavier full-length *sarisa*, consistent with Polybius' measurements. This may mean that the resulting reconstruction somewhat overstates the resource intensity of the elite peltast units.

Other Spears: Xyston, Dory, and the 'cavalry sarisa'

There is significant debate as to the choices of spears for Macedonian cavalry. In practice, it seems likely that there was substantial variation, both between units and also individual variation in the size, length and weight of these spears, as the cavalryman, unlike the infantryman, does not need a weapon of a very specific length in order to function with the unit. Xenophon advised the cavalryman to carry javelins (παλτά), rather than a spear (δόρυ), but Macedonian cavalry in the late Classical and Hellenistic periods appear to have been primarily lancers.[148] What lance they carried, however, has been the subject of some debate.

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[146] Asclepiodotus, *Tact*. 1.2.

[147] Sekunda (2001b), 35-6. Matthew (2016), 49-51.

[148] Xen. *On Horsemanship* 12.12. Sekunda (2013), 68. Connolly (1981), 71-72. Snodgrass (1967), 114.

Parallel to the efforts to reconstruct the infantry *sarisa* following the discoveries from the royal tombs at Vergina were efforts to reconstruct Macedonian cavalry weapons, particularly the so-called 'cavalry *sarisa*,' assumed to be an unusually long cavalry lance likened, by Manti, to Cossack cavalry lances.[149] Clear references to cavalry *sarisophoroi* are relatively scant in the literature. Arrian mentions *sarisophoroi* at Granicus and again against the Scythians at Tanais, but the term appears nowhere else in his corpus; they appear to be the same unit as the *prodromoi* or scouts.[150] Otherwise, the term does not appear at all save for references in Polyaenus' *Strategemata* and a single reference in Polybius, both of which clearly relate to infantry armed with *sarisae* rather than cavalry.[151] Instead, the weapon of the Macedonian cavalry is consistently called either a *xyston* or a *dory*.[152] This leaves two possibilities: first that the *sarisa*-bearing cavalry was, as suggested by Snodgrass, a brief experiment by Alexander, swiftly discontinued, or second that the name *sarisophoroi* was merely a regimental title or a use of the term *sarisa* in a very general sense to mean simply a long spear when in fact these units continued to use the standard Macedonian cavalry spear.[153] In both cases, as suggested by Sekunda, the surviving representational and archaeological material should be taken as evidence for the standard cavalry spear, the *xyston* (sometimes called by the more general term *dory*), rather than a longer specialist cavalry 'pike.'[154]

[149] E.g. Markle (1977), Markle (1978); Manti (1983).

[150] Arr. *Anab*. 1.13.1, 1.14.1, 4.4.6.

[151] Polyaenus, *Strat*. 2.29.2. Plb. 12.20.2.

[152] Sekunda (2001b), 37-40. Sekunda (2013), 68.

[153] Snodgrass (1967), 114.

[154] Sekunda (2013), 68. Sekunda (2001b), 37-40.

Arrian's account of Granicus, focused on the cavalry engagement, gives important clues as to the design of the *xyston*. He notes that the Macedonian *xystoi* were superior to Persian spears in part because they were made out of cornel-wood, and that Aretis fought on in the battle with the butt of his spear once the head had been broken off.[155] Representational artwork confirms the latter point; the rider from the Kinch Tomb, generally taken to be a Macedonian lancer, wields a spear that has a tear-drop shaped second point on the back end (fig. 5.8); Sekunda notes that this style of cavalry spear also occurs in earlier Greek artwork.[156] Connolly suggests that a grey fragment of the Alexander mosaic behind the figure of Alexander is very likely to be part of the iron butt of his spear.[157] Both Alexander on the mosaic and the rider from the Kinch tomb seem to grip the spear about three-fourths of the way from the tip.

Connolly attempted to reconstruct this weapon, but his effort was hampered by the assumption that the weapon in question was a cavalry *sarisa*, and thus by nature relatively long, rather than the shorter *xyston*. Consequently, even though Connolly estimated, accounting for the scale of the image, that the weapon Alexander carries on the Alexander mosaic would have been around 3.5m long, he attempted to recreate a substantially longer (4.87m) one. Ingeniously, Connolly also observed that the object Andronicos had mistakenly identified as a *sarisa*-head (cat. H12) was consistent with the winged butt of the lance of the Kinch tomb cavalryman, and that the significant weight of the piece (1.235kg) would function as the counter-balance to allow the spear to be gripped close to the rear, as shown in the representational evidence. Connolly then combined this butt with one of the mid-sized Vergina spear tips (cat. H10), serving as the

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[155] Arr. *Anab*. 1.15.5-7.

[156] Sekunda (2001b), 38-39. Connolly (2000), 105.

[157] Connolly (2000), 106.

head of the spear.[158] The result was a functional weapon, as demonstrated in Connolly's test by equestrian John Duckham although, as Connolly notes, "not entirely satisfactory."[159]

Instead it seems more reasonable to suppose, as Sekunda does, that the weapons depicted in the Alexander mosaic and Kinch tomb painting are *xystoi.*[160] Many of the difficulties in Connolly's reconstruction can thus be solved by abandoning the notion of a cavalry *sarisa,* and instead reconstructing the weapon as a shorter *xyston* of c. 3.5m consistent with the representational evidence. The shorter length serves to move the point of balance back. Connolly reported that the center of balance on his reconstruction was about one-third of the length of the spear from the rear end; a shorter shaft shifts the center of balance to approximately a quarter of the spear's length from the rear, where the figures on the Alexander Mosaic and the Kinch tomb are shown to be gripping the weapon.[161] The metal-weight of this reconstruction, taken by combining the winged spear-butt (cat. H12, 1.235kg) and the mid-sized Vergina spear-point (cat. H10, 0.235kg), produces a total metal-weight of 1.470kg. As with the infantry *sarisa*, the limited number of published exemplars for the components makes it impossible to establish a normal range of reconstructions for these weapons, but it must be assumed that they varied significantly from one cavalryman to the next.

In addition, it is necessary to consider the shorter *dory*, the traditional one-handed hoplite spear. Some cavalry may have opted to carry the *dory*, and it seems to have remained the primary close-combat weapon for the *thureophoroi*. Several funeral stelae from Sidon pictured

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[158] Connolly (2000).

[159] Connolly (2000), 108.

[160] Sekunda (2013), 68. Sekunda (2001b), 38-9.

[161] Point of balance calculations courtesy of Chris Crapuchettes and WASK Engineering.

by Sekunda show *thureophoroi*, many of them with the *dory*; he notes the similarity of this weapon to the Roman *hasta*.[162] Plutarch likewise notes the shorter thrusting spear as the typical armament of the *thureophoros*.[163] Unfortunately, I know of no study of Hellenistic short-spears, but as noted in the previous chapter, the parameters for one-handed thrusting spears are relatively consistent, making it useful to extrapolate from previous periods. Jarva suggests that the hoplite's *dory* during the Archaic or early Classical period might typically be c. 2.2m long, with a spear-head from 0.2 to 0.4kg, broadly consistent with Republican Roman spearheads discussed in the previous chapter, if somewhat heavier.[164] Jarva dismisses Markle's suggestion, based on the smallest of the Vergina spear-tips (cat. H7), that the tip of a spear might be less than 200g. However, given the comparative Roman and Gallic evidence (discussed in the previous and following chapters respectively), it is difficult to dismiss the possibility of such small tips.[165] Jarva suggests 0.25kg as a maximum weight for Greek spear-butts, proposing a typical example at c. 150g; this is again somewhat heavier than the examples for the *hasta*.[166] A spear with a heavier tip would require a heavier ferrule in order to maintain the point of balance. It would produce a weapon somewhat heavier than the Roman *hasta*, but not unreasonably heavy. The metal-weight of the *hasta* of the previous chapter ranged from 130g to 420g; Jarva's data for the *dory* suggests reconstructions ranging from c. 200g to c. 600g of metal-weight. Into this range,

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[162] Sekunda (1995), 73-4, Pl. 65-69.

[163] Plut. *Philop*. 9.1.

[164] Jarva (1995), 137-8.

[165] Jarva (1995), 138, n. 956. Markle (1977), 324-5.

[166] Jarva (1995), 138, n. 958.

we may insert a median case of c. 400g, combining a relatively typical 250g spearhead with a 150g ferrule.

Swords: Xiphos and Kopis

The standard sidearms in Hellenistic armies carried, by all appearances, by every kind of soldier, were swords of two types, the *xiphos* and the *kopis*. The distinction between them is worth specifying at the outset for clarify. What is meant by *xiphos* here is a strongly waisted double-edged straight-sword (fig. 5.9), while the *kopis* is a forward-curving single-edged sword (fig. 5.10), synonymous with the narrow meaning of the word *machaira.*[167] Care must be used with the latter term, however, as it is sometimes employed as a generic word for a sword of any type. Some older scholarship, perhaps overly influenced by Plutarch's description of Macedonian sidearms as μικρά ἐγχειρίδια, has asserted that the phalangites had only daggers to defend themselves, but the evidence strongly points to swords as regular equipment.[168]

As noted above, the military regulations of Amphipolis specify a *machaira* for the regular infantry. Given the continued presence of the *xiphos*, the word *machaira* here must be taken to mean 'sword' generally, rather than a curved sword specifically; representational evidence continues to show both weapons. Even when sheathed, *xiphos* and *kopis* can be told apart by their different hilt and pommel structure. The *kopis* generally features an asymmetrical hilt which curves around the hand, whereas the *xiphos* generally features a symmetrical hilt, sometimes with a scalloped or lobed pommel, or alternately with a disc-pommel (fig. 5.11). This difference is well illustrated by the two lunette paintings in the Tomb of Lyson and Kallikles,

[167] Note esp. Xen. *On Horsemanship* 12.11 for the distinction between types.

[168] Plut. *Aem*. 20.10. Scholars suggesting daggers, e.g., Markle (1977), 332.

both of which feature swords painted as if suspended from the ceiling; each has a pairing of a *kopis* and a *xiphos* (fig. 5.12).[169] Miller also detects a *xiphos* at the side of a phalangite depicted at the 'Great Tomb' at Lefkadia.[170] Again, he *xiphos* seems to be the dominant sword-type in the funeral images of *thureophoroi* compiled by Sekunda.[171]

The *xiphos*-type is somewhat shorter and more strongly waisted than the Roman *gladius hispaniensis*; the type seems to have remained relatively consistent from the 5th century into the Hellenistic period.[172] An example from Vergina (cat. H1) published by Markle was 55cm long with a well-preserved blade; the tang is broken off and lost, but would have added another c. 8cm to the end of the blade making the weapon originally c. 65cm long (fig. 5.13).[173] Markle weighed the remaining fragment at 300g; accounting for the missing tang, the intact original might have weighed around 400g.[174] A very well-preserved example of the type from the late Classical period can be seen in the 'Sword of Beroia' (cat. H2, fig. 5.9); it is 55cm long with a strongly waisted blade that is 4.5cm at the thickest and 3cm at the thinnest.[175] Using the same digital reconstruction methods as with the two Šmihel *gladii* in the previous chapter, I estimate

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[169] Miller (1993), 54-5.

[170] Miller (1993), 54; Pl. 8b.

[171] Sekunda, (1995), pl. 66-86. Note esp. pl. 85, where the 'lobed' pommel of a *xiphos* can be seen on the otherwise heavily damaged fresco.

[172] Consistency of the type: G. Tourgatsoglou, "Το ξίφος Τῆς Βέροιας: Συμβολή Στη Μακεδονική Οπλοποιια των Ύστερων Κλασικών Χρόνων," in *Ancient Macedonia IV, Fourth International Symposium* (Thessaloniki, Institute for Balkan Studies, 1986), 616-620. A. E. Remouchamps, *Griechische Dolch- und Schwertformen: Ein Beitrag zur Chronologie der Europäischen Bronzezeit* (Leiden: Brill, 1926), 34-40. The iron-age *xiphos* comprises 'Typus 15' and 'Typus 16' in Remouchamps' typology.

[173] Markle (1982), 101. P. Adam-Veleni, "Arms and Warfare Techniques of the Macedonians" in *Alexander the Great, Treasures from an Epic Era of Hellenism* ed. D. Pandermalis (New York: Onassis, 2004), 53.

[174] Assuming a tang 8cm long; 3cm wide and 0.5cm thick, as with the sword of Beroia discussed subsequently.

[175] Tourgatsoglou (1986), 611-628.

an original mass of c. 490g for the sword. Another example of the type from Rhodes in the British Museum (cat. H3, fig. 5.14) is missing only the very tip of the tang. It is 55cm long, with a maximum blade width of 4.5cm and is otherwise complete, but too badly rusted to produce a useful weight.[176] As noted above, representational evidence confirms the use of this type in the Hellenistic period. Two of the painted swords in the Tomb of Lyson and Kallikles are of this type and are apparently drawn very nearly to life-size: the north wall's *xiphos* is 67.3cm long, while the south wall's is 59.5cm.[177] Miller notes that the scale and proportions of the two painted swords differ, but the overall scale is consistent with swords of this type being between c. 55cm and 65cm; the scabbards will have added some length to the painted swords.

The other sword-type was the *kopis* or *machaira*. The *kopis* was a forward-curving single-edged sword, specialized for brutal cutting attacks; in form and function it has much in common with the Spanish falcata, discussed in the next chapter. The type, though frequently mentioned and well-known, is often presented with little evidence, though it appears as early as the sixth century in Greece.[178] Jarva offers only a single example of a long type and can only speculate about the existence of lighter versions; Connolly is forced to direct the reader to examples of Spanish falcatas for lack of Greek examples.[179] Fortunately, more examples of the type have since come to light; it seems likely that as more of these swords (many of which

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[176] The sword is listed in the catalog with a date of 1-400 AD; Ben Harridge, Asst. Collections Manager at the British Museum, confirmed in correspondence that the sword was misdated and almost certainly dates to the Archaic or Classical period based on accompanying material. The sword type would seem to rule out the beginning of that range, suggesting a Classical, late Classical or Hellenistic date to the weapon.

[177] Miller (1993), 54.

[178] Remouchamps (1926), 40-44.

[179] Jarva (1995), 138. Connolly (1981), 77.

languish, unpublished, in museum collections) are identified and published, our understanding of the type will improve greatly.

The *kopis* seems to have come in two forms, with a longer blade for use by the cavalry, and with a shorter one, presumably for the infantry. One very well-preserved example of the longer type has been published by Angelos Choremis (cat. H4, fig. 5.15), found intact in the same deposit as a cavalry helm and metal cuirass, discussed below, confirming the weapon's role as a cavalryman's sword.[180] Jarva notes another example of the type from Vetulonia which currently weighs 450g, but he estimates the original weight to have been about double, or 900g.[181] The connection of this type to cavalry contexts conforms to Xenophon's advice that the cavalryman should prefer the *machaira* or *kopis* to the *xiphos*, because the former perform better than the latter in downward slashes; the greater length of these weapons may be meant to facilitate cutting downward from a mounted height.[182]

We also see evidence for a substantially shorter *kopis*, probably for use on foot.[183] The swords on the painted tomb of Lyson and Kallikles, as noted above, appear to have been painted roughly to life size; the two *machairai* there are 67cm and 58.3cm long, essentially the same size as the *xiphoi*.[184] Two *machairai*, acquired in 2001 by the Metropolitan Museum of Art, are of this type, dated by the museum to the 5th or 4th century BCE (cat. H5, H6, fig. 5.10). They are 54.6 and 56.5cm long respectively; both feature the same flat-tang construction seen in the *xiphoi*

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180 Choremis (1980), 3-21.

181 Jarva (1995), 138.

182 Xen. *On Horsemanship* 12.11. μάχαιραν μὲν μᾶλλον ἢ ξίφος ἐπαινοῦμεν: ἐφ᾽ ὑψηλοῦ γὰρ ὄντι τῷ ἱππεῖ κοπίδος μᾶλλον ἡ πληγὴ ἢ ξίφους ἀρκέσει.

183 Snodgrass (1967), 97-8.

184 Miller (1993), 54.

above. Both were measured by the museum at c. 1.5lbs (c. 700g). The analogy of the quite similar falcata discussed in the next chapter would suggest that swords of this type might also be significantly lighter than this, but it may be that the *kopis* was, on the whole, a heavier type of sword than the falcata.

Given the shape and function of these swords, scholars have tended to attribute the *kopis* to the cavalry and the *xiphos* to the infantry; as a general rule this seems correct, but significant latitude must be given for individual variation. The helmets in the tomb of Lyson and Kallikles suggest that one of the brothers was a cavalryman and the other an infantryman, so the decision to show one of each type of sword there makes sense.[185] The *kopis* was popular, however, with Greek hoplites of the late Classical period, and appears frequently in artistic representations of infantrymen from that point forward.[186] The *xiphos* also appears in representational evidence for Macedonian cavalry; Alexander wears a *xiphos* on the Alexander mosaic from Pompeii (the sword can be identified from the disc-pommel, fig. 5.11). Likewise, the Pergamum frieze, showing the equipment of a defeated Greek cavalryman, also shows a *xiphos*, rather than a *kopis* (fig. 5.4).

For the infantrymen (peltasts, phalangites and *thureophoroi*), then, we might assign as the maximum case the shorter *kopis*-type at 700g; it seems unlikely that the longer type of *kopis* would have been functional in close-order infantry formations. The lighter *xiphos* from Vergina, may make the minimum case at 400g and the heavier reconstruction of the Sword of Beroia at c. 490g the median case. For the cavalry, the maximum case may be set with the long type of *kopis* at c. 900g. The minimum case would be again the 400g *xiphos*; as noted, cavalrymen are

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[185] Miller (1993). Sekunda (2012), 44 on the identification of the panoplies.

[186] Snodgrass (1967), 97-8.

represented as still using the weapon, despite Xenophon's advice. The median case may be set at the shorter type of *kopis* at c. 700g.

There is a notable tendency in the less recent scholarship to devalue Greek and Macedonian swords, particularly in light of the tremendously effective Roman *gladius*.[187] The Greek *xiphos* of this period, however, was only slightly shorter than the Roman *gladius*, and could clearly have been a very effective weapon. However, both Greek swords have a strong tendency towards the cut over the thrust, which may have proved a liability in close combat. For the *kopis*, this function is obvious from the shape and weight of the weapon; the *xiphos* is more multi-purpose. However, compared to the *gladius*, the *xiphos* is more strongly waisted, a design feature that will tend to concentrate the weight of the weapon towards to the point. This is a desirable feature for delivering a powerful cut, as it focuses the weight of the weapon towards the center of percussion.[188] However, as with any lever (and a sword is in a mechanical sense merely a sharpened lever) shifting the weight away from the grip limits the amount of control the hand can exert on the point, making precise thrusts more difficult.

When designed with cuts in mind, the *xiphos* and the *kopis* would be more effective against lightly armored targets, but less so against an armored Roman soldier. Strong cuts can swiftly disable an opponent without the difficulty of recovering the sword that is posed by a deep thrust. At the same time, this design focus on the cut may explain in part why Hellenistic phalangites failed so rapidly and so consistently against Roman troops once exposed to close combat and unable to use their *sarisae*. The cutting attacks favored by Greek swords would have

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[187] E.g. Markle (1977), 322. Snodgrass (1967), 119. Note also Liv. 34.33-4, which places emphasis on the terrible wounds the *gladius* inflicted compared to Greek weapons.

[188] The center of percussion is the point on a sword where an impact will not produce any oscillation in the grip and thus will deliver the strongest cut. The exact position of the center of percussion will vary from sword to sword depending on the weight distribution.

been far less effective against mail armor; no amount of force will permit a sword to cut iron rings, and the padding worn underneath the armor will have absorbed most of the shock of a blow.[189] Even so, the *kopis* and *xiphos* should not be dismissed. They were formidable weapons for their intended purpose, but they were ill-suited to fight mail-armored Romans. This shortcoming may explain why both of these sword-types vanish in the Roman period, to be supplanted by Roman sword-types like the *gladius* and *spatha*.

Aspis and Pelte

Macedonian shields were constructed, like older Greek hoplite shields, with a wooden core, overlaid by a bronze sheet.[190] The Macedonian *aspis* was generally smaller than the hoplite *aspis* of the Classical period, probably to facilitate carrying the greater weight of the *sarisa*, which required two hands. The shield is described as being carried by way of a strap *(ochane*) rather than the *porpax* handle of the hoplite *aspis*; the usability of a grip system consisting of combining elbow and wrist straps with a shoulder strap (to allow both hands for the *sarisa*) has been demonstrated by Connolly (fig. 5.16).[191] The primary metal component of these shield-types is the bronze facing. In contrast to the *scutum*, the grip of Macedonian shields was, as noted, provided by a series of straps, likely in leather. A smaller version of this shield, carried by

[189] It is possible for a very strong blow to 'burst' riveted rings, but even this would not deliver a fatal cut through the armor. The 'bashing' impact of an ancient sword is minimal, which should be apparent given how light these weapons are.

[190] On the construction generally, see Liampi (1998), 9-12.

[191] *Ochane* vs. *Porpax* grip: Plut. *Cleom* 11.2. Connolly (2000), 110-111. Sekunda (2013), 81. Liampi (1998), 11.

some elite units like the Antigonid *peltastai*, was called the *pelte*; it too seems to have been bronze-covered and carried by means of the same strap system.[192]

The main point of contention concerning Macedonian shields has been their size, but more recent finds of the bronze-plate shield covers have thrown considerable light on this question. It is now fairly clear that there existed two sizes of Macedonian shield, one with a diameter of c. 70-75cm, generally identified as the *aspis*, and another smaller shield of c. 65cm in diameter, generally identified as the Macedonian *pelte*.[193] For the sake of clarity and simplicity, I will refer to the larger of these shield types as the *aspis* and to the smaller as the *pelte*, though it should be noted that the identification of these types with those mentioned in the literary sources, while very probable, is not entirely secure. The *aspis* appears in life-sized relief on a monument at Veria in Dion showing a series of carved shields; the best-preserved relief ('block A') shows two *aspides*, 76 and 73cm in diameter.[194] The two shields painted on the walls of the tomb of Lyson and Kallikles also appear to be this size, measuring 73 and 75cm in diameter.[195] Fragments of bronze shield covers of this size include one in the Florina Museum discussed by Katerini Liampi (cat. H18, 73.6cm diameter), another discussed by Demetrios Pantermales (74cm), and two more from Staro Boniče (74 and 72cm).[196] The smaller type of

[192] Sekunda (2013), 83.

[193] Hatzopoulos (2001), 83-4. Sekunda (2013), 82; Sekunda (2007), 337-9. Liampi (1998), 15-22. Cf. Markle (1977), 331 and M. Markle, "A Shield Monument from Veria and the Chronology of Macedonian Shield Types" *Hesperia* 68.2 (1999), 219-254. Markle argues for two shield types for the line infantry, a c. 65cm shield and a 90cm shield, for the period of Alexander and the Diadochi; the larger (90cm) shield is, in fact, the hoplite *aspis*, and does not seem to have remained in use. See Hatzopoulos (2001), 84, n. 2.

[194] Markle (1999).

[195] Miller (1993), 55.

[196] Liampi (1998), 55. Adam-Veleni (2004), 55. D Pantermales, "Βασιλέ[ως Δημητρ]ίου" in *Myrtos: Mneme Ioulias Vokotopoulou* (Thessaloniki: Hypourgeio Politismou - Aristoteleio Panepistemio Thessalonikes, 2000), xvii-xxii. Staro Boniče: P. Juhel and D. Temelkoski, "Fragments de "Boucliers macédoniens" au nom du roi Démétrios trouvés à Staro Bonče (République de Macédoine). Rapport préliminaire et présentation épigraphique" *ZPE* 162

shield is also well-attested. A very well-preserved example, 65.1 x. 66.9cm from Pergamum and dated to the mid-second century, is now at the Antikensammlung in Berlin (cat. H20, fig. 5.17); I will refer to this example as the 'Berlin shield.'[197] Relatively well preserved, it provides an excellent example of this smaller *pelte*-type.

An unusual example in this regard is the 'Shield of Pharnakes" (cat. H19) now at the Getty Museum, which measures 79.7 x 81.4cm. The inscription on the front (ΒΑΣΙΛΕΩΣ ΦΑΡΝΑΚΟΥ), which declares it to have belonged to Pharnakes of Pontus, dates the shield to the second quarter of the third century. This shield, due to its remarkably good condition (fig. 5.18), is frequently used as the basis for reconstruction.[198] To extrapolate from it is potentially difficult however, as it was not necessarily ever intended for battlefield use. Notably, the tabs around the edge (see figure) are still straight and may never have been bent around a wooden core; one may contrast the Berlin shield (cat. H20, fig. 5.17), where the tabs around the edge are still clearly in a bent shape. The shield is also, as noted, uncommonly large and significantly outside the range for other finds. It is currently bolted into a mount which prevents measurements of the thickness of the metal plate except on the tabs. The tabs themselves are uncommonly thick (ranging from 1.0-2.47mm, see below for comparison), further suggesting that the shield was a display piece, rather than battlefield equipment.[199] Given these measurements as well as with the royal

(2007): 165-180. P. Juhel and D. Temelkoski, "Découverte de nouveaux 'boucliers macédoniens' en Pélagonie (République de Macédoine). Aspects archéologiques et réflexions historiques" in *Pratiques et identités culturelles des armées hellénistiques du monde méditerranéen* eds. J-C. Couvenhes, S. Crouzet and S. Péré-Noguès (Bordeaux: do Boccard, 2011), 177-192.

[197] Uwe Peltz, "Der Makedonische Schild aus Pergamon der Antikensammlung, Berlin" *Jahrbuch der Staatlichen Museen zu Berlin* 43 (2001), 331-343.

[198] E.g. Connolly (2000), 109, though Connolly also considers the Berlin shield (cat. H20); his reconstruction is substantially based on the Getty shield.

[199] Measurements by Getty Museum staff.

inscription, it seems plausible that this shield was a display piece, oversized and not intended for combat use. A further problem is that the shield as presented appears to have undergone significant restorative work since its acquisition by the Getty: one may contrast an older picture of it, which shows significant damage (fig. 5.18). As a result, this particular exemplar should be treated with extreme caution.

No complete Macedonian shield survives; generally, finds are composed of fragments of the thin bronze facings, with the wooden cores having long since rotted away.[200] The poor state of preservation often make it difficult to estimate the original dimensions of the shield; even so, enough of these fragments are sufficiently well enough preserved to reconstruct both types. The bronze facings are generally very thin, though the thickness of these thin metal plates is difficult to measure and is often not recorded in publication details. The metal sheets were likely produced by hammering, so the thickness is not consistent throughout. Part of the reason why these shield facings continued to be produced in bronze is no doubt the difficulty of maintaining consistent thickness when producing hammered iron sheets. A fragment of a Macedonian shield (cat. H18) discussed by Liampi has a thickness listed at only 0.3mm.[201] The Berlin shield ranges from 0.35 to 0.5mm in thickness, and averages c. 0.4mm. The older *aspis* could be somewhat thicker, but not much: a remarkably well preserved late 6th century hoplite *aspis* (cat. H21) now in the Boston Museum of Fine Arts averages a thickness of 0.5mm.

Apart from thickness, the final dimension required for reconstruction is the depth of the dome or dish, as the bronze plate is not a perfect flat circle, but a dome. Many shield fragments

[200] The 'shield of Pharnakes' (cat. H19) noted above is a rare exception to this rule: nearly the entire facing survives. This is probably because the facing is unusually thick.

[201] Liampi (1998), 55.

are simply not large enough to provide this data, but some of the better-preserved shield covers can. The aforementioned Berlin shield (cat. H20) is 11cm deep. The 'Shield of Pharnakes' (cat. H19) is 11.8cm deep, while the Boston hoplite *aspis* (cat. H21) is 11.5cm deep. The Macedonian *aspides* depicted in relief on the Veria monument are somewhat shallower; the best preserved of the group ('Block A') are 8cm and 9.5cm deep.[202] Asclepiodotus, in outlining the ideal shield for the *sarisa*-phalanx, suggests a shield of eight palms (c. 66cm) that is "not too concave."[203] Hence, it has sometimes been assumed that the smaller *pelte* shield type of c. 65cm was flatter than the larger *aspis* type, but this does not seem to be the case.[204] Indeed, the Berlin shield, despite being of the *pelte*-type and matching Asclepiodotus' diameter measurements almost precisely, is one of the deepest shields, matching the depth of the Boston hoplite shield; by contrast the two shield-reliefs at Veria are much shallower, but they seem to depict that larger *aspis*. Given the evidence, it thus seems reasonable to read Asclepiodotus' statement as a preference for flatter shields rather than as a description of the characteristics of an entire type, and to assume that both the larger *aspis* and the smaller *pelte* probably ranged in depth from c. 8cm to c. 12cm.

Based on these parameters, it is possible to calculate the metal required for the bronze facing of both the *aspis* and the *pelte*. Beginning with the aspis, a shield of 72cm in diameter with an 8cm dish might have c. 4,270cm^2 of surface area. A domed metal plate laid over this at a thickness of 0.3mm, would have a volume of 128cm^3; in bronze this would mass 1.088kg.[205]

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[202] Markle (1999), 222.

[203] Asclepiodotus *Tact.* 5.1. Περὶ ὅπλων ἰδέας τε καὶ συμμετρίας Τῶν δὲ φάλαγγος ἀσπίδων ἀρίστη ἡ Μακεδονικὴ χαλκῆ ὀκτωπάλαιστος, οὐ λίαν κοίλη.

[204] Flatter *pelte*: Sekunda (2013), 83.

[205] This assumes that the curvature of the dish of the shield is the cap-section of a sphere; the actual surface area is likely to vary slightly depending on how the dome is curved. The Pergamum shield appears to be very close to the

This may serve as a minimum case for the *aspis*. For a maximum case, a shield of 76cm in diameter and 11cm in depth would have a surface area of 4,910cm;[2] assuming a quite thick metal plate of 0.5mm, the shield would require 2,086kg of bronze. For the median case *aspis*, diameters close to 74cm seem the most common; a bronze plate of 0.4mm over a 74cm diameter shield with a depth of 9cm would mass 1.548kg, which may serve as a median case.

The same process may be performed for the *pelte*. For the minimum case, a 64cm diameter shield, with a depth of 8cm and a plate thickness of 0.3mm, would require c. 870g of bronze. For the maximum case, a shield of 66cm diameter, with a 12cm depth and a plate thickness of 0.5mm, would require 1,646g of bronze. The median case may match the Berlin shield exactly; a 66cm diameter shield with 11cm of depth and a 0.4mm plate would require 1,292g of bronze.

Thureos

The *thureos*, the oval-shield of the *thureophoroi*, is the Hellenistic variant of the Gallo-Italian *scutum*-type. It seems to have been introduced to Greece in the early third century, but the circumstances are not entirely clear; modern scholars have suggested both the Italian campaigns of Pyrrhus of Epirus' and the arrival of the Galatians as possible vectors of transmission.[206] Plutarch describes the *thureos* used by the Achaeans as light and easy to handle,

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section of a sphere, however; note esp. Peltz (2001), 334, abb 4. Mass estimates in bronze assume 8.5g/cm density, as in the previous chapter.

[206] Stary (1981). Sekunda (2007), 339-343. More recent scholarship has tended to favor Galatian transmission, e.g. J. Ma, "Fighting *poleis* of the Hellenistic world" in *War and Violence in Ancient Greece*, ed. H. van Wees (London: Duckworth, 2000), 354. M. Eichberg (1987), 188-193. Transmission via Pyrrhus: P. Coussin, *Les Institutions Militaires et Navales* (Paris: Les Belles Lettres, 1932), 82-3, Q. F. Maule and H. R. W. Smith, *Votive Religion at Caere: Prolegomena* (Berkeley: University of California Press, 1959), 6, n. 48.

but too small to fully protect the body.[207] This description seems borne out by the representational evidence. *Thureoi* depicted on funerary stele (e.g. fig. 5.6) often extend from just above the shoulder to the mid-thigh; the shield is typically depicted as being a little less than half as wide as it is tall.[208] The *thureoi* depicted on the Athena Propylon at Pergamum, which measure 85-90cm tall, may be life-sized, although they may also represent the Gallic shield type.[209] The contrast with the *scutum*, which offered full-body protection, being both wider and taller, is marked. The depiction of the shields in relief on funerary monuments (fig. 5.6) shows them to lack the pronounced curve of the *scutum*.[210] The Kasr al-Harit shield from Egypt, discussed in the previous chapter, may also be a Hellenistic *thureos*, but it replicates the much larger and more deeply curved style of the Roman *scutum*, rather than the more common, smaller and flatter Hellenistic *thureos*.

The construction of the shield seems to roughly parallel the Roman and Gallic forms: a wooden oval core, strengthened by a wooden central *spina*, with a metal 'butterfly' boss over the wooden bulge at the center of the *spina* and possibly a metal rim.[211] The shields would have been covered in thin hide, as with the Roman shield, and are almost universally painted white. Two examples from a funerary monument at Tanagra, Greece, show a flat rim, much like the one around the edge of a hoplite *aspis*; but a second funerary monument, also at Tanagra, shows no

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[207] Plut. *Philop*. 9.1. ἐχρῶντο γὰρ θυρεοῖς μὲν εὐπετέσι διὰ λεπτότητα καὶ στενωτέροις τοῦ περιστέλλειν τὰ σώματα.

[208] Sekunda (1995), fig. 65-73. Eichberg (1987), 164.

[209] Eichberg (1987), 263.

[210] P. M. Fraser and T. Rönne (1957), 69.

[211] Sekunda (1995) reconstructs these shields with a metal *spina*, but a wooden *spina*, consistent with the evidence for the Roman *scutum* (see previous chapter) seems more likely.

rim at all, neither does it show any trace of a metal butterfly boss, although this may be a result of wear.[212] The *thureoi* on the Athena Propylon do show evidence of butterfly bosses; one of the shields, pictured by Michael Eichberg (fig. 5.19), shows a very thick rim, which seems likely to be leather rather than metal, given the thickness. The Sidon stele paintings that show the *thureos* often show it with a darkened rim (e.g. fig. 5.20) which could be metal, but could also be a leather binding; the rim is not typically the same color as the boss, which would seem to suggest leather.[213]

I know of no finds of metal shield components from the Hellenistic world which can be clearly linked to the Hellenistic *thureos*, but the parameters of the shield are well enough known to permit an informed if speculative reconstruction, based on the Roman and Gallic evidence for the metal components. As with the Roman *scutum*, the primary metal elements would consist of a metal boss and handle; some shields may also have had a metal rim. Metal bosses depicted in artwork are consistent with the 'butterfly' boss shapes found in Roman and Gallic shields; given the small size of the shields and the lack of curvature, the smaller 'Gallic-style' handle also seems likely. As just noted, evidence for metal rims on the shield is mixed; it seems likely that some shields had leather edgings, while others had metal rims. Given that the *thureos* is taken to be a light shield, poorly suited for close combat, it seems likely, but by no means certain, that metal rims were rare. A median case for the *thureos*, then, might include as metal elements only an average-weight c. 300g boss and c. 20g of metal for the handle, for a total of 320g of iron. A minimum case might posit a lighter boss (c. 200g) and a lighter handle (c. 14g), for a total metal-

[212] Fraser and Rönne (1957), 69-70, pl. 1.1, 2.4.

[213] Sekunda (1995), photo 1-3. Sekunda reconstructs the rims, boss and *spina* of these shields as being of the same metal; this seems unlikely given the coloration on the stelae.

weight of c. 214g. For the maximum case, a metal rim may be added; assuming a rim of c. 0.5mm thick, 2cm wide running the edge of a shield 80cm x 40cm, the rim might weight c. 160g.[214] Accounting for a relatively heavy (c. 300g) boss and a grip (c. 20g), the maximum case may be set at 480g of iron. The drastic difference in metal intensity between the *thureos* and the two 'Macedonian' shield types makes the decision for Greek *poleis* to rely on *thureophoroi* understandable, even though such soldiers generally performed poorly when opposed by Macedonian phalangites: it must have been far less expensive to equip soldiers of this type.[215]

Armor

Body Armor

The starting point for discussing the body-armor of regular Macedonian troops is the inscribed military regulations from Amphipolis, which assign a *kottybos* to the regular soldiers and a *thorax* or *hemithorakion* to the officers. However, two of these terms (*kottybos* and *hemithorakion*) have unclear meanings. It further complicates matters that, although the term *thorax* is sometimes used in modern scholarship to mean a bronze breastplate specifically, in Greek sources a θώραξ can mean almost any kind of full chest protection, including mail, scale and textile armors.[216] Thus, in order to avoid confusion, it seems best to first outline and reconstruct the various kinds of armor available to a Hellenistic army, before discussing which armors might correspond to which terms in the Amphipolis regulations.

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[214] An oval shield 80cm x 40cm should have a circumference of c. 200cm, thus the rim would consist of a metal band 20cm x 2cm x 0.5mm, or 20cm^3; in iron, this would mass 157.2g.

[215] Plutarch implies as much, Plut. *Philop*. 9.3-5.

[216] Use of *thorax* as a general term meaning, effectively, breastplate, e.g. Hatzopoulos (2001), 81. Fischer-Bovet (2014), 136. Examples for θώραξ used for mail armor: Plb. 30.25.2; scale armor: Hdt. 9.22.; Paus. 1.21.6; textile armor: Homer *Iliad 2*.529, Xen. *Cyropaedia*. 6.4.2 *Anab*. 4.7.15-16, Dio 78.7.1-2, a list by no means exhaustive.

Breastplates

What is often translated or described as a breastplate is, in a technical sense, actually a plate armor cuirass, in that it includes both a front-plate (which is to say, a breastplate) and a back-plate. The choice to wear only a front-plate with no matching back-plate, common in the medieval period, seems not to have been employed in the Hellenistic world. Here, conforming to the common usage, I will use the term 'breastplate' to mean this armor (the problem with using the term *thorax* being detailed above), although it should be understood that in this context a 'breastplate' includes both a front-plate and a back-plate. 'Cuirass' generally may apply to any armor that protects both the front and back of the torso; the muscle cuirass and bell cuirass are thus both cuirasses and subtypes of breastplate. The two plates are typically connected by straps or buckles over the shoulders and on the sides.[217] Adding to this protection, the armor would be worn with a leather or textile liner, which also typically includes leather strips, called *pyterges* which hang down from beneath the breastplate to protect the groin and upper thighs.

The muscle cuirass subtype, which Jarva terms a 'Type III' cuirass, appears by the early fifth century, and remained in use in the Hellenistic period.[218] This cuirass was typically made from copper-alloy, although a single example has been found in iron from the Hellenistic period, the Prodromi Cuirass from Thesprotia (cat. H23, fig. 5.21).[219] The Prodromi Cuirass also exhibits one new characteristic of Hellenistic versions of this armor, which is the addition of shoulder-plates mimicking the construction of type IV 'shoulder piece' armor.

[217] Jarva (1995), 31-2. Pausanias describes this attachment system, Paus. 10.26.5.

[218] Jarva (1995), 31. Everson (2001), 186-192.

[219] Choremis (1980).

Although the Prodromi cuirass was unfortunately published without weight or thickness data, a number of other well-preserved examples of the type in copper-alloy can serve to give a sense of it. A remarkably well-preserved example is in the British Museum, dated to the latter half of the fourth century (cat. H24, fig. 5.22). This breastplate is in copper-alloy, with a 1,186g front-plate and a 1,316g back-plate (2,502g total); there are rings on the shoulders and the sides where straps would have connected and closed the plates. A damaged example of the same type from Puglia, Italy dated to the fourth century BCE (cat. H25, fig. 5.23), also in the British Museum, has a listed weight of 7.25lbs (3,280g); some of the material from it is clearly missing, but the original mass is not likely to be more than 4kg. Two fourth century cuirasses of this type from Apulia mass 3,850g (cat. H26) and 3,363g (cat. H27).[220] As Jarva notes, the overall weight of such breastplates seems to have varied within a fairly limited range for some time; the Archaic bell cuirass from Argos (cat. H31) dated to the eighth century masses 3,360g despite being a much earlier cuirass.[221] In Thrace, a local variant of the Archaic bell cuirass remained in use at least into the fourth century; an example of this type from Chernozem, Bulgaria, dated to the late fifth century, masses 3kg.[222]

Despite the relatively clear picture offered by the archaeological evidence, reconstructed weights for Greek breastplates have tended to skew high, at times unrealistically so. Jarva's study of the weight of hoplite arms continues to be the basis for discussion, with no systematic

[220] Jarva (1995), 135. D. Cahn, *Waffen und Zaumzeug* (Basel: Antikenmuseum Basel, 1989), 58-60, 66.

[221] Jarva (1995), 135. P. Courbin, "Une tombe géometrique d'Argos" *BCH* 81 (1957), 322-386, esp. 340-350.

[222] K. Kisyov, "Le tumulus n˚ I de Chernozem-Kaloyanovo" in *L'Épopée des rois thraces: des guerres médiques aux invasions celtes 476 – 278 av. J.-C*, eds. J-L. Martinez, A. Baralis, N. Mathieux, T. Stoyanov and M. Tonkova (Paris: Musée du Louvre, 2015), 78-9. It has been suggested that these later cuirasses might have been worn with an iron pectoral or gorget to cover the neck, as the Thracian variants lack the high collar of the Archaic bell cuirass type. Everson (2001), 185-6. L. Ognenova, "Les cuirasses de bronze trouvées en Thrace" *BCH* 85 (1961): 501-538.

effort to compile the archaeological evidence since his.[223] In discussing the Argos bell-cuirass, Jarva notes that the maximum reported thickness is c. 2mm, and proposes to calculate an original of weight of 8kg on this basis; his approach has a number of problems, however.[224] First, he assumes the rough surface area of the armor to be c. $1m^2$, or $10{,}000cm^2$; this is almost certainly too high.[225] As noted below, the pattern for the detailed reconstruction of the type IV armor has a much lower surface area, while covering the same region of the body. Second, Jarva appears not to make allowances for the wide variance of armor-thickness within cuirasses. Instead, he notes that the reported average thickness of the cuirass was 2mm, and thus adjusts the 'original' mass of the breastplate from the preserved weight of 3.36kg to roughly 8kg on that basis; even so, the Argos cuirass which is quite well preserved (fig. 5.24), leaves little room for such material loss.[226]

Jarva seems to assume that the original breastplate had uniform thickness and that variations in thickness are the result of material loss, perhaps from corrosion. However, copper-alloy, in contrast to iron, corrodes protectively, meaning that the initial corrosion layer protects the rest of the metal from further corrosion; material loss is thus typically very low, even over long periods. Moreover, thickness in body-armor is often varied from section to section by design, or as a consequence of the working and forging process.[227] Jarva himself notes that "it

[223] Reliance on Jarva (1995), e.g. A. Schwartz *Reinstating the Hoplite: Arms, Armour and the Phalanx Fighting in Archaic and Classical Greece* (Stuttgart: Franz Steiner Verlag, 2009), 95-96, n. 368; Aldrete *et al* (2013), 147.

[224] Jarva (1995), 135. It should be noted that Jarva seeks in his argument to stress the considerable weight of hoplite equipment and tends to consistently make assumptions maximizing that weight.

[225] This can be compared with the same surface area suggested for the *lorica hamata* of the previous chapter. Unlike a breastplate, the *lorica hamata* extends to the knees rather than the natural waist (where a breastplate typically terminates) and is doubled on the shoulders.

[226] Jarva (1995), 135.

[227] As noted in chapter three, producing a sheet of metal of uniform thickness required specialized equipment unavailable in the classical period. Schwartz (2009), 67, also assumes significant corrosion, despite the cuirass

seems that Archaic armourers were mostly satisfied with a thickness of less than 1mm."[228] The thickness of body-armor plates actually varies a great deal more than Jarva implies, with a range from fractions of 1mm to 3.5mm being reported in the British Museum's fragments of bronze body-armor plates when measured.[229] A fragment of a breastplate from Metapontum (cat. H28) ranges from 1mm to nearly 2mm, within a single sheet of bronze. Finally, Jarva then suggests weights of 4-8kg for armors ranging from 1mm to 2mm, despite having just noted that he places a normal range at or below 1mm, and that none of his cited archaeological exemplars fits within this range.[230] The results of these computations have been repeated in subsequent works, despite the glaring flaws.[231] Far more reasonable is Connolly's computation of c. 6kg for the entirety of a hoplite's body protection, including not only the metal elements of the breastplate, but also the lining and leather *pyterges*.[232] It should be noted that Connolly's reconstruction included c. 3kg of non-metal material, which matches well with the preserved archaeological examples.

Jarva's high estimates are partly the result of a desire to harmonize the archaeological evidence with a report from Plutarch that Demetrius Poliorcetes received as a gift from Cyprus two breastplates in iron weighing 40 minas (c. 13.5 – 17.5kg) each, which were supposedly proof

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being in copper-alloy; Schwartz attributes Connolly's suggestion of 6kg for the Argos cuirass to accounting for corrosion. However, Connolly (1981), 58 makes it clear that the extra weight is to account for a textile lining or undergarment beneath the armor.

[228] Jarva (1995), 135.

[229] Pers. Correspondence with Ben Harridge, Assistant Collections Manager at the British Museum. The examined pieces were British Museum inv. 1772,0303.140a-b, 1865,0722.3, 1865,0722,4 and 1842,0728.712; max thicknesses ranged from c. 2mm to c. 3.5mm, but varied greatly within individual fragments.

[230] Jarva's heaviest example is 3.85kg. Jarva (1995), 135.

[231] E.g. Schwartz (2009), 95-6. Aldrete *et al.* (2013), 147.

[232] Connolly (1981), 58.

against a catapult shot at close range.[233] Plutarch adds that a man to whom one of these breastplates was given, Alkimos of Epirus, wore an entire panoply that weighed two talents (c. 52kg), and that it was twice the standard weight of equipment.[234] But this claim is poor ground on which to base a reconstruction. We are explicitly told that Alkimos was an unusual warrior, that the armor he was given was unusual in both material and weight, and moreover that it was an extravagant gift for a king. In addition, Plutarch's reliability here is suspect. Writing centuries later, he can hardly have been familiar with these armors and their weights, and he does not supply his own source for the information, in contrast to his account of Pydna, where he makes his reliance on the testimony of Scipio Nasica clear. Consequently, this anecdote should not be accorded greater credence than the archaeological evidence.

One standout example from the royal tombs at Aigai, the Vergina cuirass (cat. H30), needs to be discussed. Although the cuirass was first partially published in 1977 and has often been pictured and discussed (fig. 5.25), it has never been fully published with measurements.[235] Its main material is iron, but with gold detailing; the iron elements were covered with white linen, and the *pyterges*, which do not survive, were covered with gold strips. No other armor, complete or fragmentary, of this type and style from any period has been found, making the lack of published details particularly unfortunate. Along with the Prodromi cuirass previously discussed, the Vergina cuirass marks the only example of Hellenistic cuirasses yet discovered in

[233] Plut. *Demetrius* 21.3-4.

[234] Plut. *Demetrius* 21.4

[235] Initial publication: M. Andronikos, "Vergina: The Royal Graves in the Great Tumulus" *AAA* 10 (1977), 1-72. Subsequent discussion: M. Andronikos, "The Royal Tombs at Aigai (Vergina)" in *Philip of Macedon* eds. Hatzopoulos and Loukopoulos (Athens: Ekdotike Athenon S.A. 1980), 188-231; Connolly (1981), 58-9; M. Andronikos, *Vergina: The Royal Tombs and the Ancient City* (Athens: Ekdotike Athenon S.A., 1984), 140-144; Everson (2004), 192-3; Aldrete *et al.* (2013), 69-70.

iron.[236] It is remarkably thick at 5mm, and while no weight has been published, it is almost certainly uncommonly heavy at that weight, even before the gold detailing and trim on the *pyterges* are considered. While it has been suggested that this cuirass represents an alternative interpretation for the type IV 'shoulder piece' armor discussed below, it is far more likely that it represents a one-off piece of armor for a king, rather than a typical example of a more widespread type.[237] Like the two cuirasses mentioned by Plutarch, it is hard to see how this piece could have been anything but an exceptional one-off.[238]

Thus the range of weights for Hellenistic breastplates remains unclear. I have aimed, wherever possible, to let the archaeological exemplars speak for themselves. The minimum case may thus be set at the lightest exemplar reviewed (cat. R73), with c. 2.5kg in copper-alloy. The grouping of exemplars around 3.5kg (cat. H25, H31, etc) suggests a median case in that range. More speculatively, we might set a maximum case around 5kg, to allow room for exceptionally thick examples. None of the exemplars are nearly this heavy, but it seems prudent to allow for the possibility of heavier breastplates, particularly as prestige armors.

Type IV 'Shoulder Piece' Armor and the Linothorax

The other major option for armor is what Jarva terms the 'Type IV' armor, sometimes also called the 'shoulder piece' or 'tube and yoke' armor and identified with the ancient term

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[236] Noted by Everson (2004), 186-7.

[237] In this, I follow the judgment of Aldrete *et al.* (2013), 69-70. N. Sekunda, *Greek Hoplite 480 – 323 BC* (Oxford: Osprey 2000), 11, attempts to argue that cuirasses of this type were not only common, but in fact comprise the majority or even the whole of Type IV armor; it is hard to see how this view can be supported. Cf. Everson (2004), 192-3, who notes that backdating this sort of armor to the fifth century is very unlikely.

[238] It should be noted that muscle-cuirass wearing Roman generals are likewise excluded from the reconstruction of the Roman legion, and for the same reason, the object being to assess the arms and armor of the average soldier, not of elite aristocratic generals and kings.

linothorax.[239] This armor-type has recently been the subject of an extensive study by Gregory Aldrete, Scott Bartell and Alicia Aldrete, which has done much to elucidate its nature; the conclusions of that study are largely accepted here.[240] Type-IV armor consisted of a tube of material covering the chest, tied together on the left side of the body, with thick bands of material bent over the shoulders and tied down on the front of the armor (fig. 5.26). In order to provide mobility, the main tube of the armor generally terminates at the natural waist (as with a metal breastplate), but with *pteryges*, sometimes in one row, sometimes two, covering the groin and upper-thighs.[241] This armor begins to appear in representational artwork as early as c. 600 B.C.E. and continues to appear into the first century C.E..[242]

The typical material for this type of armor was probably a thick laminated linen. Modern scholars have often doubted that the Type IV armor, called a *linothorax* in our sources, was, in fact, made of linen, and they have instead posited leather as the primary material. Aldrete *et al.* demonstrate that the available evidence nevertheless argues heavily for linen as the most common material, while noting that in all likelihood at least some Type IV armors were made out of leather.[243] Aldrete *et al*. have demonstrated this proposed linen reconstruction by producing several full cuirasses and testing the resulting armor.[244] The layers of linen were

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[239] On the scholarship of this armor generally, see Aldrete *et al*. (2013), 2-4.

[240] Aldrete *et al*. (2013).

[241] Alderete *et al*. (2013), 31-36.

[242] Aldrete *et al.* (2013), 26.

[243] Leather proposed as a material, Jarva (1995), 36-7. J. K. Anderson *Military Theory and Practice in the Age of Xenophon* (Berkeley, University of California Press, 1970). Linen construction: Aldrete et al. (2013), 57-72. Note also Snodgrass (1967), 90-1, who notes the long history of textile armor and finds the idea of linen armor very plausible.

[244] The construction of the armor described here follows Aldrete *et al.* (2013); the methods are speculative to a degree, but the high correlation between the end product and the ancient evidence argues strongly for their validity.

probably laminated together with glue, a solution argued for by the clear rigidness of the armor when portrayed in artwork. Multiple layers of linen, as many as 17, are saturated with glue and allowed to dry in contact in order to bond into a rigid and quite strong material. Aldrete *et al.* subsequently tested their armor and showed it to be able to defeat a range of melee and missile weapons while weighing only 3.5 – 4.0kg, making it highly effective for the weight.

In terms of resource intensity, the primary driver of cost for this armor was the linen used in construction. Aldrete *et al.* estimate some 650 hours of production time to produce the fabric necessary for the armor, representing more than 91% of the total production time.[245] Producing the armor in leather rather than linen would have likely resulted in broadly similar costs; in both cases the armor was likely to be far less expensive than the contemporary muscle cuirass.[246] Metal elements in the construction of the most basic *linothorax* are limited to rings and attachment points for the straps which tie down the shoulder-pieces (fig. 5.27). Some of the representational evidence shows more complex attachment systems, including wheel-like central attachment points for the two shoulder straps; the evidence does not always permit their reconstruction. In artwork many examples of the armor show only rings, or even no metal elements at all, used in the attachment points for the shoulders.[247] Type IV armor was often supplemented with additional metal protective elements like metal plates and scales; these are discussed below. A plausible median case for these metal elements might then amount to c. 100g of rings and attachments. The minimum case is quite clearly no metal at all. For the

[245] Aldrete *et al.* (2013), 152-3.

[246] Aldrete *et al.* (2013), 156-8.

[247] Aldrete *et al*. (2013), 32-35.

maximum case, we might set a metal-weight of c. 500g, accounting for some of the more complex attachment systems.

Reinforced Type IV Armors

However, type IV armors often appear to have been reinforced with additional metal elements, including metal plates and scales. Aldrete *et al*. note that in the 913 instances of Type IV armor they catalog, 201 of them, or 22%, show an additional layer of protection, typically scales.[248] Given the tendency (previously noted), for ancient artwork to overrepresent high-status equipment, the relatively low appearance rate of metal reinforced type IV armors strongly suggests that this was a minority armor type. As a result, it seems best to treat this armor separately from the more standard fully textile type IV armor, rather than as a variation within the type, in order to avoid skewing the figures for the more common basic type IV armor.

While scales sometimes covered the entire armor, it was more typical that they covered only a region, most often as a band of scales extending over the lower section of the torso.[249] Alexander's armor on the Alexander mosaic shows a number of possible reinforcements. Alexander clearly has a copper-alloy scale belly-guard of a type common on type IV armor and also what may be a copper-alloy plate with a *gorgoneion* over the center of the rib-cage (fig. 5.1b). Connolly suggests that Alexander's shoulder-pieces are reinforced with iron plates, while Aldrete *et al.* read the coloration as reddish-brown or perhaps purple, and thus simple textile; damage to the mosaic prevents certainty.[250] Less expensive composite cuirasses – Alexander is a

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[248] Aldrete *et al.* (2013), 68-9.

[249] Aldrete *et al*. (2013), 68.

[250] Conolly (1981), 72. Aldrete *et al.* (2013), 50.

king, after all – might incorporate one or more of these sorts of reinforcements. As some are fairly common, it is worth assessing possible weights for them.

To reconstruct the metal requirements of these sorts of reinforcements is very difficult, however. Not only do the potential levels of armor reinforcement vary widely, but also the absence of clear recovered archaeological exemplars makes fully secure reconstruction impossible. Jarva notes a class of metal belly-guards in the archaeological record; these were metal reinforcements covering the lower torso and sometimes groin area.[251] He notes that the thickest of them seem to weigh less than 0.4kg and the lightest examples around 0.15g, being both quite small and relatively thin (typically less than 1mm thick). The chest plate Alexander wears on the Alexander mosaic is difficult to estimate; it only covers the front of his body and only the upper torso. We might suggest a plate c. 30cm wide and c. 16cm tall; if made in bronze at 1mm thickness, such a plate might weigh c. 400g. Alexander's shoulder-plates, which may be made in iron, are also difficult to estimate; if metal, they are clearly placed over a textile base and leave some of the textile uncovered around the edges. Going by Aldrete *et al.*'s measurements for the reconstruction type IV armor, we might expect an iron plate 8cm wide and perhaps 40cm long.[252] At c.1mm thickness, such a plate would weigh c. 250g; two (one for each shoulder) would then add some 500g of metal to the armor.

The most common type of reinforcement, as noted, was metal scales. These most commonly cover the belly, but scale reinforcement to the sides and chest also appear. Jarva suggests that 3,500 scales found in the Crimea might belong to a scale-reinforced cuirass of this

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[251] Jarva (1995), 136.

[252] Aldrete *et al*. (2013), 74. This assumes that approximately 2cm of fabric are showing around the edges of the plate.

type; the scales are 2.5 x 4.2cm and c. 0.5mm thick.[253] Jarva further estimates that the scales might have covered a surface of roughly 8,000cm^2, which he figures to be about the surface of a type IV armor; he suggests that this could mean all of the scales belong to a single armor which he supposes might have weighed 16kg, an extraordinarily heavy armor.[254] Judging by Aldrete *et al.*'s measurements for the reconstruction type IV armor, the total surface area to be covered with scales is likely to be significantly less than 8000cm^2. Basic calculations working from their measurements suggest a surface area to be armored around c. 6,000-6,500cm^2, depending on how areas of overlap are armored.[255] Moreover, Jarva's suggestion that each of the Crimea scales, at 10.2cm^2 surface area each, would have covered only "a little more than 2cm^2" calls for a very high rate of overlap, far higher than comparable scale armors from, for instance, the Roman imperial period.[256]

[253] Jarva (1995), 136.

[254] Jarva (1995), 136. For comparison, Claude Blaire gives 41lbs, 13.5 ounces (19kg) for the full weight of an entire German plate field armor, offering full body plate protection, dating to c. 1525. Blaire (1958), 192. The armor in question is at the Wallace collection, inv. A24.

[255] Aldrete *et al*. (2013), 74. Using the measurements provided, I estimated that the 'tube' part of the armor would have a rough surface area of c. 4,350cm^2, while the shoulder elements would add roughly 2,000cm^2 additional area; this almost certainly overstates the area to be armored, as section where the shoulder-pieces and the torso armor overlap are counted twice.

[256] Jarva (1995), 136. Cf. Sim and Kaminski (2012), 98-100. Note also the spacing of attachment holes on Roman scales showing that most of any given scale was exposed, Bishop and Coulston (2006), 97, fig 54. Groller calculated the 'lost area' created by scale overlap in the Carnuntum scales at 33-40%; Jarva's suggestion would create a 'lost area' of 80%; M. von Groller, "Römische Waffen" *Der römische limes in Österreich* 2 (1900), 85-132.

This strikes me as an unreasonably tight distribution of scales, but serves as an upper-bound. Medieval scale armors also appear to have been nowhere near this densely crowded, e.g. C. Blaire, (1958), 228-9.

Fully scale-covered armor outside of Etruria is rare, however.[257] Far more common are scale-armored belly-guards of the type Alexander has attached to his armor on the Alexander mosaic. The scales cover the lower quarter or so of the armor; if they ran entirely around the back, the total area covered might be 1,100cm^2 (c. 110cm x c. 10cm).[258] Scale armor entails a degree of overlap between the scales in order to provide full protection, and individual scales from different armors may vary significantly in size; representational artwork often simplifies these patterns and is a poor guide for scale size. Working from Roman exemplars of imperial period *lorica squamata*, Sim and Kaminski noted that in a typical pattern of Roman armor scales, 68% of the covered area would have two overlapping scales, 21% four overlapping scales, and only 11% would be covered by just a single scale.[259] Using that level of overlap as a rule of thumb and the thickness of the Crimea scales as a general guide, we might expect the belly-guard in the Alexander mosaic to require c. 1kg of bronze.[260] Acceptance of Jarva's much denser scale placement would suggest that the belly-guard might require c. 2,100g of bronze.[261]

This exercise should give some sense of the wide range of possible reinforcements; however, it is worth reiterating that the vast majority (78%) of representations of type-IV armors compiled by Aldrete *et al.* show no reinforcements at all. If Etruria is excluded from the sample,

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[257] Aldrete *et al*. (2013), 52. Nearly 40% (79 of 201) of all examples of scales on type IV armor noted by Aldrete *et al.* comes from Etruria, despite Etruria providing only a quarter of the total corpus of examples.

[258] As before, figures for the overall surface size of the armor follow Aldrete *et al.* (2013), 74.

[259] Sim and Kaminski (2012), 98-100.

[260] Of the 1,100cm2, (with 0.5mm thick scales), 748cm^2 would be covered by 2 scales (1mm total thickness), 121cm^2 by 1 scale (0.5mm thickness) and 231cm^3 by 4 scales (2mm thickness).

[261] Jarva (1995), 136. As noted above, it seems likely that Jarva significantly overstates the density and thus weight of typical examples of this kind of armor, but such estimates still serve as upper-bounds.

the percentage of unreinforced armors rises to 82%.[262] At the upper-end of these reinforcements, a cuirass like Alexander's from the Alexander Mosaic might include c. 2,500g of additional metal components, approaching the metal requirements of a lighter muscle cuirass. More commonly, cuirasses featuring one of these protective elements might range in metal-weight from c. 500g to c. 1,500g; it seems likely that most reinforced cuirasses would have fit into this range. We might set a minimum case for reinforced armors of this type at c. 500g; if any less than this, we might consider the armor to be merely a typical *linothorax*. For a median case, we may posit the most common reinforcement, the belly-guard of scales, at c. 1.5kg, splitting the difference between my estimates and Jarva's for likely typical scale weight. For a maximum case, the full range of reinforcements for Alexander's cuirass on the Alexander Mosaic seems a reasonable choice, at perhaps c. 2.5kg.

Other armor types

A number of other types of armor were available and likely present to some degree or another in the regular armies of the major Hellenistic states. Quilted armor, made of multiple layers of textile stitched together with additional loose fabric in the pockets between layers, has been suggested for Greek armies, notably by Snodgrass.[263] This type of armor was extremely common in Europe during the Middle Ages under a number of different names (e.g. *aketon*, gambeson, *pourpoint*, arming jack), but appears only very rarely in sources for the ancient world.[264] The one clear reference to armor of this type in a Hellenistic army is to 100

[262] Aldrete *et al.* (2013), 52.

[263] Snodgrass (1967), 90.

[264] Blaire (1958), 32-34.

cavalrymen in the army of Ptolemy II, equipped with Kushite-style quilted armor.[265] Plate defenses like the muscle cuirass and helmets were worn with liners, which may have often been quilted in much the same way; being textile (or possibly leather), these do not survive.[266] However, as a primary armor material, quilted textiles do not seem to have been a major armor type for Hellenistic armies.[267] The other major potential armor was mail, transmitted to the Greek world by way of the Romans and Gauls. Polybius reports 5,000 Seleucid soldiers organized as a Roman legion and armored in mail at the parade at Daphne in 166, and a mail-clad warrior appears on a grave stele from Sidon which, Sekunda argues, ought to be dated c. 154-147 BCE.[268] However, as noted in the introduction, the focus of this chapter is on the Hellenistic armies that Rome faced in battle. By 166, the Third Macedonian War was over and Gaius Popillius Laenas armed only with a *senatus consultum* had already stopped a Seleucid army; Rome's victory over the great states of the Greek East was a *fait accompli*.[269] Without evidence to show the adoption of mail armor earlier than this, it seems more sensible to exclude it from the reconstruction.

Types and Prevalence

As with the Romans of the previous chapter, to determine the prevalence of these armor types is made complicated by scarce evidence. As noted, the Amphipolis military regulations

[265] Fischer-Bovet (2014), 131.

[266] Connolly (1981), 58. Jarva (1995), 135.

[267] Aldrete *et al.* (2013), 64-67, consider the evidence for quilted construction for type IV and related armors; the evidence strongly argues for laminated construction, as they note.

[268] Plb. 30.25.3. Sekunda (1995), 23. Date of the stele: Sekunda (2001a), 68, 135-149.

[269] Liv. 45.12; Plb. 29.27.

specify the wearing of a *kottybos* for the regular infantry. The meaning of this term is unclear, though it may equate to the *kossumbe* or *kossumbos* (κοσύμβη or κόσσυμβος), a shepherd's coat, which may suggest a textile or leather object of some kind.[270] Recent interpretations have tended to see the *kottybos*, then, as equivalent to the Type-IV shoulder-piece cuirass, that is, the *linothorax*.[271] Following that assumption, the *hemithorakion* is sometimes identified with reinforced type-IV shoulder-piece cuirasses; the *thorax* of the inscription, then, must clearly mean a full muscle-cuirass; these armors were only required of the *hegemones*, meaning the first rank of the phalanx, consisting of the *lochagoi* and higher officers.[272]

The evidence for the widespread use of the *linothorax* and its role as the distinctive armor of the Macedonian phalanx is quite strong.[273] Alexander the Great, after receiving reinforcements and 25,000 sets of armor while on campaign in India, ordered the old armor burned; in order to be burned, such armor must have been textile or leather, while the quantity of armors replaced strongly indicates that the new sets armors were for the common soldiers.[274] Likewise, Caracalla, seeking to re-create Alexander's phalanx, arms his men in "breastplates of three-plied linen" according to Dio, indicating that this armor was seen as characteristic of the Macedonian phalanx.[275] Representational evidence reinforces this claim.[276] The Alexander sarcophagus shows

[270] Everson (2004), 194.

[271] E.g. Hatzopoulos (2001), 80-81. Everson (2004), 194. Connolly (1981), 80.

[272] Sekunda (2013), 89. Hatzopulos (2001), 80-1. Connolly (1981), 76.

[273] Aldrete *et al.* (2013), 14-17.

[274] Curtius 9.3.21. Diodorus 17.95.4. Aldrete *et al.*(2013), 14.

[275] Dio 78.7.1-2: Θώραξ λινοῦς τρίμιτος. Aldrete *et al.* (2013), 15.

[276] The examples in this paragraph are only the most notable in a huge corpus of representational evidence for the type-IV armor. The most exhaustive catalog of examples is to be found in Aldrete, *et al.* (2013).

an infantryman, probably a *hypaspist* to judge by his helmet (fig. 5.28), wearing a type-IV cuirass.[277] Alexander, as noted, wears a reinforced type-IV cuirass in the Alexander mosaic.[278] Tomb paintings at both the 'Bella Tumulus' at Vergina and the 'Great Tomb' at Lefkadia depict infantrymen carrying what appear to be *sarisae*, wearing white-colored type-IV armor, almost certainly *linothorakes*.[279] Likewise, the two armors painted in the tomb of Lyson and Kallikles (fig. 5.12, top) are type-IV cuirasses, apparently in white linen.[280]

Recently, Sekunda has attempted to revive the older position that the Macedonian infantry, especially the elite infantry *peltastai*, were in fact far more lightly armored.[281] He suggests that the Amphipolis decree should be read to mean that "only those in the front rank (i.e. the *lochagoi*) were equipped with body armour."[282] Such a reconstruction would mean a radical reduction in weight of the phalanx; not only would it deprive the rearmost fifteen ranks of any body armor but, given the aforementioned evidence for the ubiquity of textile armor, it would also fall to reason that very few of the *lochagoi* would have worn any metal body armor,

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[277] Pictured in Connolly (1981), 71, and listed as S-23 in Aldrete *et al*. (2013), 197.

[278] Connolly (1981), 72. Listed as P-10 in Aldrete *et al.* (2013), 206.

[279] Vergina: M. Andronikos (1984), 37. Lefkandia: Miller (1993), pl. 8b. Aldrete *et al.* (2013), 206 lists the Vergina painting as P-7 and the Lefkadia painting as P-8.

[280] Miller (1993), 52-53. Aldrete *et al*. (2013), 206 lists this instance as P-9. Sekunda (2012), 44, pl. G, reconstructs these armors as made in bronze, presumably from the slight yellow tint of the armor. Note also Sekunda (2013), 13, where the parts of the armor are described as 'plates.' This reconstruction is extremely unlikely; the *pyterges* are clearly made of the same material as the chest and shoulder straps and would need to bend in order to accommodate movement. Notably the two bronze helmets painted immediately above the cuirasses are set off in a clearly different color (as are the bronze greaves in the opposing lunette).

[281] Sekunda (2012), 33, 42-3. Sekunda (2013), 83, 89. This position in older scholarship: Launey (1949), 359; G. T. Griffith, "ΜΑΚΕΔΟΝΙΚΑ: Notes on the Macedonians of Philip and Alexander" *Proceedings of the Cambridge Philological Society* 4 (1956/7), 3-10; Snodgrass (1967), 117-8; Markle (1977), 327-8; E. Borza, *In the Shadow of Olympus: The Emergence of Macedon* (Princeton: Princeton University Press, 1990), 204-5, 298-9. Connolly (1981), 79-80, suggests something of a compromise position, that the very back ranks may have worn little armor; nevertheless, his visual reconstructions show all Macedonian soldiers wearing *linothorakes* or heavier armor.

[282] Sekunda (2013), 89.

as opposed to the *linothorax*. This reconstruction does have the advantage of a clean reading of the Amphipolis inscription: it does not require any meaning to be read into the uncertain word *kottybos*; as noted above, *thorax* can certainly be taken to include textile armors like the type-IV armor. Moreover, the inscription seems to imply that whatever the *kottybos* is, it is required of both regular soldiers and *hegemones*; this cannot mean, as Tim Everson suggests, that this is a type-IV cuirass worn underneath a breastplate.[283] Inflexible, thick and quite heavy, a type-IV cuirass could not have been worn this way. Instead, the *kottybos* in this reading might mean a military cloak, consistent with its derivation from the *kossimbos*.

The balance of the evidence, however, seems to argue against Sekunda's position. The number of replacement armors said to have been delivered to Alexander's army, 25,000, alone suggests that they could not have been merely for the *lochagoi*.[284] As noted above, Macedonian soldiers, when not heroically nude, are represented typically in type-IV armor. Against this evidence, Sekunda places a fresco from the North wall of Ala 4 in the House of Menander in Pompeii, which (he contends) shows Ajax equipped as a Macedonian peltast without armor; the fresco forms the basis of an artistic reconstruction of peltast equipment.[285] Sekunda's assumption that this mythical scene is accurate in terms of equipment is dubious, not least because, as Sekunda himself notes, the artist has chosen to dramatically shorten Ajax's *sarisa*, if in fact it is a *sarisa* at all.[286] Later writers of military manuals must be read carefully, but they too seem to reinforce the idea that the *sarisa*-phalanx is assumed to be armored. Asclepiodotus

[283] Everson (2004), 194.

[284] Curtius 9.3.21. Diodorus 17.95.4.

[285] Sekunda (2013), 40. Sekunda (2012), 43-44, pl F.

[286] Sekunda (2012), 44.

says this directly, noting that the men with Macedonian spears (meaning *sarisa*) are to be protected by *thorakes*; Arrian notes this as well.[287] Plutarch, in his description of Achaeans' transition from *thureophoroi* to phalangite troops, is also quite clear that the change required donning heavier body-armor.[288] It is hard to imagine that the body-armor of the phalangists would have been considered such a defining part of the panoply if only the front-rank, one out of every sixteen men, wore significant body-armor.

Bar-Kochva, reacting against the older assumption that Macedonian phalangites were generally unarmored, goes in the opposite direction, suggesting that Seleucid phalangites might have all worn breastplates.[289] In so doing, he does not distinguish between textile type-IV armor (which was not well understood when he wrote) and metal body protection, but opts instead to use the blanket term 'breastplate.' However he clearly has the muscle-cuirass in mind. His suggestion seems unlikely; his assumption that a breastplate was necessary to defend against arrows is flawed. Aldete *et al.* have shown that the textile type-IV provides excellent protection against missile weapons.[290] Bar-Kochva himself notes that "in this case there is no direct evidence," and he presents only general considerations suggesting that Seleucid phalangites were at least somewhat armored.[291] As noted in the previous paragraph, the balance of the evidence strongly suggests that *all* of the regular phalangites were at least somewhat armored; without specific evidence, there is no reason to suspect the Seleucids were any different in this respect.

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[287] Asclepiodotus 1.2. Arr. *Tact*. 3.1-2.

[288] Plut. *Philop*. 9.2.

[289] Bar-Kochva (1976), 55-6.

[290] Bar-Kochva (1976), 55. Aldrete *et al* (2013), 101-128.

[291] Bar-Kochva (1976), 55.

A related issue is the question of the armor of elite troops like the Antigonid and Ptolemaic peltasts. Asclepiodotus places Macedonian peltasts between the main phalanx and the light infantry (*psiloi*) in weight, but attributes this placement to a shorter *sarisa* and a smaller shield (the *pelte*); he makes no mention of a reduction in body-armor.[292] Plutarch describes the Antigonid peltasts as having "gilded equipment (ὅπλα) and new red cloaks (φοινικίδες)" at Pydna; it seems likely that what is gilt here is body-armor.[293] Sekunda emphasizes the lack of cuirasses reported in the looted equipment of the peltasts of Flamininus' triumph after Cynoscephalae; that the lighter peltasts would be unarmored fits with his view of an overall very lightly armored phalanx.[294] Hatzopoulos suggests that body-armor may have been normal for the peltasts, arguing from a funeral stele showing a Macedonian peltast in armor.[295] Based on the evidence, the armor of the peltasts was unlikely to be any heavier than that of the regular phalangites, but it is not necessarily clear that it would have been as much lighter, as Sekunda supposes. My reconstruction assumes that peltast units wear the same body armor as the regular troops, but it should be noted that this assumption is, at best, conjectural. Alternative reconstructions, however, would almost certainly have the peltasts more lightly armored, rather than more heavily so; thus objections on this point can only serve to lower the total resource intensity of the unit, rather than raise them.

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[292] Asclepiodotus *Tact*. 1.2.

[293] Plut. *Aem*. 18.7. ἄγημα τρίτον οἱ λογάδες, αὐτῶν Μακεδόνων ἀρετῇ καὶ ἡλικίᾳ τὸ καθαρώτατον, ἀστράπτοντες ἐπιχρύσοις ὅπλοις καὶ νεουργοῖς φοινικίσιν. Φοινικίδες, literally a red cloth of any kind, here should be understood as cloaks, not tunics (as the Thracians are reported wearing just before this passage); this is the Macedonian red military cloak.

[294] Plut. *Flam.*14.1. Sekunda (2012), 33.

[295] Hatzopoulos (2001), 71. Sekunda (2013), 119 agrees with the identification of this figure as a peltast, but assumes that the figure is a *hegemon* based on the body-armor he wears, as a consequence of Sekunda's assumption that only the *hegemones* wore body armor.

On the whole it seems most prudent to accept the current prevailing consensus, that the common Macedonian soldier, be he Antigonid, Seleucid or Ptolemaic, wore the textile type-IV, and that the *lochagoi* of the front ranks, corresponding to the *hegemones* of the Amphipolis inscription, wore heavier armor, meaning reinforced type-IV armor and full muscle-cuirasses. It is possible that some of the regular soldiers in the rear ranks wore less armor or lower-quality textile armor, but the lack of evidence makes quantification impossible; my reconstruction treats all of the back ranks as homogenously equipped in type-IV textile armor.[296] I include both soldiers armed with the larger *aspis* shield and elite units armed with the smaller *pelte*. Such a reading is not without problems, as noted, but it seems to conform best to the available evidence. It should be noted that the alternative is to posit a far more lightly armored formation, as Sekunda does. The full unit reconstruction presented below will also assume that the officers split evenly between reinforced Type-IV cuirasses and muscle-cuirasses; given the dominance of the Type-IV in the representational evidence, such a split probably errs on the side of giving too much weight to the muscle-cuirass rather than too little. Consequently, it seems very unlikely that the above assumptions significantly understate the total armor of the formation.

Helmets

In contrast to the near ubiquity of the second century Roman Montefortino-type helmet, a wide variety of helmets continued in use in Hellenistic armies. It is worth noting at the outset that the detailed typological and developmental studies of these helmets, notably those by Petros Dintsis and Götz Waurick, often rely on representation evidence, especially on coins, on account

[296] This is the position held by Hatzopoulos (2001), Connolly (1981), and more recently by D. Lush, "Body armour in the phalanx of Alexander's army" *AW* 38.1 (2007), 15-37. Both Connolly and Lush allow for a fairly wide range in quality and availability of textile body-armor for the back ranks of the phalanx, while Hatzopoulos merely suggests a non-metallic body-defense without further specification.

of the often-limited archaeological record.[297] Neither of the studies named considers the weights of the helmets, and many examples are not fully published, or they reside in museum collections which were not willing or able to weigh them. In addition, both studies also rely heavily on helmets recovered from Italic contexts; the Southern Italian variants of these helmets tend to be more common in the archaeological record than recovered examples from the Greek East, where the latter exist at all. Some of the remaining examples have been restored, rendering their current weights, at best, only approximations of the original weight. As a result, it must be stressed that this discussion of the weights of helmets is rather more tentative than the rest of this chapter.

The standard helmet of the Macedonian infantry was known as the *konos* (κῶνος). It is heavily featured on Hellenistic bronze coinage, especially the shield/helmet bronze coinage type, and these representational depictions have been connected with a class of archaeologically recovered helmets, allowing for the identification of the *konos*-type with archaeological exemplars.[298] The *konos* was, in fact, a Macedonian descendant and variant of the successful Lacedaemonian *pilos* type; modern works sometimes refer to the entire type-group as either *pilos* or *konos*; intermediate forms are sometimes termed 'pilos/konos' types.[299] Pierre Juhel persuasively argues that this helmet should be understood as the standard one of the regular infantry, with the 'Phrygian' type (discussed below) being the mark of elite units like the

[297] G. Waurick, "Helme der hellenistchen Zeit und ihre Vorläufer" in *Antike Helme* (Mainz: Verlag des Römisch-Germanischen Zentralmuseums, 1988), 151-180. P. Dintsis (1986).

[298] P. Juhel, "The Regulation Helmet of the Phalanx and the Introduction of the Concept of Uniform in the Macedonian Army at the End of the Reign of Alexander the Great" *Klio* 91 (2009): 342-355. Dintsis (1986), 57-87. Waurick (1988), 156.

[299] Dintsis (1986), for instance reserves the term 'konos' to only the late forms of the helmet and classes. Waurick (1988), 161-158 refers to the entire joint *pilos-konos* type together as the *pilos*. On the derivation of the *knonos* type from the *pilos*,see Dintsis (1986), 71-73, Waurick (1988), 151-162.

hypaspists.[300] A plumed example of the second century *konos* type is painted on the walls of the Tomb of Lyson and Kallikles (fig. 5.12, bottom, right), possibly connected to the infantry equipment shown in the opposite lunette.[301]

Within this basic type there is considerable variation. Regional variants were developed in Southern Italy (e.g. cat. H34), and the long-lasting use of this helmet results in considerable variations over time as well (fig. 5.29).[302] Some variants have attachments for cheekguards while others do not, and there is wide variance in the height of the helmet bowl, from relatively low types (e.g. cat. H37) which come close in form to late Boeotian-type helmets (discussed below), to very high vertical helmets (e.g. cat. H32). Reconstruction is further complicated by a relative lack of well-preserved exemplars.

To reconstruct all the variants of this type is beyond the scope of this work; the following reconstructions instead focus on examples of types of *pilos*/*konos* helmet that remained common in the second century.[303] Waurick divides the main group of the *pilos*-type initially into Italic and Greek (geographic, rather than cultural) variants, along with early shape variants (with different neck protection) that do not persist into the second century.[304] A decorated example of the Italic type from the British Museum (cat. H33, fig. 5.30), dated between 325 and 275 by the Museum, masses 920g; the fairly simple high bowl shape distinguishes the Italic types. A

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300 Juhel (2009).

301 Miller (1993), 53. Sekunda (2012), 44-5, suggests that the helmet may be taken along with the shield in same lunette, to identify this helmet as possibly belonging to Lyson, and suggesting that he was a heavy cavalryman. Miller (1993), 49, n. 79 expresses reservations concerning this identification.

302 See esp. Dintsis (1986), bailage 3-5, for charts showing the development of the relatively wide range of sub-forms.

303 Following, in particular, G. Waurick's dating and identification of charts, G. Waurick (1988), Beilage 1. On the type in general, note Feugere (1994b), 27-29, Dintsis (1986), 57-86, Waurick (1988), 151-158.

304 Waurick (1988), 151-158.

simpler, probably contemporary example from the Antikensammlung in Berlin (cat. H34), masses 720g. Neither example will have had cheek-guards. Another example at the Antikensammlung (cat. H32, fig. 5.31), found in Upper Egypt and dated to the fifth century by the museum, represents an early Greek type, with the upper part of the helmet projecting out slightly from the rim and an overall lower bowl; it masses 725g, though it is partially restored. Waurick also identifies late types, which seem to be borrowing design elements from contemporary Boeotian and Attic helmet types, including a lower bowl and a rim. An example of this type from the Ashmolean (cat. H37, fig. 5.32), dated to the second century, masses 826g. Many of these later types did have cheek-flaps, as with the painted example from the Tomb of Lyson and Kallikles; so the mass of these later examples could be somewhat higher.

The other type of helmet generally associated with the infantry is the 'Thracian' or 'Phrygian' type, distinguished by a larger, forward sloping decorative knob (typically hollow) on the crest.[305] This type is frequently depicted in artwork, such as on the infantryman on the Alexander sarcophagus (e.g. fig. 5.28), but archaeological finds seem less common. Juhel argues that this helmet was likely the mark of the elite hypaspists. That could explain both the prominence of this elite helmet in artwork, which tends to bias towards elite units, as well as its relative scarcity in the archaeological record.[306] An example of this type, dated to the middle of the fourth century from the British Museum (cat. H39; miscategorized in the museum catalog as an Attic-type helmet, fig. 5.33), has a shallow knob almost completely submerged in the body of the helmet and masses only 529g, but is somewhat damaged. Even so, it is substantially more

[305] Dintsis (1986), 50-53 refers to this helmet as the 'tiara-shaped' helmet '*tiaraartiger helm*', but notes the use of Thracian and Phrygian to describe the helmet. Waurick (1988) and Juhel (2009) opt to use 'Phrygian' and I have followed this usage.

[306] Juhel (2009), 354. In artwork, cf. Waurick (1988), 166, abb. 40-45.

than 50% complete, so we may suppose that it never weighed more than 1kg, perhaps closer to 700g in its original form.[307] Another Phrygian helmet (cat. H40, fig. 5.34), from Southern Italy has a more typical and pronounced knob and is well preserved, although no weight for this piece is published.[308] The metal used in these helmets does seem to be significantly thicker than in the *pilos*/*konos* types; the previous example has a reported metal thickness of up to 6mm in places. Another badly damaged example (cat. H41) from Italy dated to the late third or early second centuries ranges from 2.3 to 6.9mm in thickness; as it is gilded, it is clearly an elite product, but it shows that this type can be quite substantial.

Next is the 'Attic' type, a continuation of a classical design, marked by a relatively low bowl, an extension to protect the back of the neck, and a thin decorative central ridge over the back of the crest (fig. 5.35).[309] This type appears in artwork associated with both the infantry and the cavalry. A figure on the Aemilius Paullus monument (fig. 5.36), clearly an infantryman by his shield, wears such a helmet.[310] A grave stele for a Nikanor, son of Herakleides, shows a Macedonian cavalryman also wearing an Attic helmet.[311]

Both in artwork and archaeological examples, Attic and Phrygian helmets seem easy to confuse, perhaps suggesting that the two types were converging. Sekunda first identified the second helmet in the Tomb of Lyson and Kallikles (fig. 5.12, lower left) as a Phrygian/Thracian

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[307] For identification of this type as Phrygian, rather than attic, note Dintsis (1986), esp. his cat. 99 and 100, which also feature very shallow crest-knobs. Likewise Waurick (1988), 166, abb 45.

[308] Carratelli (1996), 652.

[309] Feugere (1994b), 31-34. Waurick (1988), 169-174. Dintsis (1986), 105-112.

[310] Sekunda (2012), 23. Taylor (2016), 562.

[311] Sekunda (2012), 11. The gravestone is Kilkis Archaeological Museum inv. No. 2315.

type, but subsequently he identifies nearly identical helmets as of the Attic type.[312] Likewise the museum entry for cat. H42 lists it as a Phrygian helmet, though by Dintsis or Waurick's typology it is far closer to an Attic type with the thin 'comb' crest, even though it does lack the brow-guard common in Attic helmets. The museum identification for cat. H39 has this problem reversed, identified as an Attic-type helm, but with the thicker top-knob and higher helmet bowl it is more likely a Phrygian type. This is not to call out failures in identifying the previous examples, but merely to note that the two helmet types, though clearly distinct at the ends of the spectrum, can blend in to each other.

The weights for Attic helmets vary considerably. At the high end, one from the early third century BCE found in Albania and now at the Antikensammlung in Berlin (cat. H43, fig. 5.37) masses 1010g. This helmet is well preserved and retains one cheek-guard; the original weight is likely to be somewhat higher (to account for the missing cheek-guard), perhaps c. 1,100g. Another, undated example from Pergamon, now at the Antikensammlung, is unrestored at 995g, but lacks both normal cheekguards (but there are signs of an attachment point). Finally, a third helmet at the Antikensammlung from Melos masses only 470g (cat. H44); both cheek-pieces are missing and the helmet has had some restoration work, but it seems unlikely that it ever weighed more than c. 700g. The helmet is decorated and clearly made of fine workmanship (fig. 5.38); relatively light helmets were not merely restricted to low-quality examples. Another example of the type in the British Museum (cat. H42), originally found in Lake Copais, Boeotia and dated to the fifth century, masses 898g, but also lacks cheek-guards.

[312] Sekunda (2006), 60. Cf. Sekunda (2012), 23 Sekunda avoids typing the helmets in Sekunda (2013), 10-11, despite discussing them in detail.

What seems to be the last common type of helmet in Hellenistic armies of this period was the Boeotian helmet, which is typically only seen in cavalry contexts.[313] The distinct feature of this helmet was its wide brim, which often has grooves in it that make it look almost 'crumpled.' The rider behind Alexander on the Alexander Mosaic wears such a helmet (fig. 5.39), as do the two cavalryman with him on the Alexander sarcophagus (fig. 5.40).[314] Xenophon advises the use of a Boeotian helmet for fighting on horseback, which seems to confirm the specialized nature of this type of headgear.[315] Unlike most geographic signifiers for helmet types (i.e. 'Thracian' 'Phrygian' or 'Attic'), the Boeotian helmet type can actually be associated with Boeotia, and does thus appear to be the helmet advised by Xenophon.[316] One fairly well preserved example of this type of helmet is the Ashmolean Boeotian helmet, found originally on the Tigris river and thought to be associated with Alexander's campaigns (cat. H46). The helmet has some moderate damage on the crown, but is overall fairly intact and masses 1,005g.

Summing up, the wide range of helmet types available to Hellenistic soldiers makes confident reconstruction difficult. This challenge is compounded by the much more limited archaeological record for the Greek East. Nevertheless, some conclusions may be ventured. The well-recognized trend in Greek helmets towards lighter and thinner types has left the typical Hellenistic types substantially less massive than their Roman counterparts.[317] Few Hellenistic helmets mass a kilogram, and I found no examples with published masses significantly above

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[313] Feugere (1994b), 29-30. Dintsis (1986), 1-22, Waurick (1988), 159-163.

[314] Additional artistic representations, see Waurick (1988), 159-161; Dintsis (1986), 1-11, taf. 1.4 - 4.1.

[315] Xen. *On Horsemanship* 12.3.

[316] The helmet, for instance, is a strong Boeotian funerary motif, see P. M. Fraser, T. Rönne, (1957). Waurick (1988), 159.

[317] Trend towards lightening Greek helmets beginning in the Archaic, note Jarva (1995), 134.

that figure, though it does seem likely that some of the heavily decorated Phrygian helmet types, worn by elite soldiers, would have exceeded it. The lighter helmets make a great deal of sense within the Macedonian fighting system. The primary threats to a Macedonian phalangite, armed with a long *sarisa,* were other *sarisae* and missile weapons rather than heavy downward cuts. Hellenistic helmet forms evidently did respond to changing threats; the encounter with Gallic armies in the third century seems to result in the addition of reinforced brow-ridges to many helmet types as a response to the threat posed by Gallic swords.[318] Equally, part of the explanation for the greater robustness of Italian helmets compared to their Greek counterparts may be due to the longer duration and greater intensity of the Gallic threat in Italy.

In terms of the metal-weights of these helmets, for the regular infantry, both the phalangites and the regular peltasts (that is, the peltasts not in the *agema*) as well as *thureophoroi*, we may reconstruct a minimum case at 720g, matching the simpler *pilos/konos* types (e.g. cat. H34, H32). For a median case, the second century Ashmolean *konos* (cat. H37) at 826g seems typical; we may add 100g to account for the missing cheek-flaps, bringing the median case to c. 926g. For a maximum case, a relatively heavy Attic type helmet, such as cat. H43 at 1,010g (perhaps 1,100g at most to account for the missing cheek-guard) seems reasonable. For elite units, like the Antigonid infantry *agema* and the Seleucid *argyraspides*, the maximum case ought to be set significantly higher, perhaps around 1,250g to account for the heavier and thicker variants of the prestigious Phrygian helmet-type, though it must be recalled that not all such helmets were so heavy (e.g. cat. H39). For the cavalry, both the Attic and Boeotian helmet types were common. We might set the minimum case at an Attic helmet of 700g (e.g. cat. H44), a median case c. 926g, and a maximum case of c. 1,100g (e.g. cat. H43,

[318] Everson (2004), 181. Connolly (1981), 80.

H42, H46), accounting for both heavier Attic-type helmets and helmets in the style of the Ashmolean Boeotian helmet.

Greaves

As noted, the Amphipolis regulations also specify the wearing of greaves for the regular infantry. The Tomb of Lyson and Kallikles features a pair of painted greaves (fig. 5.12), which may be part of the infantry panoply; Miller suggests that these are made of leather, but copper-alloy seems more plausible. Notably the greaves are a different color than type-IV armor in the opposite lunette, and appear to match the color of the helmets, especially the Attic-type helmet, fairly closely.[319] The greaves are of the anatomical type which emerged in the Late Archaic and continued into the Classical period. The hypaspist on the Alexander sarcophagus (fig. 5.28) does wear greaves, again of the anatomical type, but none of the riders on the sarcophagus do so. That said, the wearing of greaves, even by the infantry, does not seem to have been universal. The Macedonian warrior, apparently an infantryman, painted in the façade of the 'Great Tomb' at Lefkadia (fig. 5.41) does not wear greaves.[320] The previously mentioned relief of a Macedonian sculpture on the funeral stele of Idomenes shows a Macedonian peltast with no greaves.[321] Damage makes it is difficult to tell for certain, but none of the Macedonians on the Aemilius Paullus monument appears to be wearing greaves; one may note especially figure 8 (by Taylor's numbering), who is clearly a Macedonian infantryman by his shield and has an intact

[319] Miller (1993), 51-52. Miller's reasoning for supposing the greaves are leather is based on the fact that the greaves clearly wrap tightly around the leg, but as will soon be apparent, this is a standard feature of copper-alloy Greek greaves. Note Jarva (1995), 96-100.

[320] Miller (1993), pl 8b.

[321] Hatzopoulos (2001), pl. VI. Sekunda (2013), 119.

leg, but does not appear to be wearing greaves.[322] Macedonian cavalrymen are typically shown without greaves in all contexts, and do not appear to have worn them.[323] Thus it seems that greaves were uncommon among the cavalry and common, but far from universal, among the infantry.

The archaeological record for Greek greaves is surprisingly robust; along with helmets and shields, they seem to have been a preferred equipment type for inclusion in ritual deposits in sanctuaries and burials.[324] As a result, the basic structure of this armor is fairly well understood. Greaves typically fit snugly to the leg, with a textile liner between the metal plate and the leg itself. Earlier greaves attached this liner through perforations on the edges of the greaves, whereas later examples lack these perforations and use liners that may have been tied in the back. The metal plate of the greaves during the late archaic period becomes increasingly thin and flexible to allow for the greave to be ‘snapped’ on and held to the leg by tension. After the end of the Archaic period, the metal plates of Greek greaves were not generally tied off at the back or attached to a foundation garment in the way that medieval greaves are.[325]

As noted, although there are a significant number of preserved greaves, the published evidence tends to skew heavily in favor of examples from Greek settlements in Southern Italy and towards earlier periods, with the major exception being from the sanctuary at Olympia.[326]

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[322] Taylor (2016), 562.

[323] Note esp. Hatzopoulos (2001), pl. 1-4; Sekunda (2012), 11. Everson (2004), 195 notes this. Xenophon advises cavalrymen to wear leather boots rather than greaves, Xen. *On Horsemanship*, 12.10; the Macedonians seem to have followed this practice.

[324] Jarva (1995), 111. Jarva reads this as suggesting variable panoplies, but it is hard to imagine the hoplite who acquires greaves but not body armor; it seems more likely that certain items are more commonly given as votives than others.

[325] Jarva (1995), 99-100.

[326] Jarva (1995), 84-100.

Jarva does present a table with a number of weighed examples from his typological groupings. These are included in the table below (under Jarva's catalog numbers noted by the B-prefix), alongside Southern Italian examples from my catalog:[327]

Table 5.2: Greaves, Weight and Thickness, by date

Cat. No.	Date	Region	Length	Mass	Thickness	Notes
B2593	650-550	Olympia		850g		
B2660	650-550	Olympia		930g		
B2784	650-550	Olympia		1,000g		
B2659	650-550	Olympia		740g		
B2682	650-550	Olympia		450g		
B2780	650-550	Olympia		1,100g		
H49a	550-500	Ruvo	43cm	580g	1.6-2.5mm	Pair w/ H49b
H49b	550-500	Ruvo	42cm	623g	2.1-3mm	Pair w/ H49a
B4864	c. 550	Olympia		1,100g		
B309	c. 525	Olympia		850g		
H48a	6-5th cent.	Tarquinia	46.9cm		1.9mm	Not part of a pair
H48b	6-5th cent.	Tarquinia	46.2cm		2.5-4mm	Not part of a pair
H47a	6th-5th cent.	Apulia	41.5cm	609g	0.7-1.4mm	Pair with H47b
H47b	6th-5th cent.	Apulia	43.8cm	677.7	0.7-1.4mm	Pair with H47a
H50	500-450	Unknown (S. Italy?)	45.72cm	759g	2.2mm	Pair with H51
H51	500-450	Unknown (S. Italy)	45.72cm	773g	2.4-4mm	Pair with H50
B7175	5th century	Olympia		560g		
B5752	5th century	Olympia		680g		
H52a	c. 330	Apulia	41.5cm	909g		Pair with H52b
H52b	c. 330	Apulia	41.2cm	738g		Pair with H52a
H53a	c. 330	Apulia	39cm		0.8-1.1mm	Pair with H53b
H53b	c. 330	Apulia	40cm		0.8-1.1mm	Pair with H53a

Greaves tended to grow thinner and lighter over the Archaic period; Jarva notes an average weight close to 0.8kg per greave, but that the last group in his typology, the Anatomy group which he dates to the fifth century, tends to mass around 0.6kg per greave.[328] This

[327] Jarva (1995), 136-7.

[328] Jarva (1995), 136-7.

reduction in weight is mirrored in the Italian examples, but not as strongly; as with other armor types, the Western Greeks seem to have held on to heavier defensive equipment longer. The diminishing record for greaves in later periods compared the Archaic period is generally attributed to decreasing prevalence; that is, fewer greaves occur in the archaeological record because the equipment itself was becoming less common, a trend which seems to have continued in the Hellenistic period, despite the mention of greaves on the Amphipolis inscription.[329]

A median case, then, for a pair of greaves may be set around 1.5kg of copper-alloy, similar to cat. H50-H51. A minimum case can then be set around 1.2kg, matching the later examples from Jarva as well as cat. H47a-b, while a maximum case might be set at 1.65kg, roughly matching cat. H52a-b. The second question is prevalence: as noted, it is clear both that some Hellenistic infantrymen did wear greaves, but also that many did not. Overall, the majority of the representational evidence for Hellenistic infantrymen appears not to show greaves, as noted above. The evidence does not permit confidence as to how common greaves were in this period. Everson supposes that they might have been worn only by officers (*hegemones*) in most Hellenistic armies, but he notes that this claim runs afoul of the testimony of the Amphipolis inscription; perhaps the Antigonid army was different in this respect.[330] My reconstruction below of the metal-weight of units assumes that all of the *hegemones* wore full sets of greaves, but that perhaps only half of the regular infantry did, and that the lighter peltasts probably did not.

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[329] Everson (2004), 159-160, 195. Connolly (1981), 60. Snodgrass (1967), 110.

[330] Everson (2004), 195.

Quantitative Analysis

Metal-Weights for Hellenistic Infantry

Table 5.3 presents the estimated metal-weights for each piece of infantry equipment, both for *sarisa* infantry (regular phalangite and peltast units) as well as *thureophoroi*. As noted, for equipment types where the limited archaeological evidence does not allow for a range of reconstructions, only a median case is presented; this should not be taken to mean that this reconstruction is precise (quite the opposite), but rather that the range of error is uncertain. Taking these factors into account, Table 5.4 then presents the resulting metal-weights for Hellenistic infantry in minimum, median, and maximum cases.

As with the previous chapter, it is necessary to aggregate these figures in order to represent the larger units in which they fought; this aggregation is even more important in the case of Hellenistic armies because of the large gap between the equipment of the front rank of *hegemones* and that of the rest of the army. The basic unit for Hellenistic armies seems to have been the *syntagma* of 256 soldiers (16x16 square); the Antigonid equivalent was called a *speira* and seems to have been the same size.[331] The arrangement of this system is described by Asclepiodotus, whose account is no doubt simplified and essentialized, but nevertheless provides a basis for working out an average metal-weight per-man.[332] A *syntagma* of *sarisa*-infantry would contain 16 *hegemones* (deployed in the front rank) and 240 regular soldiers. As noted in the previous section, I have assumed that while all of the *hegemones* wear greaves, only half of the regular infantry do, and none of the regular peltast infantry do. Based on these assumptions,

[331] Sekunda (2013), 90. Hatzopoulos (2001), 77. Connolly (1981), 76.

[332] Ascleipdotus, *Tact*. 2.7-9. The *syntagma* also had five supernumeraries, a herald, signalman, musician, an aide and a file-closer, who were not in the regular battle order and are not counted here.

the average metal-weight per-man of the heavy infantry is presented in table 5.5. As the *thureophoroi* do not have sub-types, the figure for these soldiers is simply carried forward. Included in table 5.5 for comparison are the metal-weight averages for the Roman heavy infantry (assuming 40% of the troops wore mail) from the previous chapter.

Table 5.3: Reconstructed metal-weights for Hellenistic infantry equipment by type

	Minimum	Median	Maximum	Used by
Sarisa		1,167g		Phalangites, Peltasts
Dory	200g	400g	700g	*Thureophoroi*
Sword (*Xiphos*/*Machaira*)	400g	490g	700g	All Infantry
Aspis	1,088g	1,548g	2,086g	Regular phalangites
Pelte	870g	1,292g	1,646g	Peltasts
Thureos	214g	320g	480g	*Thureophoroi*
Muscle Cuirass	2,500g	3,500g	5,000g	*Hegemones* (Phalangites, Peltasts)
Reinforced Type-IV Cuirass	500g	1,500g	2,500g	*Hegemones* (Phalangites, Peltasts)
Textile Type-IV Cuirass (*Linothorax*)	0	100g	500g	Phalangites, Peltasts
Helmets	720g	926g	1,100g	All Infantry
Greaves	1,200g	1,500g	1,650g	*Hegemones*, some phalangites

Table 5.4: Reconstructed Metal-weights for Hellenistic infantry by soldier type:

	Minimum	Median	Maximum
Phalangite (no greaves)	3,375g	4,231g	5,553g
Phalangite (with greaves)	4,575g	5,731g	7,203g
Phalangite *Hegemon*, Muscle Cuirass	7,075g	9,131g	11,703g
Phalangite, *Hegemon*, Type IV	5,075g	7,131g	9,203g
Peltast	3,157g	3,975g	5,113g
Peltast *Hegemon*, Muscle Cuirass	6,857g	8,878g	11,263g
Peltast *Hegemon*, Type IV	4,857g	6,878g	8,763g
Thureophoros	1,534g	2,136g	2,980g

Table 5.5: Reconstructed Average Per-Soldier Metal-Weights for Hellenistic Heavy Infantry

	Minimum	Median	Maximum
Phalangites	4,106g	5,177g	6,632g
Peltasts	3,326g	4,219g	5,419g
Thureophoroi	1,534g	2,136g	2,980g
Roman Heavy Infantry (40% *loricatus*)	4,279g	6,810g	9,732g

Non-Metal Equipment Requirements – Wood and Textiles

As with the Roman army, although worked metal will have represented the most expensive element of the heavy infantry panoply, wooden and textile elements make up a significant portion of the weight. This intensity in wood and textiles is at its greatest for the regular phalangite troops wearing the textile type-IV *linothorax*. For such a soldier, the raw weight of wooden and textile equipment significantly exceeds that of the metal elements. Connolly's reconstruction of the *sarisa* and *aspis* suggest total weights of 4.05kg and 8.60kg respectively; subtracting out the weight of the metal elements suggests 2.88kg of wood for the *sarisa* and 7kg for the *aspis*.[333] Aldrete *et al*. suggest that a normal weight for the all-textile type-IV *linothorax* would be between 3.5kg and 4kg.[334] Accounting for a helmet liner, shield-straps and other textile or leather elements of the panoply, we might then suppose that the average phalangite carried around 9.9kg of wood and perhaps 4.5kg of leather and textile into battle.

Heavy Cavalry and Cataphracts

Likewise, combining the reconstructions of the previous section suggests a reconstruction for the regular Hellenistic heavy cavalry as presented in table 5.6; it is clear that both the textile Type-IV armor and the muscle-cuirass were worn by Hellenistic cavalry, but not in what ratios, so panoplies with all three types of armor are represented here.[335] On the other hand, as noted

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[333] Connolly (2000), 109. This assumes the median-case thickness of the metal facing on the shield, as Connolly does not indicate how thick he made his shield-facing. For the *sarisa*, if ash wood rather than cornel wood is used, the weight would be a bit less, Sekunda (2001b).

[334] Aldrete *et al*. (2013), 146.

[335] Hellenistic representations of cavalrymen show type-IV cuirasses, note Hatozpoulos, pl. 3a, IV. Likewise, one of the brothers commemorated by the Tomb of Lyson and Kallikles seems to have been a cavalryman, but the tomb

previously, evidence for the Seleucid ultra-heavy cataphract cavalry is insufficient to allow for reconstruction. Bar-Kochva supposes it unlikely that Seleucid cataphracts were as heavily armored as later Parthian and Sassanid cataphracts.[336] Working from the very limited representational evidence, Mariusz Mielczarek suggests that Seleucid cataphracts may have only featured segmented armor for the horse's head and breast (a *chamfron* and *plastron*), a claim which seems consistent with the segmented armor found at Ai Khanum and the spoils of armor displayed on the Pergamum frieze.[337] Notably, the iron construction of the segmented plates from Ai Khanum was very thin; although no absolute thickness measurements are given, the *plastron* is noted to be thin enough to be substantially flexible.[338] For the rider, Mielczarek suggests segmented arm defenses and greaves, as seen on an equestrian figurine from Syria depicting what is probably a cataphract, who interestingly is depicted wearing a type-IV textile armor, rather than a muscle cuirass.[339] A precise estimate based on this information is not possible, but a very rough order-of-magnitude estimate may be ventured. Taking the median muscle-cuirass wearing heavy cavalryman as a baseline, I have estimated another 5kg of iron for the armor of the horse and 1kg for the additional segmented arm protection, bringing the total metal-weight to 12,916g (as shown in Table 5.6), very roughly double the required metal for a median regular heavy cavalryman. The metal-weights for Roman *equites* from the previous chapter are also listed for comparison.

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shows two type-IV cuirasses, Sekunda (2012), 44-5, Miller (1993), 52. Alternately, muscle cuirasses designed for wear on horseback have been found, e.g. Choremis (1980b). Everson (2001), 189.

[336] Bar-Kochva (1976), 75.

[337] Mielczarek (1993), 71-2.

[338] P. Bernard *et al*. (1980).

[339] Mielczarek (1993), 71. Note also that cataphracts do not appear to have used shields.

Table 5.6: Reconstructed metal-weights for Hellenistic cavalry by type:			
	Minimum	Median	Maximum
Cavalryman, Type-IV textile cuirass	2,784g	3,516g	4,450g
Cavalryman, Reinforced type-IV cuirass	3,284g	4,916g	6,450g
Cavalryman, muscle cuirass	5,284g	6,916g	8,950g
Seleucid Cataphract (rough estimate)	12,916g		
Roman *Equites*	5,620g	8,190g	10,980g

Comparisons and Conclusions

Comparing these results to those of the previous chapter offers useful insights, both on a per-man basis, as well as for entire armies or deployments. On the individual level, this comparison suggests that Roman soldiers were markedly better equipped than their Hellenistic opponents. The median case figures (from the previous chapter, table 4.9) for the metal-weight requirements of Roman heavy infantry range from 6.59kg to 7.67kg, compared to only 5.18kg for the heavier phalangite units (like the Antigonid or Seleucid *chalkaspides* or regular Ptolemaic *sarisa*-infantry) and 4.22kg for the lighter Antigonid and Ptolemaic peltast units. Even in the median case, Roman soldiers wearing only the lighter pectoral defense, the worst equipped heavy infantry in a Roman legion, carry slightly more worked metal (5.6kg for the *hastati* and *principes*, 5.23kg for the *triarii*) than the average Hellenistic soldier. As shown in table 5.5, we might expect the average Roman soldier to have carried around 1.6kg more worked metal into battle than his Hellenistic heavy-infantry counterpart; the difference amounts to just over 30% of the Hellenistic phalangite's metal-weight. The same is true for the comparison of Hellenistic cavalry with Roman *equites*, with the difference in metal-weight largely a consequence of the high metal-intensity of mail armor.

Put another way, the average Roman heavy infantryman traded around 2kg of textile equipment for an additional 1.6kg of metal and 2kg of wood compared to the equipment of a Hellenistic phalangite; as discussed in the previous two chapters, such a trade almost certainly involved a large increase in cost. Most of this additional material expenditure was in defensive equipment, with the larger Roman *scutum* driving the increased wood requirements, and heavier Roman body-armor and helmets driving the increased metal requirements. Against lighter Hellenistic troops, like *sarisa*-peltasts and *thureophoroi*, the Roman advantage in defensive equipment becomes even more pronounced.

This advantage in defensive equipment may go some way to explaining the surprisingly low reported Roman casualties in major battles against Hellenistic armies. Polybius reports only 700 Roman losses at Cynoscephalae compared to 8,000 Macedonians killed and 5,000 captured.[340] Livy reports only 300 Roman dead at Magnesia, but notes that many more were wounded, which seems a testament to the effectiveness of Roman armor at preventing lethal damage.[341] In contrast, he reports some 53,000 Seleucid dead and 1,400 captured.[342] At Pydna, Plutarch reports 25,000 Macedonian losses, but gives the Roman losses at 100 (after Poseidonius) or 80 (after Nasica).[343] Livy, for the same battle, notes "not more than 100" Roman losses, 20,000 Macedonians killed and 11,000 captured; as with Magnesia he notes many more Romans were wounded than killed.[344] This is significant particularly because the Macedonian phalanx at Pydna was successful in its initial attack and apparently inflicted many wounds, yet few of them were fatal.[345] While we must be wary of exaggeration in these reports, the

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[340] Plb. 18.27.6.

[341] Livy 37.44.2.

[342] Livy 37.44.1. Appian echoes these figures, App. *Syr*. 36, but this may not represent independent confirmation if Appian is working from the same source as Livy (likely Polybius).

[343] Plut. *Aem*. 21.7.

[344] Liv. 44.42.

[345] Initially successful Antigonid assault, Plut. *Aem*. 20.1-6.

remarkable consistency of low Roman casualties in major engagements with Hellenistic armies suggests some truth behind these reports. Given heavier Roman armor and larger Roman shields, it seems reasonable to suggest that the greater amount of resources that the Romans dedicated to defensive armaments may have significantly contributed to their low casualty rate and consequently to ultimate victory. Moreover Hellenistic weapons, particularly swords, were ill-suited to fight against mailed opponents, though this observation should not be taken too far: the *sarisa* was perfectly capable of defeating mail, as Plutarch notes.[346]

Sekunda attributes Rome's victory to "its ability to conscript horde after uncomplaining horde of Italian peasant manpower," and that "lack of manpower, rather than inferiority in military technique, sealed Macedon's fate." Though the current consensus embodied in the 'demographic approach' discussed in the first chapter is rarely stated so boldly, Sekunda's formulation provides an effective summation of its conclusion that the Hellenistic world could not hope to compete against Rome's endless supply of mere warm bodies for the legions. Given the forgoing analysis, this claim cannot be sustained. Rome's soldiers were not only more numerous, but they were also better and more expensively equipped. Yet, as noted in the first chapter, the major states of the Hellenistic world were about as large, as resource rich and as populous as the Roman Republic. Indeed, in some instances, they were dramatically more so. Why, then, were the Hellenistic great powers not able to mobilize resources on the same scale as the Roman Republic? We will return to this question in the conclusion, but first it is important to look too at the often neglected armies of the pre-state peoples who also opposed Rome in the third and second centuries.

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[346] Plut. *Aem*. 20.4.

Figure 5.1a-c: The Alexander Mosaic

a: Mosaic Overview

b: Alexander in detail

c: *Sarisae* in detail

Figure 5.2: Thracian Warriors from Kazanluk Tomb Painting.[347]

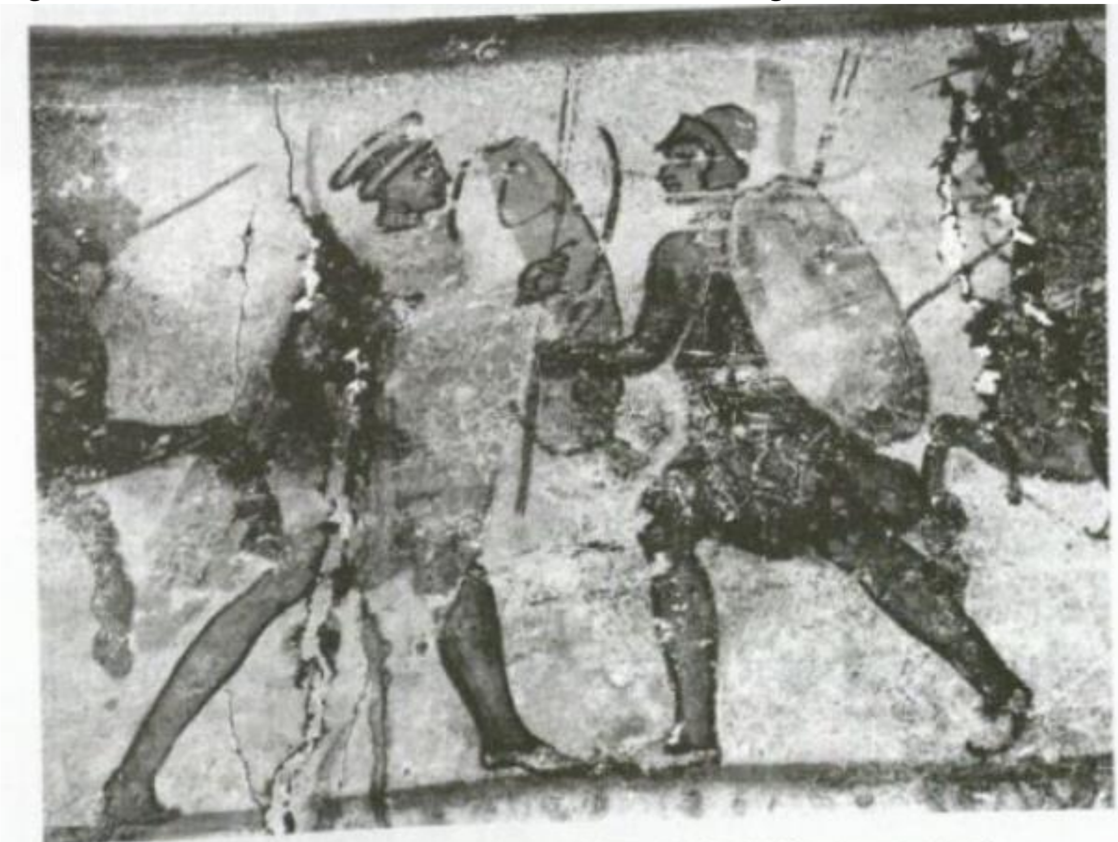
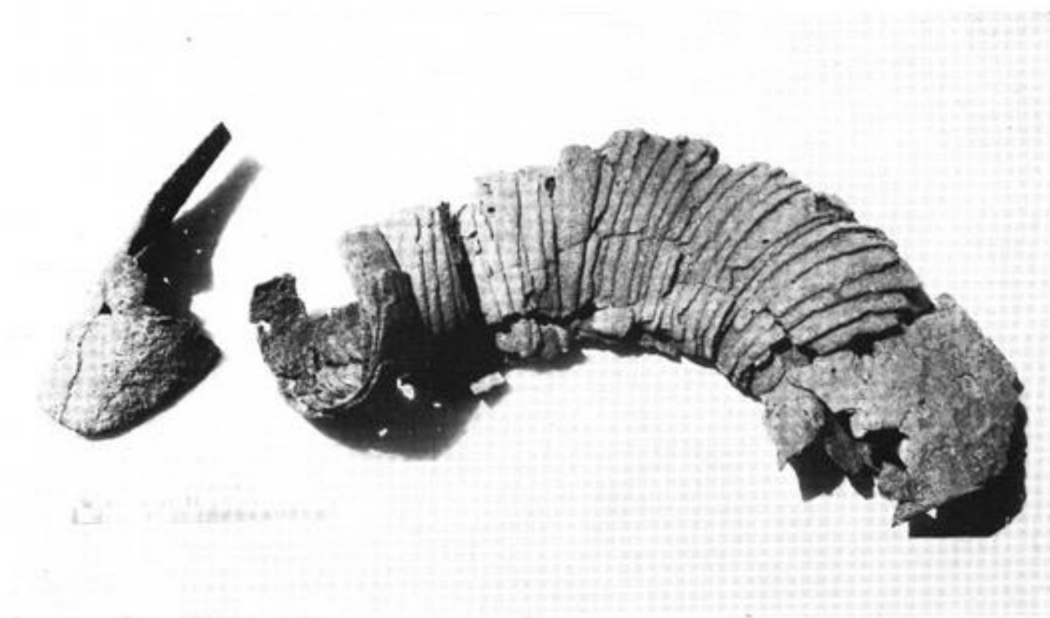


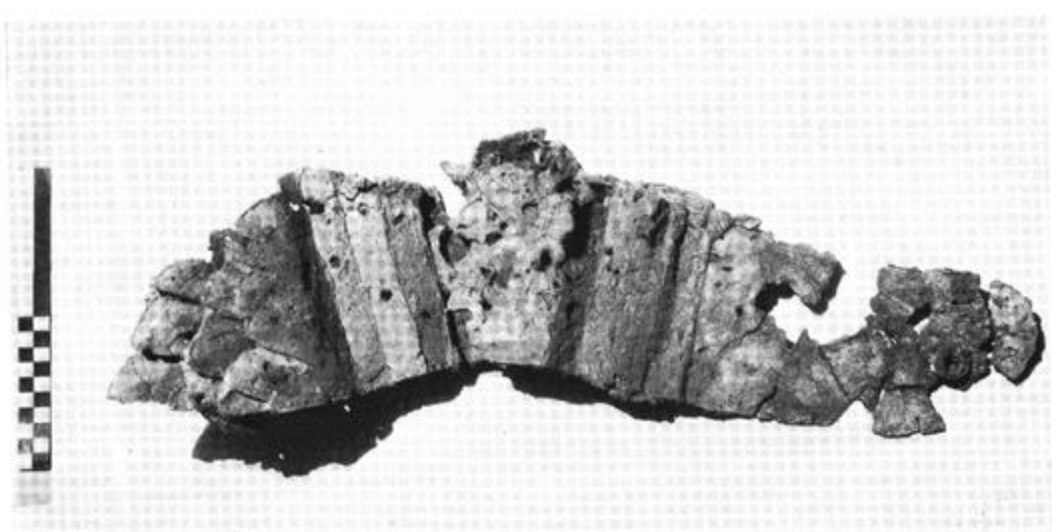
Fig. 8.2 Thracian warrior shown in the Kazanluk Tomb (after Zhivkova 1975: pl. 14)

[347] Image from Sekunda (2013), 121.

Figure 5.3: Segmented metal plates, possibly Seleucid Cataphract armor, from Ai Khanum.[348]



Aï Khanoum. — Arsenal. Armure de cataphractaire : *a)* Jambière gauche avec protège-pied.

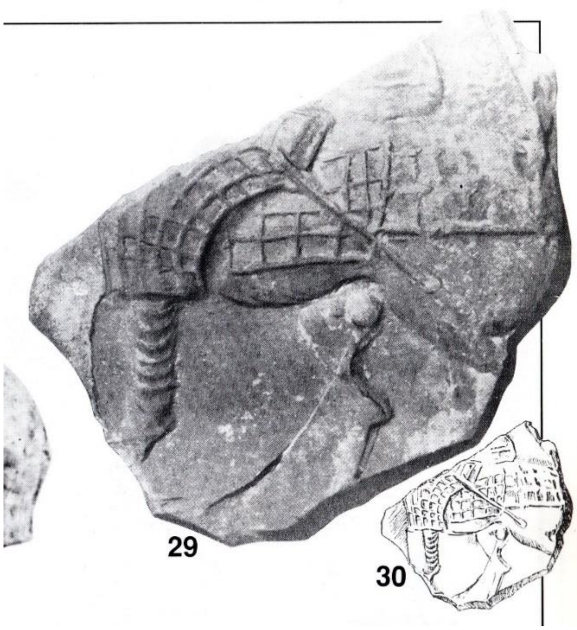


b) Paire d'épaulières.

[348] P. Bernard *et al*. (1980),

Figure 5.4: Detail from the Temple of Athena at Pergamum showing spoils of war
Equipment Shown:
Top Left: *Pilos*/*Konos Type helmet.* Top Right: *Xiphos* in sheath.
Bottom, Left to Right: Type-IV Textile cuirass, horse face-guard (*chamfron*), masked helmet and possibly segmented arm-guards.

Figure 5.5: Terracotta relief fragment showing a cataphract from Khwarezm.[349]



[349] Sekunda (1994), 76, fig. 29-30.

Figure 5.6: Funeral Stele with *thureophoroi*
Left: 5a, Detail from the Stele of Dioskourides of Balboura, from Sidon.[350]
Right: 5b, Detail from Stele of Hekatiaos, from Sidon[351]

[350] Sekunda (1995),72, color plate 3.

[351] Sekunda (1995), 73, fig. 66.

Figure 5.7: Scale drawing of *sarisa* and spear elements from Vergina/Aigai.[352]
From Left to Right, drawings correspond to my catalog: H12, H7, H8, metal sleeve (unnumbered), H10, H11.

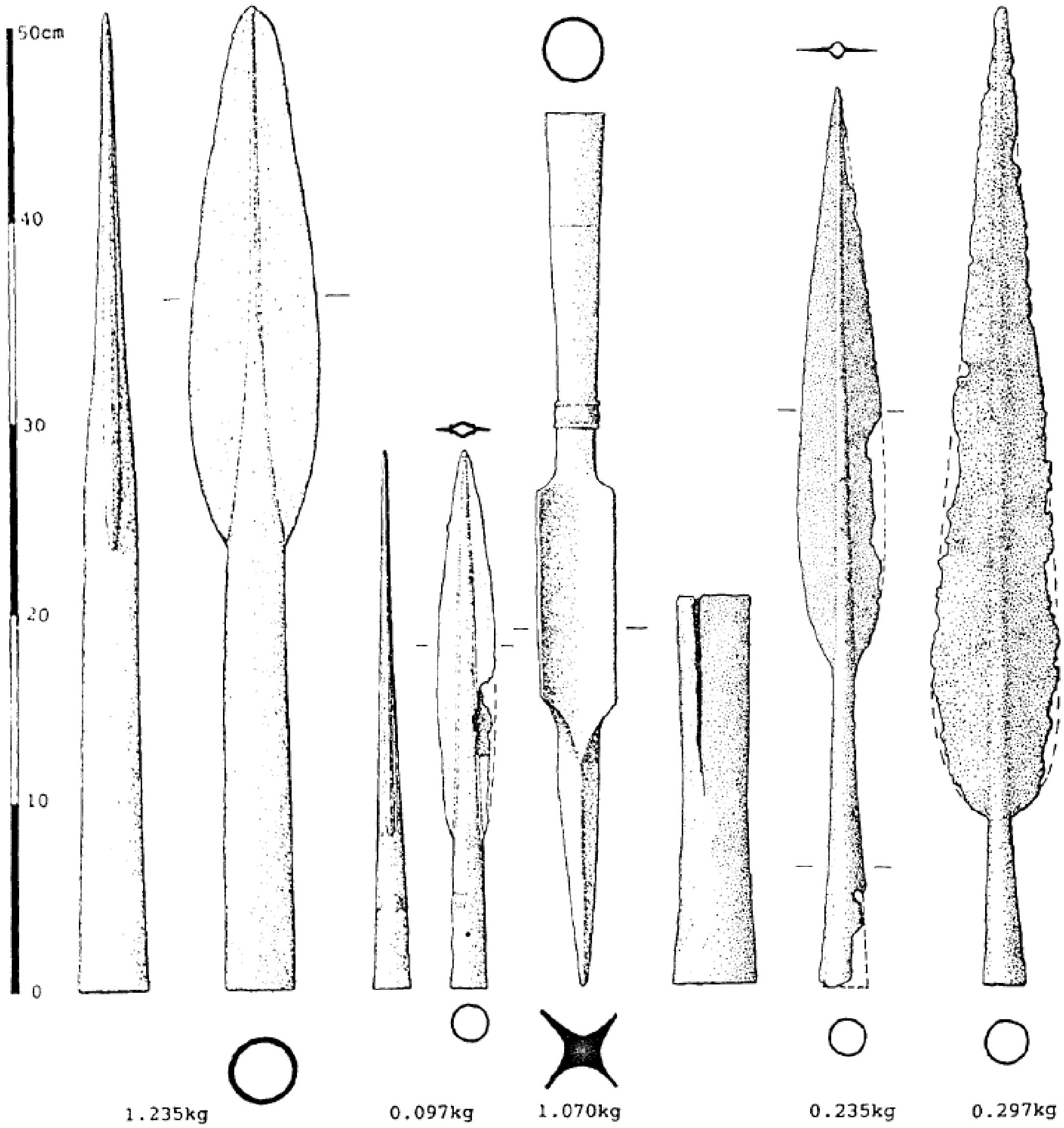


Fig. 1: The sarissa *parts from Vergina: a, b, c, d the pieces published by Androicos in 1970. e, f two* sarissa *heads published by Markle in 1982.*

[352] Connolly (2000), 104.

Figure 5.8: Macedonian lancer from the Kinch Tomb at Noussa[353]

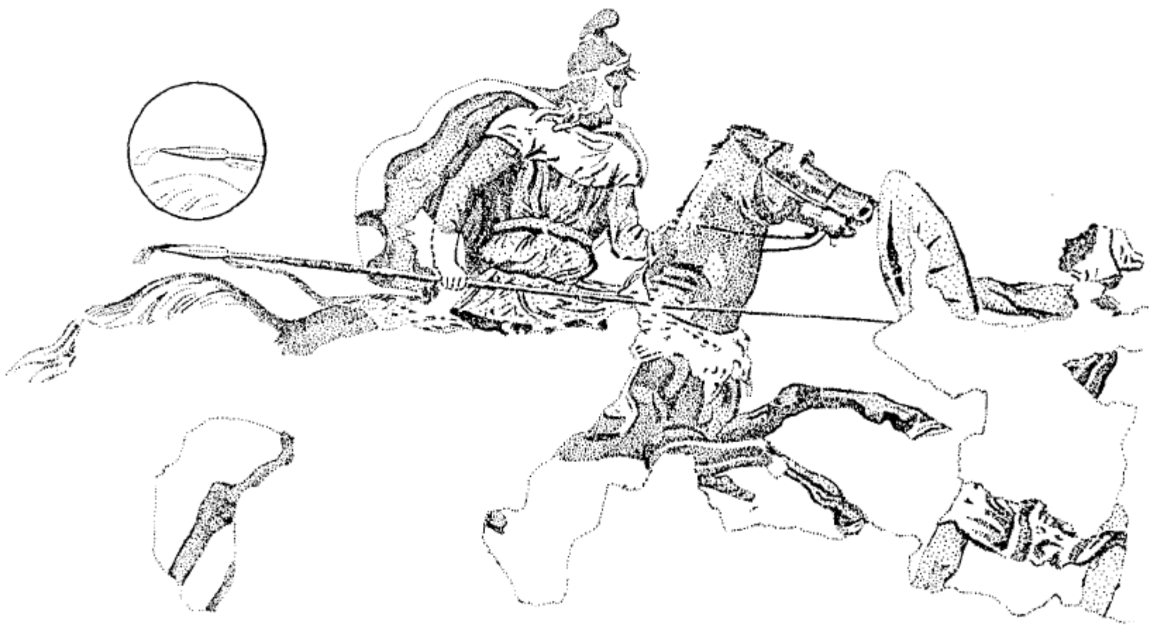
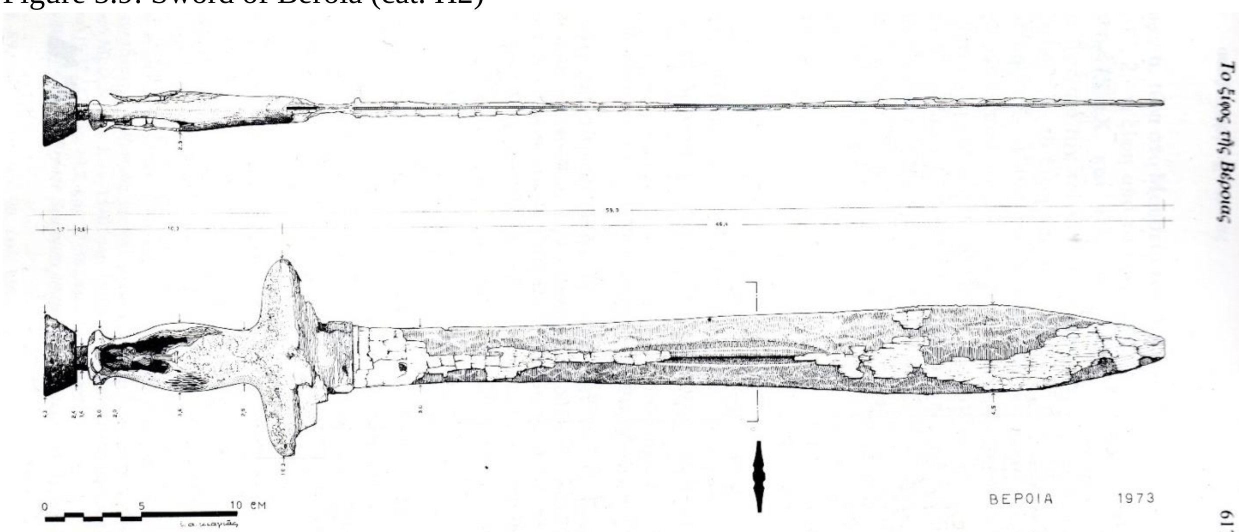


Fig. 2: The wall painting of a Macedonian cavalryman from Kinch's tomb at Noussa with an inset showing the spear butt.

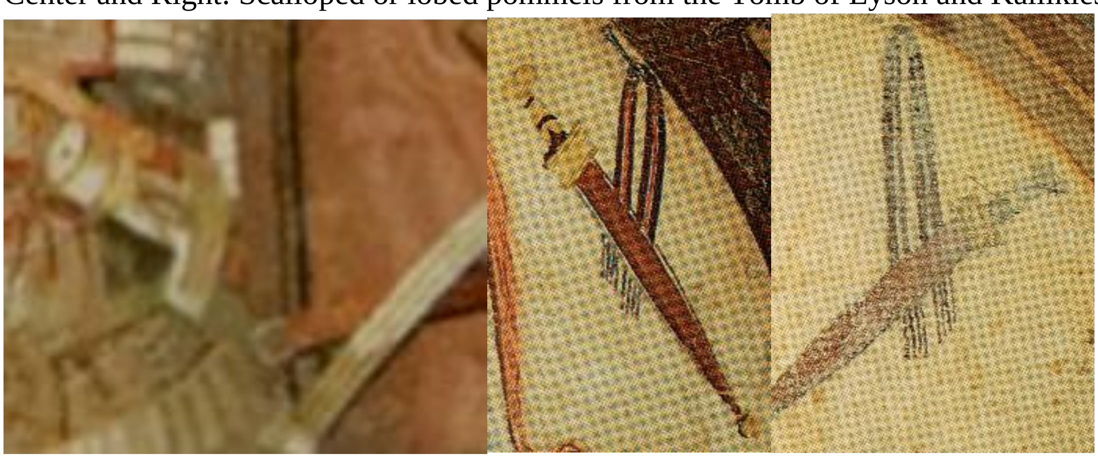
Figure 5.9: Sword of Beroia (cat. H2)



353 Connolly (2000), 105.

Figure 5.10: Iron *machairae* from the MET
Top: Cat. H5. Bottom: Cat. H6.

Figure 5.11: Pommel Types on the *xiphos*
Leftmost: Detail of disc-pommel from the Alexander Mosaic
Center and Right: Scalloped or lobed pommels from the Tomb of Lyson and Kallikles:[354]



[354] Details from Miller (1993), pl 3.

Figure 5.12: Paintings of equipment from the Tomb of Lyson and Kallikles:[355]
Top: South Lunette
Bottom: North Lunette

[355] Miller (1993), pl 3.

Figure 5.13: Macedonian *Xiphos* from Vergina/Aigai (cat. H1)

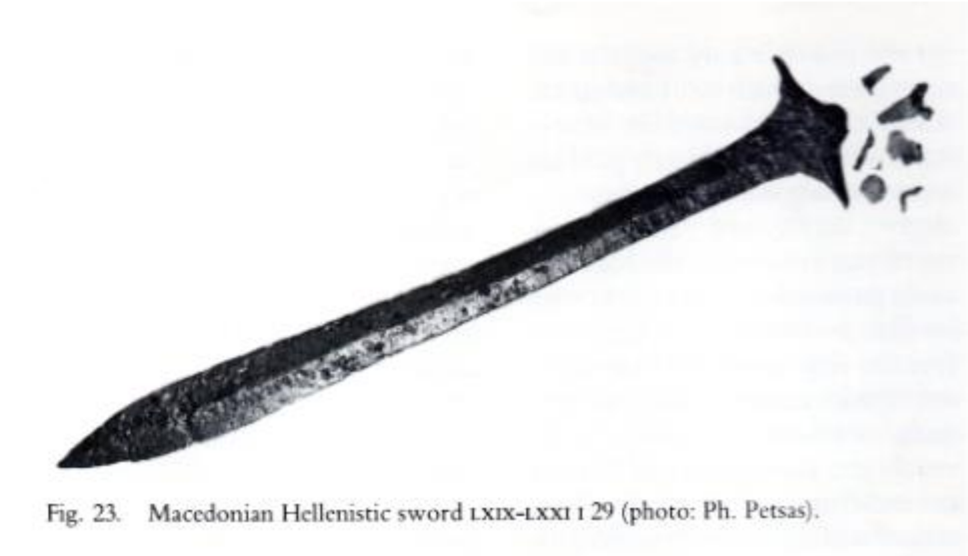


Figure 5.14: *Xiphos* from the British Museum (cat. H3)

Figure 5.15: Long bladed *kopis* from Thesprotia.

Figure 5.16: Reconstructed Macedonian *aspis* with grip-system demonstrated by Connolly.[356]

[356] Connolly (2000), 110.

Figure 5.17: Macedonian shield from the Antikensammlung in Berlin. Front (top) and back (bottom) view. Note the serrated flanges for securing the cover to the wooden core of the shield.[357]

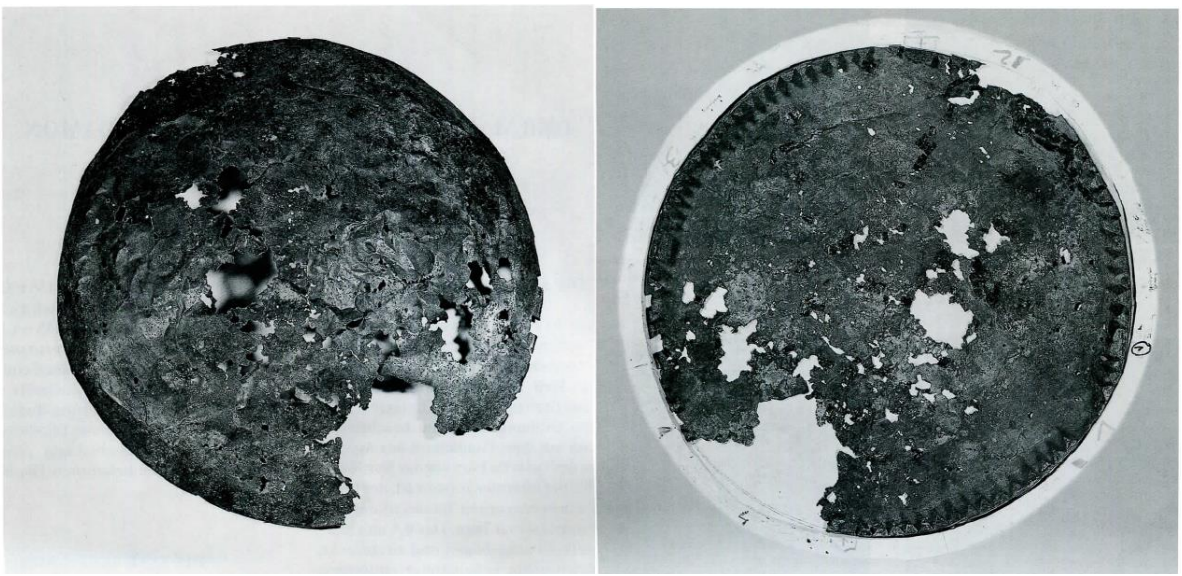
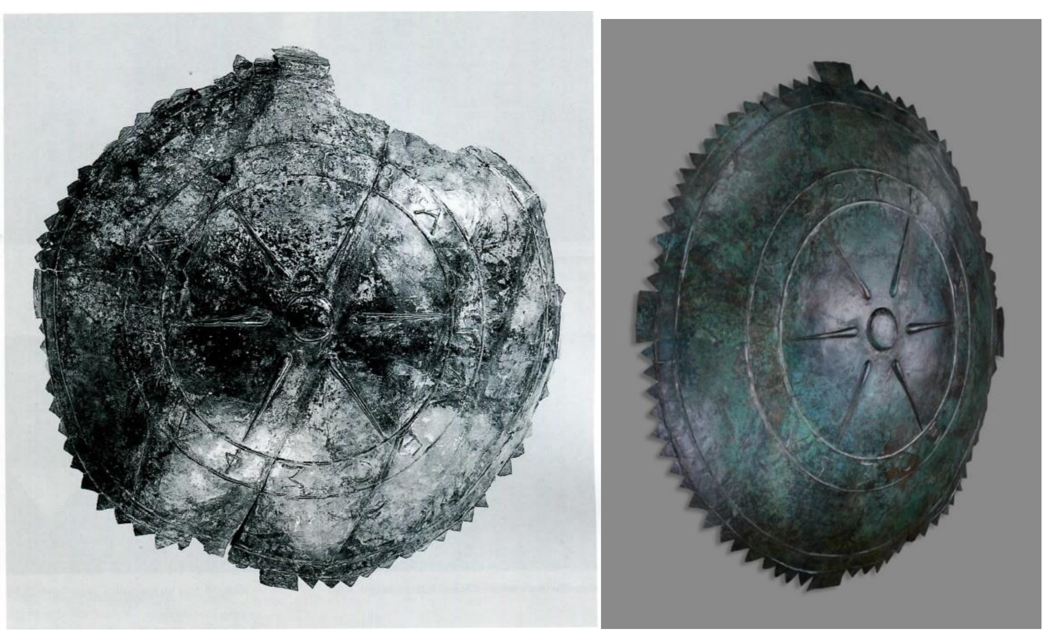


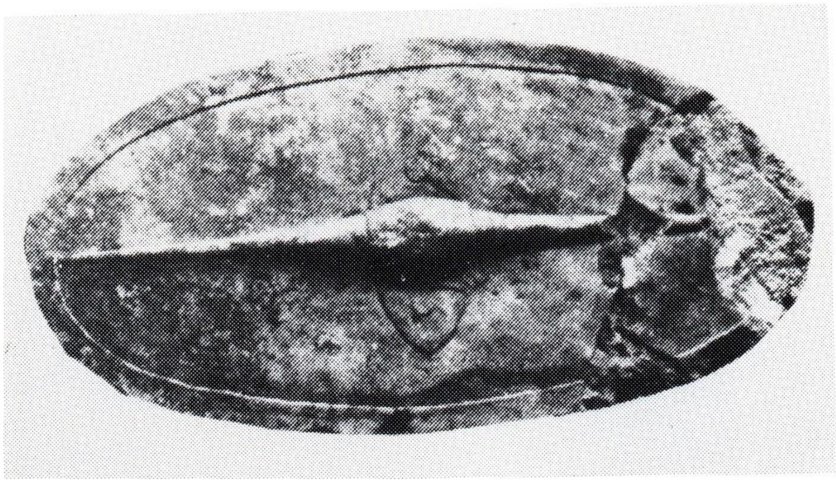
Figure 5.18: Shield of Pharnakes (Getty Museum), Original (left), current state showing extensive restoration (right).[358]



[357] Peltz (2001), 332-3.

[358] Left image, Peltz (2001), 336. Right image, J. Paul Getty Museum.

Figure 5.19: Shield in Relief from the Temple of Athena in Pergamum.[359]



[359] Eichberg (1987), 263, taf 21b.

Figure 5.20: *Thureophoros Thorakitai* with *thureos*, on the Stele of Salamis, from Sidon. Note that the coloring of the edge of the shield does not match the (faint) coloring of the boss.[360]

Figure 5.21: Prodromi Cuirass (cat. H23) from Thesprotia[361]

[360] Sekunda (1995), 71, color plate 2.

[361] Choremis (1980), 10, fig 4.

Figure 5.22: Muscle cuirass in the British Museum (cat. R73)


Figure 5.23: Damaged muscle cuirass in the British Museum (cat. H25)

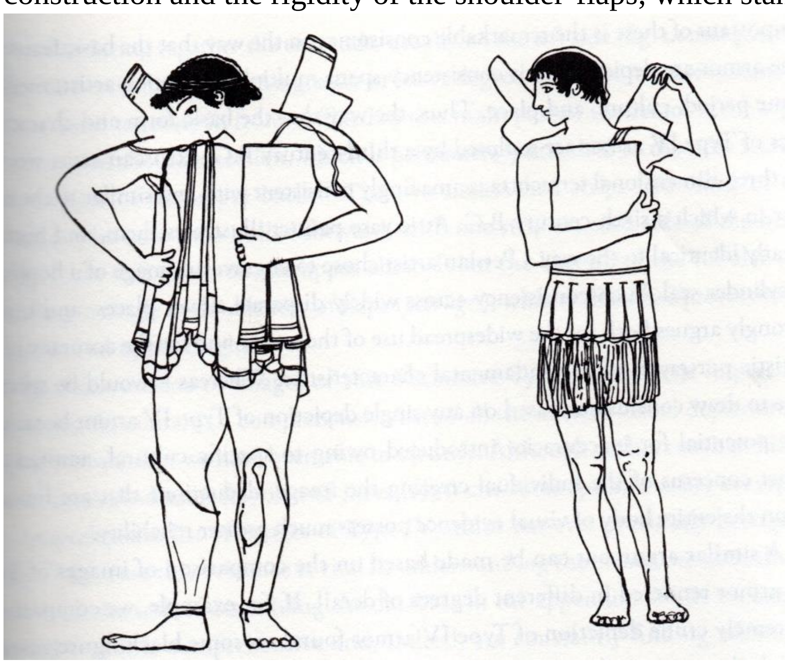

Figure 5.24: Archaic Bell Cuirass from Argos with helmet (cat. H31).[362]

Fig. 19. — L'armure d'Argos, vue d'ensemble.

Figure 5.25: Iron Cuirass from Vergina/Aigai

[362] Courbin (1957), fig. 19.

Figure 5.26: Arming scenes featuring type-IV textile body armor. Note the 'tube-and-yoke' construction and the rigidity of the shoulder-flaps, which stand upright when not tied down.[363]



[363] Aldrete *et al*. (2013), 23.

Figure 5:27: Reconstructed type-IV textile body armor, demonstrated by Aldrete.[364]

[364] Aldrete *et al* (2013), pl. 6.

Figure 5.28: Detail from the Alexander Sarcaphagus showing a *hypaspist* wearing type-IV cuirass

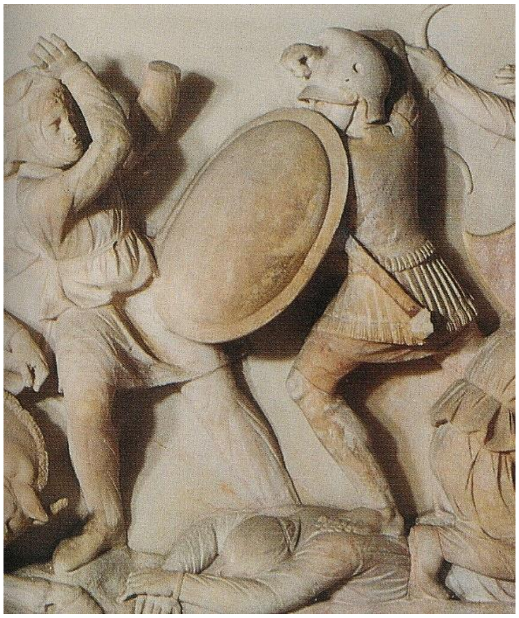


Figure 5.29: Variations of the *Pilos/Konos* helmet-type.[365]

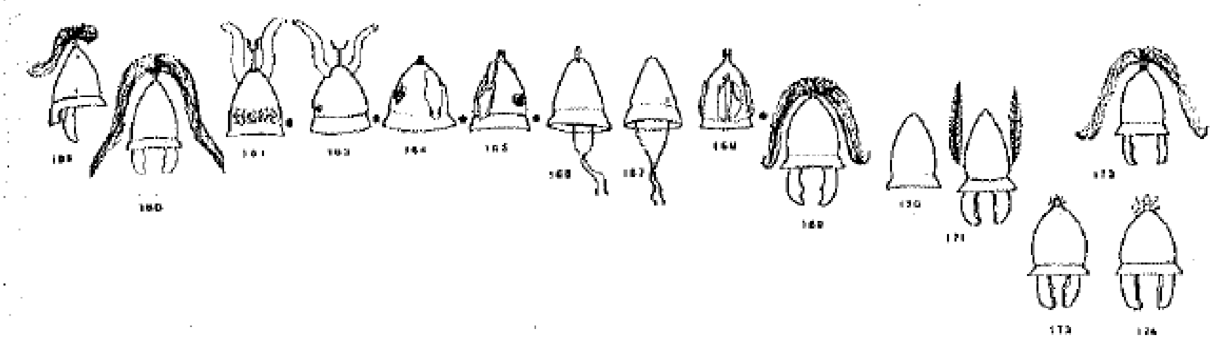


Fig. b

From *pilos* to *kônos*. The typologies made by P. Dintsis highlighted the change from one to the other of the two types at the start of the Hellenistic period. Extract from Dintsis (n. 25), Beilage 3.

[365] Juhel (2009), fig b. Dintsis (1986), beil. 3. I have shown Juhel's simplification of Dintsis' much larger diagram here for clarity's sake.

Figure 5.30: Southern Italian Pilos/Konos type helm with decorations (cat. H33).

Figure 5.31: Pilos/Konos type in the Antikensammlung, Berlin, found in upper Egypt (cat. H32).

Figure 5.32: *Pilos/Konos* helmet-type in the Ashmolean Museum (cat. H37).

Figure 5.33: Thraco-Phrygian Helmet type in the British Museum (cat. H39).

Figure 5.34: Decorated Thraco-Phrygian Helmet from S. Italy (cat. H40).[366]

[366] Carratelli (1996), 652.

Figure 5.35: Attic helmet from Boeotia, now in British Museum (cat. H42).

Figure 5.36: Detail from the Aemilius Paullus Monument showing an Infantryman wearing an Attic-type helmet.[367]

[367] Detail from Taylor (2016), 562, fig 1.

Figure 5.37: Attic-Type Helmet in the Antikensammlung, Berlin (cat. H43).

Figure 5.38: Attic-Type helmet in the Antikensammlung, Berling (cat. H44)

Figure 5.39: Insert from the Alexander Mosaic showing Boeotian Helmet on Rider

Figure 5.40: Riders on the Alexander Sarcophagus with Boeotian helmets (figures on extreme right and extreme left)

Figure 5.41: Phalangite from the 'Great Tomb' at Lefkadia.[368] Note that the figure carries an *aspis* and what appears to be a *sarisa*, but wears boots without greaves.

b. Macedonian tomb at Lefkadia. The "Great Tomb" **(Tomb 18C)**. Painted warrior from facade

[368] Miller (1993), pl. 8.

CHAPTER SIX: PRE-STATE PEOPLES

While the previous two chapters have dealt with Rome and the other great states of the Mediterranean, it is also important that this analysis include the equipment and military systems of the many pre-state peoples that Rome came into conflict with in the third and second centuries. Pre-state peoples are often neglected in treatments of Roman expansion and imperialism, but it is important to keep in mind that eventual consolidation of Roman control, and the establishment of a state apparatus over these pre-state peoples, was by no means a forgone conclusion.[1] Pre-state armies could and did deeply disrupt the Mediterranean state system, and on occasion (such as with the Galatian invasions or the wars of the Cimbri and Teutones) seriously imperil or even destroy well-established states. And though it would take centuries, Rome's *imperium* did eventually collapse into a situation where the majority of its territory would once again be pre-state (or rather, post-state). Moreover, in addition to pre-state societies being formidable adversaries in their own right, pre-state warriors often feature in the ranks of the armies of the major powers of the Mediterranean, either as mercenaries or as dependent peoples. The military landscape of the third and second century Mediterranean is thus one in which the many pre-state peoples are not to be ignored.

[1] Much of the scholarship on Roman imperialism discussed in the first chapter is focused heavily on state-to-state interaction. Particularly notable is Eckstein's approach, in both Eckstein (2006) and Eckstein (2008), definitionally focused on a condition of 'interstate anarchy,' which then naturally excludes pre-state peoples. Likewise, though to a lesser extent, Harris (1979) remains far more focused on Rome's interactions with other state-peoples in the Mediterranean.

This chapter focuses on the resource intensity of the military equipment of pre-state peoples primarily in the western Mediterranean, particularly the peoples of Gaul and Spain. These were certainly not the only militarily significant pre-state peoples in the Mediterranean world, but they were the ones with which Rome had the most interaction in this period and who were the most militarily relevant to Roman activities. Moreover, as will become apparent, the archaeology on the military equipment from pre-Roman Gaul and Spain has reached a point that makes the approach employed in the previous chapters tenable here too; the same cannot be said of the homelands of the many other pre-state peoples of the eastern Mediterranean.[2] This chapter, then, will begin by defining the peoples and material cultures to be examined, before advancing the evidence for reconstructions of the metal-intensity of the military equipment from the third and second centuries found in Gaul and Spain. The chronological limit here is important to note, as both Gallic and Spanish military equipment evolved continuously. Some particularly notable equipment types are effectively excluded by a focus on the third and second centuries. However, such a focus is necessary to render this analysis comparable with the previous chapters. In addition to analyzing the resource-intensity of pre-state militaries, this chapter will revisit the question of the resource intensity of Carthaginian land armies in the Second Punic War. While this may seem a strange place to return to them, those armies operating in Spain and Italy, particularly Hannibal's own army, were primarily made up of Spanish and Gallic mercenaries fighting in their own distinctive style. As a result, the military equipment of late third century Spain and Gaul also formed a very large component of the military equipment of soldiers fighting for Carthage in the Second Punic War.

[2] The sharp limits on our understanding, in particular, of the military equipment of Thrace and Illyria were touched on in the previous chapter.

The Pre-State Peoples of the Western Mediterranean

By definition, the divisions between and among pre-state peoples lack the clarity and precision of those between states. As a result, it is necessary at the outset to clarify what peoples here are being discussed and how certain common terms for them are being used. The Romans termed the people living immediately north of Italy as *Galli*, while the Greeks called them *galatai* or *keltoi*; as a result, Gaul and Celt are the two most common terms of reference for these peoples. English and German language scholarship in particular has tended to prefer the term 'Celt' and 'Celtic' (or *kelten* and *keltische*) to describe these peoples and their culture. However, this usage is not without difficulties. As frequently applied, 'Celtic peoples' is taken to encompass not only the Gauls, narrowly understood, but also many of the peoples of pre-Roman Britain and those of north-western Spain (the Celtiberians and Lusitanians, among others). When referring primarily to a family of related languages, this grouping has linguistic merit, but it is impossible to speak of a single material culture across this wide of a space, especially if it is taken to include the peoples of Scotland or Ireland.[3] Moreover, this usage of the term often comes with the unhelpful assumption that these people are 'Celtic' in not only a linguistic or material culture sense, but also in an ethnic or hereditary sense, an assumption that the archaeology often does not, or indeed cannot, support. Moreover, the conception of a 'Celtic world' as a cultural or ethnic unity runs afoul of the considerable evidence for deep and meaningful divisions between a diverse host of different 'Celtic' peoples.

[3] On these problems and the troubled history of the term 'Celt,' note especially S. James, *The Atlantic Celts: Ancient People or Modern Invention* (Madison: University of Wisconsin Press, 1999). Note also, largely *contra* James, D. W. Harding and W. Gillies, "Introduction: Archaeology and Celticity" in *Celtic Connections*, vol 2, eds. W. Gillies and D. W. Harding (Edinburgh, University of Edinburgh: 2005), 1-14.

Because this study is focused on material culture and military systems, it is possible to avoid these pitfalls. I therefore propose to use the terms Gallic and La Tène culture in a substantially more limited sense than the common usage of 'Celt' and 'Celtic,' which will otherwise be avoided except when referring to Celtic languages, in particular the Celtic-language-speakers of the Spanish Meseta, discussed later in this section. In this study, 'Gallic' should be understood to signify a specific material culture connection. That is to say that I term those peoples, regions or objects 'Gallic' which are connected to observable La Tène material culture, in particular elements of weapons and armor associated with that material culture. As will soon become apparent, Gallic military material culture is consistent enough, even over a large geographic area, to speak of a Gallic military system, at least inasmuch as weapons, armor and their employment in battle are concerned. This assertion, that there is a conceptual unity in Gallic warfare, even as there is great diversity in Gallic peoples, is echoed in the sources, which will be discussed in the subsequent section. At the same time, assignment of any given artefact or site to a 'Gallic' context should not be taken necessarily to mean that individuals once connected to it would have seen themselves as part of a broader cultural community. Instead, the investigation of 'Gallic warriors' should be understood, effectively, as investigation of warriors who fought in Gallic fashion, regardless of culture, tribe or allegiance.

It is also necessary in this context to discuss the periodization of La Tène artifacts. A number of different periodization systems exist for La Tène material culture (fig. 6.1). Because this study is focused on Roman military activity in the third and second centuries, its key period of interest is the period variably referred to as the 'Middle' La Tène or La Tène II, corresponding broadly to c. 300 to c. 100.[4] As a result, Late La Tène (post-100) sites, most notably Alesia, are somewhat less useful, although material from both the Early and Late periods are occasionally of use in understanding the development or use of Gallic military material culture.[5]

The complications involved in discussing military material culture in the Iberian Peninsula are effectively the opposite of those in Gaul. Rather than dealing with a fairly consistent material culture in the context of political and tribal fragmentation, as in Gaul, Spain plays host not only to a remarkable array of peoples, but also to multiple clearly distinguishable material cultures.[6] In particular a sharp divide in material culture developed, distinguishing the peoples of the North and West of the country, particularly in the highland Meseta from the peoples living along the Mediterranean coast, which is to say the regions of (moving from the south to the north) Andalusia, the Levante and Catalonia.

In particular, the Iberian Peninsula was host to a number of Celtic-language speaking groups, concentrated predominately in the Meseta and the west of the peninsula.[7] The initial explanation for the presence of Celtic-language speakers in Spain, championed by Pere Bosch Gimpera, was a sequence of waves of 'Celtic' immigration beginning in the sixth century. However, the archaeological evidence has not tended to support this explanation, and the means

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[4] In this, I am following the chronological framework of J. Déchelette, *Manuel d'archéologie préhistorique celtique et gallo-romaine;* vol. 4: *Second âge du fer ou époque de La Tène*, 2nd ed. (Paris: Picard, 1927).

[5] M. Redde, *L'Armée Romaine en Gaule* (Paris: Editions Errance, 1996).

[6] Spain, here and following, should be understood to refer to what the Romans would have called *Hispania*, that is the entire Iberian Peninsula, including both modern Spain and Portugal. On the differences between the peoples of the Meseta and the coastal region, note J.S. Richardson, *Hispaniae: Spain and the Development of Roman imperialism, 218-82 BC* (Cambridge: Cambridge University Press, 1986), 16-7. J. S. Richardson, *The Romans in Spain* (Malden: Blackwell, 1996), 9-16. S. J. Keay, *Roman Spain* (London: British Museum Publications, 1988), 8-24. L. A. Curchin, *Roman Spain: Conquest and Assimilation* (London: Routledge, 1991), 15-23.

[7] R. J. Harrison, *Spain at the Dawn of History: Iberians, Phoenicians and Greeks* (London: Thames and Hudson, 1988), 140-2. M. C. F. Castro, *Iberia in Prehistory* (Cambridge: Blackwell, 1995), 349-67.

by which the linguistic and material-culture geography of the Iberian Peninsula as subsequently observed by Greek and Roman writers developed is not fully understood.[8] Among the groups here were the Celtiberians and the Lusitanians; in the scholarship, the term Celtiberian has come to be used as short-hand for all of the Celtic language speaking peoples in the Meseta; I follow this usage here.[9] The coastal region, often classified as Iberian in contrast to the Celtiberian Meseta, was more heavily urbanized, and included Greek and Phoenician colonies alongside native inhabitants.[10] In contrast, although there were a number of fortified hilltop sites in the Meseta, these were small compared to the towns of the coast; within the Meseta itself, most of the larger of such settlements are concentrated in the north east, in the area inhabited by the Celtiberians proper.

The result, insofar as this study is focused, is the existence of at least two (and potentially more) different military material cultures. In practice, as Fernando Quesada Sanz has argued, the situation is more complex, with significant movement of military equipment and technology between the coastal and Meseta regions and local variation within those regions, much of which is likely not yet apparent due to the still somewhat limited state of the archaeological evidence.[11] In particular, while the military equipment of the peninsula had been converging during the sixth and fifth centuries, it substantially diverged during the fourth century, with a Celtiberian panoply centered on short antennae swords while the Iberian panoply increasingly used the curved

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[8] A. J. Lorrio, G. R. Zapatero, "Celtiberians: Archaeology of Celts in Iberia" in *Celtic Connections*, vol 2, eds. W. Gillies and D. W. Harding (Edinburgh, University of Edinburgh: 2005), 33-55. Cf. also A. Arribas, *The Iberians* (London: Thames and Hudson, 1964), 24-9.

[9] On the difficulties in the term, note Castro (1995), 350-1.

[10] Harrison (1988); Castro (1995).

[11] F. Quesada Sanz, "Patterns of interaction: 'Celtic' and 'Iberian' weapons in Iron Age Spain" in *Celtic Connections*, vol 2, eds. W. Gillies and D. W. Harding (Edinburgh, University of Edinburgh: 2005), 56-78.

falcata. This divergence widens further during the third century with the appearance of equipment associated with both Gallic and Italic origins. In North-Eastern Spain, weapons associated with La Tène culture, particularly local variants thereof, become more common, while in the coastal region, Italic military equipment, particularly the *scutum* (or possibly Gallic oval shield) and Montefortino-style helmets become more common. These developments further deepened the distinctiveness of the regions, in part because these new equipment types largely fail to penetrate into the interior and thus are far less prevalent in the Celtiberian panoply of the Meseta.[12]

Based on this division, this study will thus suggest reconstructions for the late third and second century panoplies of both the Celtiberians of the Meseta (understood here in the broad sense to include the bulk of the Celtic language speakers) and of the Iberians of the coastal zone. It should be stressed that neither of these two groups, the Celtiberians or the Iberians, were politically united in anything like their own state; Strabo's description makes clear that both groups remained fragmented into distinct, smaller entities (fig. 6.2).[13] Prior to Rome's arrival, Carthage's control of the coastal zone may have imposed a degree of political unity among some of the Iberians, but the course of operations in Spain during the Second Punic War and the frequency with which Iberian communities defected, switched sides or otherwise acted independently, suggest that Carthaginian control was never so complete.[14]

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[12] Quesada Sanz (2005), 63.

[13] Our best information on these divisions comes from Strabo 3.4.1-14.

[14] For an overview of the volatility of the situation, see J. F. Lazenby, *Hannibal's War: A military history of the Second Punic War* (Warminster: Aris & Philips Ltd, 1978), 125-156. Harrison (1988), 80-92.

Warriors and Equipment

Gallic Warriors

Before embarking on a description of a typical Gallic warrior, it is necessary to note the artificiality of this nevertheless essential discussion. As noted, the Gallic cultural sphere was never politically united, and it does not seem that Gallic peoples or Celtic language speakers ever saw themselves as part of a single cohesive cultural unit.[15] As a result, a discussion of a Gallic military system is a necessary simplification. As will become increasingly clear, while there are broad commonalities in the material culture of warfare between Gallic peoples, there are also notable regional and ethnic variations preserved in both the archaeological record and the literary evidence. It is further safe to assume that some greater amount of variety is rendered invisible to us by the limited nature of the evidence. Nevertheless, despite this diversity, it is possible to speak of a Gallic 'military system,' in the limited sense of the interplay of a set of common weapons and their battlefield implementation.

Because this system of weapons and tactics was relatively alien to the Greek and Roman writers of the period, it is frequently described by them. The distinctive Gallic weapon was a relatively long, straight-edged one-handed cutting sword, well attested in the literary sources and archaeological evidence.[16] Spears are less frequently noted by the sources, possibly because the Gallic thrusting spear was not very different from Roman or Greek spears of the same size.

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[15] A fact that was recognized by the more nuanced ancient sources, e.g. Caesar, *B. G.* 1.1; Plb. 2.17.8, 22.1, 23.1-3; Strabo 4.1.1.

[16] Plb. 2.30.8; Liv 7.10.8-10, 22.46.5-6, 38.21.4; Diodorus 5.30.3; Dionysius 14.9; Tac. *Agricola* 36; App. *Gal*. 6. Plut. *Cam*. 40. . J.-L Brunaux and B. Lambot, *Armement et Guerre chez les Gaulois* (Paris: Editions Errance, 1987), 85-90. A. Deyber, *Les Gaulois en Guerre: Stratégies, tactiques et techniques. Essai d'histoire militaire (II[e]/I[er] siècles av. J.-C.)* (Paris: Editions Errance, 2009), 297-302. R. Pleiner, *The Celtic Sword* (Oxford: Clarendon Press, 1993).

Polybius omits any mention of spears in his accounts of the array of the Boii, Gaesatae, and Insubres at the battle of Telamon (225) and at Cluius River (223).[17] Livy follows suit, describing the Tolostobogii, a Galatian people, at Olympus Mons (189), as explicitly carrying only swords, and he omits any mention of spears from the equipment of Gallic mercenaries in Hannibal's army in his account of Cannae (216).[18] Likewise, the Gallic champion defeated by Manlius Torquatus is described as armed with a sword, but no spear is mentioned.[19] On the other hand, Dionysius, giving a full account of the Gallic panoply, includes spears (but omits javelins).[20] Diodorus also notes spears as part of Gallic arms and offers a description, "they brandish spears, which they call *lanciae*; these have iron heads a cubit in length or more and a little less than two palms broad."[21] This reference to the native name of the weapon as a *lancia* (λαγκία, equivalent to the Latin *lancea*), is itself intriguing, suggesting that the term in Latin and Greek might be a loan-word for this specific form of spear.[22]

The archaeological evidence suggests very strongly that spears were a normal part of Gallic battlefield equipment. Radomír Pleiner assembles studies of some 1,616 La Tène culture flat cemetery graves; in total his figures reveals that, while 213 (or 13.2%) of the graves

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[17] Plb. 2.28.3-8; 33.5.

[18] Olympus Mons: Liv. 38.21.4. Cannae: Liv 22.46.5. At Olympus Mons, Livy is stressing the Gallic lack of missile weapons to respond to the attack of Roman and allied skirmishers; it seems plausible that he has merely elided out the presence of spears, but it may well be that some Gallic peoples tended not to carry them. At Cannae, Livy makes no effort to describe the entire Gallic panoply, but merely contrasts Gallic and Spanish swords.

[19] Liv. 7.10.8-10.

[20] Dionysius 14.9.2. Cf. also App. *Gal*. 11.

[21] Diodorus 5.30.4. προβάλλονται δὲ λόγχας, ἃς ἐκεῖνοι λαγκίας καλοῦσι, πηχυαῖα τῷ μήκει τοῦ σιδήρου καὶ ἔτι μείζω τὰ ἐπιθήματα ἐχούσας, πλάτει δὲ βραχὺ λείποντα διπαλαίστων.

[22] Pleiner (1993), 27. J-.L Burnaux, A. Rapin, *Gournay II: Boucliers et Lances Dépôts et Trophées* (Paris, Editions Errance: 1988), 88.

contained at least one sword, 236 (14.6%) contained at least one spearhead.[23] The same analysis reveals considerable regional variation; in 13 of the 24 sites noted by Pleiner, burials with spears outnumbered those with swords. In Moravia, sword burials outnumbered spear burials 51 to 31, whereas around the Marne and the Seine, the situation was reversed, with spears outnumbering swords 18 to 7. Although it should be noted that burials with weapons in general comprised a minority (9.4%) of the sample, burials with both a spear and a sword were more common than with either weapon alone, suggesting quite clearly that the sword and spear were (as in Greek armies) complements to each other, rather than replacements. In a separate table, Pleiner assembles 34 La Tène culture graves containing helmets. Of these, 32 (94%) contained at least one sword, one contained two swords; 30 (88%) contained at least one spearhead, of which 13 (38%) contained more than one; the total number of spearheads found in the selection outnumbered the swords 44 to 33.[24] Ritual deposits also show significant concentrations of spearheads; the excavation of the sanctuary at Gournay-sur-Aronde has yielded at least 72 spearheads and 53 spear-butts.[25] Thus while not necessarily emphasized by the sources, it is clear that a one-handed thrusting spear was as much a standard weapon of Gallic warriors as the sword, though we should be alert to the potential for regional or ethnic variation between Gallic groups.

The evidence for the widespread use of javelins is more ambiguous. As noted, Livy stresses that the Tolostobogii at Olympus Mons lack any sort of ranged weapon to retaliate

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[23] Pleiner (1993), 40-41. The studies Pleiner cites are broken down by region: Marne, Seine-Marne, Ardennes, Switzerland, N. Italy, Bavaria, Bohemia, Moravia, Slovakia, Hungary, Yugoslavia and Romania.

[24] Pleiner (1993), 46-7. It is unfortunate that Pleiner remains throughout his study distinctly uninterested in the presence of these spearheads.

[25] Brunaux and Rapin (1988).

against Roman and allied missile troops.[26] Polybius notes a similar inability to counter ranged skirmish tactics at Telamon.[27] Diodorus, however, reports javelins as part of the Gallic panoply, and Caesar reports their use by Gallic armies during his campaigns in Gaul.[28] A number of javelin-heads have been recovered from the sanctuary at Gournay-sur-Aronde, as well as from the site of La Tène itself, though they do seem to be less common overall.[29] It is possible that the popularity of the javelin was subject to regional or ethnic variation; Alain Deyber notes that the *gaesum*, a Gallic word for a type of javelin, seems to have given the name to the *Gaesatae*, so it is possible that the weapon was a local specialty.[30]

Both sword and spear were used in conjunction with a large, center-grip oval shield from the same family of shields as the Roman *scutum* and the Hellenistic *thureos*.[31] Like the sword, the Gallic shield is nearly always present in literary descriptions of Gallic weapons.[32] Livy notes of the shield that it was long like the *scutum*, but not as wide, and lacked the *scutum*'s characteristic curve, being instead flat-faced.[33] This description is confirmed by the wooden remains of three shields dredged from the lake at La Tène; such a shield is also shown on the

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[26] Liv. 38.21.4.

[27] Plb. 1.30.1-4.

[28] Diodorus 5.30.4. Caes. *B.G.* 1.26, 5.34. Diodorus also reports that Gallic chariotry threw javelins from the chariot before dismounting to fight with swords, Diodorus 5.29.1.

[29] Brunaux and Lambot (1987), 94-5. Deyber (2009), 306-308. Gournay: Brunaux and Rapin (1988), 88. La Tène: Lejars (2013), 155-156.

[30] Deyber (2009), 306-7. This notion seems at odds with Polybius, who notes the *Gaesatae* at Telamon were badly prepared to retaliate against missile fire, Plb. 2.30.1-4.

[31] As noted in the previous chapter, Gallic incursions are a likely cause for the introduction of the *thureos* to the Hellenistic world. Brunaux and Lambot (1987), 97-101. Deyber (2009), 287-296. On the broader origins of this kind of shield, note Stary (1981), Eichberg (1987), 166.

[32] Plb. 2.30.3. Liv 7.10.9, 10.29.11, 22.46.5. Dionysius 14.9.2. Diodorus 5.30.2. Caesar, *B.G.* 1.25.

[33] Liv. 38.21.4. Note also Plb. 2.30.3.

statue of the Mondragon Warrior (fig. 6.3).[34] Shield-fittings, particularly the iron bosses and handles of shields, are well established in the archaeological record.[35]

The amount of armor worn by Gallic warriors varied a great deal. Diodorus spells this out explicitly, noting that "some have iron cuirasses of chains, but others are satisfied with the armor nature has given them and go into battle naked."[36] Polybius notes that at Telamon, the warriors wearing cloaks (σάγοι) and trousers (ἀναξυρίδες) were protected against the attacks of Roman javelin troops, suggesting that these garments might have had some significant defensive value.[37] Diodorus also notes the use of decorated bronze helmets.[38] In fact, the Gauls by this period made helmets in both copper-alloy and iron, in at least two different styles.[39] Gallic armor thus ran the range from a complete absence of body protection to elite Gauls with metal helmets and mail armor; the former would be one of the least protected warriors on an ancient battlefield, while the latter, well protected indeed, one of the heaviest armored. The varied and complex evidence for armor among Gallic warriors deserves more in-depth treatment and will be returned to later in the present chapter.

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[34] Connolly (1981), 118-9. Brunaux and Lambot (1987), 97. Deyber (2009), 293.

[35] Ritual deposits: E.g. Gournay-sur-Aronde, Brunaux and Rapin (1988). Shields also figure in warrior burials, Pleiner (1993), 39, 59-60.

[36] Diodorus 5.30.3. θώρακας δ᾽ ἔχουσιν οἱ μὲν σιδηροῦς ἁλυσιδωτούς, οἱ δὲ τοῖς ὑπὸ τῆς φύσεως δεδομένοις ἀρκοῦνται, γυμνοὶ μαχόμενοι.

[37] Plb. 2.30.1.

[38] Diodorus 5.30.2.

[39] U. Schaaff, "Keltische Helme" in *Antike Helme* (Mainz: Verlag des Römisch-Germanischen Zentralmuseums, 1988), 293-317. M. Feugere, *Les Casques Antiques: Visages de la guerre de Mycenes à l'Antiquité tardive* (Paris: Editions Errance, 1994), 51-76. Deyber (2009), 287. Brunaux and Lambot, (1987), 102-107. Dionysius 14.9.2 implies that naked Gallic warriors also lacked helmets, placing this description in the mouth of the Roman dictator Camillus; it is unclear how far this report should be credited.

Apart from horse fittings, the equipment of Gallic cavalry is not always readily distinguishable from infantry equipment.[40] The Gundestrup Cauldron, of uncertain date, shows a procession of four horsemen (fig. 6.4), apparently mailed, helmeted and armored with spears but without shields, while a votive plaque from Baratella shows Gallic cavalry, again with spears, but also with oblong shields apparently of the type common to Gallic infantry.[41] Again it is necessary to be aware of the possibility of significant regional or chronological variation, but it seems likely that, on the whole, Gallic cavalry carried the same sort of equipment as the infantry: sword, spear, javelins, helmets, armor and sometimes shields.[42] That said, this equipment was likely to be of generally higher quality, as Gallic cavalry seems to have been drawn largely from aristocrats and their retinues. Consequently, I assume that mail armor was normal for mounted warriors.[43] Gallic cavalry had a reputation for effectiveness, to the point that Caesar seems to have used Gallic cavalry to the exclusion of Roman cavalry.[44] Gallic peoples were also some of the last to use the chariot in battle. However, the last reported use of Gallic chariotry was at the Battle of Telamon (225), although the chariot remained in use in Britain until Caesar's time.[45] Given that the chariot had been abandoned as a weapon of war on the mainland of Europe for the majority of the period under consideration, it seems sensible to exclude it from this reconstruction, as it did not play a role in most of the Gallic armies that Rome faced.[46]

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[40] On horse fittings: Deyber (2009), 328-9.

[41] Deyber (2009), 292-3.

[42] Deyber (2009), 292-3, 326-35. Connolly (1981), 126.

[43] J.-L Brunaux, *Guerre et Religion en Gaule, Essai D'Anthropologie Celtique* (Paris: Editions Errance, 2004), 57-9.

[44] On the reputation of Gallic cavalry, note Plut. *Marc*. 6.4. Caesar's cavalry: Keppie (1984), 100.

[45] Plb. 2.28.5. Caesar, *B.G.* 4.33. Connolly (1981), 126.

[46] On Gallic chariots, including some efforts at reconstruction, note Deyber (2009), 322-326.

Gallic Spears

The typical Gallic spear was a one-handed thrusting spear similar to the Greek *dory* or the Roman *hasta*. Assessing the overall length of the spear is difficult, since the wooden haft is typically lost. Iconographic depictions are often of somewhat limited use, as the figures and their weapons may not be drawn to scale, but tend to suggest a weapon only slightly larger than the bearer.[47] Burial deposits offer more information; spears frequently had to be broken in half in order to be included with the deceased in a grave, which allows a maximum length of the wooden haft to be calculated based on the relative position of the surviving metal spear point and butt. Jean-Louis Brunaux and André Rapin, while stressing the uncertain nature of such estimations, note that they seem to indicate lengths between 2.4 and 3m. Moreover, a single complex spear recovered from La Tène, with the haft still intact, measures 2.55m.[48] Taken together, then, the evidence indicates a one-handed spear, with a length typically around two to three meters, which is to say roughly the same size as the *hasta* or the *dory*. In terms of the diameter of the shaft, Brunaux and Rapin note that the majority of spearheads found at the sanctuary at Gournay-sur-Aronde have socket diameters between 2 and 2.2cm, suggesting a normal thickness in that range.[49]

There is far more evidence for variation in the shape and weight of spearheads; both spearheads and spear-butts seem to be made exclusively in iron in this period. Brunaux and Lambot note particularly that the Middle La Tène period shows the greatest range and variety of

[47] Brunaux and Rapin (1988), 90-92.

[48] Brunaux and Rapin (1988), 93-5.

[49] Brunaux and Rapin (1988), 97.

spearhead types.[50] Examining a sample of more than 70 spearheads, Brunaux and Rapin advance a typology in five main groups (fig. 6.5).[51] Each of these groups in turn has sub-groupings denoted by letter. Examining 53 spear and javelin points from La Tène in the Schwab Collection, Thierry Lejars expands this typology to seven groups, adding typological groups for javelin points (Group VI) and for spearheads with octagonal, rather than round, sockets (Group VII, fig. 6.6).[52] Nearly all of these spearheads have pronounced central ridges down the center of the blade of the spearhead up to the point, and all but one example have circular sockets, affixed to the haft by either rivets or nails driven through holes at the base. Middle La Tène spearheads were made exclusively in iron.

Group I, termed the 'classic form,' is the most common in both of the sample sets from the Schwab Collection and at Gournay; Brunaux and Rapin note that this type has the most stable shape and remains in use throughout the period.[53] This form is tear-drop shaped, with a round base and a smooth arc to a triangular point. In Group II, the 'convex form,' the blades of the spearhead form more of an oval than teardrop shape, without a strongly defined point distinct with the body of the spearhead.[54] This type, though not as common as Group I, is still well represented in both sample sets. Brunaux and Rapin's dating would suggest, however, that apart from the IIc variant, Group II spearheads generally date to the mid-third century, rather than the second. Group III, the 'wide form,' are relatively wider for their length; the type is rare and

[50] Brunaux and Lambot (1987), 95.

[51] Brunaux and Rapin (1988), 133-134.

[52] Lejars (2013), 149-158.

[53] Brunaux and Rapin (1988), 133. Lejars (2013), 149-51.

[54] Brunaux and Rapin (1988), 133. Lejars (2013), 151-2.

Brunaux and Rapin date it early, with only the last sub-type, IIIc having much presence in the second century.[55]

Group IV is a distinctive group, which Brunaux and Rapin refer to as the 'bayonet type;' these spearheads extend the mid-ridge into a long, thin point with a rectangular or rhombic section.[56] Brunaux and Rapin date this type to the early second century, making it a relatively late emergence. One can see that the earlier Type IIa and IIIc spearheads seem to be moving developmentally in this direction, experimenting with extended tips. The purpose of these spearheads would seem to be defeating armor. The extended point would function much the same way at splitting open mail armor as the square-sectioned Roman 'bodkin' spearheads discussed in chapter four. Nevertheless, this type is both late chronologically and relatively rare, presumably because the rarity of body-armor in Gallic armies made armor-piercing weapons unnecessary most of the time. Finally, Group V, which emerges at the end of the second century, is an elaboration on the 'classic form' but with the addition of a secondary bulge in the blade of the spear towards the base.[57] Brunaux and Rapin term this type 'biconvex.' This type seems more common than III or IV, but less than I or II.

While the Gournay-sur-Aronde spearheads were published with only length measurements, the spearheads and javelin-tips from La Tène published with the Schwab Collection were published with complete measurements and weights, which are shown, organized by type group, in Table 6.1 below. It should be noted that while all of the major type groupings, denoted by a Roman numeral, are represented in this sample, some of the minor

[55] Brunaux and Rapin (1988), 133-4. Lejars (2013), 153-4.

[56] Brunaux and Rapin (1988), 134. Lejars (2013), 154-5.

[57] Brunaux and Rapin (1988), 134. Lejars (2013), 155-6.

types, denoted by a lowercase letter, are not. Type VI, which covers javelin-heads, is discussed in a later section and included in a separate table there. An additional pair of well-preserved La Tène type spearpoints from the British Museum's collection are appended to the end of the table; the type classification for these spearpoints is mine.

Table 6.1: La Tène Spearpoints from the site of La Tène, by type

Cat. No.	Type	Length (cm)	Blade Length (cm)	Blade Width (cm)	Socket Length (cm)	Weight (g)	Notes
G69	Ia	17.2	9.9	4.0	7.3	121	
G55	Ia	21.2	16.2	3.6	5.0	132	
G56	Ia	24.7	20.2	3.1	4.5	122	
G63	Ia	25.4	19.0	5.3	6.4	125	
G64	Ia	24.6	19.8	4.5	4.8	103	
G65	Ia	22.2	15.2	3.4	7.0	91	
G66	Ia	26.3	14.9	3.8	11.4	151	
G70	Ia?	28.3	22.4		5.9	112.7	Incomplete
G57	Id	38.8	32.8	7.4	6.0	224	
G58	Id	46.3	40.8	7.5	5.5	259	
G60	Id	34.2	29.5	7.2	4.7	211	
G61	Id	34.3	28.8	6.2	5.5	188	
G62	Id	31.6	26.0	6.2	5.6	162	
G54	IIb	22.5	17.5	7.9	5.0	151	
G59	IIb	28.6	23.2	7.4	5.4	174	
G45	IIc	54.6	30.0	4.2	24.6	296	Incomplete
G46	IIc	34.4	20.5	4.3	13.9	200	
G47	IIc	35.5	25.0	3.4	10.5	147	
G48	IIc	30.9	19.5	3.3	11.4	142	
G49	IIc	28.6	19.0	3.4	9.6	128	
G71	IIc	39.2	25.0	4.8	14.2	162	
G50	IIc	30.5	17.5	2.8	13.0	160	
G72	IIc	40.1	24.5	3.7	15.6	201	Incomplete
G52	IIIc	24.3	39.1	7.5	4.5	115	
G73	IV	27.7	21.3	3.3	6.4	115	
G74	IV	19.0	10.2	3.0	8.8	75	
G53	Vc	45.0	39.1	8.9	5.9	295	
G67	Vc	40.3	35.0	6.5	5.3	173	
G68	Vc	39.3	34.0	7.7	5.3	198	
G46	VII	17.2	10.0	1.5	7.2	102	
G76	Ib	30.2		7.13		146	BM; Findspot: River Thames
G75	Ib	38.7		3.2		138	BM; Findspot: Unknown (France)

The base of a La Tène spear was typically fitted with an iron spear-butt; these come in two main styles, which occur at roughly the same rate (fig. 6.7). The first type is a simple socketed, conical spear-butt. This type consists of a hollow cone, affixed by a pair of rivets or nails, much like the spear-butts of the Roman *hasta*.[58] These socketed butts are almost always conical and rounded, although square-sectioned butts do appear rarely at both La Tène and Gournay-sur-Aronde.[59] The second type is what Brunaux and Rapin refer to as the *talon à soi*e, which consists of an iron cone affixed to a long, thin steel nail which is driven up into the base of the spear to attach the spear-butt.[60] The spear-butt itself was manufactured by winding layers of metal around the central shank, creating a spiral pattern which can be observed with a metallographic cross-section (fig. 6.8).[61] Variants of this type with square or octagonal cross-sections are more common, but still seem to be a minority.[62] A more significant variation in this style is the presence of an additional metal sleeve or ferule either as a separate metal ring placed above the spearbutt or incorporated directly into the spear-butt itself (fig. 6.9). This extra metal ring, either attached or independent, would have the added benefit of preventing the wood of the base of the haft from splintering when the spear-butt was inserted.[63] Table 6.2 below lists measurements for the spear-butts from the Schwab Collection; 53 spear-butts were also found at

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[58] Brunaux and Rapin (1988), 104-5. Lejars (2013), 158-9.

[59] Brunaux and Rapin (1988), 181, 236.

[60] Brunaux and Rapin (1988), 105-107. Lejars (2013), 158-9.

[61] Brunaux and Rapin (1988), 104.

[62] Brunaux and Rapin (1988), 106.

[63] Brunaux and Rapin (1988), 106.

Gournay-sur-Aronde, but these were published without measurements and as such are substantially less useful and thus not listed in the table.

Table 6.2: La Tène Spear-butts from the site of La Tène, by mass

Cat. No.	Type	Cross-Section Shape	Length (cm)	Max Diameter (cm)	Mass (g)	Notes
G77	Socket	Square	7.8	1.0	17.9	Circular socket section
G78	Socket	Circle	5.5	1.8	21	Incomplete
G79	Socket	Circle	6.7	2.0	22	Damaged
G80	Socket	Circle	4.9	1.8	40	Flat base
G81	Nail	Circle/Hexagonal	7.6	2.0	45	Hexagonal base Circular top
G82	Nail	Circle	7.2	2.1	46	
G83	Nail	Circle	6.9	2.1	47	
G84	Nail	Circle	7.8	2.2	47	
G85	Nail	Circle	9.1	2.1	55	
G86	Socket	Circle	7.6	2.4	72	
G87	Nail w/ ferrule	Circle	10.2	2.5	82	
G88	Nail w/ ferrule	Octagonal	10.1	2.4	91	
383.2	Socket	Circle/Rectangular	17.2	1.9	102	Square base Circular socket
383.17	Nail w/ ferrule	Octagonal	11.3	2.8	123	
383.7	Nail w/ ferrule	Octagonal	15.0	2.6	135	
383.9	Nail w/ ferrule	Octagonal	17.1	2.7	153	
383.8	Nail w/ ferrule	Circle	15.6	2.8	154	

As is apparent from the last two tables, there is considerable range in the metal-weight for spears of this type. For spear-butts, the socketed types tend to be substantially lighter than the nail-attachment types; the exception to this rule (cat. G89) has an extended square spike base in the manner of a Greek *sauroter* and seems to be an atypical example. Moreover, not all spears may have been fitted with a metal spear-butt, if the rate of preservation at ritual sites is indicative of the relative frequency of spearheads and butts. Lejars notes in a series of graphs that from La

Tène some 269 spearheads were recovered compared to 52 butts; at Gournay-sur-Aronde the figure is 69 spearheads for 53 butts. Only the site of Ribemont-sur-Ancre showed the preservation of butts at a greater rate than spearheads.[64] It is important not to overread this evidence, however. Lejars proposes a number of potential causes for differences in the preservation and recovery of spearheads and butts. Of particular note is his suggestion that the spears in ritual sites, many of which may have been combat spoils, may have been broken and deposited without butts.[65] In reconstructing metal-weights for spears, I have assumed that all spears had metal butts of one type or another. Javelins, discussed in the next section, which gain little from a metal spear-butt, are assumed not to have any.

While there is considerable range for the metal-weights of both spearheads and butts, it is worth noting that preserved examples of both tend to cluster towards the middle and lower ends of that range; most of the heaviest examples seem to be relative outliers. As a result, the median case is likely to be a fair bit closer to the minimum case than the maximum case. The minimum case for a complete spear may thus be set at 125g, representing one of the lighter circular-socket spear-butts combined with a relatively light spearhead. For a median case, iron elements close to the average of the sample in tables above would be around 230g; a 160g spearhead combined with a 70g spear-butt. For the maximum case, a relatively heavy spearhead of the II or V types combined with a nail-and-ferrule spear-butt could be as heavy as 450g.

[64] Lejars (2013), 159-60.

[65] Lejars (2013), 160.

Gallic Javelins

The other key hafted weapon in the Gallic panoply was the javelin. As noted previously, the literary evidence for the use of javelins by Gallic armies is mixed; sometimes javelins are mentioned, but in several cases Gallic armies are said to be without any significant number of ranged weapons.[66] Chronological distinctions may play a role alongside regional ones. Brunaux and Rapin note of the javelin-heads found at Gournay-sur-Aronde that they were substantially more common in Early La Tène, with very few finds in the Middle period.[67] The use of the javelin seems to revive in Late La Tène, possibly motivated by increasing exposure to the Roman army; the Roman *pilum* also begins appearing in Gallic sites in this period.[68] Thus in the period comprising the core of this study, the javelin was a less common weapon, although by no means entirely absent. Javelins could be thrown by hand, but also by way of a throwing strap, in Latin known as an *amentum*; a javelin thrown this way was a *tragula*.[69]

The only metal element for a Gallic javelin appears to have been the tip. Lejars appends javelin tips to Brunaux and Rapin's typology as Group VI, and assigns 12 complete specimens from La Tène to this type; these are shown in Table 6.3 (for typology, note fig. 6.6). The subtype VIb is distinguished from VIa by the much longer socket resulting in a generally greater overall length and weight. Lejars notes that type VI is more common in the Early La Tène period, while VIb occurs mostly at the end of the Middle La Tène and in the Late La Tène

[66] Javelins as part of the panoply: Diodorus 5.30.4. Caes. *B.G.* 1.26; 5.34. Gallic armies unable to retaliate against missile troops, Plb. 2.30.1-4; Liv. 38.21.4.

[67] Brunaux and Rapin (1988), 128. Brunaux and Lambot (1987), 94-5. Lejars (2013), 155-6.

[68] Brunaux and Rapin (1988), 128. Connolly (1981), 118-9.

[69] Caesar *B.G.* 5.35; 5.48.

periods.[70] Following this data, a minimum case may be set at 44g (corresponding to cat. G33). The median case ought to reflect the greater weight of the later type VIb javelin tips, suggesting a median case at c. 200g; this is towards the higher end of the spectrum of weights, but should be taken to reflect more on the javelins of the Late period after the weapon re-emerged into prominence. For a maximum case, the heaviest exemplar (cat. G42) at 269g will serve.

Table 6.3: Javelins from the site of La Tène by Subtype

Cat. No.	Type	Length (cm)	Blade Width	Socket Length (cm)	Mass (g)
G30	VIa	16.8	3.2	7.3	121
G31	VIa	14.0	2.7	6.0	94
G32	VIa	12.0	2.3	5.0	68
G33	VIa	12.5	2.2	5.0	44
G34	VIa	16.4	2.2	8.4	110
G36	VIa	23.7	2.5	13.7	158
G37	VIa	25.5	3.0	8.0	128
G38	VIa	24.0	3.0	8.0	105
G39	VIa	17.3	2.3	10.8	119
G40	VIb	31.5	3.2	20.0	203
G41	VIb	34.8	2.2	22.8	174
G42	VIb	41.1	4.5	20.1	269

The La Tène Sword - Terminology

Unlike most of the swords in this study, no ancient technical term for the Gallic sword comes down to us. Polybius distinguishes the weapons ethnically, merely calling it a “Gallic sword” (ἡ Γαλατικὴ μάχαιρα). The use of the word *machaira* over *xiphos* may be to stress that these swords are cutting rather than thrusting weapons, as Polybius himself is quick to note; he

[70] Lejars (2013), 156.

quite clearly cannot mean that it was curved.[71] Livy follows this usage in Latin, referring to Gallic swords as *gladii* or *arma* with an added ethnic signifier when necessary.[72]

Likewise, the modern scholarship has settled on no specific term for this sword. English language scholars sometimes refer to the weapons as 'longswords,' but this usage is deceptive and unhelpful, as it implies an analogy between two very different weapons. The term 'longsword' as a typological distinction typically refers to a Late Medieval two-handed sword emerging in Europe c. 1350 (sometimes also called a 'bastard sword').[73] This later medieval sword, however, is very different from a Gallic sword; the former is a dedicated two-handed sword with a blade typically around 100cm in length, while the latter is a one-handed sword with a substantially shorter blade.[74] The French-language scholarship more often avoids attaching a technical term to these weapons.[75] In German, Peter Stary refers to Gallic swords as *die Latèneschwerter*.[76] I follow this German usage in English, referring to this weapon-type as 'La Tène swords,' which has the advantage of specificity without the unhelpful imprecision of the

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[71] Plb. 2.30.8, 3.114.1-3.

[72] Liv. 7.10.8-10; 22.46.5.

[73] Middle and Late La Tène swords referred to as longswords, e.g. R. Pleiner, *The Celtic Sword* (Oxford: Clarendon Press, 1993). I. M. Stead, *British Iron Age Swords and Scabbards* (London: British Museum Press, 2006), 9. The 'longsword' commonly understood corresponds to Oakeshott types XIIa, XIIIa, XVa, XVIa, XVII, XVIIIb and XVIIIc. E. Oakeshott, *The Sword in the Age of Chivalry* (London: Lutterworth Press, 1964); E. Oakeshott, *The Archaeology of Weapons: Arms and Armour from Prehistory to the Age of Chivalry* (Woodbridge: Boydell Press, 1960).

[74] The one-handed nature of the La Tène sword is exemplified by the short length of the sword's tang, which tends to be c. 15cm, providing a grip long enough to be held by just one hand. Two-handed swords typically feature much longer hilts.

[75] E.g. Brunaux and Lambot, (1987), 85. T. Lejars, *La Tène: La collection Schwab (Bienne, Suisse). La Tène, un site, un mythe 3.* (Lausanne: Cahiers d'archéologie romande, 2013), 91-2. Both use the non-technical *l'épée* to denote a sword of no particular type.

[76] P. F. Stary, *Zur eisenzeitlichen Bewaffnung und Kampfesweise auf der Iberischen Halbinsel* (Berlin: Walter de Gruyter, 1994), 122-6.

term 'longsword.' Where relevant, the term may be modified by a period-marker, e.g. 'Middle La Tène sword' to denote a sword of the style of the Middle La Tène period.

The La Tène Sword – Typology and Reconstruction

The La Tène swords of the third and second centuries evolved out of the early La Tène sword types. Swords of the early period (c. 500-300) tend to be significantly shorter, with a stronger taper and sharper thrusting points.[77] During the Middle La Tène period (c. 300-125), swords tended to become longer, with a less pronounced taper eventually giving way to parallel edges and an increasingly rounded tip. In the Late La Tène period (c. 125-1), these trends are accentuated, particular with the increasing absence of a pointed tip on the swords (fig. 6.10).[78] Of these groups, it is the Middle La Tène period, covering the third and second centuries, that is most relevant to the present study. The loss of taper, increase in length and eventual loss of the tip all suggest a steady shift from an emphasis on the thrust towards an emphasis on the cut; Middle and Late La Tène swords had a shape extremely well adapted for powerful cutting strokes, but increasingly poorly suited to the thrust. La Tène swords were made exclusively in iron and steel; indeed, the greater strength of iron was required to enable the longer, cut-oriented design.

The structure of a Middle La Tène sword was relatively simple (fig. 6.11). The sword typically had a long blade (60-75cm), with parallel edges that tapered to a point only towards the tip. A small metal guard (or *croisière*) divides the blade from the hilt. This guard hugs the

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[77] A sword 'taper' is the degree to which it narrows to a point over the blade. A sword with a strong taper has a blade that is essentially an elongated triangle, while a sword with little taper will have the edges of the blade running nearly parallel to each other. A tapered blade is thus the opposite of a parallel-edged one.

[78] Brunaux and Lambot (1987), 120. Pleiner (1993), 4-5. de Navarro, (1972), 17-33. Note also Stead (2006)1-2, 9, on the chronology of these sword-types in Britain. Stead's chronology largely mirrors the pattern on the continent.

shoulders of the blade; they in turn shape to the wooden guard which would have protected the hand (fig. 6.12). The tang itself is typically square in section and ends with a disc-button which serves to fix the hilt to the sword. While the point of the La Tène sword is beginning to fade in the Middle La Tène period, most swords at this time still retained a point and were thus capable of thrusting.[79]

The comparatively numerous preserved examples also makes it relatively straight-forward to estimate the normal metal-weight of these sword-types. Table 6.4 shows measurements, including masses, for 29 examples of this type. The masses for these swords tend to cluster between 500 and 650g, with just a handful of outliers. It should be noted that some of the heaviest examples (cat. G3, G18, G9, G8, G10), were measured with their sheaths; some are so badly rusted that the sheaths cannot be removed. Lejars notes the average mass of the sheaths in the Bienne collection as 267g, with the heaviest example at 526g; so the sheaths included in these measurements may add considerable mass, although in several cases the sheath is

[79] Pleiner (1993), 62-3.

Table 6.4: Middle La Tène Swords, by preserved length (r. = reconstructed)

Cat. No.	Total Length (cm)	Blade Length (cm)	Max Blade Width (cm)	Mass (g)	Notes
I26	70.2		4.2	410	Iberian; find location: Cerro de las Cabezas
G19	73.9	59.2	4.45	448	British; find location: River Thames
G18	75.4	61.2	6.1	1225	Massed with sheath, ring suspension
G16	77.7		3.65	410	
G3	78.2	63.8	4.1	695	Rusted into sheath
G12	79.2 (r. 82.6)	64.0	4.7	642	
G19	79.5	72.6	3.7	480	
G21	79.5	64.2	4.1	437.6	Blade is in two fragments. Possibly pattern-welded.
G23	79.5	65.5	5.1	574	
G2	79.7	63.6	4.1	490	Point lost
G5	79.9	65.1	3.95	472	
G22	80.5	64.9	4.0	497	
G9	81.0	64.3	3.7	840	Rusted into sheath
G4	81.6	66.5	4.57	594	
G24	81.6	64.9	4.7	575	
G15	81.9	65.6	5.02	607.5	
G28	82.5	65.2	4.8	643.1	
G13	83.2	66.8	4.6	636	
G29	83.4	67.7	3.9	549	
G27	84.3	66.4	4.4	662.3	
G14	85.0	67.9	4.9	661	Possibly pattern-welded
G7	85.8	68.9	4.11	500	Possibly pattern-welded
G8	85.8	69.3	3.7	813	Rusted into sheath
G6	86.4	71.3	4.05	577	
G10	86.5 (r. 87.0)	69.8	4.3	1003	Massed with sheath, Possibly pattern-welded
G11	87.8	72.2	3.88	578	Possibly pattern-welded
G26	88.2	72.8	4.2	578.3	
G20	89	72.9	3.8	530	Tip missing (c. 1cm)
G25	90.7	75.1	4.0	531	

incompletely preserved.[80] That said, the data in the table suggests a maximum case metal-weight of roughly 700g, a median case of 610g (representing the largest cluster of masses), and a minimum case of roughly 425g.

The La Tène Sword: Battlefield Characteristics

The Greek historical tradition preserves an impression of the poor quality of La Tène swords, that does not entirely accord with the archaeological evidence.[81] This poor reputation first appears in Polybius, who notes in the context of the Battle of Telamon that Gallic swords would bend after the first stroke and need to be bent back into shape.[82] The same report is repeated subsequently by Plutarch and Polyaenus, with Polybius as their likely inspiration.[83] Subsequent metallographic examinations of La Tène swords has produced a more complex picture. Radomír Pleiner, combining his own metallographic examinations with the broader literature, assembled a sample base of 122 swords.[84] Quality within this sample varied widely; 36% of the examined swords consisted entirely of softer iron, and Pleiner suggests that around 40% of the sample were of inferior quality generally. However, 40.3% of swords examined in full cross-section had steel edges, and a smaller subset of these weapons show more complex

[80] Lejars (2013), 113.

[81] On this generally, see Pleiner (1993), 157-164.

[82] Plb. 2.33.3.

[83] Plut. *Cam*. 41.4. Polyaenus, *Strat*. 8.72.

[84] Pleiner (1993). Note also J. M. de Navarro, *The Finds from the Site of La Tène: Volume I, Scabbards and the Swords Found in Them* (London: Oxford University Press, 1972).

pattern-welding.[85] Pattern-welding can leave a 'streaky' or 'fibrous' appearance on a blade when it is polished; this can offer a hint to the metallurgical quality of blades which have not been metallographically examined; I have noted in Table 6.4 instances where blades in the sample are reported to have streaky or fibrous appearance. However, it must be noted that it is possible to produce this appearance on a blade during manufacture without true pattern-welding, so that an inferior blade might appear as a high-quality pattern-welded one.[86]

Any attempt to extrapolate from Pleiner's data to a ratio of superior to inferior swords in Gallic armies is not without problems. Most notably, there is no reason to suppose that the preserved archaeological sample is representative. Given that the majority of recovered La Tène swords come from either burial or ritual deposit contexts, it falls to reason that preservation may disproportionately favor high quality weapons. In that case, we might expect the prevalence of inferior weapons among poorer Gallic warriors to be potentially quite high, though impossible to estimate with precision. Nevertheless, as Pleiner notes, Polybius' characterization of Gallic swords as being of poor metallurgical quality and of dubious usefulness as cutting weapons on the battlefield must be rejected as an over-dramatization.[87] It is possible that Polybius' anecdote about swords bent so badly that they needed to be straightened mid-combat may owe something to a misinterpretation of the tendency, observed in the archaeological evidence, for swords to be heavily bent prior to ritual deposit; this practice appears to be unrelated to battle damage.[88]

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[85] Pleiner (1993), 79-167. Pleiner notes regional variations as well; the highest quality swords in the sample came from Northern Italy and Southern Germany. A set of swords from sites in the Czech Republic and Slovakia showed the odd regional variation of having only one steel edge, with the other made of soft iron.

[86] de Navarro (1972), vii.

[87] Pleiner (1993), 168.

[88] Plb. 2.33.3. Pleiner (1993), 158. S. Reinach, "L'épée den Brennus," *L'Anthropologie* 17 (1906): 343-356. *Contra* Reinach, Walbank (1957), 209, who considers Polybius' story a soldier's fabrication told to and then

The shape and function of La Tène swords may have proved more of a liability than their metal composition. Ancient descriptions of these swords, most notably by Polybius and Livy, stress their utility at cutting but relative inability to thrust effectively.[89] It is possible to overstate this point; most Middle La Tène swords, properly sharpened, would have been able to thrust into an unarmored opponent. While swords of this period increasingly feature a rounded tip (e.g. cat. G25, G26, fig. 6.13), these tips seem to have been sharp (that is, the edge was ground to sharpness, rather than that the tip was drawn to a point), rather than blunt.[90] Such a point would, however, have been far less effective at thrusting through armor, particularly mail. As discussed with 'bodkin' style spearpoints in both Roman and Gallic contexts, the key to defeating mail is in concentrating force on the inside of a single ring in order to burst it open. This a rounded point cannot do. A mailed warrior, either a Roman soldier or a Gallic elite, would have been very well protected from a La Tène sword, which could neither cut through his mail nor thrust through it. In assessing this apparent design failure, it is important to remember that weapons evolve based on the pressure exerted by long-term security threats. The primary threat to a Gallic warrior was, most of the time, another Gallic warrior; as noted above, both were likely to be unarmored or lightly armored. In that context, a rounded point, which allowed for more mass to be focused at the point of percussion and thus favored the cut, makes battlefield sense. Against a Roman army of increasingly mail-armored soldiers, however, this feature became a critical design flaw; most Gallic warriors carried a sword which would have likely struggled to defeat Roman mail armor.

repeated by the historian. On ritual deposits of military equipment, often intentionally damaged, bent or destroyed, see Brunaux and Lambot (1987), 41; Brunaux and Rapin (1988), 47-54.

[89] E.g. Plb. 2.30.8, 33.5. Liv. 7.10.9-10. Plut. *Cam*. 40.3. Dion. 14.9.13.

[90] Pleiner (1993), 62-3.

Gallic Oval Shield

The typical Gallic oval shield was closely related to the Roman *scutum* and may have been the direct predecessor of the Greek *thureos*; as such, it shares most of the basic design elements of these shields (fig. 6.14). The basic structure of the shield consists of an oval-shaped flat wooden core with a gap in the center for the hand. Over this gap was laid the *spina*, a wooden ridge down the center of the front the shield, with a bulge to cover the grip gap. This construction was covered with a thin layer of hide or parchment to protect the wooden core. It was then held together by the attachment of a metal boss, and possibly metal rims on the top and bottom of the shield, as well as a leather binding around the entire rim of the shield. The boss, which covers the front-face of the central bulge of the *spina*, is riveted through the shield to connect with the maniple, the metal bar that anchors the handgrip, on the opposite side. The boss, by pressing the core, grip and *spina* together tightly, adds strength to the structure of the shield.[91]

Polybius and Livy report that the Gallic shield was not large enough to cover the entire body.[92] Diodorus seems to contradict this claim, reporting that Gallic shields were as tall as a man.[93] The archaeological and representational evidence confirms the former report; several shields recovered from La Tène seem to be somewhat smaller than the Roman *scutum*, though larger than a Greek *thureos*.[94] The most intact shield recovered from La Tène (cat. G114) measured 110cm long, and 50.7cm wide; the original width is estimated to have been between 52

[91] Structure of the Gallic shield: Brunaux and Rapin (1988), 13-27. Brunaux and Lambot (1987), 97-101. Lejars (2013), 162-165. Deyber (2009), 287-296. Connolly (1981), 119-120.

[92] Plb. 2.30.3. Liv. 38.21.4.

[93] Diodorus 5.30.2.

[94] Connolly (1981), 119.

and 54cm.[95] This conforms well with the representational evidence, such as the size of the shield of the Mondragon warrior, which rests on the ground and comes up to the figure's chest (fig. 6.3).[96] Analysis of the wood remains of the recovered La Tène shield (cat. G114) by Patrick Gassmann suggests that it was constructed out of a pair of flat wooden planks, rather than the multi-layered 'plywood' construction of the Roman *scutum*.[97] The Gallic shield, as Polybius and Livy note, provides less protection, especially from missile weapons, than the Roman *scutum*, as the lack of a curve to the shield means that the bearer cannot put his entire body into the dish of the shield.[98] However, it would have been lighter and easier to handle; Connolly estimated 6-7kg of mass for the entire Gallic shield (including wooden and leather elements), compared to 10kg for the *scutum*.[99]

The primary metal component of the shield is the boss, which consists of a curved metal hull spanning the ridge of the *spina* and a pair of 'wings' into which the rivets binding the shield together are driven. Working from the large number of preserved bosses at the sanctuary at Gournay-sur-Aronde, Brunaux and Rapin have established a morphological chronology for the

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[95] Lejars (2013), 163. P. Gassmann, "Nouvelle approche concernant les datations dendrochonologiques du site éponyme de La Tène (Marin-Epagnier, Suisse)" *Annual Review of Swiss Archaeology* 90 (2007): 75-88.

[96] Lejars (2013), 163. For a more extensive discussion of the representational evidence, see Brunaux and Rapin (1988), 16-27; Connolly (1981), 118-120.

[97] Gassmann (2007), 80-82. Cf. the construction of the *scutum* described by Polybius, Plb. 6.23.3, where ἐκ διπλοῦ σανιδώματος ταυροκόλλῃ πεπηγώς should be taken to read "[it is made] from two layers of wood laminated together with bull's hide glue" rather than, as in Paton's translation, "made of two planks glued together." Bishop and Coulston (2006), 61-62.

[98] Plb. 2.30.3. Liv. 38.21.4.

[99] Connolly (1981), 119.

boss (fig. 6.15), defined primarily from the shape of its 'wings' or flanges.[100] The most consistent shape, in use across nearly the entire period, is the rectangular-winged boss (type I). A set of smaller boss-types (types II, III and IV) emerges in the fourth century, but largely disappears by the mid-second century; these types generally shorten the wings or round-off the corners, making them rather smaller. Finally, a number of larger boss-types (V, VI and VII) come into use in the second century; the last of these types eventually seems to evolve into the round Gallic bosses found at mid-first century sites like Alesia.[101]

While the bosses from Gournay-sur-Aronde were published without weights, the bosses from La Tène in the Schwab Collection have been weighed and published, as have a pair of intact bosses from the British Museum. These are listed below in Table 6.5, sorted by type according to the Brunaux and Rapin typology. More detailed measurements of these bosses, such as the height or length of the wings, are listed in the catalog. Many of the bosses from La Tène were poorly preserved. Where the original size of the boss can be reasonably ascertained, I have given my estimate for the original dimensions, as well as an estimate of the original mass based on the mass of the preserved elements. The maniple (the hand-bar) is not included in these figures unless noted.

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[100] Brunaux and Rapin (1988), 79-84. Lejars (2013), 165-168, offers an alternate typology in only two groups based on whether the boss has rectangular or trapezoidal wings; I have opted to use Brunaux and Rapin's more detailed typology.

[101] Bosses at Alesia, note Redde, (1996), 70.

Table 6.5: Gallic Shield Bosses by Type.

Cat. No.	Type	Length (cm)	Hull height (cm)	Mass (g)	Damage?
G100	I	22.5		335	Juncture between wing and hull restored with plaster
G105	I (II?)	35.1	10.0	217	Complete, with two rivets.
G99	II	20.3	12.2	298	Fragments, restored with plaster
G101	V	27.4(p) c. 32(r)	11.0	174 (p) c. 300 (r)	One wing and hull missing; maniple still attached by a rivet. Maniple included in measurements
G102	V	26.4	10.8	195.6	Complete, with two rivets.
G103	V	29.0	8.2	197	Complete, with two rivets
G104	V	20.8 (p) c. 30 (r)	10.3	180 (p) c. 225 (r)	One wing missing, large crack on the hull, one rivet preserved.
G106	?	11.7 (p)	10.2	167 (p)	Only the hull remains, both wings lost

Note: *p* indicates preserved measurements; *r* indicates reconstructed estimates.

In accounting for Gallic shield boss types, some allowance must also be made for the smallest and largest types (III/IV and VI), which are not represented in this sample. As noted, type III and IV bosses can be significantly smaller than the examples listed in the table. One of the smallest finds, a type IIIa boss from Gournay-sur-Aronde (cat. G95), is only 4.2cm high and c. 15.25cm long; accounting for the curve of the hull, the original unbent iron band, if flattened out, would have been c. 18cm.[102] At an average thickness of 1mm, the mass of a flat iron plate of that size would be only c. 70g.[103] On the other hand, the type VI boss is defined by having wings that stretch nearly the entire width of the shield; at Gournay, these were recovered only in fragments.[104] One such example (cat. G96) is listed with a hull height of 13.8cm; one wing is

[102] Brunaux and Rapin (1988), 174, cat. n˚ 755. Brunaux and Rapin only list a single measurement, either the height of the hull or the length, for each boss; the remaining measurements for the Gournay bosses I have taken from the scale drawing and are marked with a 'c.' to indicate they are only approximations.

[103] This and subsequent estimates of the mass of Gournay-sur-Aronde bosses are only approximations; absent detailed measurements, full reconstruction can only give a false impression of certainty.

[104] Brunaux and Rapin (1988), 81-2, cat. n˚ 2706-7, 3242.

broken off and the hull has a large hole in the center. However, judging by the intact wing, the original boss would have been perhaps c. 47.5cm long and might have massed c. 550-600g.[105]

The boss was riveted through to a maniple, the bar that provided the structural strength to the grip of the shield and served to bind it together.[106] This component, consisting of a metal bar (the 'stem') with disc-shaped extensions (the 'flanges') at either end for the rivets, is generally quite light, as can be seen on Table 6.6; all of these maniples are from the site of La Tène.[107] The flanges of these maniples range from fairly simple disc or hemisphere shapes (e.g. cat. G108, G109), to more complex or decorative shapes (e.g. G111, G112).

Table 6.6: Gallic Shield Maniples from the site of La Tène by mass

Cat. No.	Length (cm)	Stem Length (cm)	Stem width (cm)	Flange Width (cm)	Mass (g)	Notes
G109	12.5	9.1	0.6	3.2/3.3	6.3	Minor damage to flanges.
G112	12.8 (p) 13.0 (r)	9.6	0.9	5.6	8.16	Incomplete, roughly half of one flange is missing
G107	15.2	10.4	0.8	3.7/3.8	10.9	Complete.
G108	13.9	10.5	0.5	5.2/5.7	14.1	Complete.
G110	14.3	10.2	0.5	7.0/7.5	15.9	Minor damage to flanges
G111	15.2	10.4	0.8	3.7/3.8	18.9	Complete
G113	16.3	11.5	0.9	2.7/3.0	24.5g	Complete

Note: *p* indicates preserved measurements; *r* indicates reconstructed estimates.

[105] Calculating both wings as flat metal sheets (18.5cm x 13.8cm x 1mm) in iron gives a mass of c. 400g; the hull might add another 150-200g, cf. cat. G106 on Table 6.5. It is possible that such a large boss would be made thinner in the wings to avoid excessive weight; Brunaux and Rapin (1988) provide no thickness measurements for any individual boss, so this must remain speculation.

[106] In the case of a plywood shield (like the Roman *scutum*), the riveted construction serves to press the plywood layers together. For plank construction (like the La Tène shields), the same construction serves to press the wood-joins together.

[107] Lejars (2013).

The final metal element attributed to the Gallic shield is a metal rim, covering the top and bottom curve of the shield.[108] Unlike for the Roman *scutum*, however, ancient sources describing the Gallic shield do not explicitly mention an iron rim. This may simply be a consequence of the level of detail in the sources; no description of the Gallic shield is as thorough as Polybius' description of the *scutum*, so it is possible that the fairly minor point of metal rims simply escaped notice.[109] No metal rim survives on the dredged shield from La Tène, nor any trace of rivet holes, although this may simply be because those parts of the wooden planking are not preserved.[110] I am not aware of any finds of metal strips that have been identified as Gallic shield rims.[111]

The representational evidence also seems to offer little help. The Mondragon Warrior's shield (fig. 6.3) shows no trace of a rim at all, while many depictions of Gallic shields such as those on the Gundestrup Cauldron (fig. 6.4), or the Pergamum frieze (shown in the previous chapter, fig. 5.19), show a wide rim along the entire curve of the shield; this should be understood as a leather binding, rather than a metal one.[112] As a result, there is no clear evidence for metal rims on any Gallic shield, apart from the assumption that, being very similar to the Roman *scutum*, it would have this structural element too. However, it is important to point out that one of the key functions of the metal rim, preventing the delamination of the shield, would

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[108] This rim is routinely included in artistic reconstructions of the shield, such as Brunaux and Rapin (1988), 12-13.

[109] Cf. Polybius on the *scutum*, Plb. 6.23.2-5, with sources for the Gallic shield, e.g. Diodorus 5.30.2; Plb. 2.30.3-8, 3.114.1; Liv. 7.10.8-11; 22.46.5; 38.21.4. However, it is worth noting that adding metal rims to Roman shields is presented as an innovation, rather than an adaptation, Plut. *Cam*. 40.4.

[110] Gassmann (2007), 80.

[111] Note that this is true also for Roman *scuta* from the Republic; metal reinforced shield rims from the imperial period are known however, see ch. 4.

[112] The wide binding strip around the edge of the shield is a common appearance, see Brunaux and Rapin (1988), 25; Brunaux and Rapin also consider this to be likely a leather binding strip, rather than metal.

potentially not be as necessary in a shield constructed from a pair of metal planks joined together, as was the method used on the recovered La Tène shield. Comparatively speaking, late Anglo-Saxon and Viking shields, which also used plank construction, albeit with a larger number of smaller parallel planks, do not generally have metal rims either.[113] It seems prudent to exclude a metal rim from the minimum and median case for these shields, as it does not seem to have been a common structural element. For the maximum case, a metal rim over the top and bottom will be included, because some Gallic elites may have at least thought to copy it from the Romans, assuming the idea had not existed indigenously.

The minimum case for the metal-weight of the Gallic shield may then be set as low as c. 85g, representing a smaller, type III boss and a similarly minimal maniple, with no rim. The median case is significantly more substantial at c. 220g, representing a heavier type I or V boss at c. 200g and a more complex maniple at c. 20g. Finally, the maximum case is metal heavy indeed at perhaps 700g, representing a shield with metal rims on the top and bottom and a larger type VI metal boss (which in turn requires a longer maniple).[114] As with offensive Gallic weapons, there is a tremendous range between the most and least resource-intensive variants, a trend which proves to be even more pronounced with armor.

[113] T. Dickinson and H. Härke, *Early Anglo-Saxon Shields* (London: Society of Antiquaries of London, 1992), 29-30, 52. Perhaps the most famous such shield, the Sutton Hoo shield, was found with copper-alloy bands which may have been a shield rim, but this is exceptional; the majority of such shields show no signs of having this sort of reinforcement.

[114] 550g for the boss; 120g for two rims (on this calculation, see ch 4), and 30g for the maniple (roughly double the mass of cat. G108 and G110).

Gallic Armor

Prevalence

The limited use of armor by the Gauls at first seems paradoxical; the heaviest Roman defensive wear of this period derives from Gallic armor and helmet types, yet Gallic peoples themselves often fought unarmored and occasionally nude. Varro notes that the Roman mail armor, the *lorica hamata*, was of Gallic origin, and the archaeological evidence seems to confirm this.[115] Mail finds are rare, both because such armor seems to have been the preserve of the elite, but also because mail, by its nature, tends to be preserved at lower rates. In particular, mail armor is readily repairable, with broken rings merely needing to be replaced or repaired. Mail is also readily transferable or inheritable, as it does not need to be, and indeed should not be, close fitting to the body.[116] Finally the thin rings of mail armor, produced in iron, are very vulnerable to rust; mail is often found in 'concretions' of rings rusted together.[117] Nevertheless, mail finds do occur in Gallic contexts from an early date. Notably, the Ciumești warrior-burial, has been dated by the other materials in the deposit to Late La Tène I (c. 300).[118] Remarkably, mail armor even reached Britain at a fairly early date; a nearly full shirt of abutted mail armor was found in Kirkburn dated to late in the La Tène I period.[119] In contrast, as discussed in chapter four, the earliest clear representational evidence or archaeological evidence for Roman mail armor (the

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[115] Varro, *De Ling. Lat*. 5.116.

[116] Note, for instance, the ease with which Hannibal's troops repaired and reused Roman mail, Plb. 3.114.1.

[117] See Chapter 4 for a discussion of Roman mail finds in concretions.

[118] M. Rusu, "Das Keltische Fürstengrab von Ciumeşti in Rumänien" *Bericht der Römisch-Germanischen Kommission*, 50 (1969): 267-297.

[119] I. M. Stead, *Iron Age Cemeteries in East Yorkshire: Excavations at Burton Fleming, Rudston, Garton-on-the-Wolds and Kirkburn* (London: English Heritage, 1991), 55-6.

Pydna monument and the ring finds at Numantia, respectively) come from the second century. Literary sources place the presence of the armor somewhat earlier, perhaps in the late third century, but still far later than the evidence for the armor in the Gallic world. Likewise, the Roman copper-alloy Montefortino helmet was itself an Italian variation on, and development from, the Gallic iron Montefortino-type.[120]

Despite this array of advanced defensive options, the average Gallic warrior appears to have had very limited protection beyond his shield. References to effective Gallic defensive wear in the sources are very few. Plutarch notes that the Gallic king slain by Marcellus at Clastidium (222) wore a brilliant set of armor (πανοπλία) of an undisclosed type.[121] Lucian the Sophist has Antiochus relate a battle-order in which the Galatian front-rank (supposedly out of 24 ranks) was bronze-armored; little credibility can be placed in such a report, save that it was a commonplace that most Galatians fought unarmored.[122] Diodorus mentions mail armor in his description of the Gallic panoply, but contrasts it with Gallic warriors fighting nude.[123] At Telamon (225), Polybius notes that the bulk of the Gallic force is protected only by cloaks (σάγοι) and trousers (ἀναξυρίδες); that these garments reportedly provided meaningful protection from javelins may suggest an intentional textile defense, but this is still far short of the protection offered by mail.[124]

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[120] U. Schaaff, "Keltische Eisenhelme aus vorrömischer Zeit" *Jahrbuch des Römisch-Germanischen Zentralmuseums* 21 (1974): 149-204. Feugere (1994), 37.

[121] Plut. *Marcellus* 8.

[122] Lucian *Zeux*. 8.

[123] Diodorus 5.30.3.

[124] Plb. 2.30.1.

Nevertheless, the great preponderance of the evidence suggests that the average Gallic warrior was quite lightly armored.[125] The comparison of more heavily armored and thus 'rational' Romans with the less heavily armored, 'irrational' Gauls was itself a literary commonplace.[126] Moreover, as noted previously, the battle narratives surviving in the literary evidence often either explicitly or implicitly note the lightly armored nature of most Gallic infantry.[127] The repeated motif of the upward Roman thrust into the belly of a Gallic foe itself assumes a lack of protection on a part of the body that, for a Greek or Roman soldier, would likely have been armored.[128] The evidence from burial deposits follows this implication; even among burials already including weapons, helmet finds are uncommon and mail cuirass finds are exceedingly rare.[129] Leather and textile protections, particularly for the head, have been suggested to fill this apparent gap in preservation; such head coverings would not be preserved archaeologically.[130] The helmets of the infantry on the Gundestrup cauldron feature a similar pattern to their body-wear, perhaps suggesting a non-metal head protection; the metal helmets of the cavalry above them are clearly of a different material.[131] On the other hand, the otherwise

[125] Connolly (1981), 125-6. Brunaux and Lambot (1987), 106-8. Brunaux (2004), 56-7. Deyber (2009), 282-7.

[126] E.g. Dionysius 14.9-10; Liv. 7.10.7-10, 10.29.2; App. *Gal*. 6.

[127] Plb. 2.30.8. Liv. 10.29.6-7, 22.46.5, 38.21.4.

[128] E.g. Dionysius 14.10. Liv 7.10.10.

[129] Pleiner (1993), 46-58. Compared to a sample of 297 weapon burials, Pleiner presents only 33 burials with helmets (all of which contained at least one spear or sword), only one of which (the Ciumeşti burial already mentioned) contained a cuirass. Indeed, of the 105 burials presented in detail by Pleiner, the Ciumeşti burial remains the only burial containing a cuirass of any kind, in this case of mail.

[130] Brunaux and Lambot (1987), 106-7. Deyber (2009), 285-6.

[131] Cf. the find of a decorated metal helmet at Ciumeşti, Rusu (1969), which is nearly a perfect match for the helmet of the lead cavalryman.

naked warrior on the Braganza Brooch (British Museum 2001,0501.1, fig. 6.16) wears a Montefortino style helmet, albeit apparently without cheek-guards.[132]

Despite the prominence of naked Gallic warriors in the literary evidence, this seems to have been a relatively unusual fighting style, even for the Gauls. Diodorus notes that some Gauls fought nude while others fought armored; later in the same passage on military equipment he notes that some Gauls "gather up their shirts with belts plated with gold or silver," suggesting that the Gauls also fought clothed but unarmored.[133] Dionysius has Camillus describe Gallic warriors as entirely nude without exception, but this description, placed in context of a distant and highly mythologized event, can hardly be considered reliable save that it was well known that some Gauls fought nude.[134] Reports of nude warriors in specific battles are exceedingly few. Of the four Gallic peoples at Telamon, only the Gaesatae are reported as having fought nude.[135] Polybius also reports that the Gauls in Hannibal's army at Cannae were naked (γυμνός), but Livy adjusts this report, while clearly relying on Polybius, to say merely that the Gauls were naked (*nudus*) from the navel up (*super umbilicum*); in either case, they are clearly unarmored, as are the Spanish mercenaries they are deployed with.[136] Caesar's remark that the German Suebi trained to withstand a cold climate nude, sometimes presented as more evidence for nude Gallic warfare, should be taken as the opposite; Caesar specifies clearly that the Suebi are

[132] The brooch: British Museum 2001,0501.1. F. Quesada Sanz, "The Braganza Brooch warrior and his weapons: the Peninsular context" in *La Fíbula Braganza*, ed. A. Perea (Madrid: Ediciones Polifemo, 2011), 137-156. Note that the warrior here is probably best understood as Celt-Iberian, rather than Gallic, as discussed below.

[133] Diodorus 5.29.2, 5.30.3. τινὲς δὲ τοὺς χιτῶνας ἐπιχρύσοις ἢ καταργύροις ζωστῆρσι συνέζωνται.

[134] Dionysius 14.9.2.

[135] Plb. 2.28.4-8. The other tribes present were the Insubres, Boii and Taurisci.

[136] Plb. 3.114.4. Liv. 22.46.6.

Germans rather than Gauls. Moreover, the training described is in peacetime, rather than a description of battlefield dress.[137] Caesar presents this activity as unique to the Suebi, part of what makes them "the most warlike" (*bellicosissima*) of the Germans. If this were common practice in Gaul, it would hardly be worth comment in this context.

Representational evidence from the Greek and Roman world favors depicting the Gallic warrior as nude, particularly in the context of the 'dying Gaul' motif, but in assessing actual practice among Gallic peoples, these depictions are less useful. Depictions of nude warriors in Gallic artwork are uncommon, but not entirely unheard of. A fifth century Hallstatt scabbard depicting a military procession (fig. 6.17) shows three infantrymen with oval shields. The shields obscure most of the body, but the apparently uncovered chests of two warriors can be seen above the rim of their shields; in contrast, the mounted warriors in the procession are clearly shown as armored, with what may be a quilted textile armor.[138] The Braganza Brooch (fig. 6.16) has also been taken to be a depiction of a naked warrior with La Tène material culture weapons. However, the brooch itself is a mix of La Tène, Iberian and Greek stylistic elements.[139] Moreover, Quesada Sanz argues that the warrior in question is more likely Iberian or Celtiberian than Gallic.[140] However, the vertical alignment of the sword and lack of a baldric, along with the presence of a belt, suggest the more complex suspension system of a Gallic, rather than Iberian, sword scabbard. Even if the warrior carrying those weapons and fighting in the nude is

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[137] Caesar *B.G.* 4.1.

[138] J.-L. Brunaux, *Les Gaulois: Sanctuaires et rites*, (Paris: Editions Errance, 1986), 107.

[139] D. Williams, "The Braganza Gold Brooch: its maker, iconography and use" in *La fibula Braganza*, ed. Alicia Perea (Madrid: Ediciones Polifemo, 2011), 127-135.

[140] F. Quesada Sanz, "The Braganza Brooch Warrior and his Weapons" in *La fibula Braganza*, ed. Alicia Perea (Madrid: Ediciones Polifemo, 2011), 137-156.

ostensibly Spanish, he is still depicted fighting as a nude Gallic warrior, providing additional confirmation that such warriors did exist. Nevertheless, as Dyfri Williams notes, the depiction of a warrior in the nude like this is unusual for artwork from Spain or Gaul.[141] Nude Gallic warriors, while existing in Gallic art, are thus distinctly uncommon, which may suggest that the prevalence of this type of war-dress (or lack thereof) may have been overemphasized by Greek and Roman sources.

In order to account for this vast range in armor-use, I propose three scenarios for calculating reconstructed metal weights. The first, a mailed warrior with a helmet, corresponds to the best equipped Gallic warriors and should be taken as perhaps typical for the upper-end of the Gallic elite. The next scenario, a warrior wearing no mail, but with a metal helmet, corresponding to most reconstructions for common Gallic warriors, but in practice most applicable to the well-to-do Gallic warrior, given how rare helmets seem to be in the La Tène archaeological record. The final scenario is a warrior with neither armor nor helmet, corresponding to the poorest Gauls. In each instance the warriors carry the same weapons, a shield, a sword and either a thrusting spear or javelins.

Mail Armor

The basic form of mail armor has been discussed in chapter four; because the Romans imported Gallic mail armor as the basis for the *lorica hamata*, the form remains essentially the same. Some of the representational evidence for this armor in Gallic contexts, such as the Vacheres warrior (fig. 4.28), have already been discussed as well. Gallic mail armor consisted of a tunic of mail, stretching to the knees, typically with an additional layer of mail shoulder-doubling to provide extra protection to the shoulders from downward cuts.

[141] Williams (2011), 127.

Recovered Gallic mail does seem to show a greater diversity in design and construction than Roman mail. While nearly all European mail armor in any period, including all recovered Roman mail armor fragments, follows the four-in-one link pattern (in which each ring is linked to four others), a fragment of Gallic mail recovered from Tiefenau (cat. G117) has the rings joined in a six-in-one pattern.[142] While the majority of mail armor alternates riveted and solid rings, both the Ciumeşti armor rings (cat. G115) and the Yorkshire mail coat (cat. G116) have rings which are end-abutted.[143] This construction would allow for much faster assembly of the armor, but significantly reduce the protective value because a thrust could more easily split the rings to penetrate through. The Yorkshire coat is also unusual in the overall style. As noted in chapter four, the normal configuration of mail armor in this period, both Gallic and Roman, was to add an additional layer of protection over the shoulders. Instead, Ian Stead notes that the shoulders of the Yorkshire coat hold up the armor and that the coat otherwise lacks sleeves, which is to say that it is constructed in a similar style to the tube-and-yoke construction of the Greek *linothorax*.[144]

Likewise, the size of the rings in Gallic armor is also substantially more variable than comparable Roman examples from the Republic or the early Empire. The Ciumeşti rings (cat. G115) came in two fragments, the first of which had a wire thickness ranging from 0.8 to 1.8mm and a ring diameter between 8.5mm and 9.2mm. The second fragment, apparently part of the same armor, was significantly finer, with a wire-thickness of 1.2-1.4mm and ring diameter

[142] F. Müller, "Das Fragment eines keltischen Kettenpanzers von Tiefenau bei Bern" *Archäologie der Schweiz*, 9 (1986), 116-123. Müller, unfortunately, does not provide a diagram of the link-pattern beyond this description and it is difficult to see the exact link pattern from the images he does include.

[143]M. Rusu, "Das Keltische Fürstengrab von Ciumeşti in Rumänien," *Bericht der Römisch-Germanischen Kommission*, 50 (1969): 267-297. Stead, (1991), 54-7.

[144] Stead (1991), 54-7.

between 7.2 and 7.5mm.[145] The wire thickness of the Yorkshire mail coat (cat. G116) ranges from 1.5 to 1.9mm, and ring diameter from 8.2 to 9.2mm.[146] The published information about the Tiefenau armor rings (cat. G117) does not include the range of ring-size, but does note that the rings generally were c. 1.3cm in diameter with wire roughly 1mm.[147] Felix Müller, in discussing the Tiefenau armor rings, also notes an as-yet unrestored concretion of rings from Lausanne with ring diameters of between 5mm and 6mm.[148] While the latter two examples are hard to assess, the overall impression is of a significantly greater range of variation within a single armor, or even a single fragment of mail, than is present in Roman mail, which may speak to a lower degree of precision in the manufacture of the armor rings.

Given the limited sample size for both Republican Roman and Gallic mail, it is impossible to make any comparisons with a great deal of certainty, but some hypotheses may be advanced. Both the Ciumeşti and Yorkshire mail coats were likely produced well before the widespread adoption of mail by the Romans; the unusual design elements in Gallic mail may be the result of an early period of experimentation. Alternately, what appears to us as standard design elements for the armor, such as shoulder-doubling, the four-in-one pattern, and riveted ring construction, may merely seem so because they were the model on which the Romans homogenized the armor for their use and thus spread through conquest, replacing other local varieties. Finally, the apparent wider variation in ring-size introduces the tempting hypothesis that Roman mail, at least by the early imperial period, was produced to a higher quality standard

[145] Rusu (1969), 277-8.

[146] Stead (1991), 56.

[147] Müller (1986), 120-1.

[148] Müller (1986), 121.

than Gallic mail of the previous period had been. This hypothesis would be reinforced by the common presence of end-abutted ring construction which is, as noted, an inferior form in terms of the protection offered. While it may well have been the case that Gallic mail was overall lower in quality, it must be stressed that the sample size for Gallic armor rings remains very small. So it is possible that this appearance is simply the result of accidents of preservation rather than a reflection of real difference.

Because Gallic mail armor and the *lorica hamata* used the same materials and the same basic form, the metal-weight reconstructions of the two armors may be regarded as identical, with the same maximum, median and minimum cases (5.95kg, 4.8kg and 3.8kg respectively), with some necessary caveats. A minority of early Imperial Roman mail finds show much smaller ring-sizes (and thus much higher ring-counts for a complete armor, e.g. cat. R62, R64, R68 and R70) than have been observed in the Gallic finds discussed here. Moreover, as noted, Roman mail uses the more time intensive riveted-ring construction, whereas Gallic mail is frequently end-abutted.[149] At the same time, it is equally likely that mail armor of the Roman Republic did not attain the quality of the early Imperial samples. It seems more likely than not that Roman mail was of generally higher quality by the end of the second century BCE; it was certainly more common. But quantifying this difference in quality is not possible with the current limited evidence.

[149] The additional mass of the rivets in the rings is also likely to add a small but significant amount of mass to the *lorica hamata* when compared with end-abutted mail, but the exact amount is very difficult to calculate in the absence of the recovery of complete and intact armors.

Helmets

La Tène culture helmets of the third and second century were made in both copper-alloy and iron. However, despite the differences in materials, iron and copper-alloy Gallic helmets follow the same general patterns of morphology (fig. 6.18). The basic form of helmet consists of a hemispherical bowl, frequently stretched vertically, with a thickened or cabled lower rim. Most helmets also feature some extension of the helmet at the rear base to protect the back of the neck, either by drawing out the helmet bowl or with an attached metal neck-guard. Metal cheek-guards, as with the Roman Montefortino-type helmets, are a standard element, although these are often not preserved archaeologically with the helmet; their presence can frequently be inferred through the presence of attachment holes. Finally, some helmets have an additional knob at the crest of the helmet (fig. 6.19).

English language scholarship has tended to further divide these helmet types between Montefortino-type helmets, defined as having a knob mounted on the crest, and Coolus helmet types, which lack a knob.[150] Both types occur in both iron and copper-alloy. This typology, which is better suited to the Roman variants of these La Tène culture types, is not entirely satisfactory. Unlike the Roman Montefortino-type helmets (produced in copper-alloy exclusively), the crest-knob of the La Tène culture helmet is typically a separate metal element, secured through a punch-hole in the top of the helmet (fig. 6.20).[151] Moreover, Roman helmets of the Middle Republic do not generally show the same elongated neck-guards as contemporary La Tène culture helmets. Finally, some helmets, like the Ciumești helmet (fig. 6.21), defy both

[150] E.g. Paddock (1993), Connolly (1981), 120-122; Robinson (1975), 13-41. This typology is not used in non-English language scholarship, such as Schaaff (1988), 293-326; Bernaux and Lambot (1987), 102-106; Lejars (1996), 96; Feugere (1994), 57-65.

[151] Schaaff (1988), 295-6, 300.

type-groups.[152] Thus, a typology that generalizes from the Roman forms of helmets, which were imitations, rather than adoptions, of the form, is apt to be misleading. Ulrich Schaaff instead divides the iron helmet types based on decorative elements and on whether the neck guard is a supplementary attached element or of one piece with the helmet. Such a typology, focused primarily on decorative rather than structural elements, while valid generally, is of limited use for the present study.[153] A more comprehensive type-study of La Tène culture helmets of this period would clearly be valuable. For the present study I have opted to use the Montefortino/Coolus terminology, because of the clarity it offers, despite the problems it also poses. It must be stressed, however, that the use of these terms should not be taken to mean that the La Tène culture types are identical to their Roman counterparts.

Regardless of type, even a limited sample of La Tène culture helmets demonstrates the considerable range in quality, decoration and metal-weight. A pair of copper-alloy 'Coolus' type helmets in the British Museum (cat. G122 and G120) mass 514g and 598g respectively; both are complete save for the cheek-guards, which are missing; Paddock suggests that the latter helmet may never have had cheek-guards, the visible holes on either side being for securing a chin-strap.[154] The latter of these helmets had a thickness over the bowl between 0.5 and 1mm.[155] Another helmet of this type (cat. G121) found in the Po River has a bowl thickness of 0.8-1mm (no weight is given); Paddock suggests that it ought to be understood as a Gallic helmet and thus

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[152] Rusu (1969), 272-5.

[153] Schaaff (1988), 297.

[154] Paddock (1993), 675.

[155] Paddock (1993), 675.

dated to pre-200 BCE.[156] Overall, the Coolus type helmets appear to be generally more humble, less decorated affairs than the Montefortino types; they seem thus generally to have also been somewhat lighter, although it is difficult to extrapolate from the current small sample-size.[157]

In contrast to these simpler examples, an early and heavily decorated iron helmet (cat. G118, fig. 6.21) was found with the mail fragments in the Ciumești warrior burial; the helmet is badly damaged, making a weight less useful, but the average thickness over the bowl is around 1.5mm, suggesting an original mass (without the decorative bird-crest) perhaps around 1.5kg (cf. for instance cat. R83 or R86).[158] The helmet, which is made in iron, has a copper-alloy decorative bird secured to the crest, using the same attachment manner typical of La Tène culture style knobs; both the decorative bird and the attachment-protrusion for the crest are hollow. This assembly follows the typical method for attaching a crest-knob for La Tène culture helmets, where the knob is inserted first through a rounded hollow cone of metal which sits against the crown of the helmet; the base of the knob is then flattened against the inside of the helmet bowl, securing the entire assembly in much the same way as the tang of a sword might be hammered flat against the base of the pommel (fig. 6.20). This sort of construction allows for larger decorative knobs without excessive weight. Another example of this type is a partially restored helmet now at the Antikensammlung in Berlin (cat. G119, fig. 6.22).[159] This helmet is made in iron, but features copper-alloy decorations applied to the exterior. The helmet as it is now, with restoration work, masses 725g.

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[156] Paddock (1993), 680.

[157] One may note however that the 'Coolus' types rarely have additional decoration, whereas the Montefortino types frequently do, note esp. Connolly (1981), 121, fig. 1-18 and Schaaff (1988).

[158] Rusu (1969).

[159] Schaaff (1988), 514-5, K103.

Assessing the normal weight of these helmets for the purpose of reconstruction is difficult, as it is clear that there was a significantly wider range of cost, quality and decoration in La Tène culture helmets in than their Roman counterparts. Few, if any, Roman Montefortino helmets were as decorated as either the Ciumești or Berlin helmets (cat. G118 and G119). At the same time, no Roman helmet in my sample is as light as either of the British Museum Coolus helmets. Indeed, the lightest Roman Montefortino in my sample (cat. R88, Table 4.5) massed 680g without cheek-guards, and perhaps c. 900g if those cheek-guards were restored, making it around a third heavier than the Coolus-type examples above. Likewise, no Roman Montefortino was measured with a thickness of less than 1mm, compared to minimum thicknesses of 0.5 (cat. G120) and 0.8 (cat. G121) in some La Tène culture helmets. Compared to Roman helmets, then, the minimum case must be significantly lower, as low as 500g to account for the very light Coolus type helmets. The maximum case, on the other hand, is not likely to be much higher than the Roman Montefortino, simply due to wearability issues; 2kg, somewhat heavier than my estimate for the Ciumești example (to account, in part, for the large crest-decoration), seems reasonable. For the median case, a tentative figure around c. 725g, as with the Berlin helmet, seems reasonable, though it is difficult to assess what is a typical or average example without more comprehensive typological studies.

In addition, it must be noted that, unlike in the Greek and Roman world, metal helmets were not universal standard equipment among Gallic peoples, especially in the Middle La Tène period. As Lejars notes, "De façon générale, en Gaule du Nord comme dans la plus grande partie du monde celtique l'usage du casque reste exceptionnel. Il faut attendre La Tène finale pour en trouver une trace significative."[160] Representational evidence from the Gallic world often shows warriors either without helmets or with non-metal head-coverings. The apparently textile helmets of the infantry on the Gundestrup cauldron have already been noted above. A procession on a fifth century Hallstatt-culture scabbard shows warriors in procession with long oval shields and spears, but without helmets (fig. 6.17).[161] In contrast, a similar procession of warriors on the situla Arnoaldi shows each with a helmet, most including the distinctive knob of the Montefortino-type.[162] As noted, this varied picture fits in with the evidence from warrior burials, in which helmet deposits are substantially less common than weapon deposits, suggesting that perhaps many such warriors either did not possess a helmet, or that a helmet was simply too valuable to be deposited permanently; of course, ritual reasons for differences in burial and in ritual deposits cannot be ruled out, but the concordance between the burial evidence and the representational evidence is suggestive.[163] The potential presence of warriors lacking helmets in Gallic armies further underscores the considerable variability in Gallic panoplies, between the elite who owned a high-quality bronze-decorated iron helmet like the Ciumești helmet, and a non-elite who may have gone to war with either only a leather or textile head protection, or even no head protection at all.

[160] T. Lejars, "L'armement des Celtes en Gaule du Nord à la fin de l'époque gauloise" *Revue archéologique de Picardie* (1996), 96.

[161] Brunaux and Rapin (1988), 14.

[162] Brunaux and Lambot (1987), 51.

[163] Pleiner (1993), 46-58.

Iberian Panoplies

It is better to talk of Iberian panoplies rather than a single set of equipment for the Iberian Peninsula. After the sixth century, the military material culture of the peninsula becomes markedly complex, on account of the interaction of two parallel, yet interrelated material cultures, Iberian and Celtiberian. Moreover, not only are some distinctive equipment types associated with La Tène or Roman material culture adopted, but distinctive location variations based on these types also emerge, creating a military material culture that is a mix of imported, indigenous and adapted designs. As a result, the military equipment of the region is complex. Differences between the military equipment of the Celtiberians (the term here being used to mean not only the people so named in the ancient sources, but also many of their neighbors who seem to share much of the same military material culture), associated with the Meseta region, and of the Iberian population, concentrated in the Levante and Andalusia, are marked. At the same time some equipment is shared between the two groups, and Quesada Sanz notes that there is significant exchange between the two regions, particularly for equipment from the coastal Iberian region moving inland into the Meseta.[164]

Two brief descriptive panoplies for the region survive in the textual evidence, but both conform only partially to the archaeological evidence. Diodorus describes the Celtiberians as carrying either a Gallic style shield or else a round wicker shield about the size of a Greek *aspis* and an iron, two-edged sword.[165] For armor, Diodorus notes that the Celtiberians have bronze helmets and greaves made of hair (τρίχινος), which might mean a leather or rawhide covering.[166]

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[164] Quesada Sanz (2005).

[165] Diodorus 5.33.3.

[166] Diodorus 5.33.3.

Diodorus reports a second panoply for the Lusitani, neighbors of the Celtiberians to the west and also evidently Celtic-language speakers.[167] This panoply consists of a durable small round shield "woven with sinew" (διαπεπλεγμένη νεύροις), possibly a misunderstanding of the leather or hide surface of a wooden shield, a javelin made entirely of iron (ὁλοσίδηρος), and swords and helmets "about the same as the Celtiberians."[168] Diodorus' description seems to completely neglect body armor, but it is unclear if this is an intentional indication that it was uncommon, or simply an omission. Moreover, some of Diodorus' attributions do not seem to be supported by the archaeological evidence. His attribution of the all-iron javelin, known generally by the Latin term *soliferreum*, only to the Lusitani seems to be an error; the *soliferreum* appears archaeologically not only in the entirety of the Meseta, but also in the Iberian coastal zone.[169] Diodorus' placement of shields in the Gallic style in Celtiberia seems to be another error; the remains of such shields tend to be concentrated in Catalonia and along the coast, rather than penetrating inland.[170] In short, Diodorus, in presenting this panoply, appears to have conflated military equipment common in the Meseta and on the coast.

Strabo also provides a description of the arms of the Lusitani.[171] He describes the round shield as about two feet in diameter, but reports that it lacks a handle, and is instead carried by a shoulder-strap. This last point is only partially accurate, as many of the handles of the Iberian round-shield, known in Latin as the *caetra*, survive and often have fittings for a leather strap for

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[167] Diodorus 5.34.4. τῶν δ᾽ Ἰβήρων ἀλκιμώτατοι μέν εἰσιν οἱ καλούμενοι Λυσιτανοί.

[168] Diodorus 5.34.4-5. φοροῦσι δὲ κράνη καὶ ξίφη παραπλήσια Κελτίβηρσιν.

[169] F. Quesada Sanz, *El Armamento Ibérico. Estudio tipológico, geográfico, functional, social y simbólico de las armas en la Cultura ibérica (siglos VI-I a.C.)* (Montagnac, Spain: Editions Monique Mergoil, 1997b), 317-22.

[170] Quesada Sanz (1997b), 539, 544-5.

[171] Strabo 3.3.6.

carrying, but also a handle for use in combat. Strabo further reports that the common soldiers wear textile body-armor (λινοθώρακες) and leather helmets, but that a few wear mail armor and metal helmets. It is worth noting that, apart from this statement, there is no evidence for the use of mail armor in Spain in the pre-Roman period.[172] For offensive weaponry, Strabo reports that they use the *kopis*, along with spears and javelins. The description of the native sword as the *kopis* might be intended by Strabo to mean the well-attested Spanish falcata. If this is the case, he has erred in conflating the sword of the Lusitani with the falcata; the latter seems to have been far more common in the coastal Levante. Of Iberian warfare generally, Strabo reports that "the Iberians all began, it is said, as peltasts, and were light-armored, on account of brigandry, as I said of the Lusitani, using javelin, sling and cutting-sword [μάχαιρα]."[173]

Given the limitations of these descriptions, it seems more prudent to proceed from the archaeological evidence primarily, while keeping the literary evidence in mind. Thus, this section will discuss Iberian equipment piece by piece, presenting the evidence for both resource intensity and geographic range of use. It will then be possible to suggest complete panoplies at the end. As noted previously, by the third century the military equipment of the Celtiberian Meseta had diverged significantly from that of the Iberian coastal region. Based on the geographic and chronological distribution of recovered examples, Quesada Sanz has proposed a set of panoplies, divided by both region and period (fig. 6.23).[174] My reconstructions will primarily follow this schema, divided into two panoplies, one Celtiberian and one Iberian. A third panoply, corresponding more roughly to the equipment of a fifth century Celtiberian elite,

[172] Quesada Sanz (1997b), 577-8.

[173] Strabo 3.4.15. πελτασταὶ δ᾽ ἅπαντες, ὡς εἰπεῖν, ὑπῆρξαν οἱ Ἴβηρες καὶ κοῦφοι κατὰ τὸν ὁπλισμὸν διὰ τὰς λῃστείας, οἵους ἔφαμεν τοὺς Λυσιτανούς, ἀκοντίῳ καὶ σφενδόνῃ καὶ μαχαίρᾳ χρώμενοι.

[174] Quesada Sanz (1997b), 615-619. See also Quesada Sanz (2005).

will also be computed, to give a sense of the absolute upper-bounds of metal-intensity for Spanish military equipment in the pre-Roman period.

Swords – La Tène, Antenna, Falcata

The falcata was a forward-curving single-edged sword similar to the Greek *kopis* common in the coastal regions of Spain beginning in the fifth century (fig. 6.24). Representational and archaeological evidence for the weapon are strongly concentrated in the Levante region (although the occasional example does appear in the Celtiberian Meseta), suggesting that this was a distinctively Iberian, rather than Celtiberian, weapon.[175] The origin of the falcata has been a subject of significant debate, with arguments advanced for an indigenous origin, or development from Hallstatt or La Tène precedents, or development from either the Greek *kopis* or from that sword's Near-Eastern predecessors.[176] Quesada Sanz plausibly suggests derivation from the Greek *kopis*, but by way of sixth century versions of that weapon introduced into Italy, arriving in Spain in the mid-fifth century.[177] Regardless of the origin, the falcata's forward-curved construction enabled it to deliver powerful cutting blows which would have been highly effective in a military environment where armored opponents were extremely rare.

Fortunately, the falcata is a well-attested type in the archaeological record, allowing for fairly confident reconstruction. Moreover, the type is fairly consistent in dimensions; out of a sample of 189 falcatas included in Quesada Sanz's study, the smallest was 41cm long and the

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[175] Find distribution: Quesada Sanz (1997), 67-78. P. F. Stary, *Zur Eisenzeitlichen Bewaffnung und Kampfesweise auf der Iberischen Halbinsel* (Berlin: Walter de Gruyter, 1994), 119-20.

[176] For an overview of this debate, see Quesada Sanz (1997), 126-33.

[177] Quesada Sanz (1997), 133-61. Stary, likewise, favors Greek introduction, Stary (1994), 120-2.

largest 71.5cm, with the vast majority of the samples clustered in the center of that range.[178] Unfortunately, Quesada Sanz's data on these falcatas did not include weight. However, it was possible for me to have five of the most complete examples of the sword-type at the Museo Arqueológico Nacional (MAN) in Madrid weighed; the results are shown in Table 6.7. Although this sample is small, the relative consistency of the mass of the swords is significant, if not surprising. One of the design features common on the falcata is complex grooves, called fullers, on the thick back end of the blade.[179] These fullers allow the smith to finely control the weight of the weapon without compromising the point of balance or the structural stability, as would be the case if the blade was either shortened or had its width reduced. Of the swords in the sample, all five have fullers running the length of the back of the blade.

Table 6.7: Iberian Falcatas by Length

Cat. no.	Total Length (cm)	Handle Length (cm)	Max Blade Width (cm)	Mass (g)
I10	52.5	11.3	5.7	530
I9	52.8	10	5.7	390
I6	53.1	11.5	5.8	510
I5	53.2	10.0	6.7	473
I7	58	11	6.5	740
I8	60	12.5	6.4	530

The Iberian Peninsula also was host to several straight, double-edged swords. Some of these, such as the *Frontón* sword-type, distinguished by a round pommel and triangular shape, fall outside the chronological range of this study.[180] Two key types, however, remain common enough to merit further discussion: the indigenous style of Antenna sword, and locally adapted versions of the La Tène sword-types (particularly from La Tène I and II).

[178] Quesada Sanz (1997), 85-6. Stary (1994), 119 gives a similar size range: 47-70cm, most between 53 and 65cm.

[179] Quesada Sanz (1997), 92-5.

[180] On this type, see Quesada Sanz (1997), 173-87.

Spanish Antenna swords are distinguished by the shape of the pommel. As the form emerges in the fifth century, these pommels tend to have two widely spread antennae at the base of the grip; by the late fourth century, the two antennae have drawn progressively close together and, in some cases, effectively merged, creating a double-lobed style pommel (e.g. cat. I4, fig. 6.25).[181] Quesada Sanz sets out a typology for these swords in six groupings; of these, only the last two (groups V, and VI) enter the chronological reach of this study.[182] Geographically, finds for the V and VI types are densely clustered in the Soria-Guadalajara region; they are thus clustered around the ancient site of Numantia.[183] Altogether, the Antenna sword, including these two most relevant latest types, has a strong association with the Celtiberian material culture; Quesada Sanz notes that the Antenna sword is commonly seen as the Celtiberian equivalent for the Iberian falcata; the geographical distribution seems to reinforce this impression.[184]

All of the Antenna sword-types are extremely short. Quesada Sanz notes that the average blade-length for the chronologically latest group, VI, is only 34.4cm, around half the length of a Roman *gladius hispaniensis*; the preceding type V is only slightly longer, with an average length of 40.6cm in Quesada Sanz's study.[185] As a result, swords of this type tend to be quite light. Three examples of the type VI at the MAN Madrid are shown with measurements in Table 6.8 below. As smaller swords, these Antenna swords are fairly light, although not as dramatically

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[181] The early types are types A and B in Bosch Gimpera's typology and associated with the fifth and early fourth century, whereas types C and D are associated with the fourth century and after. P. Bosch Gimpera, "Los celtas y la civilización céltica de la Península Ibérica" *Boletín de la Real Sociedad Española de Excursiones* 19: 248-301. Quesada Sanz (1997), 190-1.

[182] Quesada Sanz (1997), 205-27.

[183] Quesada Sanz (1997), 221-6.

[184] Quesada Sanz (1997), 188, 211-26. Stary (1994), 127-8.

[185] Quesada Sanz (1997b), 221-24. Quesada Sanz, "*Gladius Hispaniensis*: an archaeological view from Iberia" *JRMES* (1997a), 262.

light as their size might suggest, partly as a consequence of the construction of the grip. On these types of swords, the iron tang in fact serves as the entire grip (fig. 6.25); it thus survives, in contrast to other Mediterranean swords where the tang is a relatively thin strip of metal encased in an organic (wood or leather) grip.

Table 6.8: Type VI Antenna Swords from MAN Madrid by Length

Cat. No.	Length (cm)	Blade Length (cm)	Max Blade Width (cm)	Mass (g)	Date
I4	41	30.5	3.9	430	400-200
I3	44		6	410	300-200
I2	49.8	40.5	4.0	350	400-200

The other potential sword-choice in the period under consideration was swords derived from late La Tène I type swords, but locally produced. As Quesada Sanz notes, very few of these swords are well preserved, hence a complete and systematic study of the type is currently impossible.[186] Nevertheless, it is possible to outline the basic specifications of the type. The Iberian (here a geographic, not cultural, signifier) variants of the La Tène type derived from the late La Tène I swords, rather than from the substantially longer La Tène II types discussed in the previous section.

The La Tène I design is, however, taken over by local smiths and altered. Notably the suspension and scabbard system progressively changes from the Gallic suspension-loop with iron-plate scabbard to an organic scabbard with a ring suspension typical in Spain in the period.[187] By the end of this evolution, the sword has also settled to a blade-length of c.60cm (see fig. 4.8); it is this form of the sword which is most likely the immediate predecessor of the Roman *gladius hispaniensis*.[188] As Quesada Sanz notes, while few of these swords are well-

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186 Quesada Sanz (1997b), 250.

187 Quesada Sanz (1997b), 250-55; Quesada Sanz (1997a), 263-5.

188 Quesada Sanz (1997a), 256, 265-6.

preserved, making weighting difficult, one example of a La Tène -type sword in an Iberian context from MAN Madrid (cat. I1) is largely intact. Its total length of 70.2cm is consistent with the lengths suggested for this type, and it has a preserved mass of 410g. Further evidence is provided by the Roman variant of this weapon; as Quesada Sanz notes, the third century locally manufactured 'La Tène' Spanish sword type was "virtually identical" to the Republican swords now generally accepted to represent the *gladius hispaniensis* type and discussed in the previous chapter.[189]

Geographically, the distribution of the local La Tène I variants swords is wider than the other two types. It is important to distinguish swords of the La Tène II type (already discussed in form in the previous section) which are also found occasionally in Spain, particularly in Catalonia; Quesada Sanz associates their appearance with the period of the Second Punic War.[190] These imported swords, Quesada Sanz notes, are almost always found associated with other markers of La Tène culture military equipment and with their distinctive suspension and scabbard system; they never become as common in Spain as the local variant of the La Tène I sword.[191] Of these Spanish variants, while the largest cluster of finds is centered on the eastern Meseta near Numantia (as with the Antenna swords), a second significant cluster of finds occurred in Catalonia, and further small finds occur somewhat infrequently in Andalucia.[192] Thus this type of sword, while more common in the Celtiberian cultural zone, was apparently

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[189] Quesada Sanz (1997a), 268.

[190] Quesada Sanz (1997b), 259.

[191] Quesada Sanz (1997a), 262.

[192] Quesada Sanz (1997b), 255-7.

available in both Iberian and Celtiberian military material cultures, and so would have provided a potential alternative to both the Celtiberian antenna sword and the Iberian falcata.

Keeping in mind the geographical distribution of each of these types, it is possible to propose maximum, minimum and median cases for the swords carried by Spanish warriors. For the Iberian warrior, the minimum case may be set at c. 400g, corresponding to the lightest preserved falcatas (cat. I9), as well as to the lighter examples of the locally produced variant of the La Tène I sword (cat. I1). For the median case, the cluster of falcatas around 530g suggests a median in this range. Finally, for a maximum case, the very heavy falcata (cat. I7) at 740g suggests this upper bound. For the Celtiberian warrior, a minimum case of 350g corresponds well with the lighter Antenna swords (e.g. cat. I2), while a median case ought to be set at perhaps c. 410g to represent the cluster of Antenna swords at that weight, as well as the local variant La Tène swords. For the maximum case, it is necessary to consider a mass of at least c. 700g, corresponding to the rough median case for the *gladius hispaniensis,* following the reasoning that the Roman sword-type itself was an adaption of Iberian or Celtiberian La Tène sword variants.

Shields – Caetra, Oval shields

The common shield of the Iberian Peninsula was the center-bossed round shield known by its Latin name, the *caetra*. The basic construction of the shield is a flat wooden disc, 50-70cm wide, with a round gap in the center for the grip. This gap is covered by a round, domed iron boss which is riveted through to an iron maniple on the rear face of the shield, much as with the *scutum* (fig. 6.26).[193] The styles for the metal elements of this shield – the boss and handle – vary considerably both chronologically and geographically. Unlike the Gallic oval shield and the

[193] Quesada Sanz (1997b), 489-93.

Roman *scutum*, which generally feature larger bosses and small maniples, the *caetra* can have maniples with wings that run nearly the entire diameter of the shield, although smaller, simpler handlebars are also common.[194]

The maniples of the *caetra* range from simple small bands, akin to the maniples of the *scutum* or Gallic oval shields, to much larger hand-holds with broad wings reinforcing the back of the shield (fig. 6.27). Quesada Sanz has divided these into a typology in seven groups. Of these typological groupings, archaeological examples of group II (maniples with small curved wings) and group III (maniples with triangular fins) are by far the most common, outnumbering all of the remaining groups together.[195] As such, this reconstruction will focus on these types. Although Quesada Sanz does not present weights for the examples in his catalog, I was able to have several examples in the collection at MAN Madrid weighed (cat. I18-I23). None of these examples are complete, but they may give a sense for the rough range of metal requirements.

At the smallest, many of smaller Group I and II maniples are no larger than the maniples on Gallic shields; Quesada Sanz notes that the normal length of subgroup IIA1 varies between 21-23cm in length.[196] In contrast, the subgroup IIA2 tends to be larger and, Quesada Sanz notes, is substantially more frequent; these tend to have lengths between 20.5 and 35cm. An example of this type (cat. I18) consists only of the handle and a single wing, and is 16.4cm long and 31.29g. Accounting for the missing bit of handle and a matching wing, the maniple when originally made was likely c. 23-24cm long and probably massed no more than c. 55g.

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[194] It seems worth noting that this same style of construction, with a long handle-bar providing strength to the shield, along with a smaller hemispherical boss, is also typical of Early medieval Anglo-Saxon shields; this is not a case of influence, but merely of two geographically and chronologically separated cultures apparently coming to similar solutions for similar problems. Dickinson and Härke (1992).

[195] Quesada Sanz (1997b), 499-508.

[196] Quesada Sanz (1997b), 502.

Maniples from Group III can be substantially larger. Subtype IIIA has an average length of 37.2cm, while IIIB has an average length of 61.5cm but is far less frequent than the former.[197] An example of this type (cat. I19) consists of only one wing and part of a handle, and is 20cm long and 37.7g. Accounting for the missing wing and part of the handle, the maniple was likely originally c. 35cm long and probably massed c. 65g. Considerably larger examples do exist; Subtype IIIA has an average length of 37.2cm, while IIIB has an average length of 61.5cm, although it is far less frequent than the former. A quite large example is listed by Quesada Sanz as being 71cm long with a 10cm wide handle.[198] Such a maniple, if constructed to the same thickness as the MAN examples, might mass c. 167g.[199]

The circular bosses used on the *caetra* also ranged considerably in size, although by the end of the third century some of the larger types of boss are increasingly rare. The largest boss-type, which Quesada Sanz classes as type I, ranges between 30 and 40cm and is manufactured in copper-alloy.[200] The boss consists of a central hemispherical dome with a large flat extension at the base covering a significant portion of the shield. Bosses of these types occur in both the coastal region and the Meseta, but finds of this type fade out by the third century.[201] If this type of boss was in use at all by the period of Roman involvement in Spain, it was likely exclusively

[197] Quesada Sanz (1997b), 504. Two more subtypes, IIIC and IIID exist, but both have only a single exemplar, and must be thus judged extremely rare.

[198] Quesada Sanz (1997b), 500, 928, cat. 859.

[199] Proceeding from the listed measurements and a scale drawing, I estimated a surface area of approximately 200cm^2 per wing and 30cm^2 (somewhat wider than the previous example) for the handle. This suggested a total combined surface area of 430cm^2, which at an average thickness of 0.5mm, in turn suggests a volume of 43cm^3, for a mass in iron of 167g. The average thickness estimate of half a millimeter was in turn derived from the measured masses of the MAN examples (cat. I18-I23).

[200] Quesada Sanz (1997b), 508-11.

[201] Quesada Sanz (1997b), 508.

an elite product. One well preserved example of this type at MAN Madrid (cat. I15, fig. 6.28) is 33.5cm in diameter; the reported thickness of the metal plate is 2mm. However this measurement, like those for cat. I16 and I17 (see below) seems to be a maximum, rather than average, figure. Removing the boss from the wooden mounting board for weighing or remeasurement was not possible, but assuming that the thickness reported is a maximum figure and the average thickness is c. 1.5mm, the original mass of the boss might be estimated at c. 1,224g.[202] A second early boss-type, classed by Quesada Sanz as type II, consists of a central hemispherical home with a number of radial projections; like the type I bosses, this type does not appear to have been used after the third century. An example of this type (cat. I17, fig. 6.29) from MAN Madrid weighs 193.67g and is very nearly complete, with only two of the radial flanges broken off. As noted, such bosses disappear from the archaeological and representational record, replaced in the Meseta by much smaller iron bosses and in the coastal zone increasingly by oval shields.

In the Meseta, a smaller, iron boss type appears during the fourth century. Classed by Quesada Sanz as Type III, it consists of only a hemispherical iron dome with a small flat concentric extension around the base, covering the gap in the shield created by the hand-hold (cat. I16). Rivets driven through the base hold the boss to the shield, but do not necessarily intersect with the grip in the manner of a La Tène or Roman shield.[203] This simple boss type is typically quite small, with diameters between 10-15cm, and with the dome typically 8-10cm

[202] From the museum's scale image, the central dome of the boss appears to be roughly 12cm wide, and perhaps c. 5cm tall, suggesting a total surface area of the central dome around 191cm^2. With a total diameter for the boss of 33.5cm, this would leave the flat part of the boss at a surface area of 768cm^2 (a circle with a diameter of 33.5, with a circular gap in the center c. 12cm in diameter), suggesting a total surface area for the boss of 959cm2; if the metal of the boss varied between 1-2mm (average c.1.5mm), this would give a total volume of 144cm^3, for a mass in copper-alloy of c. 1,224g.

[203] Quesada Sanz (1997b), 514-5.

across at the base and between 3-5cm tall. Somewhat larger types, with dome heights up to 7.6cm and diameters of c. 20cm exist, but are quite rare.[204] One such iron boss at MAN Madrid (cat. I16, fig. 6.30), has a maximum diameter of 16.2cm and a dome 3.5cm tall; the boss masses 127.05g. The boss has a reported thickness of 2mm, which in turn must be an average figure; at uniform 2mm thickness, the boss would have been nearly three times as heavy.[205] These smaller iron bosses seem to have been generally confined to the Meseta region, suggesting use by Celtiberian, but not Iberian, peoples.[206]

The other shield-type available in Spain was oval shields of the Gallic type. As Quesada Sanz notes, these were late arrival to the peninsula, their introduction dating no earlier than the middle of the fourth century and perhaps as late as the third.[207] However, by the late third century, shields of this type had become common in the coastal zone, particularly in Catalonia; in most areas they appear to have coexisted with the older, indigenous *caetra*.[208] Stary has suggested that the expansion of the oval shield in Spain corresponds to a spread in Gallic armaments more generally, a thesis that Quesada Sanz persuasively refuted.[209] Instead, the oval-

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[204] Quesada Sanz (1997b), 514-5.

[205] Calculated from the surface area implied by the museum measurements. The dome should have a surface area of c. 151cm^2 (assuming a dome 3.5cm high and c. 6cm in radius at the base), while the surface area of the flat base would be c. 93cm^2 (the area of a circle with a diameter of 16.2cm, with a circular gap in the center of a diameter of c. 10cm), suggesting a total surface area of c.244cm^2, at 2mm in thickness, this produces a total volume of 48.8cm^3, suggesting the total mass in iron of 382.5g, which three times the actual mass of the boss. Even accounting for damage to the surface of the boss, it seems certain that the actual average thickness of the metal plate is less than 1mm.

[206] Quesada Sanz (1997b), 514-5.

[207] Quesada Sanz (2010), 145. Quesada Sanz (1997b), 544-5.

[208] Quesada Sanz (1997b), 544-5, 619.

[209] P. F. Stary, "Keltische Waffen auf der Iberischen Halbinsel" *Madrider Mitteilungen* 23 (1982): 114-144. Stary (1993), 115-119. Quesada Sanz (1997b), 545. F. Quesada Sanz, "Montefortino-type and related helmets in the Iberian Peninsula: a study in archaeological context" *JRMES* 8 (1997c): 151-166.

shield appears to have been integrated into the pre-existing Spanish systems of warfare alongside more long-standing equipment.

Without a broader range of weighed examples of each of these types, it is not feasible to establish a range of cases. Hence, I propose only median cases for each type; this is not an expression of confidence but rather of uncertainty, in that the full range of possible metal-weights for these shields is unclear. As noted, by the third century, the oval shield of the Gallic type had become increasingly common in the coastal zone; for this a median case of c. 220g, following on the reconstruction in the preceding section, seems reasonable. On the Meseta, pairing a typical type III iron boss (such as cat. I16) with a relatively average-sized maniple (such as cat. I19) suggests a median case for the Meseta *caetra* of c. 200g.[210] The equipment of local elites could be considerably heavier; adding a large winged maniple to the previous *caetra* produces an estimated metal-weight of c. 300g. And, as noted, the very large copper-alloy bosses in use by elites in the coastal region in the fourth century, and possibly later, can mass more than 1kg; combined with a large maniple, such an early elite *caetra* might have massed c. 1.4kg. Nevertheless, by the third century, the most common types by far, in both the representational and archaeological evidence, are the humbler former examples.[211]

Javelins – the Soliferreum

Javelins of several common types have already been discussed in this and previous chapters. Of these, the Roman-style *pilum* makes fairly frequent appearance in the

[210] Roughly 135g for the small iron boss (following cat. I16) and roughly 65g for a mid-sized handle (following cat. I19).

[211] Quesada Sanz (1997b), 619.

archaeological evidence outside of the context of Roman military operations in Spain, suggesting that it may have been adopted as a consequence of contact with the Romans well before they established complete control of the peninsula.[212] But the distinctive Spanish javelin, in use over much of the peninsula, was the *soliferreum*. As the Latin term implies, this javelin was made entirely in iron, with no wooden haft. It is thus quite unlike missile weapons seen elsewhere in the Mediterranean world, and our Greek and Roman sources were quite intrigued by it.[213] It consists of a metal haft, typically with a thickened center for a grip.[214] The haft is typically quite long; Quesada Sanz notes that 66% of complete *soliferrea* have lengths between 180 and 205cm, with the average length of complete examples being 193.5cm.[215] The form of the tip varies considerably (fig. 6.31): the most common type (3 in fig. 6.31) is an arrow-head shape with a pronounced mid-ridge and relatively wide wings. However, square-sectioned bodkin points, and even round-sectioned needle-points, are known.[216]

To reconstruct the original mass of these weapons is difficult, given the remaining evidence. Recovered *soliferrea* are frequently folded over multiple times and occasionally broken into multiple pieces, especially in burial deposits, most likely for ritual reasons.[217] Moreover, the nature of a long, relatively thin iron rod makes deposited *soliferrea* more vulnerable to corrosion or damage than many other types of military equipment. One complete,

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[212] Quesada Sanz (1997b), 325-43.

[213] Liv 34.14.11. Diodorus 5.34. The common usage is to refer to this weapon with the Latin term *soliferreum*; any indigenous name for the weapon is lost. Diodorus, writing in Greek, calls the weapon a σαυνίον ὀλοσίδηρος, an "all-iron javelin."

[214] Quesada Sanz (1997b), 308-10, fig. 178.

[215] Quesada Sanz (1997b), 310-1.

[216] Quesada Sanz (1997b), 311-2.

[217] Quesada Sanz (1997b), 325.

but heavily bent, example of a *soliferreum* from MAN Madrid (cat. I14) masses 600g. It has a recorded length of 63cm, but this is clearly a measurement of the current folded configuration (fig. 6.32); the original length is likely more than 190cm. Another example (cat. I13), masses 400g, split into two fragments; like the previous example, the recorded length appears to be only a measurement of the longest fragment. The preserved elements (fig. 6.33) measure perhaps 160cm long and appear to be still missing the tip of the weapon; assuming it was of a fairly standard length of c. 195cm, we might expect the original to have massed c. 550g. Quesada Sanz notes that eight well-preserved examples in the Museum of Cordoba had an average mass of 683g, with a maximum of 800grams and a minimum of 620grams; two more examples from the Peyros necropolis massed 650g and 750g.[218] The relatively low metal-weight for a two-meter long iron weapon is explained by the thin shaft; the shafts of the two above examples from MAN Madrid have maximum thicknesses in the shaft of only 1 and 1.2cm respectively.

The origin of the *soliferreum* in Spain remains unclear.[219] It was, however, already common by the Second Punic War and remained so considerably after.[220] As late as 38, Appian reports that one of Sextus Pompey's commanders, Menecrates, was wounded when struck by a *soliferreum*, which Appian explicitly describes as Iberian and with a barbed tip.[221] Geographically, the *soliferreum* occurs frequently in both the coastal Iberian zone and the Meseta Celtiberian zone, suggesting that it was a key part of both styles of warfare.[222] For most

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[218] Quesada Sanz (1997b), 311. Y. Solier, G. Rancoule, M. Passelac, "La nécropole de 'Les Peyros' (VI siècle av JC) à Couffoulens (Aude)" *Revue Archéologique de Narbonnaise* Suppl. 6 (1976), 72.

[219] Quesada Sanz (1997b), 317-22. Quesada Sanz favors introduction from Languedoc/Aquitania.

[220] Quesada Sanz (1997b), 315-7.

[221] App. *Bel Civ*. 5.82. This battle occurred in the context of Octavian's failed invasion of Sicily in 38 BCE.

[222] Quesada Sanz (1997b), 317-22.

of the period under consideration, a Roman-style *pilum* seems to have been an alternative to the *soliferreum*; *pila* occur frequently in the archaeological record both in the Meseta and the Levante.[223] Notably, adapted Spanish *pila* tend to be of the lighter, socketed type (which would have been most similar to the *soliferreum* in terms of weight and flight characteristics), rather than of the heavier, tanged variety; typically they have broad-bladed tips, rather than the narrower tips of many Roman *pila*.[224]

Quesada Sanz suggests that in combat the *soliferreum* might have performed much like the *pilum* in terms of range and penetration.[225] While reconstruction and testing would be needed to determine this with certainty, it seems unlikely that the two weapons would have had similar characteristics. The greatest difference is weight: while a *soliferreum* might include as much as 800g of iron (compared to c. 300g in most types of *pila*), the *soliferreum* lacks the heavy wood haft of the *pilum*. In particular, the heavy socketed *pila*, ranging in reconstructions from 1.1 to 1.7kg in total weight, could have been twice as heavy as a *soliferreum*. Even the lightest *pila* reconstructions, such as Connolly's reconstruction of the socketed *pilum* discussed in chapter 4, put the weapon's total weight at nearly 1kg, roughly 20% heavier than a *soliferreum*. This difference would impact not only range, but also penetrative power; as noted in chapter four, the apparent purpose of the heavy wooden haft on the *pilum* was to provide mass behind the point to drive it through shields and armor. The *soliferreum,* lacking any such backloaded mass, would presumably not perform the same. Moreover, while the tips of Roman *pila* tend to be narrow and quite sharp, in order to punch through a resistive surface like a shield,

[223] Quesada Sanz (1997b), 325-43.

[224] Quesada Sanz (1997b), 326-30.

[225] Quesada Sanz (1997b), 324.

the heads of *soliferrea* are generally (though not always) wide-bladed spear-shapes. The purpose of the wings in such shapes is to deliver a wider, more disabling wound. Even so, they severely impair any armor-penetrating ability of a weapon, as the wide surface means that the momentum of the weapon has to push aside more of the armor in order to penetrate.[226] In essence, while the Roman *pilum* seems to have been adapted to defeat shields and armor at close range, both the Spanish *soliferreum* and the Spanish varieties of the *pilum* seem to have been more designed for lightly armored or unarmored targets. This was a sensible adaptation given that, apart from the Romans themselves, nearly all warriors in Spain were lightly armored.

While Roman soldiers generally carried *pila* in pairs, Quesada Sanz notes that the burial evidence argues against this practice in Spain; *soliferrea* and *pila* are never found in pairs, but are often associated with thrusting spears in assemblages of grave-goods.[227] Thus in estimating the metal-weight added by the weapon, a maximum case may be set at a single relatively heavy *soliferreum* of c. 800g. The median case, at c. 700g, corresponds to a more average *soliferreum*, while the minimum case at c. 300g represents a warrior carrying a single *pilum*, as discussed in chapter four. Given the wide geographic distribution of both the *soliferreum* and the *pilum* in Spain, it seems prudent to assign the weapon to both Iberian and Celtiberian panoplies.

Spears

Both the Iberians and Celtiberians also made use of a one-handed thrusting spear as a regular part of the panoply. As with the *soliferreum*, there is rather less variation between the spears common in the Iberian and Celtiberian zones, with most types crossing over from the

[226] Quesada Sanz (1997b), 310. Connolly (2000).

[227] Quesada Sanz (1997b), 325.

coastal region into the Meseta or vice-versa.[228] The most common types of spearheads by far were oval, arrow or 'tear-drop' shaped spearheads with strong central ridges, very much like Gallic or Greek spearheads of the same period. The notable regional variation peculiar to Spain is a group of very large spearheads of over 30cm and sometimes as much as 70cm in length; in Quesada Sanz's typology of spearheads from Spain, these are type 1 and 2.[229] However, chronologically, these types belong to the earlier period; type 1 is already rare by c. 450 and has vanished by 400, while type 2 is rare by 350 and has vanished by 300.[230] Both thus fall outside of the chronological scope of this study. Without these unusually large variants, Spanish spearheads fall into the same general size range as Gallic or Greek spearheads and share many of the same basic forms.[231] Consequently, although Quesada Sanz's typology does not include typical weights, it seems reasonable to suppose that the spears in the Iberian Peninsula had roughly the same metal requirements as similar spears in the Gallic and Greek worlds.

Helmets and Armor

Compared to Italy, Greece or even Gaul, the armor used in Spain was generally light and made much greater use of organic materials (leather, textile) over metal. Beginning with helmets, Quesada Sanz notes that during the fourth century and most of the third, metal helmets do not appear to be part of any Spanish panoply, failing to appear in either the archaeological or

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[228] Quesada Sanz (1997b), 359-98. Stary (1993), 141-2.

[229] Quesada Sanz (1997b), 399. These two large groupings in turn represent a number of smaller subtypes. Type 1 includes Quesada Sanz's types IA, IB, IIA and IIB, while type 2 covers Va VIA, VIIA, IIIA and IIIB.

[230] Quesada Sanz (1997b), 404, fig. 247.

[231] Quesada Sanz (1997b), 399-404. The same seems to have been broadly true of spear butts, Quesada Sanz (1997b), 427-31. It should be stressed, this is a comparison of one-handed thrusting spears and not the *sarisa*.

representational evidence.[232] Metal helmets had been part of the panoplies of local elites from the seventh to the fourth centuries, but these helmet styles disappear from the archaeological record and tend to be quite rare in any case.[233] Instead, there is significant representational evidence suggesting that head protection for common soldiers, beginning in the fifth century, was made of organic material, perhaps of hardened leather.[234] Quesada Sanz notes from the literary and representational evidence that even after the introduction and spread of metal helmet types in the third century, organic material helmets likely remained more common than metal ones in most of the peninsula, although such organic material helmets are not preserved archaeologically.[235]

Metal head protection was introduced (or more correctly, reintroduced) towards the end of the third century, particularly in the form of Roman-style copper-alloy Montefortino helmets. Although some Gallic helmet types do occur, particularly in Catalonia, they remain rare and are frequently associated with other Gallic artefacts, rather than Iberian ones.[236] Iberian artisans appear to have begun manufacturing copies of the Roman Montefortino-type domestically. Quesada Sanz notes that these helmets begin appearing in the Iberian coastal zone during the third century in Iberian, rather than Roman, contexts.[237] Paddock classifies these local versions of the Montefortino as Type V, dating them to the third and second centuries, noting that their

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[232] Quesada Sanz (1997b), 570.

[233] Quesada Sanz (1997b), 570.

[234] Quesada Sanz (1997b), 570.

[235] Quesada Sanz (1997b), 570. Note also Strabo 3.4.15, whose description of organic helmets and body-armor conforms to the representational evidence.

[236] Quesada Sanz (1997b), 570-1.

[237] Quesada Sanz (1997b), 571.

shape, finish and quality are sufficient to suggest they are not of Italian manufacture, but rather local imitations; moreover, he notes, they are frequently found in Spanish or Gallic grave deposits.[238] Paddock assumes that, although none of these Spanish Montefortino helmets have been found with cheek-guards, they may have had them. However, Quesada Sanz, examining the burial evidence, finds that the cheek-guards are systematically omitted from Iberian manufactured Montefortino type helmets; he attributes the omission to the well-established habit of Iberian artisans for adapting foreign weapons and armor to local needs and styles.[239]

To account for this range of possible head-protection in the reconstruction, it seems reasonable to set the minimum case for the metal-weight of an Iberian warrior at zero; the median case can match a relatively light Roman Montefortino type (see chapter four), but without the cheek-guards, suggesting a metal-weight of c. 700g. For the maximum case, c. 1,200g corresponds to a higher quality Montefortino, but again without cheek-guards, as the Iberian variants appear not to have them. For the Celtiberians, metal helmets arrive later and appear far less frequently, so it seems prudent to assign a helmet only to the maximum case; thus, c. 1,200g, corresponding, as with the previous example, to a higher quality Montefortino type helmet, seems reasonable.

In terms of body armor, a similar situation holds. Evidence for elite metal body-armor first appears in the sixth century, including rare finds of metal breastplates in the North of Spain.[240] More notably in this period, both in the Levante and the eastern Meseta, both representational and archaeological evidence emerges for an armor made of copper-alloy discs

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[238] Paddock (1993), 513-5. In particular, Paddock describes these local variants as being of inferior quality.

[239] Quesada Sanz (1997b), 571.

[240] Quesada Sanz (1997b), 577, 583.

(fig, cat. I28).[241] These discs were suspended in a harness of metal chains or leather strips, typically with front and back plates, along with smaller discs protecting the shoulders and upper-thighs (discs: cat. I25-I27; complete harness I28). A complete harness of this sort could be a considerable investment; a pair of circular front and back plates at MAN Madrid (cat. I25 and I26) mass 470g a piece, while a single smaller disc, possibly a shoulder- or thigh-guard (cat. I27) masses 140g. A complete harness might then require c. 2.2kg of copper-alloy.[242] However, along with the early experiments in metal helmets, evidence for such disc-harness armors disappears by the third century, with the possible exception of the circular disc pectoral found at Numantia (cat. I24), which could potentially be of either Iberian or Italian origin.[243] Instead, the representational evidence suggests that body-armor in Spain at the beginning of Roman military activity there consisted primarily of textile or other organic material; the exact nature of these organic material armors is unclear as they are not preserved archaeologically.[244] Strabo, however, seems to confirm the representational evidence, as he notes that the most common armor among the Lusitani was a *linothorax*, presumably meaning not the Greek model of textile armor (which does not appear in the representational evidence), but instead indicating the use of textile or organic-material armor more generally.[245]

[241] Quesada Sanz (1997b), 572-7. Quesada Sanz (2000), 159-165.

[242] This assumes front and back discs at c. 500g, and 6 secondary discs, each at c. 200g.

[243] Notably, both the Italic and Spanish traditions of disc-pectorals worn in harnesses would have disappeared centuries prior to the apparent context of the Numantia pectoral. Given the style of decoration on the Numantia pectoral which consists of circular designs oriented around a central knob (a known motif for the Spanish disc-harness but not for the Italian pectorals) Spanish origin seems more likely despite the Roman find-context.

[244] Quesada Sanz (1997b), 578-83.

[245] Strabo 3.4.15.

Quantitative Analysis I: Pre-State Panoplies

Table 6.9 shows the totals for the metal-requirements of each panoply; Roman and Macedonian figures are included for reference.[246] Although most of the categories used here have already been discussed, it is worth noting again that the Celtiberian aristocrat's panoply - included both for completeness and to provide a sense of the absolute upper-limits on the military equipment available in Spain - is fundamentally anachronistic to this study, as it includes elements (the disc-harness and a large type I copper-alloy shield boss) which had passed out of use by the end of the third century when Rome become involved militarily in the region. Two observations can immediately be made: first, that the gap between the best equipped and worst equipped warriors among pre-state armies is uncommonly large; and second that, overall, the armies of the great Mediterranean states were far more expensively equipped on average than those of pre-state people, Romans being the most expensively equipped of all.

[246] Equipment included in each reconstruction: Gallic aristocrat: Spear, two javelins, La Tène sword, oval shield, mail armor, helmet. Gallic warrior (helmet): Spear, two javelins, La Tène sword, oval shield, helmet. Gallic warrior (no helmet): Spear, two javelins, La Tène sword, oval shield. Celtiberian aristocrat: Spear, *soliferreum* or *pilum*, sword (Antenna or La Tène), *caetra* with type I boss, helmet, disc-harness cuirass. Celtiberian warrior: Spear, *soliferreum* or *pilum*, sword (antenna or La Tène), *caetra* with small iron boss, helmet (maximum case only). Iberian warrior: Spear, *soliferreum* or *pilum*, sword (falcata or La Tène), oval shield, helmet (median and maximum case)

Table 6.9: Reconstructed metal-weights for Pre-State warriors by type:			
	Minimum Case	Median Case	Maximum Case
Gallic aristocrat (helmet, mail armor)	5,023g	6,985g	10,320g
Gallic warrior (helmet)	1,223g	2,185g	4,370g
Gallic warrior (no helmet)	723g	1,460g	2,370g
Celtiberian aristocrat (helmet, disc-harness)	4,875g	5,662g	7,550g
Celtiberian warrior	975g	1,540g	3,420g
Iberian warrior	1,045g	2,380g	3,410g
Roman Heavy Infantry (average, 40% *loricatus*)	4,279g	6,810g	9,732g
Macedonian Phalangite	4,106g	5,177g	6,632g

But it is also important to note the key way in which these two observations are intertwined: the difference in overall resource intensity is itself the consequence of the large gap between the equipment of the elite and that of the common warrior. Unlike with the Romans or Macedonians, the evidence simply does not allow for confident estimates of how many Gauls might be equipped like the aristocrat in the above reconstruction, except that it was clearly very few.[247] As already noted, military equipment that might server as a marker of elite status, particularly mail armor, helmets and pattern-welded swords, is very rare, despite the reasonable expectation that elite military equipment tends to be preserved at higher rates. This observation accords with the literary and representational evidence already discussed, which clearly suggests that the vast majority of pre-state warriors in Gaul and Spain had very limited armor.

This military environment had an important secondary impact, namely that the weaponry in both Spain and Gaul seems to have developed primarily to counter lightly armored opponents. Both the Iberian and Gallic panoplies strongly favor cutting swords; a strong cut has the advantage of rapidly disabling an unarmored opponent (whereas even a lethal wound from a thrust may take some time to kill or disable). To disable an opponent swiftly in this manner is all

[247] N. Roymans, *Tribal Societies in Northern Gaul: an anthropological perspective* (Amsterdam: Universiteit van Amsterdam, 1990), 17-45.

the more important to a soldier who is himself lightly armored. But, as noted in the previous chapter with reference to the Greek *kopis*, cutting attacks are far more easily repelled by armor than thrusts are. Thus, most of the pre-state sidearms specialize in a style of strike that is optimal against an unarmored foe, but woefully inadequate against an armored one; the primary exception, the versatile cut-and-thrust swords of the Meseta, were, of course, the weapons swiftly adopted by the Romans.[248]

The same tendency is visible in hafted weapons as well. The comparison between pre-state weapons and their counterparts in Italy is instructive. As discussed in chapter four, Roman/Italian hafted weapons had developed variants that seem to have been specialized against armor, particularly the long 'stiletto' or 'bodkin' (type-C) point spearheads and *pila* with narrow, square-pyramidal shaped points. The *pilum* itself likely represents an example of an armor- or shield-piercing missile weapon, as the weight of the heavy wood haft seems designed to push the narrow point and long iron shank through any defensive material.[249] In contrast, by far the most common shape of tip for both javelins and thrusting spears in both Spain and Gaul is a strong mid-ridge with wings in either 'tear-drop' shape or a simple oval.

Of particular note is that Spanish artisans appear to have applied this type of tip to adaptations of the Roman *pilum*, despite this tip being foreign to the Roman weapon being imitated.[250] The wings of the spear-tip are not structurally critical. Rather, the weight of the tip and the force of impact are carried by the mid-ridge, which is itself structurally an extension of the socket and transfers the energy of impact into the haft. Instead, the function of the wings of

[248] Quesada Sanz (1997a).

[249] Connolly, "Reconstruction" (2000), 45-6.

[250] Quesada Sanz (1997b),

the tip is to deliver a wider wound by broadening the area of impact, thus permitting the target to be more rapidly disabled. However, against an armored target, this shape requires the weapon to push aside more of the material of the armor in order to strike the person behind it. As with swords focused on cutting, the very features that make these weapons effective against unarmored targets - an ability to inflict broad, rapidly disabling wounds - make them less effective against armor.

The ancient literary sources treat this design tendency as an inherent flaw (particularly in the context of the La Tène sword). However, it is more appropriate to understand the development of pre-state weapons, not as inferior, but as a response to the security environment which prevailed in their homelands.[251] Although we lack the sources to construct a history of these regions in any detail prior to Roman involvement, it is abundantly clear that the pre-state peoples of Gaul and Spain were already heavily militarized and politically fragmented and that local warfare was endemic.[252] As a result, the threat from peers - that is, other lightly armored, pre-state peoples - was both high and continual. In contrast, the threat of Roman intervention was effectively a 'black swan' threat: highly improbable on any given day, but massive, indeed existential, in its potential negative implications.[253] Given the continuous military pressure from other pre-state neighbors, it would have been an extremely risky move for any one group of Gauls, Iberians or Celtiberians, to recalibrate their military material culture in order to meet the different sort of threat that armored Roman heavy infantry posed.

[251] Plb. 2.30.7-8; Plb. 3.114.1; Liv. 22.46.5; Dionysius 14.10; Tac. *Agricola* 36.

[252] Brunaux (2004), 37-47; Roymans (1990); Arribas, (1963), 73-87; Castro (1995), 251-276.; Quesada Sanz (2000), 26-28.

[253] The term 'black swan' used this way derives from N. N. Taleb, *The Black Swan: the impact of the highly improbable* (New York: Random House, 2007).

This tendency to design for warfare against local peers is compounded by the nature of military material culture itself, both in how it is developed and how it is produced. In all of these societies, the Romans included, weapons are not so much designed as they are adapted and experimented with. This approach is, in no small part, a result of the sort of craft-knowledge required; a smith able to produce one sort of sword may lack the experience and knowledge of the methods to produce another. This limitation is most clearly attested for the Roman *gladius* where as noted in the *Suda*, the Romans were able to copy the shape of the sword, but not its method of manufacture.[254] The same may be true of the efforts in Spain to copy the Roman *pilum*; as noted above, Spanish-produced *pila* adopt the socketed joining system and wider, oval-winged tips common in the hafted weapons that already existed in the Iberian Peninsula. Such a design, a compromise of Roman and Iberian elements, may simply be a consequence of Spanish smiths copying the Roman designs as best they could with the skills and techniques they already had. That is not to rule out efforts to develop weapons which would be more effective against armor. The Group IV 'bayonet type' Gallic spear-tip discussed above is almost certainly an effort to do just this, albeit a clearly transitional form that seems never to have reached final expression.

Even if new weapons could be adapted for use against more heavily armored opponents, the decentralized nature of pre-state organization, combined with the expense of producing new weapons, made rapid widespread adoption of new weapons extremely difficult. As a result, the development and evolution of weapons among nearly all pre-modern people, with or without the state, was typically an evolutionary process that might take centuries to adequately evolve to counter new or sudden threats. Pre-state peoples who suddenly found themselves bordering

[254] *Suda*: μ 302, *machaira*, which is a fragment of Polybius, see chapter four, n. 42.

Roman territory did not have centuries to adapt; in some cases, they did not even have decades. The battlefield impact of that sudden shock will be discussed in the following chapter. For now, it is sufficient merely to stress that weapons technology among the pre-state peoples of the western Mediterranean was not inferior. Rather, it had simply adapted to face a specific, local kind of threat: other relatively lightly armored pre-state peoples.

Quantitative Analysis II: Carthaginian Armies and Pre-State Peoples

Because Carthage's armies were often composite forces, drawn from of many different sources of manpower fighting in native style, it is only now that we may return to a discussion of the material intensity of Carthaginian armies, this time focusing on the land armies of the Second Punic War. By the fourth century, Carthage's armies, especially those deployed overseas, were predominantly composed of mercenaries.[255] These mercenaries seem to have continued to fight in their own style and with their own equipment, even when fighting for Carthage. In Taylor's view, the Montefortino-type helmets found among the Egadi wrecks along with North African ballast and amphorae suggest that the Carthaginians were making use of Italian mercenaries at this point, with those mercenaries being responsible for bringing the distinctively Italic helmet design.[256] Livy and Polybius are both explicit that the Spanish and Gallic mercenaries in Hannibal's army on the eve of the Battle of Cannae fought in their own style and with their own equipment.[257] Iberians, drawn largely from the Carthaginian controlled coastal region, made up

[255] On this topic generally, note M. J. Taylor, "Finance, Manpower and the Rise of Rome" (Ph.D. Dissertation, University of California, Berkeley, 2015), 40-50.

[256] Taylor (2015), 45-6. Tusa & Royal (2012). Burns (2003), 73-5.

[257] Plb. 3.114; Liv. 22.46.2-6.

the single largest source of soldiers for the Carthaginian effort in the Second Punic War; Taylor estimates that the peak mobilization of Iberians was roughly 75,000, roughly half of the Carthaginian army at the height of the war.[258]

Hannibal's army in Italy provides a useful case-study. Polybius reports that after crossing the Alps, it numbered 12,000 African infantry, 8,000 Iberian infantry, and 6,000 cavalry (undifferentiated by type or origin); from here on, the losses to the African corps were made up, at least initially, by Gallic mercenaries from the Po River Valley.[259] By the battle of the Trebia, Hannibal's army had absorbed, following Polybius' numbers, some 14,000 Gallic warriors: 9,000 infantry, and 5,000 cavalry.[260] At Trasimene, Hannibal's losses are accounted by Polybius at around 1,500, notably most of them Gallic, rather than Iberian or African.[261] Polybius notes that at Cannae Hannibal's infantry line was about 40,000 strong, but he does not break down this figure beyond noting that it includes Iberians, Africans and Gauls. Lazenby supposes that by this point there might have been "something like 10,000 Africans and 6,000 Spaniards left," which would leave some 24,000 Gauls.[262] Thus, to suggest a comparative figure, Hannibal's forces in Italy over the first three years of his campaign in Italy conceivably totaled 12,000 Africans, 8,000 Iberians and perhaps 25,000 Gallic infantry, along with around 11,000 cavalry, roughly half of it Gallic.

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[258] Taylor (2015), 46-7. W. Ameling, *Karthago: Studien zu Militär, Staat und Gesellschaft* (Munich: C. H. Beck'sche Verlagsbuchhandlung, 1993), 212-3.

[259] Plb. 3.56.4.

[260] Plb. 3.72.2, cf. Plb. 3.56.4. J. F. Lazenby, *Hannibal's War* (Warminster: Aris & Phillips, 1978), 56.

[261] Plb. 3.85.5.

[262] Plb. 3.114.5. Lazenby (1978), 81.

Using the estimates in this chapter and previous ones, it is possible to reckon the total metal intensity of this force. Both Polybius and Livy note that by the Battle of Cannae Hannibal had re-equipped his entire African force (but not the Iberian or Gallic troops) with captured Roman arms; thus by Cannae there should be little difference in the resource intensity of the Roman and African infantry.[263] Carthage's African troops, like its citizen forces, seem to have fought in a phalanx much like hoplites; it is thus a remarkable tribute that by Cannae, Roman equipment was deemed sufficiently superior to warrant almost completely replacing the Africans' original arms and armor.[264] Notably, the Iberian and Gallic warriors were not similarly re-equipped.[265] If we assume, then, that Hannibal's African infantry will have thus matched the average metal intensity of the Roman heavy infantry, the median case estimate for the entire infantry force Hannibal fielded after crossing the Alps comes to 143,742kg, or roughly 3,190g per soldier on average.[266] For comparison, the average median figure for the Roman heavy infantry at the lowest prevalence for the *lorica hamata* (one-third) is 6,595g; for a Roman legion, including the *velites*, the average figure would be 4,456g. The inclusion of Hannibal's cavalry would no doubt raise his *per capita* metal intensity figure, but not enough to match the Roman figures. Even if all of Hannibal's African cavalry, including the Numidians, were as heavily armed at their Roman counterparts, and his Gallic cavalry contingent were all equipped in mail armor, the *per capita* figure would rise only to 4kg. In fact the 'true' figure must be significantly

[263] Plb. 3.114.1. Liv. 22.46.4.

[264] Plut. *Tim*. 28.1. Taylor (2015), 41-5.

[265] Plb. 3.114; Liv. 22.46.2-6.

[266] The Carthaginian African troops are assessed at 6,595g per soldier (the median case for Roman forces one-third *loricatus*); the Iberians at 2,380g (as per the above section) and the Gallic troops split evenly between 2,185g and 1460g (as per the above section).

lower, as we know that the Numidian cavalry at Cannae still fought as light cavalry against the Romans.[267]

Meanwhile, Hannibal's army was almost certainly far heavier than the Carthaginian armies operating in Spain, which were forced to rely far more on Iberian mercenaries and had little opportunity to armor themselves at the Romans' expense.[268] As Taylor has recently argued, Carthage's outlays in the Second Punic War, simply in manpower terms, were a match for Rome until the loss of the recruiting grounds in Spain began to drain away Carthage's own mercenary manpower reserves.[269] But that wide net in turn diluted the heavy infantry core of the Carthaginian army. In the hands of a military master like Hannibal, this weakness mattered little. Indeed, at Cannae the inability of Hannibal's Gallic and Iberian forces to hold back a Roman advance was even incorporated into the battle-plan.[270] Everywhere else, however, the Romans met with substantially more success than failure, and the Roman qualitative advantage seemed quite apparent. Carthage was the only state to match Rome's commitment in manpower, but it could not do so without sacrificing the quality.

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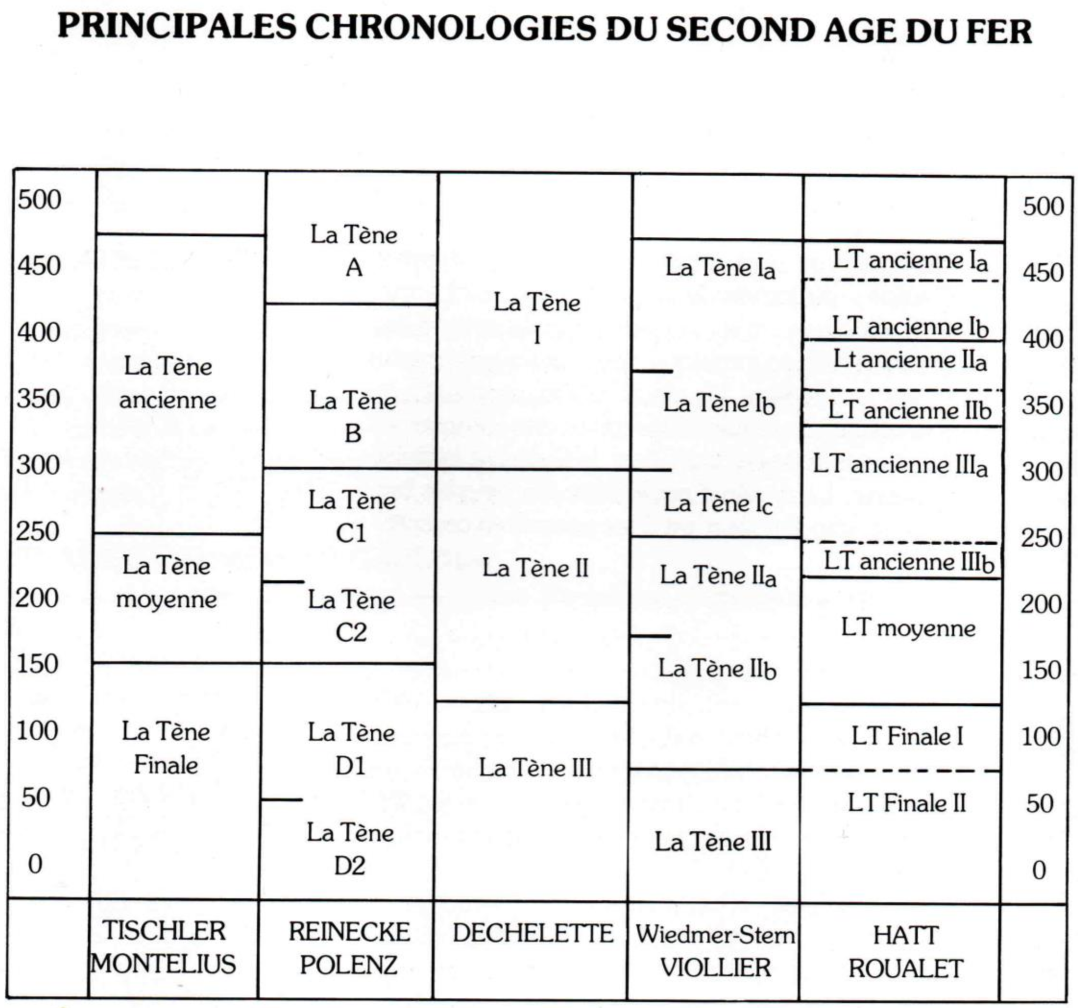
[267] The Numidians at least were almost certainly more lightly equipped, as they fought as lighter skirmish cavalry, e.g. Plb. 3.72.9. Note that this figure also does not account for Hannibal's light troops, so this total must be somewhat inflated on that count as well. Numidian light cavalry at Cannae: Plb. 3.116.

[268] Taylor (2015), 46-7.

[269] Taylor (2015), 36-50.

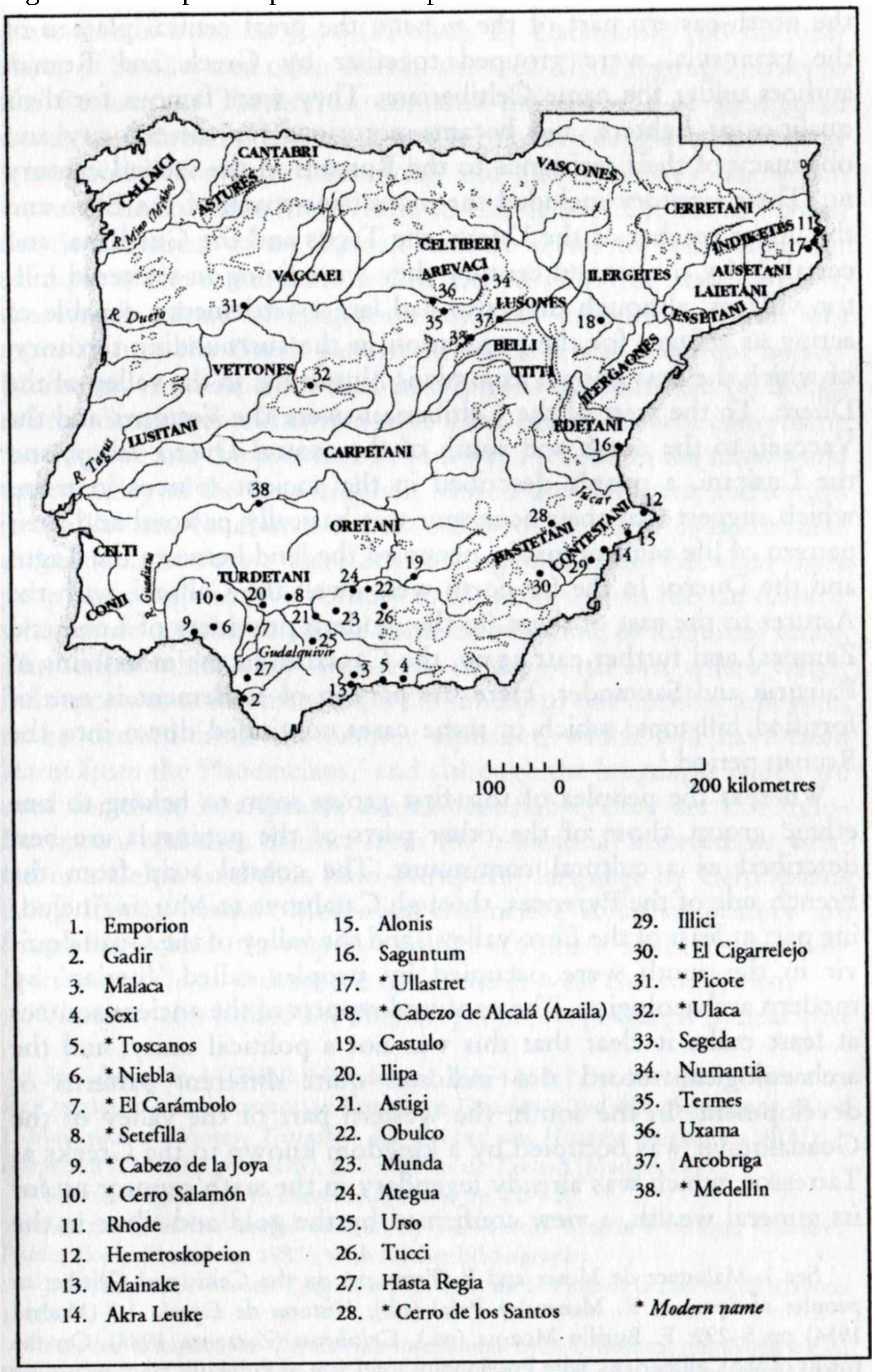
[270] Plb. 3.114-5.

Figure 6.1: La Tène periodization[271]



[271] Brunaux and Lambot (1987), 6.

Figure 6.2: Peoples of pre-Roman Spain[272]



Map 2. Pre-Roman Iberia

[272] Richardson (1996), 11.

Figure 6.3: Mondragon Warrior[273]

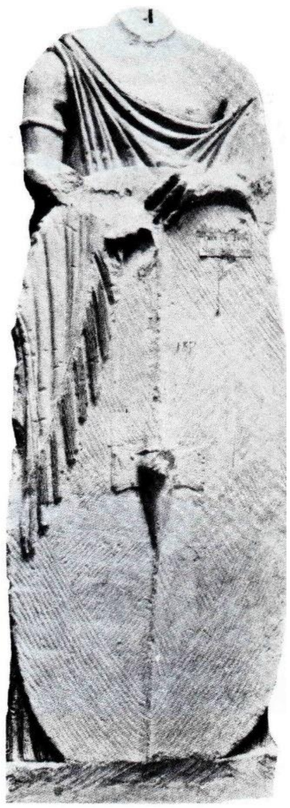
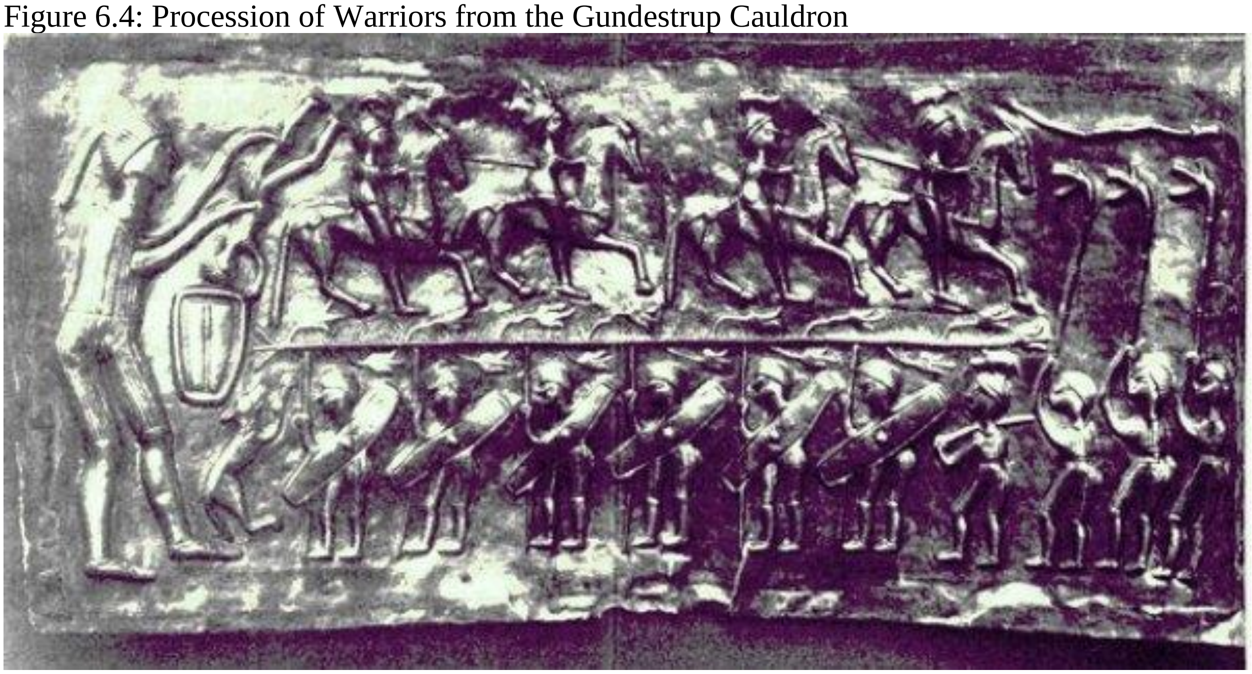
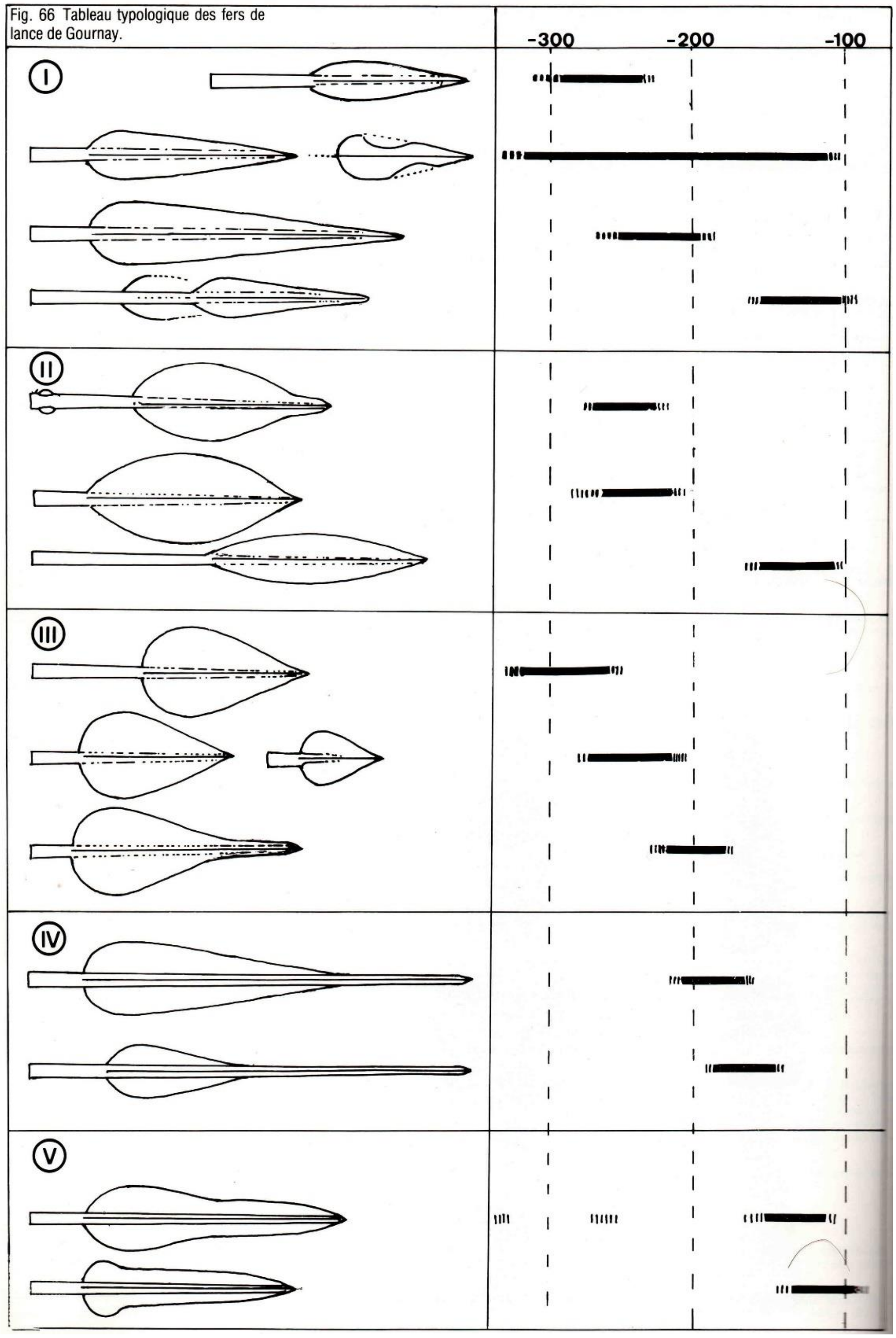


Figure 6.4: Procession of Warriors from the Gundestrup Cauldron



[273] Brunaux and Lambot (1987), 97.

Figure 6.5: La Tène Spear Morphology and Chronology[274]



[274] Brunaux and Rapin (1988), 132.

Figure 6.6: Extended La Tène Spearhead Morphology[275]

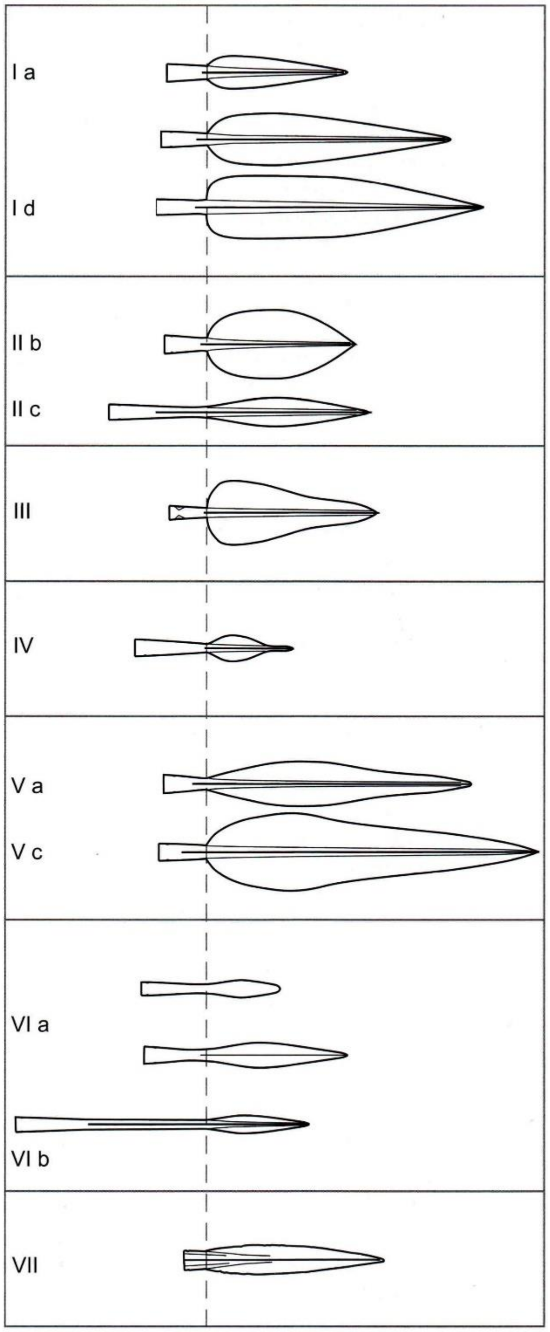


Fig. 126 : Groupes typo-morphologiques des fers de lance et de javelot.
I – formes convexes à carène moyenne et pointe triangulaire,
II – formes convexes à carène haute, avec ou sans pointe dégagée,
III – formes larges et trapues avec pointe triangulaire,
IV – formes de type « baïonnette »,
V – formes biconvexes,
VI – fers de javelot,
VII – fers à douille octogonale.

275 Lejars (2013), 151.

Figure 6.7: La Tène Spear-Butts[276]

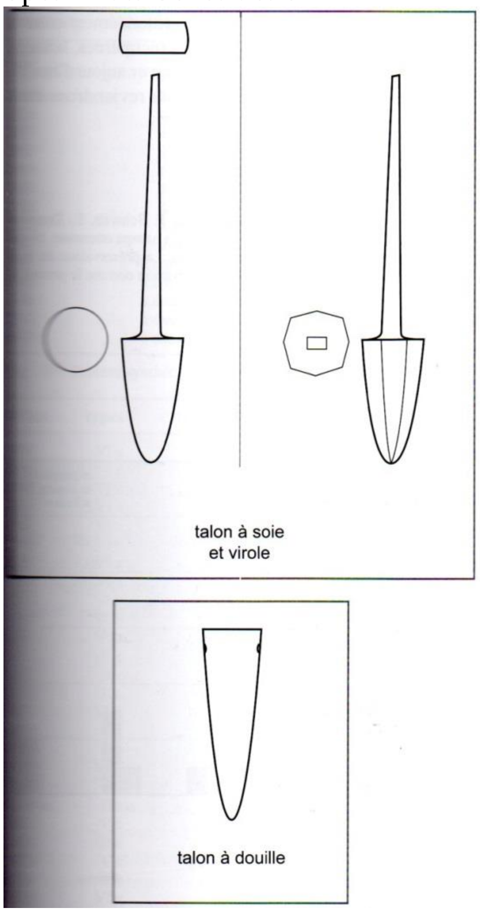
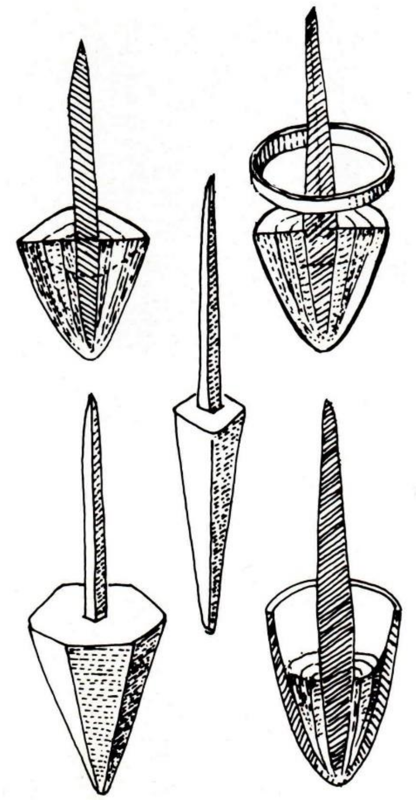


Figure 6.8: La Tène Spear-Butt Construction[277]

[276] Lejars (2013), 151, fig. 132.

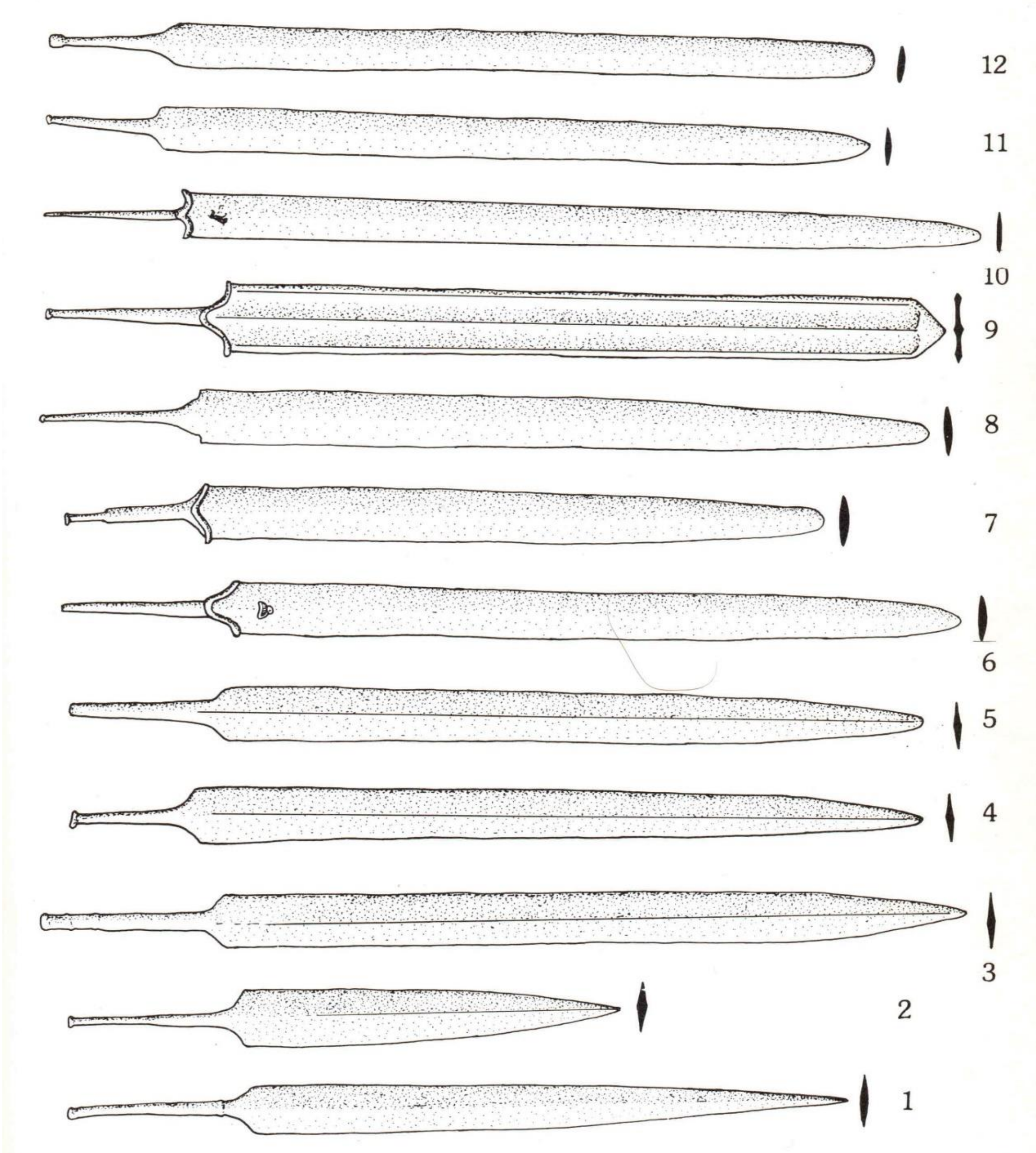
[277] Brunaux and Rapin (1988), 104.

Figure 6.9: La Tène Spear-butts, showing ferules (top and lower right)[278]



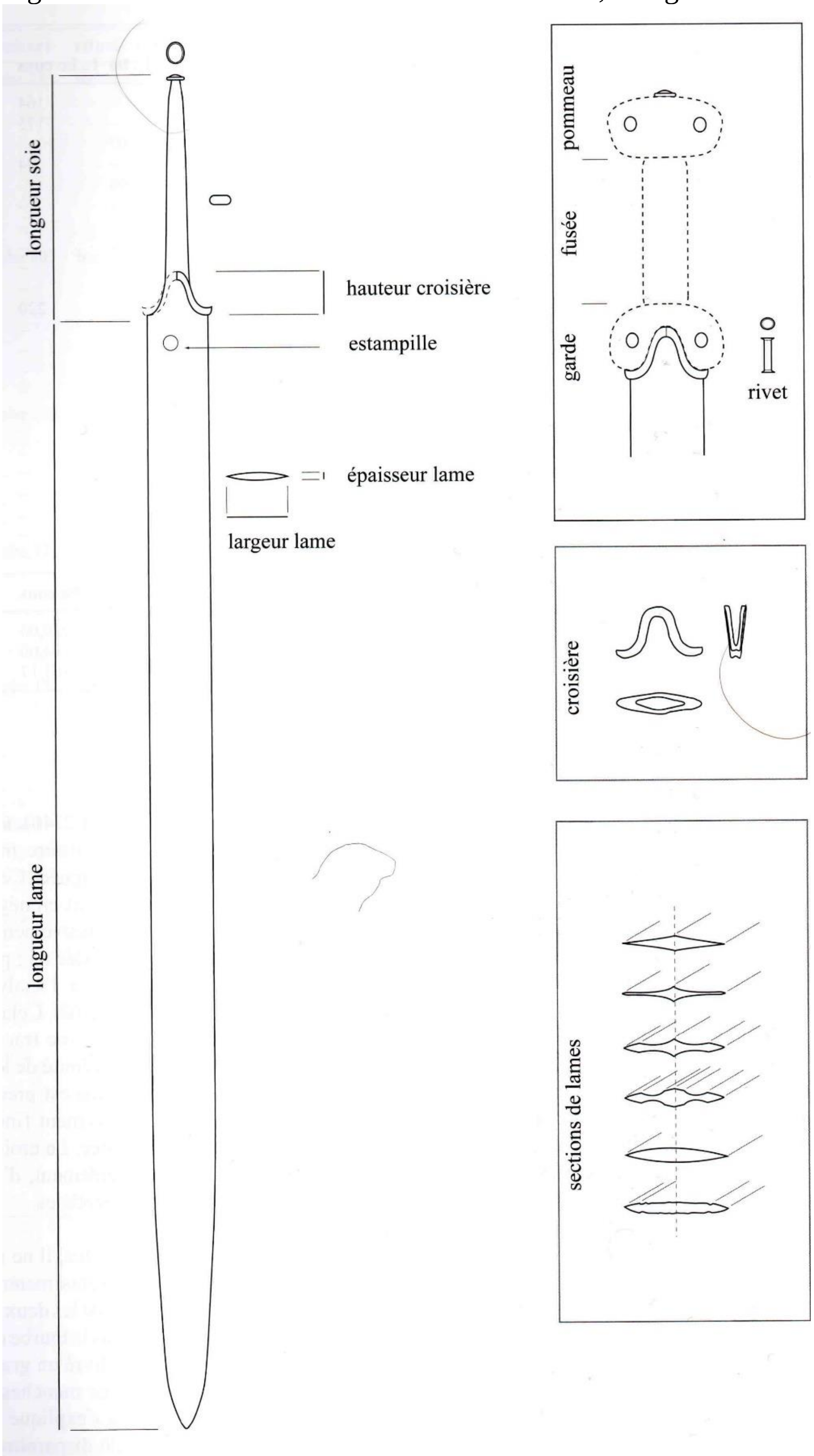
[278] Brunaux and Rapin (1988), 106.

Figure 6.10: Development of La Tène Swords. Swords are presented in rough chronological order. Brunaux and Lambot assign swords 1-5 to Early La Tène, 6-9 to Middle La Tène and 10-12 to Late La Tène.[279]



[279] Brunaux and Lambot (1987), 120-1.

Figure 6.11: Structure of a Middle La Tène Sword, along with reference for measurements[280]



[280] Lejars (2013), 114.

Figure 6.12: Blade-Shouldering and Pommel Structure in La Tène Swords[281]

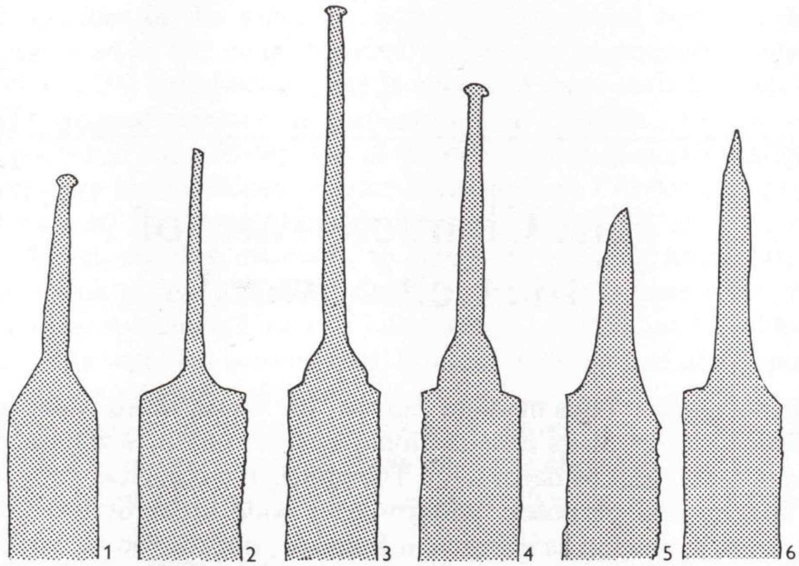


Fig. 5. Examples of types of blade-shouldering which contributed to the form of the hilt.

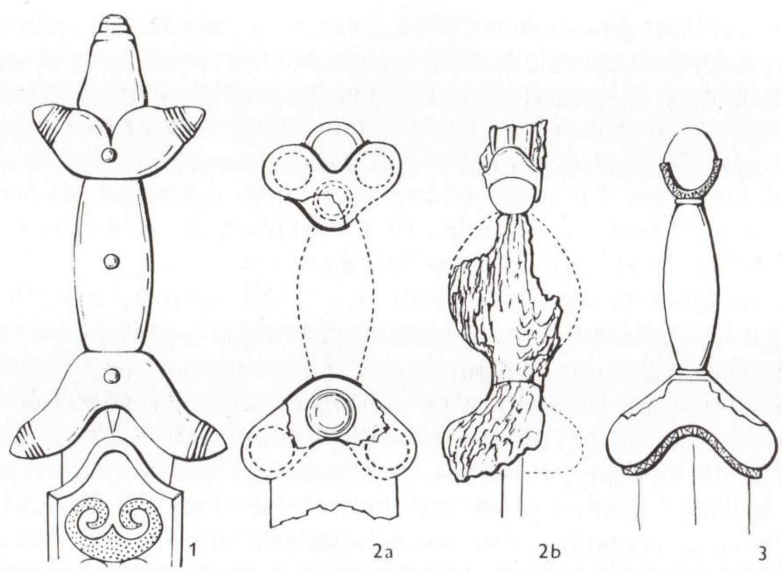


Fig. 6. La Tène period sword-hilts

[281] Pleiner (1993), 62-3.

Figure 6.13: Scale drawing of cat. G25, G26.[282]

[282] Lejars (2013), 230.

Figure 6.14: Structure of the Gallic oval shield (note also the inclusion of a spearhead and butts)[283]

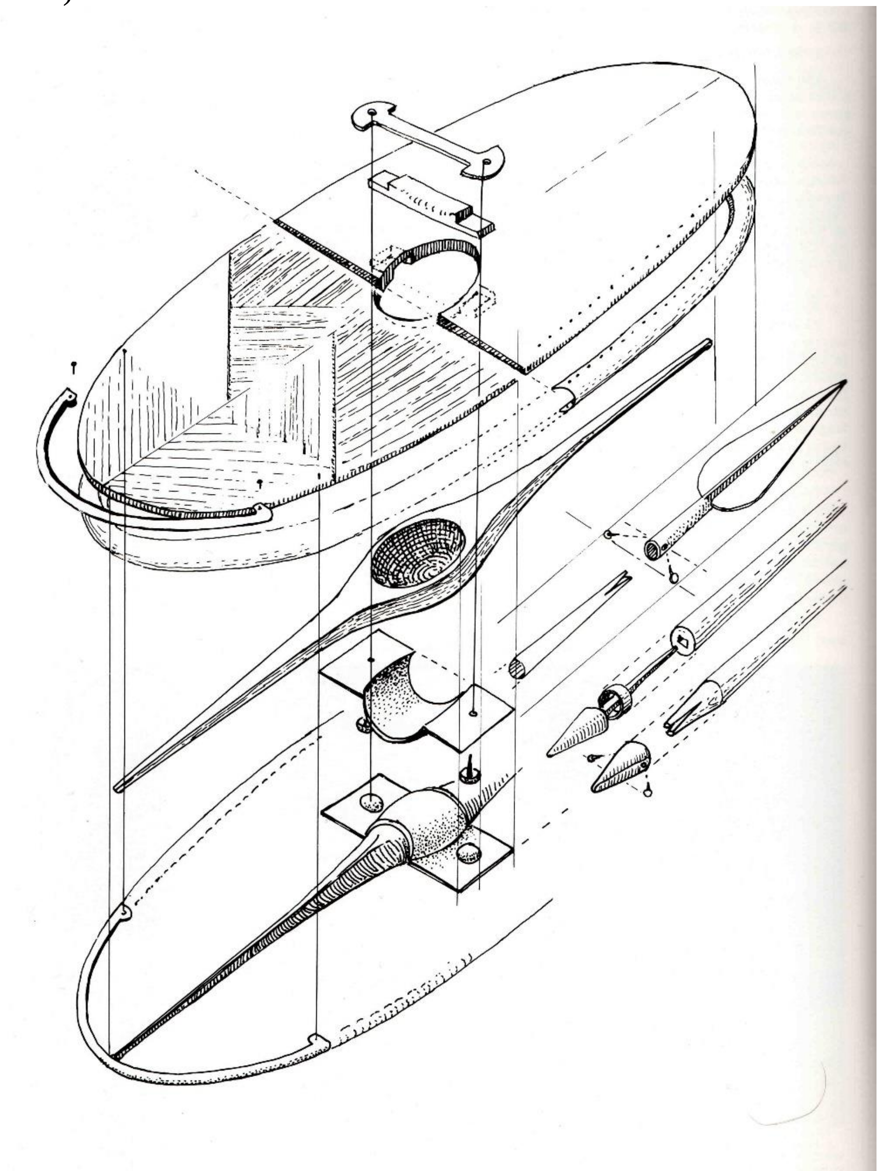
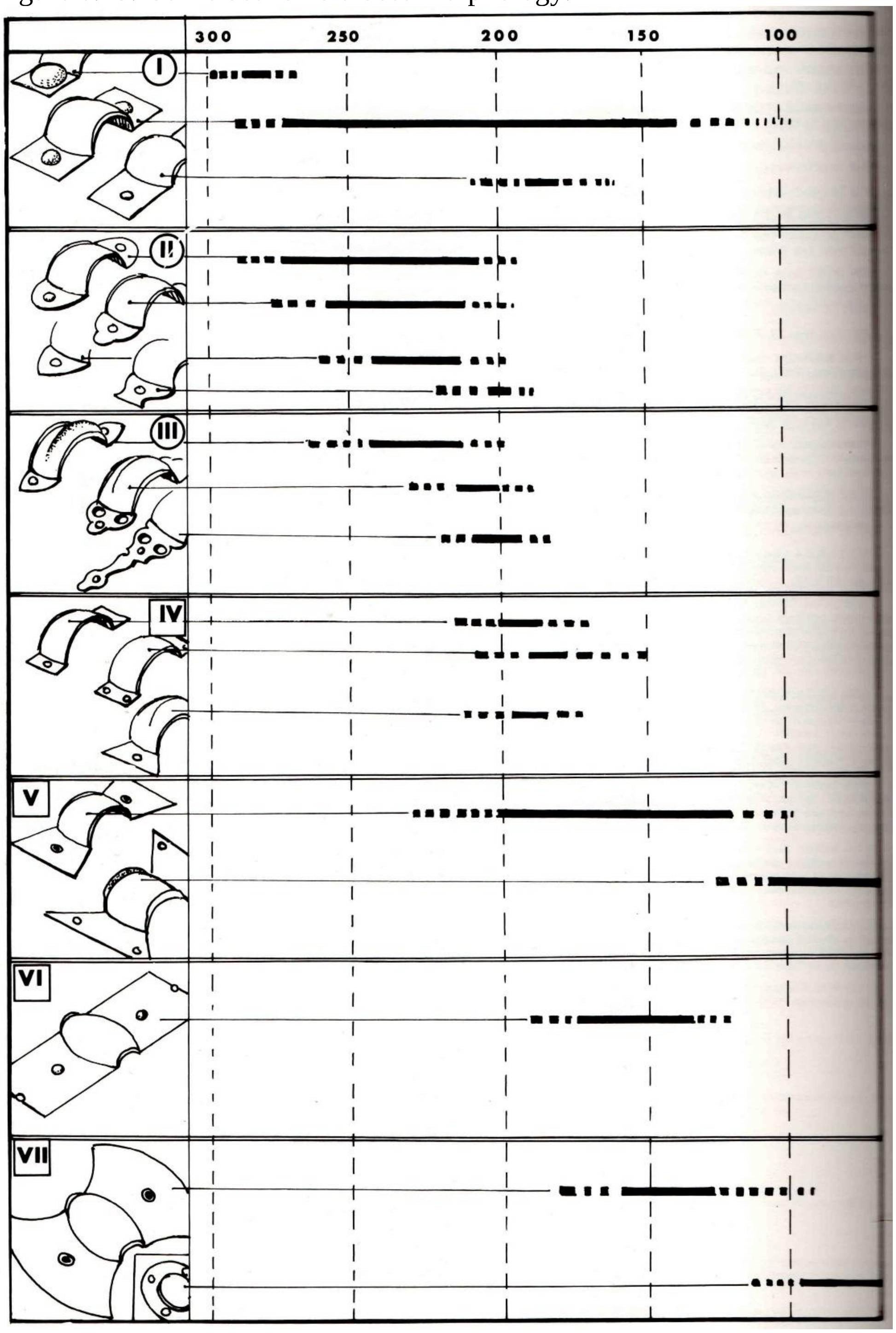


Fig. 1 Éclatés d'un bouclier et d'une lance celtiques.

283 Brunaux and Rapin (1988), 12.

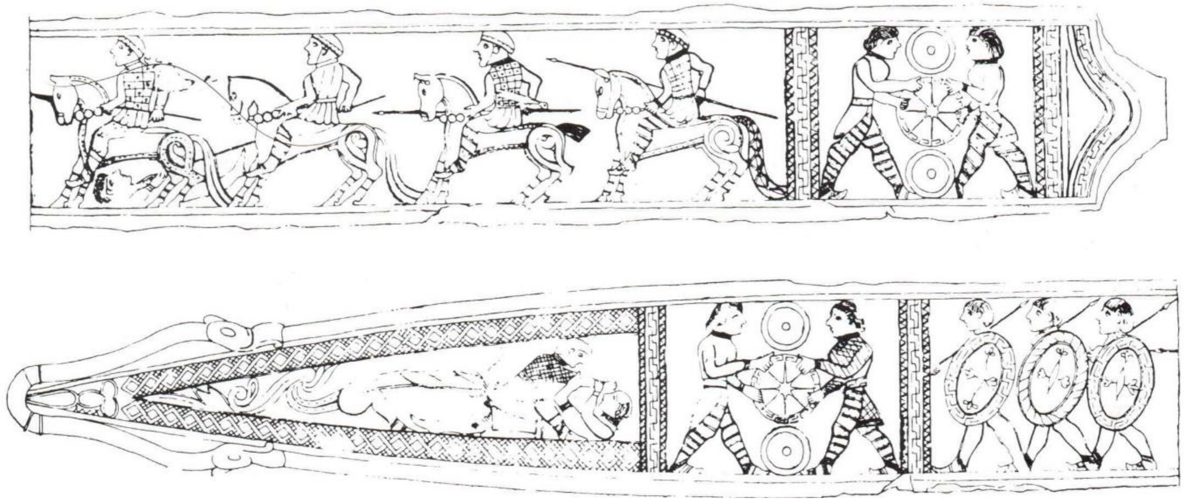
Figure 6.15: Gallic oval shield boss morphology.[284]



[284] Brunaux and Rapin (1988), 78.

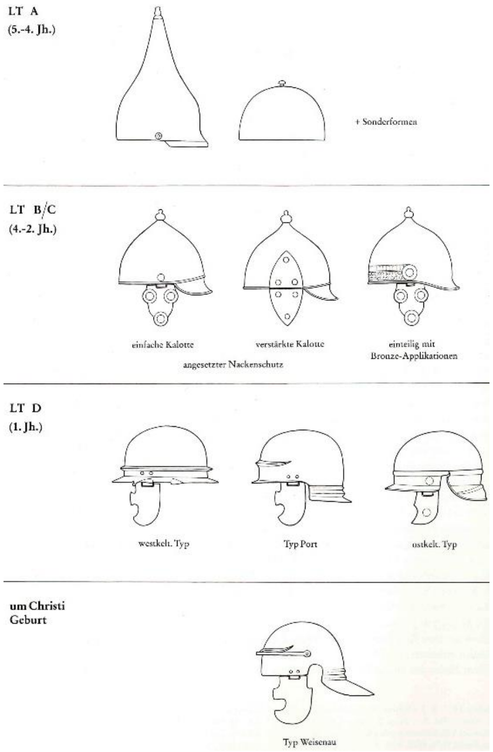
Figure 6.16: Detail from the Braganza Brooch (British Museum 2001,0501.1)

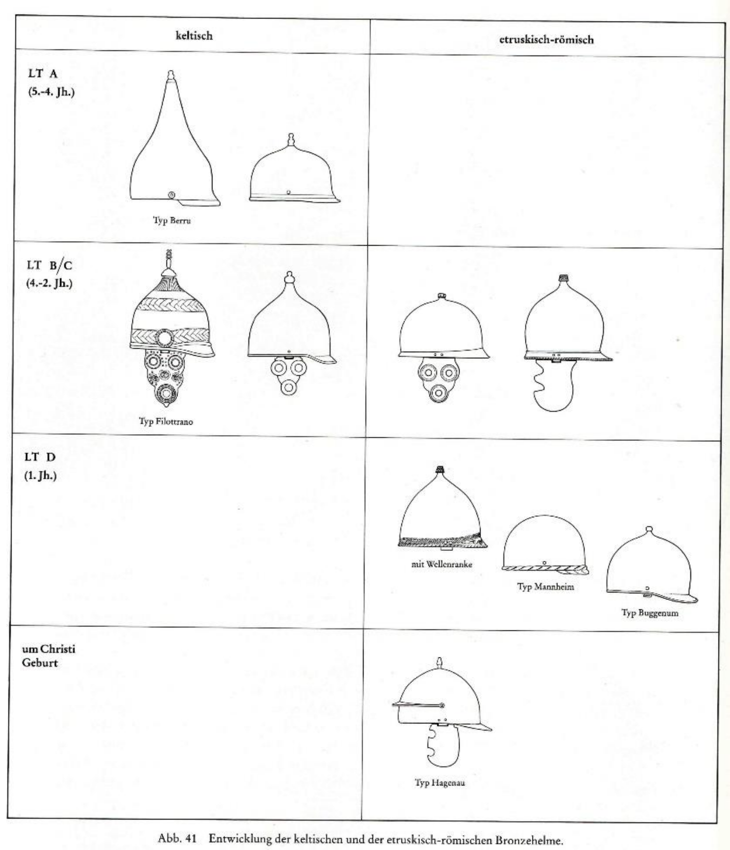
Figure 6.17: Military procession from a Fifth Century Scabbard from Hallstatt[285]



[285] Brunaux (1988), 106.

Figure 6.18: Chronology and Morphology of La Tène helmets, in iron (top) and bronze (bottom).[286]





[286] Schaaff (1988), 294, 316.

Figure 6.19: Examples of La Tène helmet forms[287]

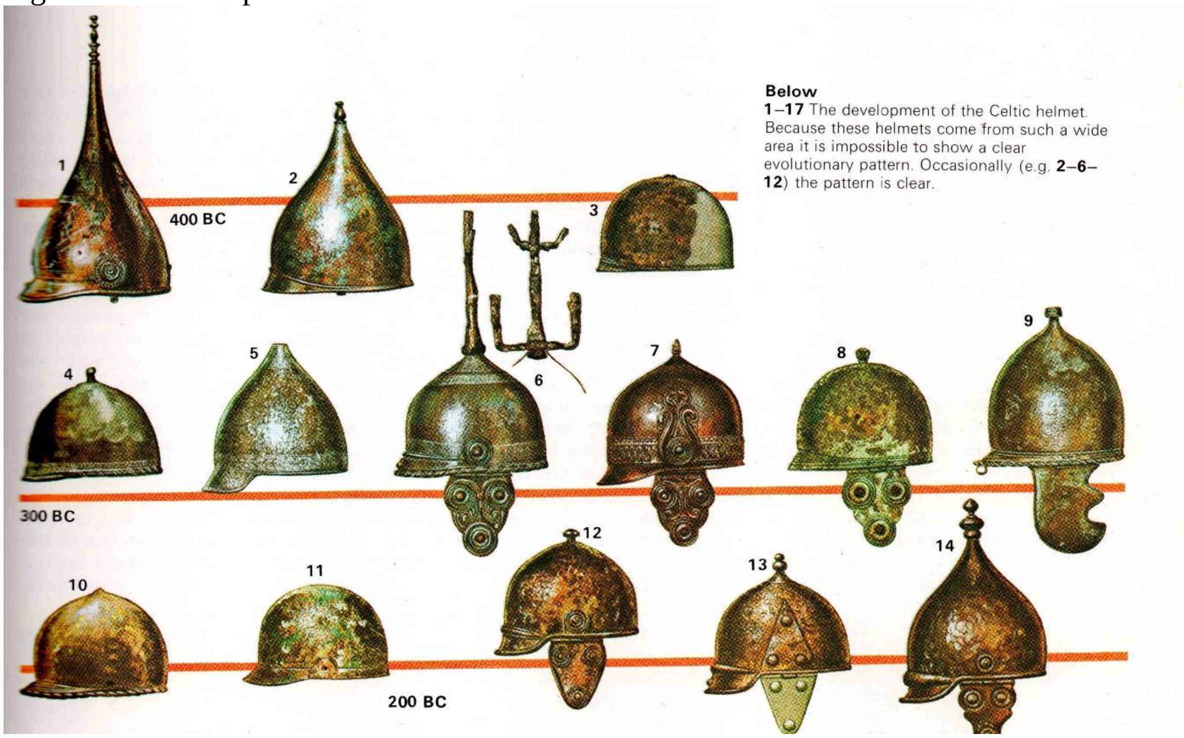


Figure 6.20: La Tène helmet construction[288]

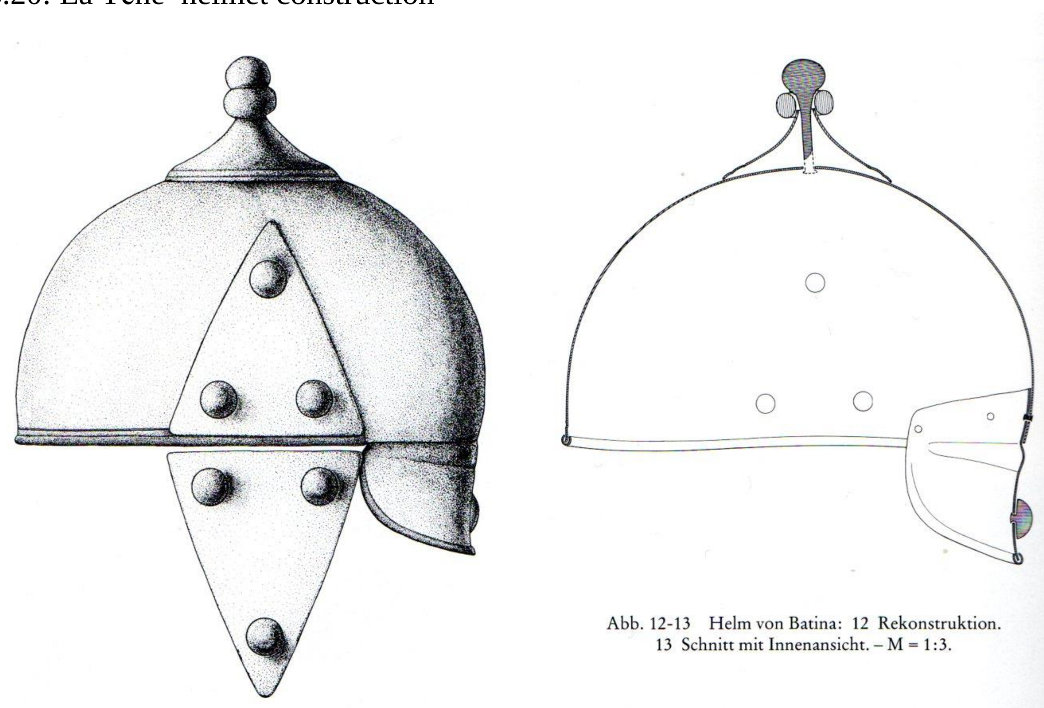


Abb. 12-13 Helm von Batina: 12 Rekonstruktion.
13 Schnitt mit Innenansicht. – M = 1:3.

[287] Connolly (1981), 121.

[288] Schaaff (1988), 300.

Figure 6.21: Decorated helmet from Ciumești[289]

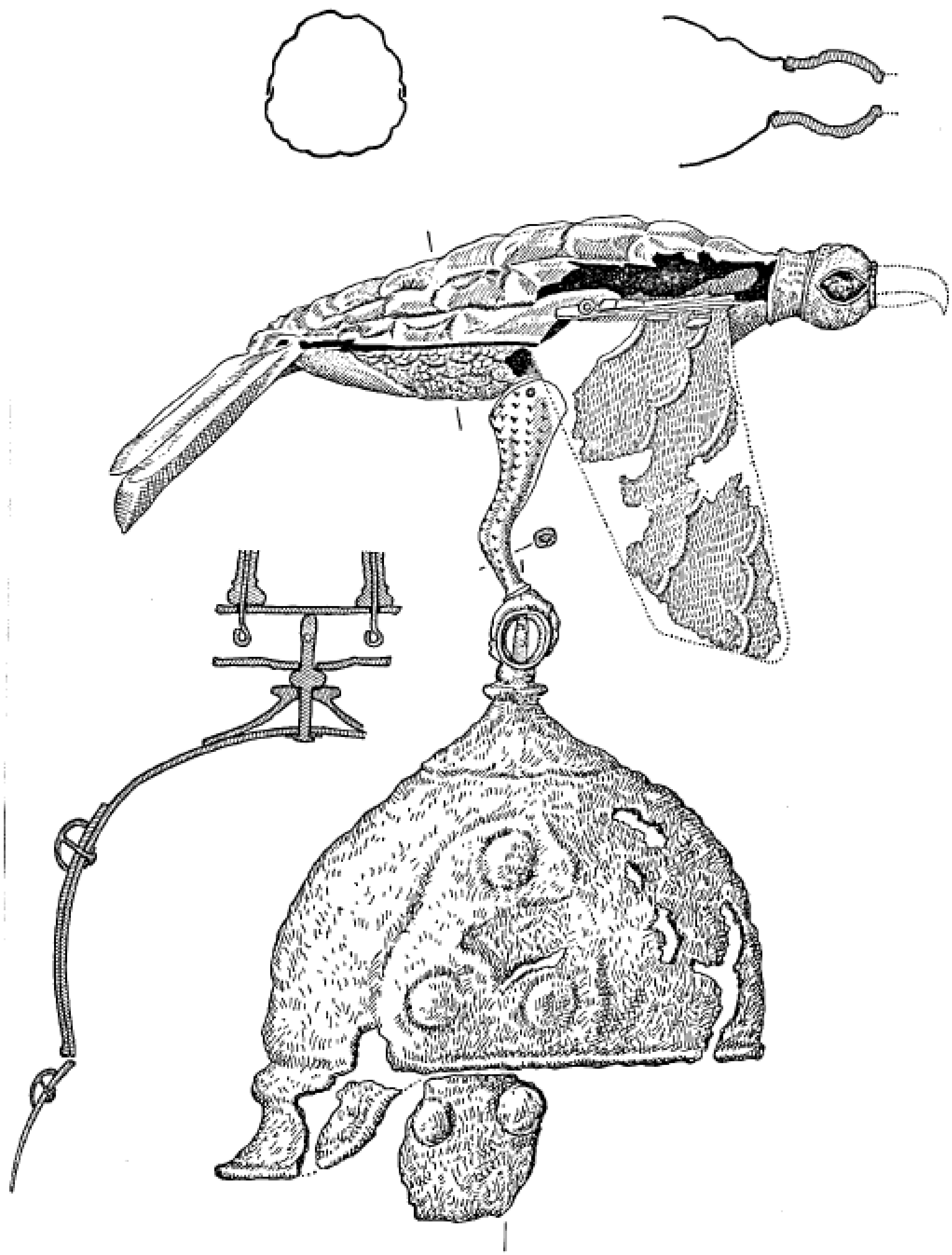


Abb. 2. Ciumeşti. Helm in Seitenansicht mit Schnitt. M. 1:3.

[289] Rusu (1969), 269.

Figure 6.22: ‘Montefortino’-type La Tène helmet, cat. G119

Figure 6.23: Iberian Panoplies by geographic area and chronological period.[290]

FASE	ARMAS	BAJA ANDALUCIA	ALTA ANDALUCIA, SURESTE, LEVANTE MERIDIONAL	LEVANTE SEPTENTRIONAL Y CATALUÑA	MESETA ORIENTAL	MESETA OCCIDENTAL
FORMATIVA (mediados s. VII-fin VI)	DEFEN.	Escudos de cuero Cascos cuernos (?) Cascos corintios(?)	Escudos de cuero Capacetes metal (?)	?	?	?
	OFENS.	Lanzas largas Espadas rectas de lengüeta en Fe Flechas de arpón	Lanzas largas Versión en Fe de espada del Bronce Final	Espadas de antenas importadas. Espadas de lengüeta en Fe. *Pila.*	Lanzas largas Jabalinas	¿Espada Miraveche? ¿Puñales Ae?
ANTIGUA (ppios. s. V a find s. V a.C.)	DEFEN.		Discos-coraza Grebas metálicas Protectores acolchados Escudos de cuero Escudos de madera con manilla corta Cascos de penacho Tachones de escudo y umbos radiales	Coraza de peto Grebas metálicas Tachones de escudo y umbos radiales Protección de material orgánico.	Discos-coraza Cascos de bronce Tachones escudo Prot. orgánica(?)	Quizá a fines del siglo escudos pequeños de umbo metálico
	OFENS.	Puntas de flecha de arpón	Espada frontón Puñal frontón Falcata Espada antenas tipo III Lanza larga tipos 1 y 2 Jabalinas tipo 12 *Soliferreum* *Pilum*	Espadas de antenas de tipos languedocienses. Lanzas tipo 1 Jabalinas tipo 12 Puntas de flecha de aletas *Soliferreum* y *Pilum*	Espadas antenas tipos I,II,III Espada frontón Lanzas largas Jabalinas *Soliferreum* *Pilum*	Espadas Miraveche Primeros puñales tipo III (Monte-Bernorio)
PLENA (*c.*400-*c.*230 a.C,)	DEFEN.		Escudos de manilla de aletas, grandes y medianos. Protecciones orgánicas Cascos de cuero y cresta metálica Tachones (raro)	Cascos de hierro de tipo celta Al final, escudo oval	Escudos de manilla de cinta Algunos umbos de hierro	Umbos de hierro hemiesféricos y calados. Grandes umbos radiales
	OFENS.		Espada frontón (rara) Falcata Espada tipos III y IV (raras) Puñales antenas atrof. Lanzas y jabalinas de todos los tipos, con predominio de tamaños medianos y grueso nervio. *Soliferreum* *Pilum*	Espadas de La Tène Lanzas anchas y medianas Jabalinas *Soliferreum*	Espadas de antenas tipo III (raro), IV y V. Falcata (muy rara) Espadas de La Tène (fin s. IV) Versión local de la espada de La Tène (s. III a.C.) Lanzas medianas nervio aristado Jabalinas Puñales híbridos de tipo IV y V.	Puñal Tipo III (Mte Bernorio) Espada Miraveche tardía. Espada tipo VI Espada frontón (muy rara) Falcata (rara) Lanzas anchas y medianas. Lanzas con nervio de arista. Imitaciones de La Tène (desde fines s. IV a.C.)
AVANZADA (*c.* 230-c.100 a.C.)	DEFEN.	Escudo oval Escudo circular pequeño (fin del periodo) Cascos de materia orgánica (Osuna)	Escudo circular grande Escudo circular pequeño Escudo oval Protecciones acolchadas. Cascos Montefortino	Escudo oval Escudo circular (más raro) Cascos Montefortino.	Escudo circular con manilla de cinta. Umbos de hierro Escudo oval (?) Casco Montefortino (raro)	Escudo circular ligero con umbo Escudo circular ibérico ¿Cota de mallas?
	OFENS.	Versión local de espada de La Tène Falcata (rara) Lanzas medianas anchas Jabalinas ¿*Soliferreum*?	Falcata Versión local de La Tène (rara) Lanzas, con mayor frecuencia de tamaños pequeños y sin nervio Dardos y Jabalinas *Soliferreum* (raro)	Falcata (rara) Espada de La Tène e imitaciones locales Lanzas de tipo celta e ibérico Jabalinas	Espadas antenas tipos V y VI Versión local de espada La Tène Lanzas sin nervio Jabalinas *Soliferreum* Puñales dobleglobulares (VI)	Puñal tipo III,IV y VI. Espadas tipo V, VI Lanzas medianas Jabalinas
FINAL (s. I a.C.)		Aparición sistemática de armas de tipo romano republicano: cascos Montefortino y Buggenum, escudos ovales con umbos de aleta trapezoidal, *pila* pesados y ligeros, *gladii hispanienses* derivados de la versión celtibérica de la espada de La Tène, puntas de flecha de hierro de pedúnculo. Además, algunas armas de tradición indígena: escudos circulares pequeños, falcatas, lanzas y jabalinas medianas y pequeñas, armas de fortuna.				

Figure 6.24: Iberian Falcatas from MAN Madrid, from top to bottom, cat. I6, I7, and I9.

[290] Quesada Sanz (1997b), 619.

Figure 6.25: Antenna Sword, cat. I4.

Figure 6.26: Structure of the Spanish *caetra*[291]

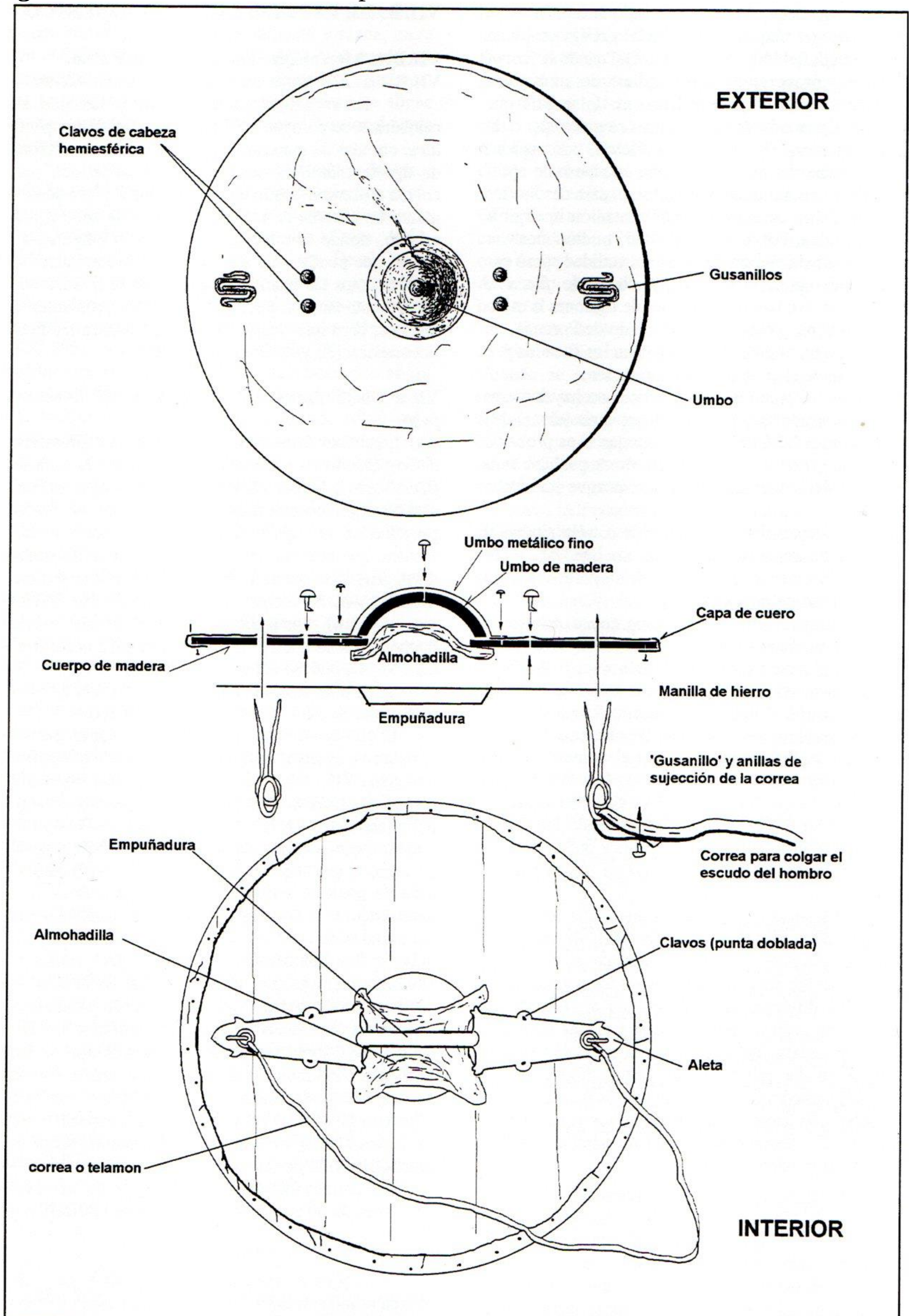
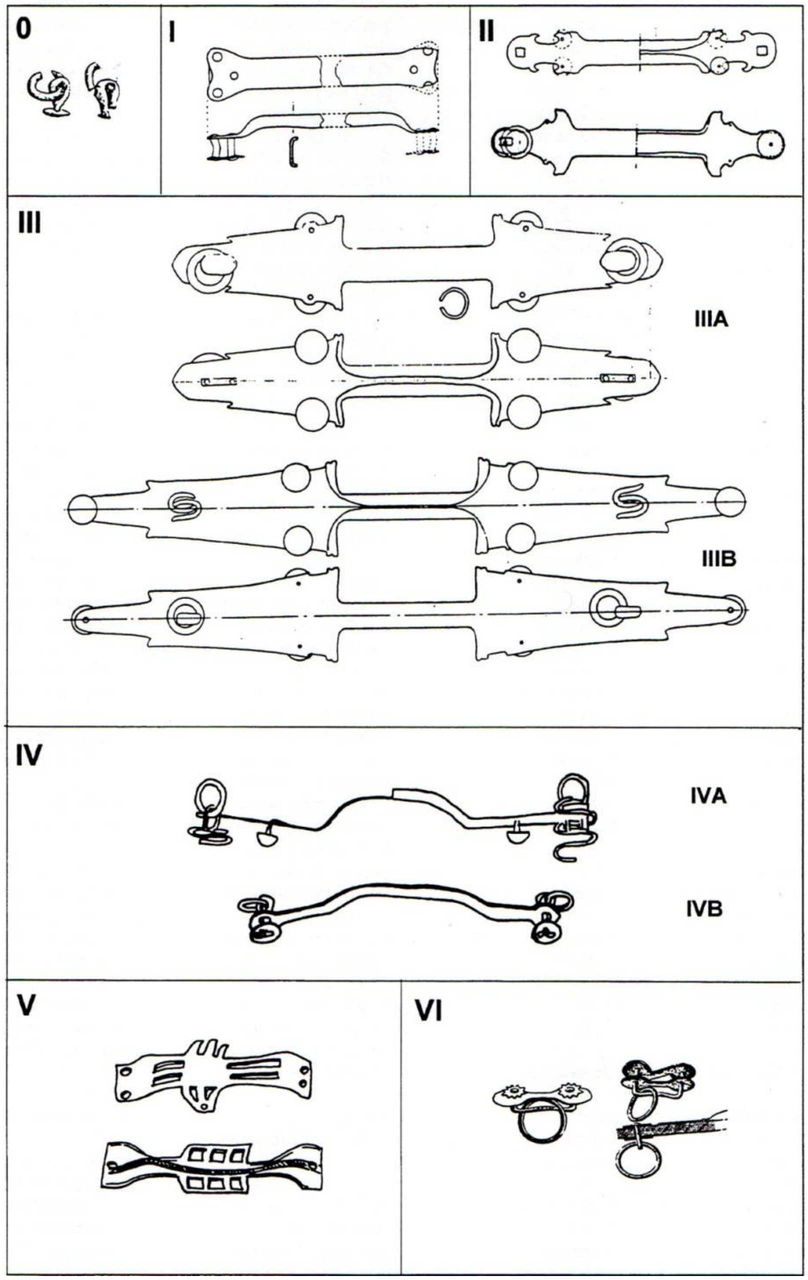


Figura: 286. Reconstrucción, elementos y denominación de la partes de un escudo circular ibérico con manilla de aletas.

291 Quesada Sanz (1997b), 490.

Figure 6.27: Typology of maniples for the *caetra*.[292]



[292] Quesada Sanz (1997b), 498.

Figure 6.28: Type IA large *Caetra* boss (cat. I15.)

Figure 6.29: Type IIA *Caetra* boss with radial projections (cat. I17)

Figure 6.30: Type IIIA small circular iron *caetra* boss (cat. I16)

Figure 6.31: Typology of tips and grips for the *soliferreum*[293]

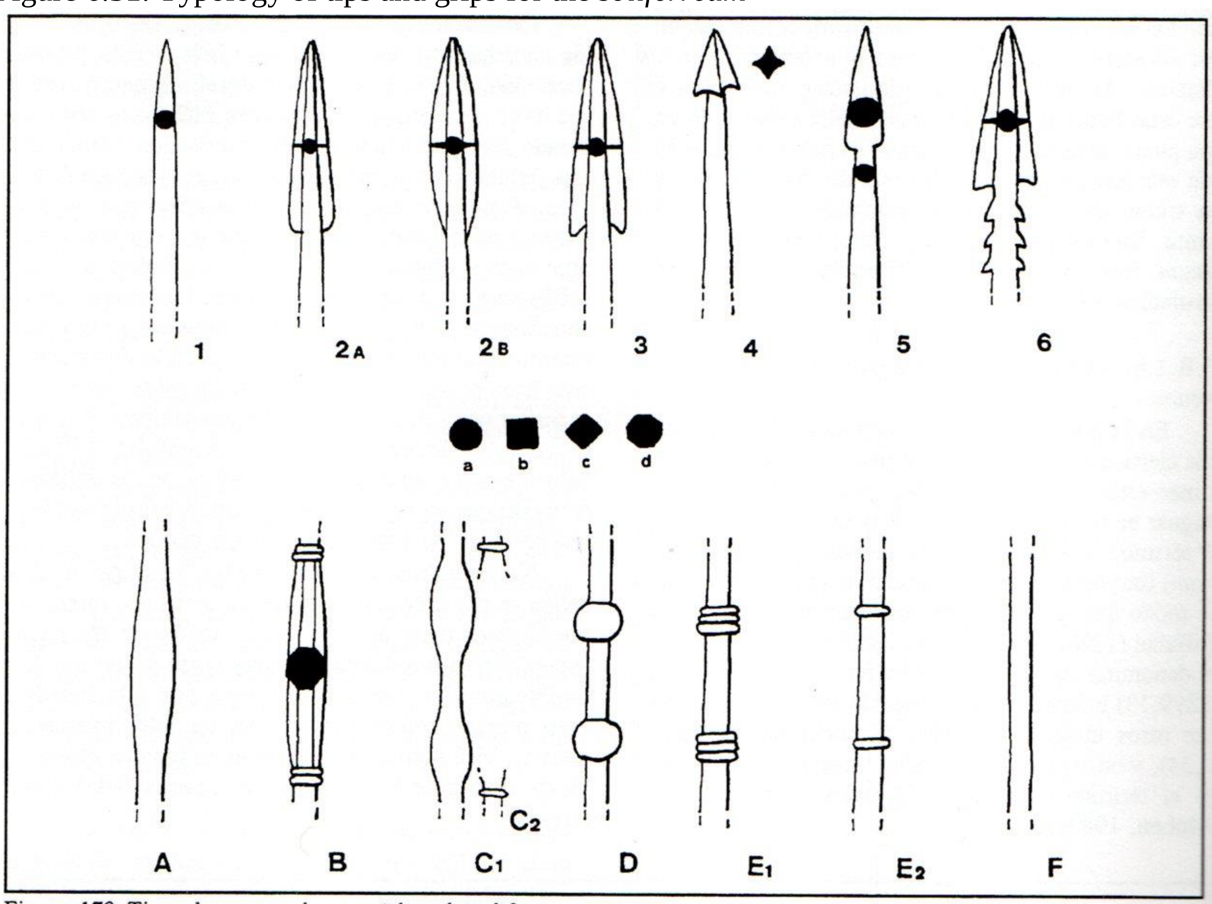


Figura: 179. Tipos de punta y de empuñdura de *soliferrea*.

[293] Quesada Sanz (1997b), 310.

Figure 6.32: Folded *soliferreum,* current configuration (cat. I14)

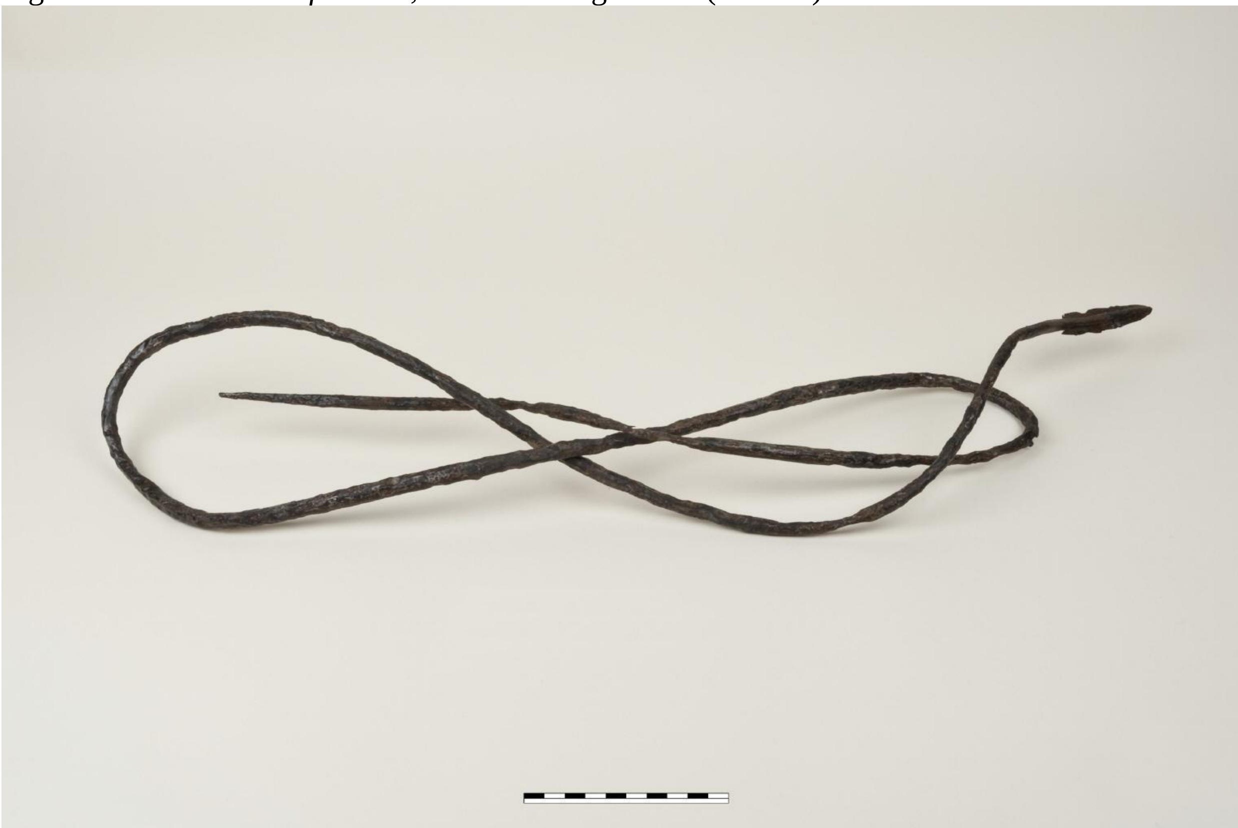


Figure 6.33: Folded and broken *soliferreum,* current configuration (cat. I13)

CHAPTER SEVEN: MOBILIZATION

The previous four chapters have laid out a series of reconstructions for the resource intensity, measured in metal-weight, of the equipment of many of the soldiers and warriors of the third and second century Mediterranean world. This final chapter makes use of these results in two parts. The first part considers the results of these studies together, engaging in a comparative analysis, addressing not only the individual resource intensity implied by the preceding reconstructions, but also the implications for armies and maximum deployments. My conclusion is that the Roman Republic comprehensively out-mobilized its rivals, deploying not only more men, but also more economic resources in the form of equipment. Combined with the analysis of other sources of cost such as logistics (see chapter three) it appears quite clearly that the Romans were able, and in fact did, dedicate far more resources to warfare during this period than any rival.

The second part of this chapter seeks to explain Roman success by analyzing the basic principles underlying the mobilization systems employed by the great powers and pre-state peoples of the Mediterranean. The two predominant systems of mobilization employed by Rome's rivals were either an 'extract and pay' system, in which revenues extracted from subject peoples were used to pay the armies subjugating them, or narrow, ethnically restricted entitlement-based systems of recruitment. The former system could be expanded to cover large territories of diverse peoples, but was brittle and suffered both from high administrative overhead and the resistance of subject peoples. The latter system, while very intensive, proved extremely difficult to expand to include new peoples or territories. Finally, the Roman system is considered. At its core, this was an entitlement-based system, but by utilizing the cultural institutions of Italy, it was able to scale massively by incorporating communities as allies. Such a system allowed Rome to mobilize a large area with little administrative overhead, thereby creating a substantial and indeed decisive advantage.

Comparative Analysis

It is worth gathering and summarizing the preceding reconstructions before embarking on a comparative analysis. A selection of the reconstructed metal-weights for infantry panoplies is presented in Table 7.1, ordered from lightest to heaviest in the median case. It should be noted that, of the examples shown below, the Roman *veles* is the only dedicated light missile infantryman. The sources do not allow for any confident reconstruction of other types of skirmish infantry, although as discussed in previous chapters, the limited evidence suggests that they would be just as light, if not lighter, than the *velites*. The more heavily equipped Macedonian *hegemones* of the front line are included in the figures for the peltasts and phalangites, since the armored front-line *hegemones* were an organic part of the *speira* or *syntagma*, the basic tactical unit of organization.[1]

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[1] Sekunda (2013), 90-1. Hatzopoulos (2001), 76-80.

Table 7.1: Comparison of Metal Intensity of Select Types of Infantry by Median Weight			
	Minimum	Median	Maximum
Gallic Warrior (no helmet)	723g	1,460g	2,370g
Veles	1,320g	1,470g	1,790g
Celtiberian Warrior	975g	1,540g	3,420g
Thureophoros	1,534g	2,136g	2,980g
Gallic warrior (helmet)	1,223g	2,185g	4,370g
Iberian warrior	1,045g	2,380g	3,410g
Peltast (average, inc. *hegemones*)	3,326g	4,219g	5,419g
Phalangite (average, inc. *hegemones*)	4,106g	5,177g	6,632g
Hastatus/*Princeps*	3,090g	5,595g	8,485g
Gallic aristocrat	5,023g	6,985g	10,320g
Hastatus/*Princeps*, *loricatus*	6,240g	8,815g	11,885g

It is further illuminating to break down these figures between offensive and defensive equipment; this is done for the median cases of the previous table in Table 7.2. Defensive equipment in this case includes not only armor but also shields. This exercise reveals that the increase in metal-weight from one panoply to the next is primarily motivated by increases in defensive, rather than offensive, equipment. Indeed, offensive equipment varies within a relatively narrow range; with only one outlier, each panoply carried between 1.2 and 1.7kg of offensive armaments. The most metal-intensive weapons belong to the Macedonian *sarisa*-infantry, on account of the substantial weight of the butt-spike required to balance the great length of the *sarisa*. But this difference is dwarfed by the variation in defensive equipment, ranging from only a few hundred grams of metal in some cases up to nearly 7.5kg. Put another way, the most metal-intensive offensive equipment set is a little less than twice as metal intensive as the least, whereas for defensive equipment, the most metal intensive is a little more than 45 times more metal intensive than the least.

Table 7.2: Breakdown by Equipment Type in the Median Case					
	Total	Offensive		Defensive	
Gallic Warrior (no helmet)	1,460g	1,240g	85%	220g	15%
Veles	1,470g	1,310g	89%	160g	11%
Celtiberian Warrior	1,540g	1,340g	87%	200g	13%
Thureophoros	2,136g	890g	42%	1,246g	58%
Gallic warrior (helmet)	2,185g	1,240g	57%	945g	43%
Iberian warrior	2,380g	1,460g	61%	920g	49%
Peltast (average, incl. *hegemones*)	4,219g	1,657g	39%	2,562g	61%
Phalangite (average, incl. *hegemones*)	5,177g	1,657g	32%	3,520g	68%
Hastatus/*Princeps*	5,595g	1,345g	24%	4,250g	76%
Gallic aristocrat	6,985g	1,240g	18%	5,745g	82%
Hastatus/*Princeps*, *loricatus*	8,815g	1,345g	15%	7,470g	85%

The Roman superiority in metal-intensity principally provides substantially greater protection. Rome's propensity toward heavier armor fits well within the pre-Roman tradition in Italy of favoring heavier protection. As Snodgrass notes, heavier forms of armor persisted among the Greeks of Southern Italy long after they became rare in Greece proper.[2] Likewise, iconographic evidence suggests that when the *linothorax* was adopted in Italy, particularly in Etruria, it was often substantially reinforced by metal scales and plates. Aldrete notes that metal scale reinforcement is roughly twice as common on Etruscan representations as on Greek and Hellenistic ones, and also that it often covered far more of the armor as well.[3] Italian helmets, as already discussed, also remained thicker and heavier; the trend towards lightness visible in Greek helmets beginning as early as the sixth century does not take hold of the Roman Montefortino helmet until the end of the second.[4] The Roman predilection for greater amounts of protection thus seems to be a continuation of the Italian military tradition of the previous centuries. More

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[2] Snodgrass (1967), 128-9. Everson (2004), 112, 144.

[3] Aldrete *et al*. (2013), 51-5.

[4] Jarva (1993), 134. Paddock (1993), 66, 801-2.

broadly, one might suppose that the Roman citizen-soldier, responsible for providing his own equipment, might have placed a higher value on his own survival than the value placed by a Hellenistic king on the life of one of his phalangites. For both reasons, Rome was uniquely well-placed to take advantage of new armor technology, such as mail.

Given then that Roman soldiers were altogether more heavily and expensively equipped than their contemporaries, we might expect Rome to have fielded fewer of them, but the opposite is the case. Taylor, in a recent study of military manpower in the third and second centuries, estimates peak Antigonid mobilization at c. 45,000 troops, including garrison troops.[5] The size of the Seleucid army is harder to guess, but Taylor figures c. 90,000 troops, with roughly 20,000 of them garrison troops.[6] The Ptolemaic army, judging from the deployment at Raphia, appears to have been roughly the same size as the Seleucid, though also heavily tied down by the need to garrison Egypt itself against native unrest.[7] Fischer-Bovet suggests that maximum-effort land forces of the Ptolemies might total at most some 90-95,000 compared to 90-110,000 for the Seleucids, with roughly 20,000 of each figure tied up in garrisons; in peacetime, the figures drop to c. 50-55,000 and c. 70-75,000 respectively.[8] In contrast, Brunt estimates that between 200 and 168, Rome's lowest mobilization was 82,900 soldiers and the highest a staggering 182,400.[9] Taylor's figures for the same are somewhat more conservative, ranging from 70,000 to

[5] Taylor (2015), 53-4. See also Hatzopoulos (2001), 36-8, 68-9, 75; Sekunda (2013), 114-9.

[6] Taylor (2015), 83-4. See also Bar-Kochva (1976), 168-9.

[7] Taylor (2015), 66-77. Plb. 5.65, 79-87.

[8] Fischer-Bovet (2014), 76. Fischer-Bovet also includes figures for the crew of Ptolemaic and Seleucid fleets, which I have excluded here to provide comparable numbers. The maximum figures for both fleets are soundly dwarfed by the size of Roman and Carthaginian navies, see chapter 2.

[9] Brunt (1971), 424.

175,000.[10] Indeed, between 200 and 168, Taylor's figures produce an average annual Roman mobilization of 110,000, higher than the peak mobilization of any of the Hellenistic states.[11] As Taylor argues, the only ancient state able to match such figures was third century Carthage, but, as noted in chapter six, Carthage was forced to compromise heavily on quality in order to do so.[12]

It is worth also putting these figures into perspective by discussing the mobilization of equipment in individual years or for individual deployments. Hannibal's infantry force for the first three years in Italy, it may be recalled from chapter six, had an estimated metal requirement of 143,742kg; accounting for his cavalry yields an upper-bound figure of c.224,000kg (roughly 246 tons).[13] In contrast, the metal intensity of the massive Roman army at Cannae alone was on the order of c. 320,000kg (353 tons) of worked metal.[14] Even allowing for the forces Hannibal lost crossing the Alps, it is unlikely that the total worked metal carried by his force approached this Roman figure, much less a figure which includes all of the Roman forces he faced during those initial three years.[15]

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[10] Taylor (2015), 18-9.

[11] If Taylor's figures to 218 are included, the average mobilization rises to 116,000.

[12] Taylor (2015), 36-50.

[13] As noted in chapter six, this figure, which assumes c. 4kg of worked metal per soldier, is an upper-bound figure, as it assumes that all of Hannibal's cavalry was mailed heavy cavalry; the Numidians at the very least were not (Plb. 3.72.9, 3.116), but Polybius' account does not allow for a detailed breakdown of Hannibal's cavalry by type.

[14] Following Polybius 3.107.9-14. Liv. 22.36.1-5 suggests the army might have been smaller, with just two additional legions, rather than four. The metal-weight estimate here assumes only 33% of Romans wore the *lorica hamata*, rather than 40% as in the other examples, to account for this battle being chronologically earlier, at a time when the *lorica hamata* was likely not as widespread. The precise calculation results in a figure of 320,796.8kg, but I have opted in this case to round heavily to avoid the misleading appearance of excess certainty.

[15] Estimating the metal-requirements of Hannibal's army prior to crossing the Alps is complicated by the lack of information as to the nature and extent of the equipment typically carried by his African troops. We may safely assume it was rather less than what the Romans were equipped with, as Hannibal made a point of re-equipping his Africans in Roman fashion, Plb. 3.114; Liv. 22.46.4. Polybius does report that Hannibal started from the Rhone

The same exercise can be equally illuminating when applied to the peak mobilizations of the Hellenistic great powers. Following the metal-weight estimates in chapter four, the metal requirements of the peak Antigonid mobilization at Citium in 197 can be estimated around 174,009kg (192 tons) of worked metal.[16] For Rome, 197 was one of the least mobilized years in decades, with only six legions deployed; nevertheless the metal requirements of those six legions and associated *socii* might conservatively total some 246,780kg (272 tons).[17] The massive Seleucid army at Magnesia, which likely represented more than three-quarters of the total Seleucid strength, required an even more formidable total of some 248,905kg of worked metal (274 tons).[18] For comparison, the Romans had an astonishing 13 legions active in 190, with consular armies in Greece and Italy and separate commands in Liguria (to be moved to Apulia and Bruttium), Aetolia, Sicily, Tuscany, Spain and Sardinia.[19] The total metal requirements of these legions and their associated allied forces amount to 534,690kg of worked metal; if Rome's non-Italian allies at Magnesia are included, the total increases to 579,827kg (639 tons).[20] In

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with 38,000 infantry and 8,000 cavalry, and arrived in Italy with 12,000 African infantry, 8,000 Iberian infantry and 6,000 cavalry; he does not specify how many of those lost in the passes were Iberian or African. Plb. 3.56.4, 60.1-5.

[16] For an army consisting of 21,000 phalangites, 5,000 peltasts, 4,000 Hellenistic cavalry, 3,000 Thracians (assessed as *thureophoroi*, but with an additional 1kg of worked metal to account for the *rhomphaia*), 2,000 Odrysian and Greek *thureophoroi*, 2,000 Gallic warriors and 3,000 light troops, for a total force of 40,000. Liv. 45.51; Sekunda (2013), 114-9.

[17] This assumes that the legions were only 40% *loricatus* and had a matching allied force of the same size. In fact, both Taylor and Brunt assume a significantly larger allied force in that year, so this figure is almost certainly an undercount. Taylor (2015), 18. Brunt (1971), 424.

[18] Following Bar-Kochva (1976), 168-9, I have assumed 16,000 regular phalangites, 10,000 *argyraspides* (also phalangites), 2,000 Hellenistic cavalry, 6,000 cataphracts, 5,000 Gallic infantry and 2,500 mailed Gallic cavalry; the remainder of the infantry seems to have been very light skirmishing troops. Liv. 37.40; App. *Syr.* 32.

[19] Liv. 37.2.1-10. Brunt (1971), 424. Taylor (2015), 18. Rome and the Seleucids also had active fleets in that year, with the Roman fleet, supplemented by allied forces, being larger.

[20] Assuming the legions were only 40% *loricatus* and that allied forces, again, were only matching in size. Brunt (1971), 424 suggests 110,900 allies for only 71,500 legion troops; for Taylor (2015), 18, the figures are 71,500 and 105,000 respectively.

short, the Romans mobilized vastly more worked metal equipment than their rivals, to the point of more than doubling the metal requirements of the peak mobilization of the largest Hellenistic state, the Seleucids.

The Roman advantage in worked metal could be offset, to a degree, by the willingness of Hellenistic kings to concentrate nearly all of their field forces for a single battle. The Roman forces at Pydna would have required only 102,825kg of worked metal, while the Roman and allied force at Magnesia might only have brought 127,396kg; those totals are lower than those for the armies they were directly facing.[21] Nevertheless, it is worth remembering that smaller Roman forces were victorious in most of the major engagements against Hellenistic armies, while still being a relatively small fraction of total Roman forces. Indeed, at Magnesia the Seleucid effort to field a very large army, at the cost of the average quality of forces deployed, seems to have been one of the major factors contributing to defeat, as the light troops on the Seleucid left collapsed at the outset of the battle and exposed the phalanx to envelopment.[22] Such concentrations also carried another danger: with nearly the entire field army in one place, a disaster such as Cynoscephalae, Magnesia or Pydna was nearly impossible to recover from in the short term, because a defeated Hellenistic king lacked sufficient forces to fall back on. Yet against Roman armies, Hellenistic kings had little choice but to concentrate nearly all of their forces and hope for the best.

It is necessary to reiterate that this Roman advantage in matériel did not mean that Roman armies would win every battle or that Roman victory was preordained. As Cannae

[21] Pydna: Liv. 44.21.2; Brunt (1971), 424. Magnesia: Liv 37.39.7-12. The Roman force at Magnesia consisted of two over-strength legions and matching numbers of *socii*, along with 3,000 allied peltasts from Eumenes and the Achaeans, along with 800 Greek cavalry and roughly 2,300 Roman cavalry, 2,200 deployed with the Greek cavalry on the right as well as 4 turmae (roughly 120 horse) on the left.

[22] Liv. 37.42. App. *Syr*. 34.

confirms quite clearly, better equipment in itself gave no certainty of victory in battle. However, as the previous chapters have endeavored to show, Rome's matériel preponderance did produce significant battlefield advantages. Of particular note is the edge supplied by Rome's increasingly widespread use of mail armor. It made all the more impact because Rome's armies were the first to deploy such armor on a large scale. As a result, Rome's adversaries generally did not yet use many weapons which could effectively defeat mail. Likewise, as discussed, the *pilum*, a metal-intensive, disposable and armor-piercing throwing weapon, was quite successful, judging by efforts to adopt it in both Gaul and Spain. Nevertheless, Rome's most decisive edge over the other peoples and states of the Mediterranean was not individual well-equipped armies, but the strategic depth provided by the ability to field a multitude of such armies without compromising their quality. It has long been observed that Rome could field more soldiers; the clearest conclusion from the preceding chapters is that these soldiers were also more expensively equipped. This observation leads in turn to an inescapable conclusion: Rome comprehensively out-mobilized the other states and peoples of the Mediterranean, not only in manpower, but also in economic resources.

This conclusion returns us to the question of the source of the exceptional Roman mobilizations which in turn enabled Roman success in this period. My analysis so far has been focused on the steady elimination of possibilities. My first chapter laid out some of the key ways in which Rome was not exceptional: Rome was not exceptionally aggressive or bellicose, nor exceptionally large

Table 7.3: Estimated annual revenues for the Mediterranean Great Powers in millions of Attic *drachmai* in the Early Second Century (Taylor 2015)

	Peak Revenues	Trough Revenues
Ptolemaic Kingdom	72	35
Seleucid Kingdom	60	40
Carthage	12	9
Rome	13	3-4
Antigonid Macedon	12	8

or populous. To these limitations we may now add that Rome was not exceptionally rich, especially at the level of state finance. In a comparative study of the admittedly limited evidence for the finances of the great states of the Mediterranean in this period, Taylor notes that Rome's own state finance apparatus was rather weak, on a par with Antigonid Macedon, and woefully outmatched by the Seleucid and Ptolemaic kingdoms (see table 7.3).[23] Moreover, the returns from Rome's campaigns were insufficient in the short term to repay the tremendous cost of Rome's military activities in the third and second centuries; Rome's wars outside of Italy did not, in fact, feed themselves.[24]

The reconstructions of chapters four, five and six have endeavored to show also that this Roman mobilization advantage cannot simply be attributed, as Sekunda has suggested, to the Roman "ability to conscript horde after uncomplaining horde of Italian peasant manpower."[25] As discussed in chapter three, the production of staggeringly vast quantities of worked metal equipment required a society to dedicate significant raw material resources, along with skilled labor. Legions of peasants were necessary, but not sufficient. Legions of smiths, miners, foresters, smelters and other craftsmen, as well as their equipment and the agricultural surplus to provision them, were also necessary. Rather than being cheap and uncomplaining, Roman soldiers were expensive to equip and to supply; they also had substantial latitude for complaining (see below). Roman armies were thus not easier to field in quantity, but in fact harder; and yet Rome did field them in quantity. The mere existence of the Italian peasantry is thus insufficient to explain Rome's tremendous advantage in mobilized resources. Instead, the answer to this

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[23] Taylor, (2015), 107-187.

[24] M. J. Taylor, "State Finance in the Middle Roman Republic: A Reevaluation" *AJP* 138.1 (2017): 143-180.

[25] N. Sekunda, "Hellenistic Warfare" in *Warfare in the Ancient World*, ed. J. Hackett (London: Sidgwick & Jackson Ltd., 1989), 133.

quandary must be found in the mobilization systems themselves of the great states and pre-state peoples of the Mediterranean.

Mobilization Systems

As discussed in the first chapter, the problem of mobilization was to extract the necessary resources from the (primarily agricultural) underlying economy in order to produce military force. Resources in this case can mean both manpower, which must be removed from the economy through recruitment, as well as supplies and equipment, which must be produced by the underlying economy. The systems for extracting and directing this agricultural surplus could also themselves impose additional costs, such as the cost of maintaining administrators and tax collectors, as well as the cost of managing resistance to resource extraction. It is not my intent here to give a complete reckoning of all the complexities of the mobilization systems of Mediterranean states, but rather to describe their primary operating principles in order to provide a contrast with the Roman system.

Engines of Force – Revenue Extraction and Professional Armies

One option for resource mobilization was an 'extract and pay' system, where the state uses military force to extract revenue which is in turn used to maintain and expand that military force. For example, Aperghis describes the chief function of the Seleucid state: "an army was maintained in order to exact tribute and fed off the process of this tribute."[26] Carlos Noreña,

[26] Aperghis (2004), 189. Note also Eckstein (2006), 82-90 and Billows (1995), 20-3 on the essentially military nature of Hellenistic monarchy.

speaking of the Roman Empire, describes this relationship as a "military-tributary complex."[27] The two tasks, the extraction of revenue and the raising of armies, were deeply interconnected because these states relied on armies of soldiers serving under the vocation principle, that is, primarily for pay or land grants, in order to extract further revenue and maintain state control.[28] The separation of the state apparatus that extracted and spent surplus from the population that generated it was in turn made all the more pronounced by a strong ethnic distinction between the two.[29] This interaction seems to have defined the mobilization systems of the Seleucid, Ptolemaic states, and formed part of a 'hybrid' system employed by Carthage and, to a lesser extent, Antigonid Macedon.[30]

Paying for military force in this manner was expensive. The going rate for service in the eastern Mediterranean in the time of Antiochos III seems to have been around 1 *drachma* per day; an *ostracon* from third-century Babylon seem to confirm this figure as a good rough approximation of the pay of Seleucid soldiers.[31] Such a figure likely did not include a normal daily ration allowance of roughly 2 obols, making the gross pay of a Seleucid soldier c. 8 obols (1 *drachma*, 2 obols). The pay rate in Ptolemaic Egypt seems to have been roughly the same when differences in the weight of currency are accounted for (a standard rate around 9 Ptolemaic

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[27] C. Noreña, "Urban Systems in the Han and Roman Empires" in *State Power in Ancient China and Rome*, ed. W. Scheidel (Oxford: Oxford University Press, 2015), 201.

[28] On the 'vocational principle,' see Landers (2003), 285-7.

[29] The 'Macedonian' character of Seleucid and Ptolemaic armies has been discussed in more detail in chapter five.

[30] For this characterization of the Carthaginian system as a hybrid one: on the primacy of mercenaries note Plb. 1.71-2, 6.52.4. Ameling (1993), 183-223. Carthage did maintain some citizen forces, Hoyos (2010), 153-5, 189-92. Some of Carthage's forces were also recruited through horizonal ties among elites, note esp. Plb. 1.78.1-9, where Hamilcar's personal relationship with Naravas, a leading Numidian, nets him 2,000 cavalry. Likewise, note the marriage alliance between Hasdrubal Gisgo and Syphax, Liv. 29.23.

[31] Aperghis (2004), 200-3. Taylor (2015), 177-8.

obols being roughly equal to one Attic *drachma*), with food supplied directly from royal reserves.[32] In comparison, Polybius places the pay of Roman soldiers at only 2 obols per day, out of which their food was deducted.[33] In a very real sense, the Roman soldier was also paid in non-monetary goods: status and a voice in the running of the Republic, along with a package of socially underwritten rights.[34]

As a result of the high cost of maintaining soldiers on the vocation principle, the state-military revenue extraction apparatus was extremely expensive, to the point that it consumed a significant part of that revenue as a form of overhead. The Seleucid system makes an effective example. The Seleucid army may have cost somewhere between 40 and 70 million *drachmae* annually, depending on the level of military activity, against a state revenue of perhaps only 60 million *drachmae* at the highest (see table 7.3).[35] In addition, the administration necessary to collect the taxes themselves incurred additional expenses. Aperghis estimates the cost of satrapal administration roughly between 2,000 and 3,000 talents (12 million to 18 million *drachmae*)

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[32] Taylor (2015), 169-70. Fischer-Bovet (2014), 73-5. W. Clarysse and E. Lanciers, "Currency and the Dating of Demotic and Greek Papyri from the Ptolemaic Period," *Ancient Society* 20 (1989): 117-132.

[33] Plb. 6.39.12. Polybius has, of course, converted from Roman currency units. The actual pay was probably 3 or 3.5 *asses*. M. H. Crawford, *Coinage and Money under the Roman Republic: Italy and the Mediterranean Economy* (Berkeley: University of California Press, 1985), 146-51. Note also Plaut. *Mostellaria* 357, where the pay of Roman soldiers is said to be *tres nummi* and Plut. *Tiberius Gracchus* 13.

[34] Landers (2003), 285, refers to this sort of system as recruitment based on 'entitlement' in contrast to the 'vocational principle' of professional, paid soldiers.

[35] Aperghis (2004), 205; Taylor (2013), 175-9. Aperghis suggests that the Seleucid military (including the navy) might cost between 7,000 and 10,000 silver talents (42 and 60 million *drachmae*) per year. Taylor argues that Aperghis has overestimated Seleucid revenues and estimates, that during periods of peak deployment, the cost of the Seleucid military might amount to 70 million *drachmae*, compared to only 60 million in revenue, with years of high military intensity made up for by surplus revenue in years of peace.

annually.[36] Thus even in peacetime, the apparatus for the extraction of tribute could be said to cost more than 50 million *drachmae*. The cost of revenue extraction consumed the great majority of all the revenue so extracted, providing little room for military expansion or rapid recovery without spending down treasury reserves. Ptolemaic revenues were greater, but so were the costs of the Ptolemaic army. Moreover, the Ptolemaic administration was, if anything, larger and more complex than the Seleucid, with fewer functions devolved on to local communities.[37]

The advantage of such a system is that it can be readily expanded through military conquest, by imposing new tribute obligations on conquered peoples to support continued military activity. But, as noted, as the state expands, the military and administrative overhead of the system increasingly consumes the additional revenue, resulting in an overall loss of efficiency. Moreover, the system is fundamentally brittle. The state was reliant on force, rather than some form of domestic legitimacy with which to motivate collective action (what we might term 'power' in contrast to force) in order to raise force or to extract revenue. Hence, the loss or demobilization of the army could produce a spiral of instability and fragmentation.[38] Likewise, expanding the military's resource base to include subject peoples weakens the control of the

[36] Aperghis (2004), 205-6; Aperghis' figure excludes the pay of the garrisons themselves, which are included under the rubric of army costs. Note also Sherwin-White and Kuhrt (1993), 48-51.

[37] On the cost of the Ptolemaic military, see Fischer-Bovet (2013), 73-4. Taylor (2015), 163-74. Fischer-Bovet estimates the Egyptian military expenses as 10,200 to 13,400 talents during wartime and around half that figure during peacetime, while Taylor estimates that military expenditures during wartime might be around 90 million *drachmae* (15,000 talents) and 40 million (c. 6,660 talents).

[38] The steady disintegration of the Seleucid empire, albeit under Parthian and Roman pressure, seems to follow this pattern. Sherwin-White and Kuhrt (1993), 217-28. In presenting power and violence (or 'force') as opposed principles, I follow H. Arendt, *On Violence* (New York: Harcourt, Brace & World, 1969). In using the term 'force' over the more specific 'violence,' I am following Wayne Lee, pers. correspondence.

state, and can result in the same instability.[39] In both cases, military and financial weakness creates further weakness, because it disrupts the fundamental engine of state power whereby military force is used to raise revenue to fund further military force.

Problems of Scale – The Antigonids and Pre-State Peoples

Antigonid Macedon's mobilization system was effectively a hybrid, but with the largest share of the state's resources arising out of the Macedonian core, rather than the subject periphery. As noted in chapter five, the largest part of the Antigonid as were the Macedonians themselves, who served as part-time, rather than professional, soldiers.[40] Soldiers were levied by conscription from their local communities and assigned to units based on wealth classifications.[41] Although far from being civic participants like Roman citizen-soldiers, the Macedonian soldiers were more integrated into the Antigonid political system than the Seleucid or Ptolemaic ones.[42] Macedonians in the Antigonid army were paid, but the evidence suggests a wage of 4 obols per

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[39] The example of this *par excellence* is the instability suffered by the Ptolemaic state after Raphia, Plb. 5.107.1-3. Fischer-Bovet (2013), 88-98 seeks instead to classify the Great Revolt more as an example of instability as a result of demobilization and fiscal failure. In either case, the fundamental brittleness of the system's reliance on military power is clear. There is also debate as to the degree to which the core Seleucid territories were demilitarized for this reason. Cf. Bar-Kochva (1976), 20-48; Sherwin-White and Kuhrt (1993), 53-6; Aperghis (2004), 193-7. In my view, the treatment of the core of the Seleucid army as fundamentally Greek and Macedonian in the sources (particularly by Polybius, Livy and, to an extent, Appian) is too strong to ignore.

[40] Thus, the dismissal of troops for the winter, e.g. Plb. 4.87.13.

[41] Sekunda (2013), 102-5.

[42] Taylor (2015), 58-9. Right to petition the king: Plb. 5.27.5-6. On soldiers' assemblies and their limited role in the acclamation of new kings, note E. M. Anson, "Macedonia's Alleged Constitutionalism" *CJ* 80.4 (1985): 303-316; E. M. Anson, "The Evolution of the Macedonian Army Assembly (330-315 B.C.)" *Historia* 40.2 (1991): 230-247. Anson contends, convincingly, that the influence of the soldiers' assemblies was a product of Alexander's campaigns, and that this influence peaked in the immediate aftermath of his death and the early wars of the *diadochoi*, only to fade again, remaining most potent in the Antigonid state. For examples of the system under Alexander, note esp. Arr. *Anabasis* 5.25.-29, 7.8.1-7.11.9.

day, somewhat below the 'going rate' for mercenaries.[43] This lower pay may have been due to the relative poverty of the Antigonid state, but it may also have represented a benefit of the rather closer relationship between the king and the army. The bulk of the phalanx thus appears to have been closer to an ethnic or 'national' militia than a professional force.

Onto this ethnically Macedonian core were grafted considerable numbers of mercenaries, as discussed in chapter five, who needed to be paid. The Antigonids seem to have raised some revenue by direct taxation of their Macedonian subjects, along the lines of Roman *tributum*; Livy even calls it such.[44] Further revenue was generated from mining, timber and royal estates, although it is difficult to put a precise figure on how much.[45] But to increase revenue further was difficult. Superficially, Antigonid-controlled Greece resembled Roman-dominated Italy, but in practice the structures of Antigonid control and Greek culture made few opportunities for developing that control into a source of resources for further warfare. Extracting any revenue or resources from the Greek *poleis* to the south required expensive continual garrisons, the 'fetters of Greece.'[46] Further resources were drained away by active and often violent Greek resistance to Antigonid control, which in turn required repeated military interventions. At the same time, the *poleis* of Greece proper were often able to use the system of honors and euergetism to limit the degree to which resources could be extracted from them, essentially trading honors for a degree of autonomy and royal benefaction.[47] The problem thus faced by the Antigonid kingdom

[43] Sekunda (2013), 106-7.

[44] Plut. *Aem*. 28.6. Liv. 45.18.7.

[45] Diodorus. 16.8.6 reports the income to Philip II from the mines to have been 1,000 talents; it is by no means clear how reliable this figure is.

[46] Plb. 18.45.5-6.

[47] Billows (1995), 70-80.

was not necessarily a lack of military resources – unsupported Greek efforts to expel Antigonid influence generally failed – but the lack of a viable social script whereby Antigonid domination could allow for the extraction of military resources. Without the ability to meaningfully scale up the resource base to cover Greece, Antigonid Macedon simply lacked the resources to compete with the other great powers, much less Rome.

Problems of scale also limited the ability of pre-state peoples to compete, although the intensive nature of entitlement-based recruitment frequently allowed such peoples to threaten larger, more established neighbors. Gallic organization provides a good, brief case-study to illustrate the major mechanisms, as we are rather better informed about the Gauls than most other pre-state peoples of the period.[48] Gallic military organization seems largely to have followed the broader social organization. The ties that bound individuals to serve militarily were largely personal, rather than institutional, which is to say that warriors fought because their family, clan, village or patron fought.[49] Direct personal ties seem to have been particularly important, both the vertical ties between poorer members of the community and the aristocracy, and horizontal ties between aristocrats.[50] Such a system was based on personal ties and legitimacy, on power rather than force. As a result, this system could potentially mobilize resources much more

[48] On the systems of pre-state peoples generally, note Gat (2006), 210-4.

[49] N. Roymans, *Tribal Societies in Northern Gaul: An Anthropological Perspective* (Amsterdam: Universiteit van Amsterdam, 1990), 17-48; Brunaux (2004), 40-7; Brunaux (1986), 107-8. These ties occur frequently in Caesar, e.g. Caesar *B.G.* 2.14.2, 4.3.4, 6.10.1, 6.13.1-3, 6.15.1-2, 8.23.5, typically using the equivalent Roman terminology (e.g. *cliens*, *familia*, etc)

[50] E.g. Polybius and Caesar on the importance of personal retinues: Plb. 2.17.12; Caesar *B.G.*6.15.1-2. Patronage networks among elites, Caesar, *B.G.*1.4, 6.12. Note also Roymans (1990), 39-40.

intensively, with very limited administrative overhead; the problem was that the power in question was personal, and thus both transitory and difficult to scale upwards.

Moreover, the very nature of pre-state peoples imposed sharp limits on their ability to mobilize resources. Lower rates of urbanism and population density significantly limited the economic base available for mobilization. Moreover, as noted in the previous chapter, the pre-state peoples of the Mediterranean were politically fragmented almost by definition and certainly in fact.[51] In the absence of stable institutions, power within tribal groups was often in flux between groups of notables and individuals aspiring to (or seeking to maintain) kingship.[52] Such tensions encouraged further fragmentation in an already fragmented political environment. In the short-term, pre-state peoples could be considerable threats, as individually effective leaders could potentially create large networks of clientage and dependence, which would allow them to mobilize resources very intensively from a larger (as compared to other pre-state peoples) economic base. However, in the long term, with the already relatively small economic base (as compared to the larger Mediterranean states) available to pre-state peoples, the tendency towards political fragmentation meant that no individual leader or tribal group had the resources to resist the great states of the Mediterranean in the long term.

The Roman Mobilization System

In contrast to the ‘extract and pay’ systems, the Roman system of mobilization was based on the ‘entitlement principle’ where a state raises military force in exchange for a socially-

[51] See chapter seven, n. 6, 15.

[52] Roymans (1990), 37-8. Cf. the fate of Orgetorix, a would-be king of the Helvetii, Caesar *B.G.* 1.4.

underwritten package of rights.[53] Rather than being built on the forced extraction of taxes to fund the creation of further force, the Roman system was more like the mobilization systems of pre-state peoples, relying on the active, willing compliance of the citizenry.[54] But unlike the mobilization system of pre-state peoples, the Roman system was institutional, rather than personal, vested in the Republic and the duties of a citizen rather than in direct vertical or horizontal ties to powerful leaders. And, critically, unlike both the Antigonid system and the pre-state systems, the Roman system had access to, and utilized, a package of pan-Italian social scripts that allowed it to be scaled up by incorporating the *socii* in Italy, while retaining the low administrative overhead of an entitlement principle system.

Willing Compliance

As an entitlement-based system, the Roman Republic relied on the active, willing compliance of the citizenry, rather than force or compulsion. This point requires some elaboration since the Roman system, notionally based on conscription, superficially resembles a compulsion-principle system. However, in considering the Roman system of mobilization it is important to resist the tendency, all too present in the literary sources, to elide out the agency of the individual Romans and *socii* who were conscripted each year. The levying of troops, the *dilectus*, is generally treated as an almost automatic process by the literary sources, which are far more focused on the decisions and actions of the Senate, consuls and dictators than on individual soldiers. Where the sources are interested in the mechanics of the *dilectus*, it is generally because of some disruption, such as popular resistance; but such disruptions were not the norm.

[53] On entitlement-based recruitment more generally, Landers (2003), 285-6.

[54] This view of the concept of of power: Arendt (1969),40-4.

As Brunt notes, the normal formula in Latin sources is simply to indicate that a magistrate or the Senate acts to, "milites (legiones, exercitum) conscribere (scribere)" or "legiones supplere," with no further elaboration on the process generally being required.[55] And certainly, the system seems to have functioned very well most of the time. But we should not forget that it relied heavily on the willingness of most of the participants to play their roles and that the coercive power of the state, while considerable, was far from limitless. Thus, rather than taking for granted that the Roman *dilectus* worked, it is worthwhile to examine how it worked.

Our best description comes from Polybius although, as Walbank notes, his is at points "over-schematic," and on the whole the evidence for the details of the practice of Roman mobilization is relatively poor.[56] Polybius describes a system where the consuls announce, each year, the day on which all male citizens liable for service based on property and age must assemble on the Capitoline. Once assembled, the military tribunes select soldiers in batches of four from each tribe, apportioning each one to a legion until the customary four legions for the year are filled out.[57] Then the military oath is taken, and the newly enrolled soldiers are told where and on what day they are to arrive to be apportioned into units.[58] On that occasion they

[55] Brunt, (1971), 635. E.g. Liv. 22.11 "decretum ut ab Cn. Servilio consule exercitum acciperet; scriberet praeterea ex civibus sociique…" or Liv. 37.4.1., "L Cornelius…pro contione edixit, ut milites quos ipse in supplementum scripsisset…"

[56] Walbank (1957), 699. Likewise, Brunt (1971), 526-627, objects that the number of *iuniores* would be far too large to assemble on the Capitoline or even in the Campus Martius as suggested by Polybius; Brunt's solution is to suggest that what Polybius describes is not the enlistment of soldiers but merely their apportioning into legions, and that the recruitment in the *municipia* outside of Rome was handled by local magistrates. The first part of the solution, while plausible, runs directly counter to Polybius' text, which is quite clear about the stages of the conscription process. Note also Walbank, (1957), 698-9.

[57] Plb. 6.19-20.

[58] Plb. 6.21.6.

are next then divided into constituent battlefield units by the military tribunes.[59] The men then reassemble, again, at a time appointed by the consuls, in this instance bearing the arms required of their assigned battlefield roles; then finally the army is deployed.[60] The Roman troops are joined at this last stage by the allies, who have previously been given instructions about how many soldiers to supply.[61]

The purpose of this outline is not mere antiquarian completeness, but rather to stress the vast latitude a Roman citizen soldier had for avoiding or evading the *dilectus*, and thus the considerable degree to which the system required the great majority of Romans to comply voluntarily. It was possible to resist the *dilectus* on the spot, although only rarely with success.[62] Unwilling soldiers could refuse to answer to their names when called, or seek exemptions from the process, or appeal to magistrates, such as the tribunes of the plebs.[63] In many cases, the Senate was forced to rely on popular commanders to resolve the situation, as in 151, when not only the common soldiers but also even the potential officers did not report for the *dilectus*, a situation eventually salvaged by Scipio Aemilianus.[64]

In addition to these more direct efforts to resist the *dilectus*, Romans could rely on indirect or passive resistance at almost every stage of military mobilization, beginning with the

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[59] Plb. 6.22-26.

[60] Plb. 6.26.1-5.

[61] Plb. 6.26.5-9.

[62] In general, on resistance to the *dilectus*, both active and passive, in the second century, see Y. Shochat, *Recruitment and the Programme of Tiberius Gracchus* (Brussels: Latomus, 1980), 55-65, and J. K. Evans, "Resistance at Home: The Evasion of Military Service in Italy during the Second Century B.C." in *Forms of Control and Subordination in Antiquity* eds. T. Yuge and M. Doi (Leiden: Brill, 1988), 121-140.

[63] Refusal to answer when called: in 494, Liv. 2.28.6-7, 2.29.2. In 275, Val Max. 4.3.4, Liv. *Per*, 14. In 169, Liv. 43.14. Exemptions: Liv. 34.56.9-12, Liv. 36.3.3-5.

[64] Plb. 35.4. App. *Spanish Wars*, 49. Liv. *Per* 48.15-18.

census. As Rosenstein notes, "The Roman census depended in the last analysis on the voluntary compliance of citizens."[65] Rosenstein further suggests that under-registration rates may have been wildly variable depending on popular attitudes towards the *dilectus*, and extreme enough potentially to lead in part to the appearance and apprehension of depopulation during the second century without any actual depopulation.[66] Likewise, soldiers could simply fail to purchase, on their own, the equipment required of their position. Polybius notes that in that case the quaestor would deduct the price of any additional equipment from the soldier's pay, but this would be a weak provision against mass failure or refusal to self-equip.[67] To combat this sort of passive resistance, the Senate might dispatch *conquisitores* to seek out recruits in the countryside, but this seems to have been done only rarely. The only reports during this period are in 213 and in 212, during the Second Punic War.[68] In practice, the Roman Republic simply lacked the complex administrative apparatus to coerce mass compliance, a situation underscored by the repeated need to resort to popular commanders in order to raise public enthusiasm for military operations in the late second century. Instead, in a system where soldiers were expected to furnish their own equipment and to travel on their own initiative to the army, Rome relied not merely on passive obedience, but also on active and willing compliance in order to field citizen armies.

The system for raising troops from the *socii* was no less reliant on this form of active compliance. Polybius relates that the consuls, at the same time as the general levy was held, sent

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[65] Rosenstein (2004), 157. On the penalties for failure to register or show up at a levy, Brunt, (1971), 391-2. On the evasion of the census, note Evans, (1988), 128-129.

[66] Rosenstein (2004), 157-8.

[67] Plb. 6.39.14.

[68] Liv. 23.32.19. 25.5.5-9. Rich, (1983), 289.

orders to the *socii* stating the number of troops they must supply and the time and place of the muster.[69] Livy's account of the muster of 193 suggests that the process of summoning the *socii* would have involved the consuls meeting representatives of the allied communities on the Capitoline.[70] In both accounts the process is treated as practically automatic, but with no real functional oversight; the only real recourse the Roman state had against resistance to recruitment by the *socii* was to declare the entire community in rebellion and to wage war on it. The limits of enforcement are perhaps most clearly demonstrated in 209, when twelve of the thirty Latin colonies simply defaulted on their requirement to furnish troops and money, claiming exhaustion from the long war against Hannibal.[71] The consuls and the Senate attempted persuasion, and lionized the remaining eighteen colonies that continued to contribute, but in the end, "of the other twelve colonies, which refused to obey orders, the senators forbade any mention to be made," and then merely moved on.[72] Livy offers that "this silent rebuke seemed most consistent with the dignity of the Roman people," but this seems merely patriotic cover.[73] In essence, the Senate was forced to concede, if grudgingly, and to give the defaulting colonies their way, because the system had no other measures short of war to compel compliance. If the *socii* did not actively comply, the Senate could in principle direct the consuls to move to declare war against them, but it could not impress or dragoon them.

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[69] Plb. 6.21.4

[70] Liv. 34.36.5. Brunt, (1971), 626.

[71] Liv. 27.9-10.

[72] Liv 27.10.10. duodecim aliarum coloniarum quae detractaverunt imperium mentionem fieri patres vetuerunt, neque illos dimitti neque retineri neque appellari a consulibus; ea tacita castigatio maxime ex dignitate populi Romani visa est.

[73] Liv. 27.10.10.

To be sure, in other circumstances Rome was more than willing to use war as a means to compel allied communities to remain subservient.[74] This expedient, however, might not result in the troops Rome actually desired. For example, even after they were subdued, many of the Italian rebels of the Second Punic War had to be debarred from military service for a time, presumably over concerns about loyalty.[75] War against the *socii* in any period would necessarily entail destroying a portion of the very resources and manpower that the Romans wished to mobilize. This weakness of the system was further complicated by the fact that citizen Roman troops do not seem to have made up a majority of soldiers in the Roman army for most of this period, nor do the Romans appear to have possessed any significant qualitative superiority over their allies.[76] The Roman state quite literally could not afford to coerce all of the *socii*. This is not to say that the system was ineffective; it was evidently tremendously effective. Rather, the point is that the system relied on widespread active compliance in the absence, in any given year or at any given *dilectus*, of direct means of coercion. Intentionally or not, the system required compliance from large numbers of both citizens and allies in order to function.

In the absence of strong coercive systems, the immediate problem of any entitlement-based system, such as Rome's, is to achieve the necessary legitimacy to obtain willing compliance. For the Roman citizen body, the mechanics of the system were broadly similar to

[74] War, of course, was a method of compliance that the Romans were more than willing to use when it was practical. On its repeated use before the Punic Wars, see P. Kent, "Reconsidering *socii* in Roman armies before the Punic Wars" in *Processes of Integration and Identity Formation in the Roman Republic*, ed. S. T. Roselaar (Leiden: Brill, 2012a), 71-84. During the Second Punic War, note especially M. P. Fronda, *Between Rome and Carthage: Southern Italy during the Second Punic War* (Cambridge: Cambridge University Press, 2010).

[75] Brunt, (1971), 278-284, 680.

[76] On the ratio of allied to Roman soldiers in the army, see Brunt, (1971), 677-686. Rich, (1983), 321-323. Contrast the need for the Seleucids and the Ptolemies to maintain 'escalation dominance' over their subject peoples. Seleucids: Bar-Kochva (1976), 52-3. Ptolemies: Plb. 5.107.1-3. On 'escalation dominance' used in this sense for the ancient world, see E. Luttwak, *The Grand Strategy of the Roman Empire* (Baltimore: John Hopkins University Press, 1976), 42.

those of a Greek *polis* or the entitlement systems already discussed above.[77] Military service explicitly underpinned citizenship and civic participation in the Middle Republic.[78] Kurt Raaflaub notes that it was military service which had changed the plebeians "from nobodies to somebodies" who would have a voice in the Republic.[79] The point is underscored neatly by the tendency of those plebeians to press their position by refusing conscription, such as in 495 and 403.[80] Moreover, as has often been noted, this civic requirement for military participation was underscored by a strong martial ethos, which encouraged military service as the most important endeavor in which a citizen male might demonstrate his quality, embodied by the concept of *virtus*.[81]

The entitlement principle was, however, hardly exclusive to Rome, and the dedication of the Roman citizen body is not enough to explain Rome's comprehensive advantage in mobilization.[82] It was, as noted in the first chapter, the primary recruitment principle behind the *polis* armies. Aristotle directly connects political participation and military service. More generally, the strong connections tying together military service and political participation in the

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[77] On the continued militarism of the Hellenistic Greek *polis*, note Ma (2000), 337-376.

[78] Military service requirements to hold office, Plb. 6.19.3. Walbank (1957), 698. Note also the structure of the *comitia centuriata* and the concentration of voting power into the centuries of the heavy infantry, Dionysius *RA* 4.16.2; Liv. 1.43.1. Lintott (1999), 55-61.

[79] Raaflaub (2005), 197. Cf. also Cicero's statement on military service in Cicero, *Caec*. 99, that a man who fails to risk his life for freedom is not deprived of it, but never truly had it in the first place.

[80] Liv. 2.24.5-8. 6.27.8. Cf. also 3.57.9-10.

[81] The literature on this point is voluminous, but note especially: Lendon (2005), 172-178. J. E. Lendon, "The Rhetoric of Combat: Greek Military Theory and Roman Culture in Julius Caesar's Battle Descriptions," *CA* 18.2 (1999), 273-329; McCall, (2002), 83-99; C. Barton, *Roman Honor: The Fire in the Bones* (Berkeley, University of California Press, 2001), 13, 42-58, 114-5. Harris (1979), 17-30. Harris confines his treatment to aristocratic *virtus*, but as Barton notes, it applied to the lower classes as well, Barton (2001), 75.

[82] See Landers (2003), 285, for examples of this principle outside of the ancient world.

Greek world, as well as military virtue and public standing, are well established in the scholarship.[83] Likewise, service in the Macedonian army seems to have given Macedonian soldiers under Philip II and Alexander the expectation of a degree of access to their king and a reciprocal responsibility on the part of their king over them.[84] There was nothing unique about the Romans were highly motivated to fight for their own Republic. Alcmena's declaration in Plautus' *Amphitryon*, that "if the only reward given to me is that my husband is hailed a conqueror in war, I say it is enough for me," and that "*virtus* surely surpasses all things: liberty, safety, life, property, parents, country and children" are comparable to the Spartan mother's order to her son to return "either with it [his shield] or on it."[85] Rather, what is exceptional about Rome's mobilizations is their extension to all of Italy. To explain this feat, it is necessary to turn again to the allies.

Clientela and the Allies

The decisive strength of the Roman system lay in the ability to mobilize the *socii* through the same entitlement-principle, thus permitting extensive mobilization with very low administrative overhead. The fundamental problem is that the entitlement system Rome utilized, as noted above, offered relatively little latitude for the use of coercive force except *in extremis*. As a consequence, the system had to provide for the 'buy-in' necessary to achieve willing

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[83] See above Ch. 1, n. 150. On Greek ideas of military virtue, note especially Lendon, (2005), 15-162.

[84] Arr. *Anabasis* 5.25.-29, 7.8.1-7.11.9. Cf. also the rebuke of Hermolaus in Curtius Rufus, 8.7.1.

[85] id modo si mercedis / datur mi, ut meus victor vir belli clueat/ satis mi esse ducam. virtus praemium est optimum / virtus omnibus rebus anteit profecto / libertas salus vita res et parentes, patria et prognati… Plaut. *Amph* 646-650.

'ἢ τὰν ἢ ἐπὶ τᾶς.' Plut. *Moralia* 241.16.

compliance, even for communities who were not Roman, and who did not necessarily see their fates as inextricably bound to Roman fortunes.

It could not simply be assumed that the *socii* would devote their resources to Rome out of a devotion to a common cause or background. Michael Fronda notes that particularly during and following the Pyrrhic War the Romans do seem to have seen Italy as a coherent entity which they controlled, but this belief does not seem to have yet spread to the allies by the Second Punic War, and would not do so until far later.[86] Instead, the communities of the *socii* continued to make decisions in terms of their own interest; apart from the Latin colonies, they showed relatively little emotional attachment to Rome.[87] Being bound to Rome more by self-interest than a sense of cultural or ethnic kinship, the *socii* would be continually reevaluating the degree to which both passive submission and active participation in Rome's wars served their interest. The loyalty of the *socii* could not simply be taken for granted, as the defections to Hannibal and the Social War demonstrated in vivid fashion.

A further obstacle to scaling up an entitlement-based system within a hierarchy of communities was what we might call the 'apprehension of slavery.' The inherent tension between the demands of honor due to free men, and the subordination required for such a system, are often remarked upon in the sources.[88] Livy has the Samnites declare to the Etruscans that

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[86] Fronda (2010), 23-29. Salmon's view is similar, that "the Roman system in Italy was divisive, not federative," Salmon, (1982), 71. Keaveny sees any process of 'Romanization' as still fundamentally incomplete even at the beginning of the first century, A. Keaveney, *Rome and the Unification of Italy*, 2nd ed. (Exeter: Bristol Phoenix Press, 2005), 33-5. *Contra* these is David, who argues that Italy was transformed into a unified state in the third century by a shared Hellenization, J.-M. David, *La Romanisation de l'Italie* (Paris: Aubier, 1994). David's argument hardly seems compelling. Note also Plb. 2.23.11-12, where Polybius notes it is only with the threat of a Gallic invasion that the *socii* considered Rome's wars to concern them directly.

[87] Fronda (2010), 28-34.

[88] On the negative impact of this tension on ancient diplomacy, note Eckstein, (2006), 60-2.

"they had taken to war again [against Rome] because a peace which reduced them to slavery was heavier to bear than a war in which they could fight as free men."[89] Slavery and servility of any kind were inherently incompatible with the honor of free men; given a choice between servility and death, the honorable man was to choose death.[90] Cicero sums up the viewpoint in the Tenth Philippic, "However, for liberty one must contend at the peril of one's life. Surely life is not in the breath, for there is no life at all in the slave."[91] The requirement, then, that free men need always reject anything that resembled servility created an unavoidable entropic force within any alliance system; the stronger the leading state grew, the more the system might resemble servitude, and the stronger the pressing demand of honor to break free would become. Even if this tension could never be entirely removed, as the words of the Samnite delegation above implies it could not be, reducing this tension as much as possible was a prerequisite for stable Roman control over the allies and access to their vast reserves of manpower and resources.

The key to reducing this tension of injured honor was in recasting the alliance system from a system of domination to a system of reciprocal, if unequal, bilateral relationships. Fortunately for the Romans, they had a script for just such a form of relationship: *clientela*, or patronage. *Clientela* provided a rubric for a reciprocal, but unequal relationship that, when handled tactfully, did not damage the honor of free men. Ernst Badian gives as a definition for *clientela*, "an inferior entrusted, by custom or by himself, to the protection of a stranger more

[89] Liv. 10.16.5. petisse pacem a populo Romano, cum bellum tolerare non possent; rebellasse, quod pax servientibus gravior quam liberis bellum esset. Cf. Thuc. 1.122.2, 1.124.3, where the Corinthian delegation explicitly refers to the members of the Delian league as "the Hellenes who are not enslaved" τοὺς νῦν δεδουλωμένους Ἕλληνας.

[90] Barton (2001), 11-14, 115-6, 126-7.

[91] Cic. Phil 10.10.20. tamen pro libertate vitae periculo decertandum est. non enim in spiritu vita est, sed ea nulla est omnino servienti. Cf. here also Cic. *Caec*. 99.

powerful than he, and rendering certain services and observances in return for this protection."[92] Importantly, performance of these services and observances was not seen as servile or dishonorable, but rather a positive source of honor. Pliny notes of the town of Tifernum, of which he was the municipal patron, that "to be outdone in affection is disgraceful."[93] The same sentiment is recorded in Dionysius' idealizing picture of patronage under Romulus where clients and patrons, "each strove not to be outdone by the other in kindness."[94] Such relationships had to be handled tactfully, often with the subordinating elements politely obscured by presenting them as *amicitia* rather than *clientele*; in so doing, the danger to the junior partner's honor could be minimized, in order to make the relationship more stable.[95]

The relationship between Rome and the communities of the *socii* were handled, at least in an idealized form, in much the same way. Cicero presents the analogy quite directly in his *De Officiis*, noting that the Romans, "must show consideration for those whom we have subdued by force but also those who, laying down their arms, fled to the *fides* of our generals…such that those who in war receive into their *fides* defeated nations are by the *mos maiorum*, patrons of

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[92] E. Badian, *Foreign Clientelae (264-70 B.C.)* (Oxford: Clarendon Press, 1958), 1. Note also Saller's definition, R.P. Saller, *Personal Patronage Under the Early Empire* (Cambridge: Cambridge University Press, 1982), 1, where *clientela* is a personal relationship involving a reciprocal exchange of goods and services between two individuals of unequal status.

[93] nam vinci in amore turpissimum est. Plin. *Ep.* 4.1.5.

[94] …ὅ τε ἀγὼν ὑπὲρ τῆς εὐνοίας ὑπὲρ τοῦ μὴ λειφθῆναι τῆς ἀλλήλων χάριτος ἔκτοπος ἡλίκος… Dionysius *RA* 2.10.4.

[95] E.g. Pliny's relationship with Q. Corellius Rufus, Plin *Ep.* 4.17.4, or Cicero's criticism of men who were unwilling to be seen as the clients of others, Cic. *De Off.* 2.69. On obscuring the subordinating nature of *clientela* by presenting it as *amicitia*, see Saller (1982), 11-21. The blurry distinction between *amicitia* and *clientela* has given rise to some scholarship questioning whether Roman foreign relations should be understood more as *amicitia* or as *clientela,* for instance, P. J. Burton, "*Clientela* or *Amicitia?* Modeling Roman International Behavior in the Middle Republic (264-146 BC)" *Klio* 85 (2003): 333-369; and M Snowdon, "Beyond *Clientela*: The Instrumentality of *Amicitia* in the Greek East" in *Foreign* clientelae *in the Roman Empire: A Reconsideration,* eds. M. Jehne and F. P. Polo (Stuttgart: Franz Steiner Verlag, 2015), 209-224. In practice, the line between *amicitia* and *clientela* seems sufficiently blurry so as to make this distinction less meaningful. Cf. Cic. *De Amicitia* 19.69 and Seneca. *Ep. Ad. Luc.* 94.14 on *amicitia* between individuals of very different status.

those people."[96] The first century CE jurist Proculus draws the same analogy, noting "likewise a people is allied (*foederatus*) either if by an equal treaty or by a treaty such that they are to obligingly maintain the *maiestas* of another people…it is understood that though the second people is superior, but not that the first is not free: indeed for as we understand our *clientes* to be free, even though they are not equal to us in *auctoritas* or *dignitas* or *vires*, thus we understand these to be free, who kindly agree to maintain our *maeistas*."[97] This observation, that *clientela* formed the basis for how Roman elites constructed their relationships with Rome's subordinate allies, forms the core of the argument in Badian's *Foreign Clientelae*, which remains an influential reading of Roman foreign policy.[98] As Badian argues, "this pattern of *mos maiorum* [meaning *clientela*] could not but be reproduced when Roman statesmen, moving in – and owing their position to – this intricate network of relationships, came to deal, on behalf of their city, with her inferiors abroad."[99] This is not to say that the Roman alliance system was itself a form or subset of *clientela*, but rather that it was analogous to, and modelled on, the practice. That analogy, however, provided the grounds for the Romans to construct relationships between Rome and the communities of the *socii* that minimized one of the strongest entropic impulses

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[96] Cicero, *de off.* 1.35. consulendum est, tum ii, qui armis positis ad imperatorum fidem confugient, quamvis murum aries percusserit, recipiendi. In quo tantopere apud nostros iustitia culta est, ut ii, qui civitates aut nationes devictas bello in fidem recepissent, earum patroni essent more maiorum. While Cicero may be taken here to speak of individual patrons of communities in the Late Republic, this passage comes in the context of the treatment of foreign states and the acceptance of defeated peoples into the citizenship; Cicero may thus as well be talking about how the *populus Romanus* ought to treat communities that submit themselves to Roman *fides*.

[97] *Dig*. 49.15.7.1 sive is foederatus est item, sive aequo foedere in amicitiam venit sive foedere comprehensum est, ut is populus alterius populi maiestatem comiter conservaret. hoc enim adicitur, ut intellegatur alterum populum superiorem esse, non ut intellegatur alterum non esse liberum: et quemadmodum clientes nostros intellegimus liberos esse, etiamsi neque auctoritate neque dignitate neque viri boni nobis praesunt, sic eos, qui maiestatem nostram comiter conservare debent, liberos esse intellegendum est.

[98] Badian, (1958).

[99] Badian, (1958), 285.

present in such systems of subordination: the pressing insult to honor implied by dishonorable servitude.

This relationship, however, did require reciprocity.[100] Rome's relationship with the *socii* has tended to be viewed quite cynically by modern scholars, understood more as a tool of Roman power than a relationship between communities.[101] The implied reciprocity of the exchange, however, was not merely an empty promise. The very nature of the network consisting of a large number of bilateral relationships required that Rome's promise of protection and military support be credible. The system was, in essence, underwritten by Roman *fides*.[102] As Eckstein notes, ancient states were forced to operate with extremely limited information about each other; as a result, concepts of honor or trust became crucial tools for guiding decision-making.[103] In the absence of information about a community's intentions, a reputation for 'toughness' was one of the only tools for deterring enemies, while a reputation for steadfastness was one of the few tools for reassuring allies. Thus, in order to maintain Rome's system of alliances, the Romans had to

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[100] There is some debate as to the nature of the formal structures of this system. For the orthodox view, which tends to assume a system of written treaties formally spelling out obligations, see E. S. Staveley, "Rome and Italy in the Early Third Century" in *CAH*^{2} vol 7.2 (1989): 420-455. Rich has argued recently that some allies may not have been bound by formal treaty; this remains an interesting if unorthodox position. J.W. Rich "Treaties, allies and the Roman Conquest of Italy" in *War and Peace in Ancient and Medieval History* eds. P. de Souza, J. France (Cambridge: Cambridge University Press, 2008), 51-75. See also M. Fronda, (2010), 23, n. 51; Kent (2012b), 56-77. The latter view, where the obligations are the implied consequences of unwritten agreements, seems more in keeping with the forms of *clientela*.

[101] Roman alliances primarily as a tool of Roman power: Badian, (1958), 15-32. J. W. Rich, (2008), 51-52. Staveley, (1989), 426. Salmon, (1982), 70-72, 92. Keaveney (1987), 3-44. David (1994). E. Gabba, "Rome and Italy in the second century BC," *CAH*^{2} 7.2 (Cambridge: Cambridge University Press, 1989): 197-243.

Older scholarship tended to assume a more beneficent and cohesive alliance system, see for instance J. S. Reid, "Problems of the Second Punic War: III. Rome and her Italian Allies" *JRS* 5 (1915): 87-124.

[102] On *fides*, see esp. E. S. Gruen, "Greek Πίστις and Roman Fides" *Athenaeum* 60 (1982): 50-68. *Fides* as a justification for war, Harris (1979), 34-5; Harris is correct to insist that *fides* rarely kept the Romans from war. Note also Badian, (1958), 47-54, for *fides* in the context of diplomacy and *clientela*.

[103] On low information: Eckstein (2006), 58-60 and Eckstein (2008), 13-4. On honor or *fides* as a motivation for war: A. Eckstein, *Moral Vision in* The Histories *of Polybius* (Berkeley: University of California Press, 1995), 56-70.

develop and maintain a reputation for willingness to fight for their allies, leading to the strong emphasis on Roman *fides*. *Fides*, after all, was the currency that the *socii* counted on for their security.

Rome was indeed quite willing to go to war in order to demonstrate Roman *fides*. As Fronda notes, Rome was willing on numerous occasions to go to war over the security of one allied community or another.[104] This was not just simple altruism. Rather, the Romans often exploited local rivalries to justify intervention and expand their influence.[105] However, the Roman concern for demonstrating *fides* is pronounced in the sources. Diodorus has Hiero describe the Roman envoys at the start of the First Punic War as "harping on the word *fides* [πίστεως]," but Hiero declares the sentiment empty because of the bad conduct of the Mamertines who the Romans had come to protect.[106] To an Italian audience, however, such an interaction might have played rather better, showcasing a Roman willingness to defend their friends, no matter the context or the cost. In another episode, related by both Polybius and Dionysius, a garrison of Campanian *socii* requested by the allied city of Rhegium during the Pyrrhic War victimized the city. The Romans responded by recapturing the city, executing the Campanians and restoring Rhegium's territory to its citizens because, as Polybius notes, they "wished, by this punishment, in as much as possible to repair the trust (πίστιν = *fides*) with the allies."[107] This same sense of *fides* also figures highly into Livy's telling of the Second

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[104] Fronda, (2010), 20, n. 47, 301, n. 44.

[105] Fronda, (2010), 21.

[106] θρυλλοῦντες τὸ τῆς πίστεως ὄνομα. Diodorus 23.1.2.

[107] βουλόμενοι διὰ τῆς εἰς ἐκείνους τιμωρίας, καθ᾽ ὅσον οἷοί τ᾽ ἦσαν, διορθοῦσθαι παρὰ τοῖς συμμάχοις τὴν αὑτῶν πίστιν. Plb. 1.7; the same incident is noted by Dionysius, 20.4.1-2.

Macedonian War and the Roman decision to withdraw from Greece afterwards.[108] While the need for the Roman Republic to regularly demonstrate the strength of Roman *fides* often led the Romans and their *socii* into war, it will also have reassured the *socii*, especially weaker communities, that when their security was on the line, Roman *fides* would be good.

It is worth noting in this context the relative unwillingness of the Romans throughout this period to trade space for time against enemies in Italy. The Romans were almost never willing to let an enemy force plunder or despoil the *socii*, even when there was a strong strategic advantage to be gained by doing so. The initial Roman force to confront Pyrrhus attempted to block him at the river Siris, deep in hostile Lucanian territory and well in advance of Rome's allies.[109] Rome made multiple attempts to confront Hannibal before he could enter peninsular Italy, first at the Rhone,[110] before engaging him well north of the Po at Ticinus and again at Trebia both in 218.[111] Despite defeats there, the Romans promptly re-engaged Hannibal the following year. Livy's explanation for C. Flamininus' fatal rush to face Hannibal is notable, that "once he saw before his own eyes the property of the allies being carried off and plundered, he considered it his own personal disgrace that the Phoenician should now be roaming through Italy…"[112] Polybius presents this as a rational calculation by Hannibal, who judged that Flamininus would "be unable to watch passively the devastating of the country, partly for fear of the jeering of his soldiers,

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[108] Eckstein (2008), 251-2, 299-300.

[109] Plut. *Pyrrhus* 16.3. Plb. 1.7.6-13. Note that it is in this context that Rhegium, which was quite vulnerably positioned, requested and received the garrison force which later created such problems, see above at n. 106.

[110] Liv 21.32. Plb. 3.45-47, 49.

[111] Battle at the Ticinus: Liv 21.39-47. Plb. 3.64-65. Trebia: Liv. 21.54-57, Plb. 3.70-75.

[112] Livy 22.3.7. postquam res sociorum ante oculos prope suos ferri agique vidit, suum id dedecus ratus, per mediam iam Italiam vagari Poenum.

partly from his own pain [at the sight].”[113] Likewise, Livy presents Q. Fabius’ troops the following year chafing at the sight of the Hannibal’s plundering of the *socii*, leading to Livy’s report of Minicius’ rebuke, “Did we come here to watch, in order to enjoy with our eyes the slaughter and burning of the allies?”[114] It is remarkable that the sight which spurns the Romans repeatedly into action is not the desolation of the *ager Romanus*, but instead the pillaging of allied communities.

It would be easy to dismiss such outrage as artefacts of Livy and Polybius’ pro-Roman stance except that Roman armies did subsequently engage Hannibal, precipitously and repeatedly. Nor was this behavior limited to the Second Punic War. At the end of the second century, the Romans would send no less than three consular armies against the Cimbri in an effort to keep them out of Italy, despite repeated military disaster, before meeting with any success.[115] Somewhat ironically, military catastrophe after military catastrophe may have reinforced trust in the Roman Republic, because it proved that the Romans were willing to suffer tremendous losses rather than permit an enemy army to attack the allied territory in Italy. The Romans might not always win, but the *socii* could hardly doubt that any foreign enemy seeking to pillage their land would have to overcome at least one Roman army to do so.

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[113] Plb. 3.80.4. συνελογίζετο διότι παραλλάξαντος αὐτοῦ τὴν ἐκείνων στρατοπεδείαν καὶ καθέντος εἰς τοὺς ἔμπροσθεν τόπους τὰ μὲν ἀγωνιῶν τὸν ἐπιτωθασμὸν τῶν ὄχλων οὐ δυνήσεται περιορᾶν δῃουμένην τὴν χώραν, τὰ δὲ κατηλγηκὼς παρέσται προχείρως εἰς πάντα τόπον ἑπόμενος, σπουδάζων δι᾽ αὑτοῦ ποιήσασθαι τὸ προτέρημα καὶ μὴ προσδέξασθαι τὴν παρουσίαν τοῦ τὴν ἴσην ἀρχὴν ἔχοντος.

[114] Livy 22.14.3 “spectatum huc” inquit Minucius, “ut ad rem fruendam oculis, sociorum caedes et incendia, venimus?

[115] Consuls defeated in the Cimbric war: Gn. Papirius Carbo in Illyricum (Liv. *Per* 63.113.6), Marcus Junius Silanus (Liv. *Per* 65.108.2-3.), Marcus Aurelius Scaurus and Gnaeus Mallius (Liv. *Per* 67.105.2-3); the last of these, at Arausio, involved the loss of both a consular and pro-consular army (note also Tac. *Ger*. 37.5). One might contrast Athens’ and Sparta’s willingness to leave allied communities to their own defenses, e.g. Plataea, Thuc. 2.3-5, 2.71-78, 3.20-24, 3.52-68, or Mytilene, Thuc. 3.28-28.

In addition to the security guarantee, an alliance with Rome provided other opportunities which reinforced the reciprocal nature of the arrangement and encouraged willing compliance.[116] The *socii* also had a chance to share in the spoils, what Tim Cornell describes as "a criminal operation which compensates its victims by enrolling them in the gang and inviting them to share to proceeds of future robberies."[117] The *socii* were entitled to a portion of the spoils of war, although they seem sometimes to have gotten less than their share; they seem also to have been entitled at least some of the time to settlement in colonies founded on seized land.[118] Moreover, loyalty and good service could be rewarded with better status within the system, which came with its own set of legal and financial benefits.[119]

Moreover, the Romans seem to have recognized the *virtus* of allied soldiers and permitted them a share of the glory of victory. Livy presents a decidedly favorable impression of the valor of the *socii*, although his late date makes it difficult to extrapolate the reception of allied valor in the second century.[120] The broader evidence tends to reinforce the impression, however, that at least some of Livy's favorable impression of the *socii* is representative of Roman diplomacy in

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[116] Cornell notes that "by drawing up this kind of balance sheet it becomes possible to understand the loyalty of the allies to Rome." T. J. Cornell, *The Beginnings of Rome: Italy and Rome from the Bronze Age to the Punic Wars (c. 1000 – 264 BC)* (London: Routledge, 1995), 367. Cornell in this seems to echo Reid, (1915): 87-124. *Contra* Reid, note Fronda, (2010), 50-51, n. 134. Salmon presents a more cynical picture than Cornell, but still concludes, "Above all, Rome put an end to fighting between Italian states with incalculable benefit to all," Salmon, (1982), 72. The situation is often viewed more negatively, especially in the late second century, cf. for instance Gabba (1989), 243.

[117] Cornell, (1995), 367.

[118] E. Badian, (1958), 149-153. Cornell, (1995), 367. Salmon (1970). In defense (*contra* Hopkins (1978)) of Salmon's argument for land assigned to *socii* in Roman colonial foundations, note E. Badian, "Figuring out Roman Slavery" *JRS* (1982): 164-169, esp. 165.

[119] For a discussion of the scholarship on this point, see: H. Mouritsen, *Italian Unification: A Study in Ancient and Modern Historiography* (London: Institute of Classical Studies, 1998), 87-108. Note also Salmon (1982), 57-72, 161-4.

[120] Valor of the *socii* in Livy: Liv. 25.14.2-12, 27.10.7-9, 44.40. On the potential influence of the post-social war annalistic tradition on Livy, see Erdkamp (2007), 47-74.

the period. Some support for the notion that the contribution of the *socii* was favorably acknowledged comes from Taylor's interpretation of the Pydna Monument, with several figures he identifies as *socii* prominently featured on the relief.[121] Livy reports that the *socii* normally received equal donatives from the sale of loot and also seem to have been included in Roman triumphs.[122] Likewise Appian reports that prior to the Social War there had been a saying, "No triumph over the Marsi or without the Marsi:" both the Marsi's unconquered history and their contributions to Roman victories were points of pride.[123] The *socii* also appear to have been fully eligible for military awards.[124] Extending recognition for martial excellence to the *socii* fits with a general Roman tendency to maintain the pleasing fiction of the *socii* as partners, if not equal ones, in Roman military success. It also facilitated Roman harnessing of allied martial virtue. Just as clients dutifully performing *officia* for their patrons could serve as a source of honor, so too could the *socii* gain distinction by the exemplary performance of their military service.

As with the Roman practice of *clientela*, the language used by the Romans to talk about the system of the *socii* tended to obscure the subordinate status of Rome's junior partners, not out of any actual egalitarian impulse, but out of a need to avoid injuring the honor of the

[121] Taylor (2016), 569-570.

[122] E.g. Livy 40.43.6-7, Livy 45.43.1-8. Taylor, 570, n. 45. Note also Plb. 10.16.2-4. This norm is broken in 177, and the *socii* protest by marching in silence during the triumph, Liv. 41.13.6-8. Livy makes it quite clear that this is exceptional. On this episode, see R. Pfeilschifter, "The allies in the Republican army and the Romanization of Italy" in *Roman by Integration: dimensions of Group Identity in Material Culture and Text* eds. R. Roth and J. Keller (Portsmouth: Journal of Roman Archaeology, 2007), 27.

[123] οὔτε κατὰ Μάρσων οὔτε ἄνευ Μάρσων γενέσθαι θρίαμβον. App. *Bel Civ* 1.46.

[124] Plb. 6.39.1-11; note esp. 6.39.6, on punishments note also 6.37.8. On rewards, see also, Pfeilschifter, (2007), 36-7, n. 39. On the common aspects of soldier life for Romans and the *socii*, note N. Rosenstein, "Integration and the Armies in the Middle Republic" in *Processes of Integration and Identity Formation in the Roman Republic* ed. S. T. Roselaar (Leiden: Brill, 2012), 85-103.

subordinated party.[125] Much as a patron might rather call his client an *amicus* than a *cliens*, the Romans engaged in a degree of polite euphemism when referring to their subject communities. The word itself, *socius*, used by the Romans both formally and informally of their allies, when used outside of a diplomatic context, as in business, implies an equal partnership. The text of the *foedus Cassianum*, the only agreement between Rome and an Italian ally for which we have a text, is instructive. As given by Dionysius, the text simply notes "There shall be peace between the Romans and the cities of the Latins," before setting out a series of equal and symmetrical obligations.[126] The text also explicitly notes that any changes must be mutually agreed upon by all parties. In practice, the relationship was far from equal, as made clear by all of the cities of the Latins having equal standing with just the one Rome; but this fact is left implied, rather than spelled out. Our evidence for the actual text of many Roman treaties is limited, but the closest they seem to have come to the "language of *kratos*" common in Athenian imperial diplomacy is a clause to maintain the majesty of the Roman people in good faith (*maiestatem populi Romani conservato sine dolo malo*), which first appears with the Roman treaty with the Aetolians, but which Rich supposes may have been a feature of at least some treaties in Italy before.[127] Yet even this formulation does not rise to the level of implying servitude, at least as a legal matter; the jurist Proculus declares those who "are obligated to courteously maintain our *maiestas* are to be considered free."[128]

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[125] One may contrast the Athenian 'language of *kratos*.' P. Low, "Looking for the Language of Athenian Imperialism" *JHS* 125 (2005): 93-111, argues that such language was a regular part of narratives of conquest and political power; but it is notable that the Romans deploy no equivalent to the Greek 'language of *kratos*' when interacting with the *socii*.

[126] Ῥωμαίοις καὶ ταῖς Λατίνων πόλεσιν ἁπάσαις εἰρήνη πρὸς ἀλλήλους ἔστω. Dionysius *RA* 6.95.2.

[127] Plb. 21.32.2-3; Livy 38.11.2. Rich (2008), 58-69.

[128] *Digest* 49.15.7.1. qui maiestatem nostram comiter conservare debent, liberos esse intellegendum est.

All of this effort would be for naught unless *clientela*, as the underlying social construct informing these relations, was known to the *socii*, but the evidence suggests that the basic pattern of social organization was fairly widespread. Roman and Italian elites were already interconnected by ties of *clientela, amicitia, hospitium,* and even familial and clan ties.[129] Italians and Italian communities, increasingly historically visible in the late Republic, were already adroit at utilizing the ties of *clientele*. Not only did local elites utilize these ties to consolidate their local status, but elites and communities alike also sought to gain influence and contacts at Rome through *clientela*.[130] Thus not only did Roman networks of *clientela* sprawl out into the communities of the *socii*, but the elite *socii* themselves seem to have had their own patronage networks along the same lines. The apparently seamless merging of these systems - for we hear of no great disruption along these lines following the extension of citizenship in Italy in the wake of the Social War - speaks to the degree to which these parallel social institutions had effectively merged. In short, the language of relation was not only one which the Romans spoke, but one that the Italian *socii* could understand and accept, at least until the changing nature of Roman power in the late second century fundamentally altered this relationship.[131]

By constructing the framework of the alliance system in this way, the Romans were able to recruit from the *socii* using the same entitlement principle, the only difference being that the valor of the *socii* underwrote their status in their own communities, rather than at Rome.

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[129] F. Münzer, *Römische Adelsparteien und Adelsfamilien* (Stuttgart: Carl Ernst Poeschel Verlag, 1920), 42-97. Note also Fronda, 30-33; Badian, (1958), 154-191.

[130] J. Nicols, *Civic patronage in the Roman Empire* (Leiden: Brill, 2014), 33-82. Of note, the earliest attested example of municipal patronage attested epigraphically Nicols gives is for the patronage of Aeclanum by a local elite immediately following the Social War.

[131] This shared understanding of course stood in stark contrast to the experience of the Greeks, most famously in the case of the Aetolians, who lacked the same cultural competence of the Italians when it came to Roman customs, cf. Plb. 20.9. *Contra* Polybius however, note Gruen, (1982): 50-68.

Although we are generally less well informed about them, the communities of the *socii* appear to have been no less militarized than the Romans. The *socii* were probably drawn up in cohorts and *turmae* of linguistically connected groups to enable communication and encourage unit cohesion. The officers of these units were the *praefecti cohortis*, who were drawn from the elites of these same communities, so that the *socii*, like the Romans, probably served under their own magistrates, or at least men of their own magisterial class.[132] The *socii* thus fought, shoulder to shoulder with their neighbors, under the eyes of their own leading citizens, exactly as the Romans did.

In combat, the *socii* were tough fighters, as the Romans were. Erdkamp notes that Livy and Polybius present the *socii* as integral to the legion, functionally interchangeable with Roman troops in quality, except where Livy's reliance on the late annalistic tradition leads him to single out units of the *socii* for praise.[133] In his description of Pydna, Plutarch memorably mirrors the martial virtue of the Romans and the allies: at one point in the line a Paelignus *praefectus* flings his unit's standard into the enemy to force his men to attack vigorously to retrieve it, while elsewhere on the same battle line, a young Marcus Cato, having lost his sword, has to rally his friends to push the line forward far enough to retrieve it.[134] That Italian and Roman military values should mirror each other so closely should come as no surprise, even as Italy remained culturally fragmented. This shared military culture was likely the product of a long process of increasing militarization and convergence in martial culture, as is to be expected from an

[132] E.g. Plb. 6.21.5, Livy 22.24.11, 23.19.17, 25.14.4-6. Plut. *Aem.* 20.1-4. On the organization of the *socii* note: Pfeilschifter (2007) and Rosenstein, (2012), 85-103.

[133] Erdkamp (2007), 47-74.

[134] Plut. *Aem*. 20.1.-3 and 21.1-5.

interstate system of militarized anarchy.[135] The *socii* were just as tough as the Romans because they had to be in order to survive in the same environment. As a result, the Romans were able to expand their recruiting base without compromising quality, and to draw on the same martial values to motivate the allies as drove the Romans themselves.

Decentralization and Resource Mobilization

Because this alliance system allowed Rome to foster such loyalty, it could be efficiently decentralized. Even so, it had not necessarily been thought out in advance or carefully designed. Rather, the skillful management of the growing roster of allies permitted the Romans to scale up piecemeal what was in fact a legacy mobilization system that had emerged out of the shifting alliances of earlier centuries. Indeed, the Roman alliance system appears to have emerged out of an Italian tradition in which broader alliances and federations were common.[136] In the middle of the fourth century, there is evidence for federations or broad military alliances among the Campanians, the Samnites, possibly the Veneti, and occasionally the Etruscans. Roman dominance of the peninsula was confirmed in what was essentially a war of coalitions between Rome and its allies on one side, and a looser coalition of Samnites, Etruscans, Umbrians and Gauls on the other.[137] Much like the institution of *clientela* that provided a model for Rome's relationship with the *socii*, the very idea of a large alliance system was already deeply rooted in the norms of Italian warfare and intercommunal relations.

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[135] On Italian military culture, see, Kent, (2012b), 17-83. On homogenization in equipment, note Burns (2003): 60-85. On convergence with anarchic state systems, note Eckstein (2008), 16-17. Waltz (1988), 620.

[136] P. Kent, (2012a), 83. See also, Kent (2012b), 51-151.

[137] On evidence for early federations among non-Latin or Romans in Italy, see Salmon, (1982), 10-34. For coalitions and fears of them in the Third Samnite War note esp.: Liv. 10.16, 21.

The number of officials and the amount of administrative overhead in this system of recruitment was extremely low, despite the very large mobilizations it could produce. For instance, Rome did not need to maintain a complete census of the *socii* or to assign administrators to organize recruitment in allied communities, as this work was handled by local magistrates.[138] Nor did the Roman state need to create a system for equipping allied or even Roman soldiers, because this was done by the individual, or in the case of some of the *socii*, perhaps by the community.[139] Likewise, the pay for the *socii* seems to be handled by their local communities, not by Rome.[140] The one component of the system which was centralized was food supply, with the allies being given their rations as a free gift from Rome, presumably to avoid the logistical nightmare of maintaining separate supplies on campaign.[141] All of this decentralization will have served to keep the costs of mobilizing Roman armies low. The efficiency that resulted was necessary for Rome to compete in the broader Mediterranean, for, as Taylor has noted, Roman state finance was far weaker than that of the other great Mediterranean powers. Rome could not afford the sort of administrative apparatus more common in the East.[142]

The private purchase of arms and equipment would have broader economic effects and serve to explain in part why Rome was able to recover so rapidly from defeat. Unfortunately, we are poorly informed about the manufacture of arms in Italy, except that it seems to have been

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[138] The census of 225, reported by Polybius, seems to have been the only complete accounting by Rome of the resources of all of the allies. Plb. 2.24.15.

[139] Self-supply of arms is clearly indicated by Plb. 6.26.1, where the soldiers are dismissed to acquire the weapons for their assigned battlefield role. Polybius further notes that the cost of replacement arms is deducted from the pay of Roman soldiers, Plb. 6.39.14.

[140] Plb. 6.21.5. Liv. 27.9.2. Note also Pfeilschifter, (2007), 31.

[141] Plb. 6.39.12-14.

[142] Taylor, (2017), 143-180.

decentralized, with centers of production in most regions.[143] Caere, Perugia and Vulci seem to have been centers of production in Etruria, to which Paddock adds Capua, Aquileia, Puglia and Reggio Calabria.[144] Representational evidence suggests that individual workshops might have been quite small.[145] Military production thus may have been quite decentralized. Arms production certainly does seem to have been privatized, with arms available for individual purchase, even during the Late Republic. Cicero claims that Cethegus attempted to excuse his large cache of weapons on the grounds that he was a private collector.[146] In the Seventh Philippic, Cicero likewise declares that the senators can see the workshops of arms (*armorum officinas*) in the city as a sign that the citizenry was preparing itself for war against Antony, despite the Senate's reluctance.[147]

During the Middle Republic, these arms-makers would have worked under near continuous demand, as Rome was almost always engaged in active military deployment. Moreover, it seems likely that, rather than waiting for conscription, most Roman *assidui* households, and likely those of the allies as well, would have kept equipment ready. In the event of a *tumultus*, the army was raised immediately and all state business was suspended, a step which would have little value unless many of the citizens already possessed the arms needed to

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[143] Paddock, (1993), 44-45.

[144] Paddock, (1993), 44-45. H. H. Scullard, *The Etruscan Cities and Rome* (Ithaca: Cornell University Press, 1967), 100, 126, 163-164. Perugia at least seems to have been in production down until at least the first century B.C..

[145] Paddock, 48-55. See also Sim and Ridge, (2002) and Sim and Kaminski, (2012), 5-78.. Sim and Ridge seem to suggest rather more centralization and larger workshops, but they also focus chronologically later, in the imperial period and in the context of permanently deployed standing armies.

[146] Cic. *In Cat.* 3.10.

[147] Cic. *Philippic* 7.13.

fight.[148] Simple economic demand, then, propelled by the need of both Romans and allies to acquire personal arms, will have the manufacture of military equipment throughout Italy, with apparently minimal state involvement.

Returning to the problem presented in the first chapter - that of encouraging specialization against a backdrop of low agricultural productivity - the aggregate demand for weapons by the entire Italian freeholding class would have motivated the production of arms on a far broader basis than state action. In this case, we may easily imagine that the demands of an *assiduus* to equip himself (or his son) for the *dilectus* provided the spur towards the more intensive utilization of his agricultural labor. Private purchase may also have encouraged a preference for heavier armor and equipment, as an individual is far less likely to economize concerning his own survival on the battlefield than a distant king or board of magistrates. Given that nearly all families of the freeholding class would maintain arms against the possibility of selection in a *dilectus* or a *tumultus*, the result is the accumulation of a deep reserve of equipment, far beyond the Republic's need for equipping any given army. Moreover, starting in the third century, the deposition of arms in burial seems to decline markedly as a practice, which would in turn keep more arms and armor in active circulation. This reserve would be intensified by the Roman practice of displaying captured spoils in positions of honor within the household.[149] As a result, the Romans could expect to be able to raise a very large proportion of Roman and allied manpower without having to limit recruitment due to equipment shortages or to suffering from a diminished battlefield capacity.

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[148] On the immediate suspension of state business and raising of an army, note esp. Cic. *Philippic* 5.31. Likewise, Liv 40.26.6, the consuls are empowered to raise suitable troops as they marched, which again, supposes that arms and equipment were already in readiness.

[149] E. Rawson, "The Antiquarian Tradition: Spoils and Representations of Foreign Armour" in *Roman Culture and Society: Collected Papers* (Oxford: Clarendon Press, 1991), 582-598.

Alongside this deep well of reserve equipment, the Roman system of broad conscription combined with continual warfare also created an extensive reserve of military experience and expertise that was broadly distributed throughout the communities of Italy. Exactly how widespread military service will have been among the entire freeholding class, both Romans and *socii*, is not entirely clear, although some modern scholars have offered estimates.[150] Rosenstein estimates that, in the first 32 years of the second century, some 627,800 soldiers participated in battles significant enough to merit mention in Livy's history.[151] If we accept Brunt's corrections for Polybius' figure of the total number of Roman and allied *iuniores* liable for conscription in 225 at 634,000, and assume that this total broadly represents the available *iuniores* at any given time, we might expect that Rosenstein's minimum figure of 627,800 soldiers would represent perhaps 46% of the total number of eligible men in a 32 year period.[152] The adoption of Brunt's figures for military deployments from 218 to 168 results in a similar figure. Including allies, Brunt's figures suppose some 6,128,900 man-years of deployments for the 51 years from 218 to 168, an average of 120,175 men under arms per year, not counting naval activity.[153]

Even without accounting for battlefield casualties and disease, the figures suggest 5.5 years of military service for each eligible male in Italy during the period.[154] This estimate fits

[150] On military service among Roman citizens, our information is rather better than for the *socii*. See esp. Rosenstein (2004).

[151] Rosenstein, (2004), 109.

[152] Plb. 2.24.15. On these numbers, and potential corrections to the figures, note Brunt, (1971), 44-60. Assuming generational cohorts are of a roughly constant size, 32 years would allow time for slightly more than 2 full generational cohorts to move through recruitment age.

[153] Brunt, (1971), 416-426. The figures for 218-200 have been roughly doubled to account for allied contingents.

[154] I calculated by breaking down Polybius' figure for *iuniores* into equal-sized year-cohorts, which suggests that roughly 22,000 eligible Romans and *socii* came of age each year. In practice, mortality (both normal and excess military mortality) would tend to raise this figure by lowering the average age among the *iuniores*, probably by a very significant margin, see Rosenstein, (2004), 107-140. Moreover, Romans would have served disproportionately

with the impression given by Livy when he notes that of all of the *iuniores* in the census of 214, only 2,000 were found who had not yet performed some military service.[155] Nearly all eligible male Italians, Romans and *socii*, would have seen at least some service in the military, with probably around half having experienced a major battle. The resulting shared experience of military service meant a wide diffusion of military knowledge in the broader culture.[156] The cost of achieving it, however, was a tremendous investment in man-hours required by nearly constant warfare and continuous conscription. Indeed, the manpower demands of Roman levels of conscription were severe enough that family structure and agriculture in Roman Italy were forced to accommodate the rhythms of military service.[157] The result was that the veterans of previous wars, with their equipment, were always available in the event of a future military disaster.

Comparative Advantage

Thus, the combination of the private purchase of equipment with decentralized recruitment and large, regular annual call-ups served to produce a thoroughly militarized population of freeholding farmers, while simultaneously directing the necessary agricultural surplus towards sufficient production of equipment. Compared to the rather narrow ethnic

more years, as the proportion of Romans in a Roman army was greater than the proportion of the total population. On the length of service in the Roman army, see Rosenstein, (2004), 189-190.

[155] Livy 24.18.8-9.

[156] Note, for instance, the broad use of military knowledge in the plays of Plautus: A joke at the expense of the *triarii* in Plaut. *Frivolaria*, fg. 5, agite nunc, supsidite omnes, quasi solent triarii. Plautus plays a joke off of the name of Hannibal's elephant in the *Pseudolus*, Plaut. *Pseudolus* 1218-21. On the background of this joke, see N. J. DeWitt, "Pseudolus and Hannibal's Elephant" *CP* 36.2 (1941): 189-190. Pseudolus also takes the time to play the triumphing general, Plaut. *Pseudolus* 562-73. On this passage, note J. Wright, "The Transformations of Pseudolus" *TAPA* 105 (1975): 403-416. Catapult jokes occur in multiple plays, e.g. Plaut. *Persae* 30-1, *Curculio*, 394.

[157] Rosenstein, (2004), 63-106.

military elite of the Hellenistic states, this system allowed Rome to mobilize not only a vast population but also a vast base of economic resources, with minimal overhead cost. The creation of such a thoroughly militarized class comprising such a large portion of the adult male population of Italy is an astounding achievement. It enabled Rome not merely to call up large numbers of men, but rather vast numbers of well-equipped soldiers, many of whom would already be combat hardened; and, in the event of defeat, Rome could call up more. This strategic depth was not the result of a single massive *dilectus,* but the product of decades of both annual musters and the steady accumulation of military equipment. The resulting depth was not only in manpower, but also in human capital, produced by generations of military service and economic capital, both in the form of vast stores of weapons and armor disbursed throughout the population, but also in the form of a vast, likely decentralized network of metal-working and equipment manufacturing.

In contrast the efforts of the Ptolemaic and Seleucid kingdoms to remake part of their militaries along Roman lines did little to revive their ailing fortunes.[158] Although the evidence is admittedly limited, it does not seem that 'Roman style' units were able to completely replace the older, less resource intensive Hellenistic core.[159] Because the strength of the Roman system was not only in the equipment itself, but also in the embedded social structures of Italy on which the

[158] Sekunda (1994/5); Sekunda (2001); but not also Fischer-Bovet (2014), 144-8 on the weaknesses of this argument.

[159] At Daphne, the Seleucid soldiers equipped in Roman style number only 5,000, compared to 20,000 armed in the Macedonian style Plb. 30.25.3. Bar-Kochva (1976), 55, 60-1. Hannibal, likewise, only reequiped the African heavy infantry of his army, perhaps 10,000 strong by Cannae, in Roman fashion: Plb. 3.114.1; Liv 22.46.4. Fischer-Bovet (2014), 148, notes that the evidence for Roman-style reform in the Ptolemaic army is mixed and unclear, but she does point out that Roman style equipment, particularly mail, seems to have been limited.

alliance was built, it would in effect be impossible to imitate abroad.[160] The problem was also economic: in the absence of a similarly effective system for extracting resources, the revenues of the Seleucid and Ptolemaic kingdoms was only just sufficient for the less matériel intensive Macedonian style of warfare. Without the Roman system of resource extraction, it was nearly impossible to sustain the Roman style of matériel intensive warfare.

The set of norms and institutions that made this Roman triumph possible does not appear to have survived the second century. Territory outside of Italy was not incorporated into the Italian alliance system, but rather was taxed to generate revenue for Rome. This shift in turn allowed for the phasing out of the burdens placed directly on Rome's smallholding farmer class, one by one. In 167, after the Third Macedonian War, *tributum* in Italy was suspended.[161] In 122, Gaius Gracchus passed a law which provided for at least some state issue of equipment. Plutarch merely notes that the law provided for clothing (ἐσθής) be issued at state expense, without deduction from pay, but this is often reasonably assumed to mark the beginning of state funded equipment more generally.[162] The requirement to serve came last, with sporadic use of volunteers in the legions in the late second century giving way to the professional armies of the first.[163] Thus, by the end of the second century, the system of mobilization which had given

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[160] The honor-preserving nature of patronage, for instance, did not translate into the Greek cultural sphere, see P. Millett, "Patronage and its avoidance in classical Athens" in *Patronage in Ancient Society* ed. A. Wallace-Hadrill (London: Routledge, 1989), 15-47.

[161] Plut. *Aem.* 38.1.

[162] Plut. *Gaius* 5.1. Taken to mean state issue, Keppie (1984), 58. No help in clarifying the law's scope comes from other sources; neither Appian's account (App. *Bel. Civ.* 21-23) nor the *Periochae* (Liv. *Per* 60) include any details on this law. Diodorus 34/35.25 implies changes to military discipline but does not specify what they were. Previously, the cost of clothing and any missing equipment was deducted from pay, Plb. 6.39.15.

[163] App. *Iber*. 84. Sallust, *Jugurtha* 86.1-4. Keppie (1984), 57-63.

Rome mastery over the Mediterranean had, by and large, been disassembled. It was no longer needed. In the Mediterranean of the first century there were no longer any peer competitors to match Rome.

Conclusions

This work set out to account for Rome's exceptional military success during the third and second centuries. That investigation began with the steady elimination of possibilities. Rome's success cannot be attributed to exceptional aggression or bellicosity; rather Rome was merely one of many aggressive and bellicose states violently competing in a condition of interstate anarchy. Nor can Rome's success be attributed to an exceptional population or resource base; Rome was neither exceptionally populous, nor possessed of exceptional resources. Finally, Roman soldiers were not exceptionally cheap or expendable. Roman soldiers were, in fact, some of the most expensive and highest quality, yet the Roman Republic was able to field them in greater quantity than any other Mediterranean state or people. The proximate cause of exceptional Roman success is thus found. Rome comprehensively out-mobilized its competitors; only Carthage truly came close to matching Roman expenditure. Such an advantage in mobilized men and matériel allowed Rome to wage wars on multiple fronts, endure losses and capitalize on success. It also enabled Roman armies to take full advantage of expensive weapons and armor, most notably mail armor. Although the fortunes of war are not predetermined, in Rome's case the advantage proved decisive.

In turn, however, this conclusion begs an investigation into root causes: what allowed Rome to mobilize such a greater proportion of its resources? The answer lies in the Roman alliance system's ability to scale up an entitlement-based mobilization system. This ability in turn was socially embedded insofar as it was reliant on a set of cultural preconditions in Italy. The most important of these was a shared social script rooted in systems of patronage whereby individuals and communities could enter into unequal, but reciprocal, relationships without the loss of honor or face. These ties were reinforced by Italy's long history of military confederations and shared military culture. Through this system, Rome was able to harness the civic militarism of subject 'allied' communities, making it possible to demand and receive a greater share of the resources of Italy in both men and matériel. This greater degree of mobilization in turn provided for the vast quantities of men, supplies and equipment on which Rome's military dominance depended. Here, then, is to be found the basis of Rome's success and the foundation of a broader *imperium* which would change both Rome, Italy, and the Mediterranean world.

ARTIFACT CATALOG

Roman/Italian

Swords

R1: Gladius, Roman

Date: c. 69

Find Location: Delos

Material: Iron

Dimensions: Length (total): 76cm; (blade): 63.1cm; (tang): 12.9cm; Width (blade): 5.7cm.

Notes: The frame of the scabbard is still attached to the sword, with the suspension clearly preserved. The blade is relatively wide and does not show signs of being waisted. The date, put forward by Siebert, is in connection to a pirate sack of the sanctuary.

Bibliography: Siebert (1987); Bishop and Coulston (2006), 55-6; Feugere (1994b).

R2: Gladius, Roman

Date: Second half of the first century B.C.

Find Location: Soknopaiou, Nesos (El-Fayyum, Egypt)

Material: Iron

Dimensions: Length (total): 94.5cm; (blade): 77.3cm; (tang): 17.2cm; Thickness (blade, shoulders): 5.8cm, (blade, waist): 4.19cm, (blade, point-transition), 5.68cm; (tang) 1.7mm.

Mass: 1.3kg (including pommel and grip)

Notes: Davoli and Miks contend the blade should be understood as a "spatha of the Nauportus type." However the blade is strongly waisted, as compared to the parallel-edged spatha and should probably be understood as an unusually large example of the *hispaniensis*.

Bibliography: Davoli and Miks (2015).

R3: Gladius, Roman

Date: c. 100

Find Location: Mouriès Bouches-du-Rhône, France

Material: Iron

Dimensions: Length (total): 76.5cm; (blade): 63.7cm; (tang): 12.8cm.

Notes: Blade is bent and badly fragmented, but the total length is preserved. Weak waisting. Original blade shape is reconstructed by Connolly.

Bibliography: Feugere (1994b); Connolly (1997).

R4: Gladius, Roman

Date: c. 20

Find Location: Berry-Bouy à Fontillet, France

Material: Iron

Dimensions: Length (total): 75.7cm; (blade): 66.7cm; (tang): 9cm.

Notes: The tang is incomplete. The sword itself is slightly waisted and preserved with parts of the scabbard frame.

Bibliography: Feugere (1994b); Connolly (1997).

R5: Gladius, Roman

Date: Unknown (Republican?)

Find Location: Boyer, France

Material: Iron

Dimensions: Length (total): 71.5cm; (blade): 67.5cm; (tang): 4cm.

Notes: Sword is slightly waisted, but damage distorts the blade-shape. Tang is incomplete at 4cm; if the tang was a more normal length (c. 13cm), the total length ought to be c. 80.5cm.

Bibliography: Feugere (1994b); Connolly (1997).

R6: Gladius, Roman

Date: Augustan (Connolly: Late Republic)

Find Location: Grave 119, Guibiasco, Switzerland

Material: Iron

Dimensions: Length (total): 81cm; (blade): 68cm; (tang): 13cm.

Notes: Primas suggests an Augustan date, but Connolly notes that the Gallic artifacts the blade was found with suggest a Late Republican date.

Bibliography: Primas (1992); Connolly (1997); Feugere (1994b); Bishop and Coulston (2006), 55-6.

R7: Gladius, Roman

Date: Augustan/Late Republic?

Find Location: Grave 471, Guibiasco, Switzerland

Material: Iron

Dimensions: Length (total): 69cm.

Notes: Tang incomplete, blade is split into two fragments, but overall length preserved. Moderately waisted, in a similar shape (but not length) to the Soknopaiou sword.

Bibliography: Connolly (1997).

R8: Gladius, Roman

Date: Caesarian

Find Location: Osuna, Spain

Material: Iron

Dimensions: Width (blade, at hilt): 6cm; (waist): 5cm. Connolly reconstructs a length of 64-65cm.

Bibliography: Connolly (1997).

R9: Gladius, Roman

Date: 118

Find Location: Tomb of Micipsa, Es Soumâ, Algeria

Material: Iron

Dimensions:

Top Fragment: Length: 29.5; Width (before sheath): 5cm

Tang: 2.1cm x 1.1cm

Lower Fragment: Length: 37.6cm; Width (max): 5.1cm; Blade Width (approx..): 4.4cm

Center Fragment: Length: 6.6cm

Notes: Find location believed to be the tomb of Micipsa, d. 118, providing date. Blade is badly damaged and corroded, broken into three fragments, but appears to be of the recognizable *hispaniensis* type.

Bibliography: Ulbert (1979); Connolly (1997).

R10: Gladius, Roman

Date: Second Century (c. 181-c. 100)

Find Location: Grad, near Šmihel, Slovenia.

Material: Iron

Dimensions: Length (blade): 66cm; Width (blade, max): 4.2cm.

Mass: digitally reconstructed, 680g

Notes: Šmihel-1. Part of a horde of weapons and military equipment. Elements of this find are now split between the National Museum of Slovenia and the Natural History Museum in Vienna, others separated/lost. Blade is well preserved (but bent in original find-context), shows slight waisting.

Bibliography: Horvat (1997); Horvat (2002); Kmetič, D., J. Horvat and F. Vodopivec (2004); Bishop and Coulston (2006), 55-6; Connolly (1997).

R11: Gladius, Roman

Date: Second Century (c. 181-c. 100)

Find Location: Grad, near Šmihel, Slovenia.

Material: Iron

Dimensions: Length (blade) 62.2cm; Width (blade, max): 4.5cm.

Mass: digitally reconstructed, 528g.

Notes: Šmihel-2. See R10 for find context. Blade is shorter and slightly less waisted than R10. Tang slightly broken off, but otherwise complete.

Bibliography: Horvat (1997); Horvat (2002); Kmetič, D., J. Horvat and F. Vodopivec (2004); Bishop and Coulston (2006), 55-6; Connolly (1997).

Pila

R12: Pila (Horvat type 1), Roman

Date: c.181-100

Find Location: Grad, near Šmihel, Slovenia

Material: Iron

Dimensions: 12 examples, ranging from 22 to 30cm in length.

Notes: Type is typified by larger points, shorter shanks and flat hafts. The *pilum* shank has a square or rectangular cross-section, from 0.7 to 1.1cm wide. Horvat (1997) classifies as type 1; Connolly (2000b) does not reconstruct the type. See R10 for find context.

Bibliography: Horvat (1997).

R13: Pila (Horvat type 2), Roman

Date: c. 181-100

Find Location: Grad, near Šmihel, Slovenia

Material: Iron

Dimensions: 7 examples, ranging from 33 to 40cm in length

Mass: Reconstructed: 340g (iron), with 1.04kg wooden haft.

Notes: Type 2 is narrower, with less emphasized barbs. Type is reconstructed by Connolly (2000b). See R10 for find context.

Bibliography: Horvat (1997); Connolly (2000b).

R14: Pila (Horvat, type 3), Roman

Date: c. 181-100

Find Location: Grad, near Šmihel, Slovenia

Material: Iron

Dimensions: 10 examples, ranging from 44 to 57cm in length

Mass: Reconstructed: 250g (iron) with 0.96kg wooden haft

Notes: Type 3 is a longer, square-hafted type, but with thinner construction and overall lower weight. Type is reconstructed by Connolly (2000b). See R10 for find context.

Bibliography: Horvat (1997); Connolly (2000b).

R15: Pila, socketed, Roman

Date: c. 181-100

Find Location: Grad, near Šmihel, Slovenia

Material: Iron

Dimensions: 47 examples, most between 30 to 38cm in length, some shorter (between 20 to 30cm in length). Sockets c. 1.3cm diameter.

Notes: Lighter, socketed type, not reconstructed by Connolly. The shank is joined to the pilum by a socket secured by one or two rivets, rather than a flat haft.

Bibliography: Horvat (1997).

R16: Pila (Flat-tanged), Roman

Date: Second century

Find Location: Talamonaccio, Italy

Material: Iron

Dimensions: 16 examples. Length (total): 25-32cm; (tang): 6-9cm; (shank and point): 14-20cm; (rivet nail, best preserved): 4.7cm.

Mass: Reconstructed: 265g (iron) with 1.015kg wooden haft.

Notes: M. Luik classifies these as 'variente 1.' They correspond to Horvat type 1 (R12) in form and size. Reconstructed (as a single type with R17) by Connolly (2000b).

Bibliography: Luik (2000); Connolly (2000b).

R17: Pila (Flat-tanged), Roman

Date: Second century

Find Location: Talamonaccio, Italy

Material: Iron

Dimensions: 3 examples. Length (total): 29.3, 32.0, 35.3cm; (tang): 8-9cm; (shank and point): 18-21.5cm; (rivet, best preserved): 5cm. Width (tang): 4-5.5cm.

Mass: Reconstructed: 265g (iron) with 1.015kg wooden haft.

Notes: M. Luik classifies these as 'variente 2.' They correspond roughly to Horvat type 1 (R12) or type 2 (R13) in form and size. Reconstructed (as a single type with R16), by Connolly (2000b).

Bibliography: Luik (2000); Connolly (2000b).

R18: Pila (Flat-tanged), Roman

Date: Late second, early first century

Find Location: Caminreal, Spain

Material: Iron

Dimensions: 4 examples:

Pilum 1: Length (max): 95.1cm; (point): 9.2cm; (shank): 65.1cm; (tang): 20.8cm. Width (tang): 4.5cm.

Pilum 2: Length (max): 100.2cm; (point preserved): 5.5cm; (point estimate): 8.9cm; (shank): 79.3cm; (tang): 17.2cm. Width (tang): 4cm.

Pilum 3: Incomplete. Length (preserved, total): 29.7cm. Width (tang): 4cm.

Pilum 4: Incomplete. Length (preserved, total): 64.3cm; (point preserved): 4.8cm; (point estimated): 8cm.

Notes: Very long examples, with flat tangs secured by two large rivets. Pilum 1 and 2 are well preserved, 3 and 4 are incomplete. Connolly (2000b) considers this type connected to the Renieblas types discovered by Schulten (1929).

Bibliography: Vicente *et al.* (1997); Connolly (2000b).

R19: Pila (Socketed), Roman

Date: Late second, early first century

Find Location: Caminreal, Spain

Material: Iron

Dimensions: 4 examples:

Pilum 1: Length (max): 32.4cm; (point) 2.6cm; (shank): 22cm; (socket): 7.7cm; (socket interior): 5.9cm. Diameter (socket, interior): 1.4cm; (exterior): 2.4cm

Pilum 2: Length (max): 50.5cm; (point) 3.9cm; (socket): 11.4cm; (socket interior): 10.5cm; Diameter (socket, interior): 2.2cm; (exterior): 2.6cm

Pilum 3: Length (max): 41.4cm; (socket): 11cm; (socket, interior): 9.6cm. Diameter (socket, interior): 2.2cm; (exterior): 2.6cm.

Pilum 4: Incomplete. Length (max): 32.9cm.

Notes: Socketed 'light' *pila*. Of the same form as R15, but substantially longer. Pilum n. 3 preserves the hole for fixing the rivet.

Bibliography: Vicente *et al.* (1997).

Spears

R20: Spearhead, Roman

Date: Late second, early first century

Find Location: Caminreal, Spain

Material: Iron

Dimensions: Length (total, preserved): 21.6; (blade): 11.5cm; (socket, external): 10cm; (socket, internal): 8.4cm. Width (blade): 3.6cm. Diameter (socket, external): 2.4cm; (internal): 1.4cm.

Mass: Reconstructed digitally, c. 225g.

Notes: Relatively small spearhead, 'tear-drop' shaped, with no mid-ridge. Attached by a circular socket (rivet holes not preserved).

Figure: 4.15

Bibliography: Vicente *et al*. (1997), n˚IG10.133

R21: Spearhead, Roman

Date: Late second, early first century

Find Location: Caminreal, Spain

Material: Iron

Dimensions: Length (total, preserved): 31.6cm; (total, est.): 32.4cm; (blade, preserved): 20.4cm; (blade, est.): 21.2cm; (socket): 11cm; (socket, internal): 8.1cm. Width (blade): 4cm. Diameter (socket, external): 2.6cm; (internal): 1.6cm.

Mass: Reconstructed digitally, c. 337g.

Notes: Relatively long and narrow spearhead, with a lenticular section and elongated 'tear-drop' shape. No mid-ridge. Attached by a circular socket with a single rivet hole.

Figure: 4.15

Bibliography: Vicente *et al*. (1997), n˚IG15.781

R22: Spearhead, Roman

Date: Late second, early first century

Find Location: Caminreal, Spain

Material: Iron

Dimensions: Length (total, preserved): 27.4cm; (total, est): 28.5; (blade, preserved): 18.3; (blade, est): 19.5cm; (socket): 9.4cm. Width (blade): 4.1cm. Diameter (socket external): 2.6; (internal) 1.6cm.

Mass: Reconstructed digitally, c. 292g

Notes: Mid-sized spearhead, with a lenticular section and 'tear-drop' shape. No mid-ridge. Attached by a circular socket secured with a single rivet hole.

Figure: 4.15

Bibliography: Vicente *et al*. (1997), n˚IG15.782

R23: Spearhead, Roman

Date: Late second, early first century

Find Location: Caminreal, Spain

Material: Iron

Dimensions: Length (total): 19.5cm; (blade): 11.6cm; (socket): 7.8cm. Width (blade): 3.5cm. Diameter (socket, external): 2.3; (internal): 1.8cm.

Mass: Reconstructed digitally, c. 237.5g

Notes: Smaller, ‘tear-drop’ shaped spearhead. Flat, apparently lenticular section (somewhat obscured by corrosion). No apparent mid-ridge. Attached by a circular socket with a single rivet hole.

Figure: 4.15

Bibliography: Vicente *et al*. (1997), n˚IG15.786

R24: Spearhead, Roman

Date: Late second, early first century

Find Location: Caminreal, Spain

Material: Iron

Dimensions: Length (total): 44cm; (blade): 34.5cm; (socket): 9.5cm. Width (blade): 2.6cm. Diameter (socket, external): 2.6cm; (internal): 1.4cm

Mass: Reconstructed digitally, 318.5g

Notes: Very large 'stiletto' or bodkin point spearhead. The blade is somewhat corroded but seems to have had a rectangular or square section. Attached by a circular socket. Unusually large for this type.

Figure: 4.15

Bibliography: Vicente *et al*. (1997), n˚IG16.388

R25: Spearhead, Roman

Date: Late second, early first century

Find Location: Caminreal, Spain

Material: Iron

Dimensions: 2 Fragments:

> Fragment 1: Length (total, preserved): 14.6cm; (blade): 5.4cm; (socket): 9.1cm; (socket, internal): 4.4cm. Width (blade, preserved): 5.7cm; (blade, est.): 6.2cm. Diameter (socket external): 2.5cm; (internal0: 1.8cm.
>
> Fragment 2: Length (total): 6.9cm. Width (max): 2.3cm

Notes: Spearhead is in two fragments: the bulk of the spearhead is fragment 1; the tip, broken off, is fragment 2.

Bibliography: Vincente *et al*. (1997), n˚IG16.357 and IG16.545.

R26: Spearhead, Roman

Date: Mid-second century

Find Location: Numantia

Material: Iron

Dimensions: Length (total): 28.4cm. Diameter (socket): c. 1.4cm. Diameter measured from scale diagram.

Notes: Socketed spearhead of the bodkin type. Significantly smaller than R24.

Bibliography: Schulten (1929), 209, taf 25.2.

R27: Spearhead, Roman

Date: Mid-second century

Find Location: Numantia

Material: Iron

Dimensions: Length (total): 15.3cm. Width (max): c. 3.6cm. Diameter (socket): c. 3.3cm. All but length measured from scale diagram.

Notes: Socketed spearhead with a 'tear-drop' shaped tip. Flat section, no mid-ridge.

Bibliography: Schulten (1929), 209, taf. 26.2.

R28: Spearhead, Roman

Date: Mid-second century

Find Location: Numantia

Material: Iron

Dimension: Length (total): 19.8. Width (max): c. 3.9cm. Width measured from scale diagram.

Notes: Spearhead with ‘tear-drop’ shape. Cross-section is rhombic and concave, with a well-pronounced mid-ridge. The socket has been broken off.

Bibliography: Schulten (1929), 209, taf. 26.3.

R29: Spearhead, Roman

Date: Mid-Second century

Find Location: Numantia

Material: Iron

Dimensions: Length (total, preserved): 13.5cm; (total, est.): 16.5cm. Width (max): c. 3cm. Diameter (socket): c. 2.5cm. All but length measured from scale diagram.

Notes: Spearhead with a ‘tear-drop’ shape and a pronounced mid-ridge. Section is rhombic, but only mildly concave. Socket appears to be only partially preserved; tip is missing (but rough size is reconstructed by Schulten).

Bibliography: Schulten (1929), 209, taf. 26.5.

R30: Spearhead, Roman

Date: Mid-Second century

Find Location: Numantia

Material: Iron

Dimensions: Length (total): 16cm. Width (max): c. 3.8cm. Width measured from scale diagram.

Notes: Spearhead, socket entirely lost. 'Tear-drop' shaped blade with a midridge, concave cross-section. Edges of the blade of the spearhead are damaged. Mid-ridge runs the length of the blade.

Bibliography: Schulten (1929), 223, taf. 45.1.

R31: Spearhead, Roman

Date: Mid-Second century

Find Location: Numantia

Material: Iron

Dimensions: Length (total): c. 21.8cm. Width (max): c. 4.6cm. Measured from scale diagram.

Notes: No cross-section shown; appears flat or convex, with no mid-ridge. Part of the socket is broken off, blade is worn on the edges.

Bibliography: Schulten (1929), 223, taf. 45.3.

R32: Spearhead, Roman

Date: Mid-Second century

Find Location: Numantia

Material: Iron

Dimensions: Length (total): c. 19.4cm. Width (max): c.1.4cm. Measured from scale diagram.

Notes: No cross-section shown; appears rectangular in section. 'Stiletto' or bodkin type spear-head, with a long, apparently rectangular-section blade, attached by a circular socket.

Bibliography: Schulten (1929), 223, taf. 45.4.

R33: Spearhead, Roman

Date: Mid-Second century

Find Location: Numantia

Material: Iron

Dimensions: Length (total): c. 15.8cm; Width (max, reconstructed): c. 4cm. Measured from scale diagram.

Notes: Spearhead with 'tear-drop' shaped blade, with a strong central mid-ridge. Circular socket is mostly lost. Substantial damage to the edges of the blade. Mid-ridge runs nearly the entire length of the blade.

Figure: 4.13

Bibliography: Schulten (1929), 223, taf 45.5.

R34: Spearhead, Roman

Date: Mid-Second century

Find Location: Numantia

Material: Iron

Dimensions: Length (total, preserved), c. 19.5cm; Width (max): c. 3.6cm. Measured from scale diagram.

Notes: Badly damaged spearhead with a flat blade. No mid-ridge. Point is missing and the edges of the badly damaged.

Bibliography: Schulten (1929), 209, taf. 26.3.

R35: Spearhead, Roman

Date: Mid-second century

Find Location: Numantia

Material: Iron

Dimensions: Length (total): c. 22cm. Width (max): c. 1.2cm. Measured from scale diagram.

Notes: Mid-sized ‘stiletto’ or bodkin point with a rectangular cross-section, attached by a circular socket.

Bibliography: Schulten (1929), taf 32.5a.

R36: Spearhead, Roman

Date: Mid-second century

Find Location: Numantia

Material: Iron

Dimensions: Length (total): c. 25.6cm. Width (max); c. 1.2cm. Measured from scale diagram.

Notes: mid-sized ‘stiletto’ or bodkin point with a rectangular cross-section, attached by a circular socket.

Bibliography: Schulten (1929), taf. 32.6

R37: Spearhead, Roman

Date: c. 80

Find Location: Caceres, Spain

Material: Iron

Dimensions: Length (total): 21.1cm. Width (max): 3cm. Diameter (socket): 2.8cm.

Notes: ‘Tear-drop’ shaped spearhead with a fairly flat blade, attached by a circular socket. No mid-ridge.

Bibliography: Ulbert (1984), 105, 224, taf 24; cat. n˚181.

R38: Spearhead, Roman

Date: c. 80

Find Location: Caceres, Spain

Material: Iron

Dimensions: Length (total, preserved): 14cm. Width (max): 3.3cm. Diameter (socket, internal): 1.3cm.

Notes: 'Tear-drop' shaped spearhead with a fairly flat blade and no mid-ridge. Left side of the blade is damaged and the point is partially lost. Socket is missing.

Bibliography: Ulbert (1984), 105, 224, taf 24; cat n˚182.

R39: Spearhead, Roman

Date: c. 80

Find Location: Caceres, Spain

Material: Iron

Dimensions: Length (total, preserved): 15.5cm. Width (max): 4.8cm. Diameter (socket): 4.8cm.

Notes: Spearhead, 'tear-drop' shape with a flat cross-section. The blade is broken off perhaps 1/2 to 1/3 of the way down, with most of the blade missing.

Bibliography: Ulbert (1984), 105,225, taf 24; cat. n˚183.

R40: Spearhead, Roman

Date: c. 80

Find Location: Caceres, Spain

Material: Iron

Dimensions: Length (total) 24.5cm. Diameter (socket): 1.8cm.

Notes: Spearhead, 'tear-drop' shaped with a strong mid-ridge running that runs the entire blade all the way to the point. This example has a very long blade, with a very short socket. The edges of the blade are badly damaged, original width uncertain.

Figure: 4.13

Bibliography: Ulbert (1984), 105, 225, taf 24; cat. n˚184.

R41: Spearhead, Roman/Numidian

Date: 118

Find Location: Tomb of Micipsa, Es Soumâ, Algeria

Material: Iron

Dimensions: Length (total): 29.7cm. Width (blade): 3.8cm. Diameter (socket): 1.6cm.

Mass: 77g

Notes: See R9 for dating. Spearhead is ‘tear-drop’ shaped with a weak mid-ridge and a rhombic cross-section, attached by a round socket. The blade is mostly intact. Ulbert classifies it as a *wurflanzenspitzen*; this is supported by the very light construction of the tip, but argued against by the shape of it, which is very wide for a throwing weapon. Could also be the tip of a *hasta*; lightness may be due to multi-purpose use (throwing, thrusting), in a Numidian context.

Bibligraophy: Ulbert (1979), 333-8, taf. 125.2.

R42: Spearhead, Roman/Numidian

Date: 118

Find Location: Tomb of Micipsa, Es Soumâ, Algeria

Material: Iron

Dimensions: Length (total): 30cm. Width (blade): 3.8cm. Diameter (socket): 1.5cm.

Mass: 73g.

Notes: See R9 for dating. Spearhead is ‘tear-drop’ shaped with a weak mid-ridge and a rhombic cross-section, attached by a round socket. The blade is mostly intact. Ulbert classifies it as a *wurflanzenspitzen*; this is supported by the very light construction of the tip, but argued against by the shape of it, which is very wide for a throwing weapon. Could also be the tip of a *hasta*; lightness may be due to multi-purpose use (throwing, thrusting), in a Numidian context.

Bibliography: Ulbert (1979), 333-8, taf. 125.3.

R43: Spearhead, Roman/Numidian

Date: 118

Find Location: Tomb of Micipsa, Es Soumâ, Algeria

Material: Iron

Dimensions: Length (total, preserved); 18.5cm; (total, est.); 21cm. Width (blade): 2.8cm. Diameter (socket): 1.3cm.

Mass: 68g.

Notes: See R9 for dating. Spearhead is 'tear-drop' shaped with a weak mid-ridge and a rhombic cross-section, attached by a round socket. The blade is mostly intact. Ulbert classifies it as a *wurflanzenspitzen*; this is supported by the very light construction of the tip, but argued against by the shape of it, which is very wide and rather long for a throwing weapon. Could also be the tip of a *hasta*; lightness may be due to multi-purpose use (throwing, thrusting), in a Numidian context.

Bibliography: Ulbert (1979), 333-8, taf 126.1.

R44: Spearhead, Roman/Numidian

Date: 118

Find Location: Tomb of Micipsa, Es Soumâ, Algeria

Material: Iron

Dimensions: Length (total, preserved): 17.4; (total, est.): 22cm. Width (blade); 2.8cm. Diameter (socket): 1.3cm.

Mass: 66g.

Notes: See R9 for dating. Spearhead is ‘tear-drop’ shaped with a weak mid-ridge and a rhombic cross-section, attached by a round socket. The blade is mostly intact. Ulbert classifies it as a *wurflanzenspitzen*; this is supported by the very light construction of the tip, but argued against by the shape of it, which is a bit wide and rather long for a throwing weapon. Could also be the tip of a *hasta*; lightness may be due to multi-purpose use (throwing, thrusting), in a Numidian context.

Bibliography: Ulbert (1979), 333-8, taf 126.2.

R45: Spearhead, Roman/Numidian

Date: 118

Find Location: Tomb of Micipsa, Es Soumâ, Algeria

Material: Iron

Dimensions: Length (total): 18.2cm; (blade): 10.7cm. Width (square head at base): 1.1cm. Diameter (socket): 1.2cm.

Mass: 66g

Notes: See R9 for dating. Spearhead is a ‘stiletto’ or bodkin point with a square cross-section. Spearhead is almost entirely intact with only light damage to the socket. Ulbert identifies this weapon as a *wurfgeschosspitze*, but this seems unlikely due to the narrow, bodkin-type point.

Figure: 4.16

Bibliography: Ulbert (1979), 333-8, taf 126.5.

R46: Spearhead, Roman/Numidian

Date: 118

Find Location: Tomb of Micipsa, Es Soumâ, Algeria

Material: Iron

Dimensions: Length (total): 17.8cm. Width (square head at base): 1cm. Diameter (socket); 1.2cm.

Mass: 67g

Notes: See R9 for dating. Spearhead is a 'stiletto' or bodkin point with a square cross-section. Spearhead is almost entirely intact with only light damage to the socket. Ulbert identifies this weapon as a *wurfgeschosspitze*, but this seems unlikely due to the narrow, bodkin-type point.

Figure: 4.16

Bibliography: Ulbert, (1979), 333-8, taf. 126.6.

R47: Spear Butt, Roman

Date: Late second, early first century

Find Location: Caminreal, Spain

Material: Iron

Dimensions: Length (total): 13.6, (socket, internal): 5.5cm. Diameter (max): 2.4cm.

Mass: Reconstructed digitally, c. 81.4g

Notes: Iron spear butt, in a simple conical shape.

Bibliography: Vincente *et al*. (1997), n˚IG16.476.

R48: Spear Butt, Roman

Date: Late second, early first century

Find Location: Caminreal, Spain

Material: Iron

Dimensions: Length (total): 8.4cm; (socket, internal): 7.5cm. Diameter (max): 2.3cm.

Mass: Reconstructed digitally, c. 69.5g

Notes: Iron spear butt, in a simple conical shape. A relatively small and light example.

Bibliography: Vincente *et al*. (1997), n˚IG16.397.

R49: Spear Butt, Roman/Numidian

Date: 118

Find Location: Tomb of Micipsa, Es Soumâ, Algeria

Material: Iron

Dimensions: Length (total, preserved) 14.7cm; (total, est.): 18cm. Diameter (socket, max): 1.2cm

Mass: 47g.

Notes: See R9 for dating. Iron spear, butt, in a simple conical shape. A quite small and light example (probably matching the much lighter spearheads found in the same deposit).

Bibliography: Ulbert (1979), 333-8, taf. 126.3.

R50: Spear Butt, Roman/Numidian

Date: 118

Find Location: Tomb of Micipsa, Es Soumâ, Algeria

Material: Iron

Dimensions: Length (total, preserved): 16.4cm; (total, est.): 17.5cm. Diameter (socket, max): 1.4cm.

Mass: 58g.

Notes: See R9 for dating. Iron spear, butt, in a simple conical shape. A quite small and light example (probably matching the much lighter spearheads found in the same deposit).

Bibliography: Ulbert (1979), 333-8, taf 126.4.

Shields

R51: Round Umbo? Roman

Date: Mid-second century

Find Location: Numantia

Material: Bronze

Dimensions: Diameter (total): 14.5cm. Width (outer flat section): 1.5cm. Height (raised portion, max): 1.2cm. Measurements from scale diagram.

Mass: Estimated 140g if made in bronze.

Notes: Bronze circular plate with a raised center. Three rivets for attachment to some sort of backing, potentially shield, like the *parma*. The center of the plate is raised in a dome, with a flat outer edge.

Bibliography: Schulten (1929), 210, taf. 26.22.

R52: Umbo, Roman.

Date: Late second, early first century

Find Location: Caminreal, Spain

Dimensions: Width (max): c. 23.5cm; (wing): c. 6cm. Height (center): c. 10cm; (max, wing): 20cm. Measurements from scale diagram.

Mass: Reconstructed digitally, 281.8g.

Notes: Iron butterfly boss from Caminreal, published without measurements, but with scale drawing. There is a rectangular puncture in the center of the hull of the boss; the right wing has a small part of the top tip missing, the left wing has lost a larger part of the top tip.

Figure: 4.20

Bibliography: Vicente *et al.* (1997), fig 40, IG 15.760; Bishop and Coulston (2006), 62.

R53: Umbo, Roman.

Date: Late second, early first century

Find Location: Caminreal, Spain

Dimensions: Width (max): c. 24cm; (wing): c. 6.25-6.5cm. Height (center): c. 11cm; (max, wing): 16cm. Measurements from scale diagram.

Mass: Reconstructed digitally, 264.3g

Notes: Iron butterfly boss from Caminreal, published without measurements, but with scale drawing. The boss is almost entirely intact, with only a bit of the top tip of one wing missing. The hulls of three of the four securing rivets are still visible.

Figure: 4.20

Bibliography: Vicente *et al.* (1997), fig 40, IG 11.630; Bishop and Coulston (2006), 62.

R54: Shield Binding, Roman (Imperial)

Date: Imperial (unstratified)

Find Location: Carnafon, Wales

Material: Copper-alloy

Dimensions: Length (total): 83mm (broken). Width: 1.9cm. Thickness: 0.5mm.

Notes: Metal shield binding for preventing the edge of a shield from delaminating. In its original state, it would have run the length of an edge of the *scutum*.

Bibliography: Chapman (2005), 106.

R55: Shield Binding, Roman (Imperial)

Date: Imperial (unstratified)

Find Location: Carnafon, Wales.

Material: Copper-alloy

Dimensions: Length (total): 110mm (broken). Width 1.9cm. Thickness: 0.5mm.

Notes: Metal shield binding for preventing the edge of a shield from delaminating. In its original state, it would have run the length of an edge of the *scutum*.

Bibliography: Chapman (2005), 106.

R56: Shield Maniple, Roman (Imperial)

Date: c. 200-300 C.E.

Find Location: Caerleon, Wales

Material: Iron

Dimensions: Length (total): 12.0cm. Width: 1.6cm. Thickness: c.6mm.

Notes: Part of the a shield grip for an imperial-era *scutum*. Perforations for nails to attach to the shield preserved at the ends of the strip; one preserves a nail. Incomplete.

Bibliography: Chapman (2005), 105.

R57: Shield Maniple, Roman (Imperial)

Date: c. 200-300 C.E.

Find Location: Caerleon, Wales

Material: Iron

Dimensions: Length (total): 22.0cm. Width: 1.5cm. Thickness: c.8mm.

Notes: Bar of rectangular section, with expanded disc at one end to provide space for it to be riveted or nailed to the shield. There is a second swelling two-fifths of the way across the surface which may have been the beginning of a second disc for the same purpose.

Bibliography: Chapman (2005), 105.

R58: Shield Maniple? Roman

Date: Mid-second century

Find Location: Numantia

Material: Iron

Dimensions: Length: 35.4cm. Width c. 2.4cm. Width measured from scale diagram.

Notes: Metal bar with three rivets driven through (still extent when diagrammed by Schulten). Schulten terms it an "iron fitting the use of which cannot be determined" but it is the right size and length for a reinforcing strip for a shield maniple.

Bibliography: Schulten (1929), 221, taf. 41.1.

R59: Shield Maniple? Roman

Date: Mid-second century

Find Location: Numantia

Material: Iron

Dimensions: Length 28.8cm. Width 3.6cm. Width measured from scale diagram.

Notes: Rectangular metal bar with two rivers. Schulten terms it an "iron fitting the use of which cannot be determined" but it is the right size and length for a reinforcing strip for a shield maniple.

Bibliography: Schulten (1929), 221, taf 41.2.

R60: Shield Maniple? Roman

Date: Mid-second century

Find Location: Numantia

Material: Iron

Dimensions: Length 14.7cm. Width: 3.3cm. Width measured from scale drawing.

Notes: Thin iron plate, bent outwards in the middle, with rivet holes on both end. Schulten terms it an "iron fitting the use of which cannot be determined" but it is the right size and length for a reinforcing strip for a shield maniple.

Bibliography: Schulten (1929), 221, taf 41.3.

Body Armor – Mail

R61: Armor Rings, Roman

Date: c. 150

Find Location: Numantia (Lager III)

Material: Bronze

Dimensions: Diameter (rings): 0.9-1.1cm. Thickness (wire of rings): 1mm. Measured from scale diagram.

Mass: Estimated, c. 0.18g per ring.

Notes: Set of ten armor rings, joined in the standard four-in-one pattern.

Bibligraphy: Schulten (1929), 210 and taf. 26.20.

R62: Armor Rings, Roman, Imperial

Date: Unknown (Imperial)

Find Location: Ouddorp, Leiden, Netherlands

Material: Gilded Bronze

Dimensions: 6 Rings. Diameter (outer): 3.062mm to 3.197mm; (inner): 2.123mm to 2.268.

Thickness: 0.51 to 0.63mm.

Notes: Individual ring measurements in Sim (1997). Quite small rings, manufactured to fairly high size standard tolerances. Alternating rivets and solid rings, in a four-in-one pattern. Likely produced by punching from a solid sheet, rather than wire-drawing.

Bibliography: Sim (1997).

R63: Armor Rings, Roman, Imperial

Date: Second century C.E.

Find Location: Caerleon, Wales

Material: Iron

Dimensions: 10 Rings. Diameter (outer): 6.6mm to 7.8mm; (inner): 4.4mm to 5.4mm.

Thickness: 0.8mm to 1.4mm.

Notes: Individual ring measurements in Sim (1997). Fairly large rings, manufactured to moderately high tolerances.

Bibliography: Sim (1997)

R64: Armor Rings, Roman, Imperial

Date: 150-250 CE

Find Location: Thorsberg, Germany

Material: Iron

Dimensions: Two rings measured (more in find) from scale image. Diameter (Outer): 3.8mm, 4.2mm; (inner): c. 3.5mm. Thickness: 0.3-0.5mm.

Notes: Rings pictured in Sim and Kaminski (2012), and discussed in Sim (1997), but without a full list of measurements.

Bibliography: Sim and Kaminski (2012), 114, 125, fig 88; Sim (1997).

R65: Armor Ring Concretion, Roman, Imperial

Find Location: Arbeia, England

Material: Iron

Dimensions: Concretion (number of rings unclear). Diameter (outer): c. 7.5mm. Thickness (ring wire): c. 1.3mm.

Notes: Concretion of rings rusted together. Measurements listed alongside image in Sim and Kaminski (2012).

Bibliography: Sim and Kaminski (2012), pl. 4b.

R66: Armor Rings, Roman, Imperial

Date: Mid-first century C.E. (listed as ‘Pre-Flavian’)

Find Location: Usk, Wales

Material: Iron

Dimensions: Ring Diameter (average): 4.3+-0.3mm. Thickness: c. 1mm.

Bibliography: Chapman (2005), cat. Ma03.

Current Location: National Museum of Wales, acc. N˚82.11H

R67: Armor Rings, Roman, Imperial

Date: Mid-first century C.E. (listed as ‘Pre-Flavian’)

Find Location: Usk, Wales

Material: Iron

Dimensions: Ring Diameter (average): 5.4±0.8mm. Thickness 1.1mm.

Bibliography: Chapman (2005), cat. Ma04.

Current Location: National Museum of Wales, acc. N˚82.11H

R68: Armor Rings, Roman, Imperial

Date: Mid-first century C.E. (listed as ‘Pre-Flavian’)

Find Location: Usk, Wales

Material: Iron

Dimensions: Six Fragments (Ring diameter; thickness)

i: 2.8±0.2mm; 0.7mm thick

ii. 2.7±0.3mm; 0.6mm thick

iii: 2.6±0.3mm; 0.6mm thick

iv 2.6±0.2mm; 0.7mm thick

v. 2.5 ±0.1mm; 0.8mm thick

vi 2.4±0.3mm; 0.7mm thick

Notes: Six fragments of mail. All six pieces probably came from the same armor of very fine mail.

Bibliography: Chapman (2005), cat. Ma04.

Current Location: National Museum of Wales, acc. N˚82.11H

R69: Armor Rings, Roman, Imperial

Date: Mid-first century C.E. (listed as ‘Pre-Flavian’)

Find Location: Usk, Wales

Material: Iron

Dimensions: Ring Diameter (average): 8.0±0.4mm. Thickness: 1.6mm.

Bibliography: Chapman (2005), cat. Ma06.

Current Location: National Museum of Wales, acc. N˚82.11H

R70: Armor Rings, Roman, Imperial

Date: Mid-first century C.E. (listed as ‘Pre-Flavian’)

Find Location: Usk, Wales

Material: Iron

Dimensions: Three Fragments; Ring Diameter (all fragments, average): 2.6±0.2mm. Thickness (all fragments, average): 0.5mm.

Notes: R70 and R71 were initially included by Chapman (2005) under a single heading (Ma07). However, Chapman reckons these rings were part of two armors, one relatively finer (R70) and one of lower quality (R71), so I have split them into two entries accordingly.

Bibliography: Chapman (2005), cat. Ma07.

Current Location: National Museum of Wales, acc. N˚82.11H

R71: Armor Rings, Roman, Imperial

Date: Mid-first century C.E. (listed as ‘Pre-Flavian’)

Find Location: Usk, Wales

Material: Iron

Dimensions: Three Fragments (ring diameter; thickness):

i. c.5.5mm; c.1.2mm thick

ii. 5.0±0.4mm; c. 1.0mm thick

iii. 6.1±0.8mm; c. 1.0mm thick

Notes: R70 and R71 were initially included by Chapman (2005) under a single heading (Ma07). However, Chapman reckons these rings were part of two armors, one relatively finer (R70) and one of lower quality (R71), so I have split them into two entries accordingly.

Bibliography: Chapman (2005), cat. Ma07.

Current Location: National Museum of Wales, acc. N˚82.11H

Body Armor – Pectoral

R72: Rectangular Anatomical Cuirass, Southern Italian

Date: 365-325

Find Location: Unknown (Southern Italy)

Material: Bronze

Dimensions: Height: 27.94cm. Width: 30.48cm. Thickness: c.2mm.

Mass: Front Plate: 877g; Back Plate 707g.

Notes: Front and back plate from a rectangular anatomical cuirass. The front plate is decorated with stylized muscles. Attachment points on the shoulders and at the sides are visible. Connolly (1986) suggests that there would have been side and shoulder plates in addition to the front and back plates.

Figure: 4.33

Bibliography: Connolly (1986).

Current Location: British Museum 1902,0428.2

R73: Rectangular Anatomical Cuirass? Italian/Western Greek?

Date: Undated

Find Location: Unknown

Material: Bronze

Dimensions: Height: 35cm

Notes: Heavily damaged front plate. Connolly (1986) identifies this as an Italian type, but it could also be the remains of a Greek-style muscle cuirass. The matching back-plate is R74.

Figure: 5.22

Bibliography: Connolly (1986)

Current Location: British Museum 1772,0303.140a

R74: Rectangular Anatomical Cuirass? Italian/Western Greek?

Date: Undated

Find Location: Unknown

Material: Bronze

Dimensions: Height: 32.5cm

Notes: Damaged back-plate. Connolly (1986) identifies this as an Italian type, but it could also be the remains of a Greek-style muscle cuirass. The matching front-plate is R73.

Bibliography: Connelly (1986)

Current Location: British Museum 1772,0303.140b

R75: Rectangular Anatomical Cuirass, Italian/Western Greek

Date: Undated

Find Location: Ruvo di Puglia, Italy.

Material: Bronze

Dimensions: Height 31.75. Width 33.02cm.

Notes: Damaged front plate. Connolly (1986) identifies this as an Italian type. The plate appears too flat to have been the front of a muscle-cuirass.

Bibliography: Connolly (1986).

Current Location: British Museum 1867,0508.196.

R76: Rectangular Anatomical Cuirass, Italian/Western Greek

Date: Fourth century

Find Location: Tomb 2, Paestum, Italy.

Material: Bronze

Dimensions: Height (front plate): 30cm; (back plate): 32cm; (side plate): 10.4cm. Width (front plate): 28cm; (back plate): 28cm; (side plate): 7.9cm.

Notes: Similar in form to R72, but with the side plates preserved.

Current Location: Paestum Museo Archeologico Nazionale, Inv. 4815.

R77: Rectangular Anatomical Cuirass, Italian/Western Greek

Date: 340-330

Find Location: Santa Croce Necropolis, Eboli, Italy

Material: Bronze

Dimensions: Height (front plate): 37cm; (back plate): 29.5cm; (connecting plates): 8.6cm and 8.9cm. Width (front plate): 27.6cm; (back plate): 29.5cm; (connecting plates): 11.6 and 12.6cm.

Notes: Rectangular cuirass with stylized anatomical surface decoration. Very similar in style to R72. The plates all have small perforations for attachment to a textile or leather packing. Only the side-plates have survived, but Carratelli (1996) notes there would have been shoulder plates.

Bibliography: Carratelli (1996), 649.

Current Location: Paestum Mueso Archeologico Nazionale, inv. 133158.

R78: Triple Disc Pectoral, Italian

Date: 400-300

Find Location: Ruvo, Italy

Material: Bronze

Dimensions: Height: 26.67cm. Thickness: c. 1mm.

Mass: 352g

Notes: Triple disc pectoral front-plate, but with significant damage. Substantial chip on the lowermost disc. Upper right disc has a significant hole in it. Crack on the lower right edge of the left disc.

Figure: 4.35

Current Location: British Museum, 1856,1226.665.

R79: Triple Disc Pectoral, Samnite

Date: Late fourth century

Find Location: Alfedena, Abruzzo, Italy

Material: Bronze

Dimensions: Height (front plate): 28cm; (back plate); 27.5cm; (shoulder plates, each): 10cm; (side plates, each): 19cm. Width (front plate): 26.5cm; (back plate): 27cm.

Bibliography: Cianfarani (1969).

Current Location: Mueso Archaeologico A. De Nino Alfedena

Helmets

R80: Helmet, Montefortino, Roman

Date: Mid-fourth to mid-third century

Find Location: Unknown (Italy?)

Material: Bronze, with iron reinforcements

Dimensions: Length: 21.5cm; Width: 16.0cm; Height: 18.0cm. Thickness: 2-3mm.

Mass: 2,010g

Notes: Rather heavy example of a Montefortino helmet; cheek-guards are intact. Find location is unknown, but Junkelmann (2000), 93 notes, "probably Italy." Junkelmann identifies this helmet as being cast bronze, but there are tool marks visible on the inside of the helmet in one image, suggesting it was raised by hammering instead. From the Axel Guttmann Collection.

Bibliography: Junkelmann (2000), 93-4, cat. AG441.

R81: Helmet, Montefortino, Roman

Date: Mid-fourth to mid-third century

Find Location: Unknown (Italy?)

Material: Bronze, with iron fragments

Dimensions: Length: 20.5cm; Width: 17.0cm; Height: 20.0cm. Thickness: 2-3mm.

Mass: 1,895g

Notes: Montefortino-type helmet; cheek-guards are intact. From the Axel Guttmann Collection.

Bibliography: Junkelmann (2000), 95-6, cat. AG323.

R82: Helmet, Montefortino, Roman

Date: Mid-fourth to mid-third century

Find Location: Unknown (Italy?)

Material: Bronze, with iron fragments

Dimensions: Length: 21.0cm; Width: 16.5cm; Height: 18.3cm. Thickness: 2-3mm.

Mass: 2,204g.

Notes: Montefortino-type helmet; cheek-guards are intact. From the Axel Guttmann Collection.

Bibliography: Junkelmann (2000), 96, cat. AG425.

R83: Helmet, Montefortino, Roman

Date: Mid-fourth to mid-third century

Find Location: Unknown (Italy?)

Material: Bronze, with iron rivets

Dimensions: Length: 20.0cm; Width: 17.0cm; Height: 18.5cm. Thickness: 1-3mm.

Mass: 1,180g

Notes: Motefortino-type helmet. The cheek-guards are lost, but the attachment points and the rivets for attachment are clearly visible. From the Axel Guttmann Collection.

Bibliography: Junkelmann (2000), 96, cat. AG542.

R84: Helmet, Montefortino, Roman

Date: Late-fourth to mid-third century

Find Location: Unknown (Italy?)

Material: Bronze

Dimensions: Length 20.5cm; Width: 16.4cm. Thickness: 1-1.5mm; 3.5mm on the rim. No height given.

Mass: 868g.

Notes: Montefortino-type helmet. The cheek-guards are lost, but the attachment points are clearly visible. From the Axel Guttmann Collection.

Bibliography: Junkelmann (2000), 106, cat. AG181.

R85: Helmet, Montefortino, Roman

Date: Third century

Find Location: Unknown (Italy?)

Material: Bronze

Dimensions: Length 22.0cm; Width: 18.5cm; Height: 22.0cm. Thickness: 2.5mm; 5mm at the rim.

Mass: 1,315g

Notes: Montefortino-type helmet. The cheek-guards are lost, but the attachment points are visible. From the Axel Guttmann Collection.

Bibliography: Juneklmann, (2000), 107, cat. AG130.

R86: Helmet, Montefortino, Roman

Date: Mid to late-third century

Find Location: Unknown (Italy?)

Material: Bronze, with tin soldering

Dimensions: Length 22.7cm; Width: 17.0cm; Height: 25.5cm. Thickness: 1-2mm; 4.5mm at the rim.

Mass: 1,180g

Notes: Montefortino-type helmet. The cheek-guards are lost. The helmet is unusually high and thin. Multiple instances of repair on the helmet.

Bibliography: Junkelmann (2000), 109-10, cat. AG290.

R87: Helmet, Montefortino, Roman

Date: Second-half of second century to first half of first century

Find Location: Unknown

Material: Bronze

Dimensions: Length: 21.2cm; Width: 19.4cm; Height: 22.7cm. Thickness: 1-2mm.

Mass: 984g.

Notes: Montefortino-type helmet. Compared to earlier examples (R80, R81, R82, etc), the trend towards lighter construction is clear. Cheek-guards are missing.

Bibliography: Junkelmann (2000), 111, cat. AG597.

R88: Helmet, Montefortino, Roman

Date: Late second to early first century

Find Location: Unknown

Material: Bronze

Dimensions: Length: 21.6cm; Width: 21.0cm; Height: 16.8cm. Thickness 1-1.5mm.

Mass: 680g.

Notes: Montefortino-type helmet. Relatively low helmet bowl. Trend towards lighter construction in the late second/early first century. There is a maker's mark on the back of the helmet reading PX. Cheek-guards lost.

Bibliography: Junkelmann (2000), 113, cat. AG266.

R89: Helmet, Montefortino, Roman

Date: Late second to first half of first century.

R89: Helmet, Montefortino, Roman

Date: Late second to first half of first century

Find Location: Unknown

Material: Bronze

Dimensions: Length: 21.0cm; Width: 18.3cm; Height: 19.3cm. Thickness: 1.5-3mm.

Mass: 960g

Notes: Montefortino-type helmet. Cheek-guards lost, otherwise intact.

Bibliography: Junkelmann (2000), 115, cat. AG310.

R90: Helmet, Montefortino, Roman

Date: 300-100

Find Location: Montefortino, Italy

Material: Bronze

Dimensions: Length: 22.86cm; Height 20.32cm.

Mass: 1,180g

Notes: Montefortino-type helmet. Cheek-guards lost, otherwise intact. Paddock (1993) assigns to type IV (third to second century).

Bibliography: Paddock (1993), cat. 192.

Current Location: British Museum 1867,0508.202.

R91: Helmet, Montefortino, Roman

Date: 250-150

Find Location: Vulci, Italy

Material: Bronze

Dimensions: Height 20.32cm. Thickness (body): c.3mm; (rim): 6mm.

Mass: 1,270g.

Notes: Montefortino-type helmet. Some surface corrosion and slightly deformed, but largely intact. Cheek-guards lost, but attachment points visible.

Current Location: British Museum 1847,0806.159.

R92: Helmet, Montefortino, Roman

Date: 220-170

Find Location: Unknown.

Material: Bronze

Dimensions: Diameter (base): 21.7cm. Height: 19.2cm. Thickness (body): c.2mm; (rim): 3.5mm.

Notes: Montefortino-type helmet. Well preserved, but cheek-guards missing. Attachment points for the cheek-guards clearly visible.

Current Location: British Museum 1975,0603.1.

R93: Helmet, Montefortino, Roman

Date: Third to second century

Find Location: Unknown

Material: Bronze

Dimensions: Height (helmet): 35cm; (cheek-guard): 14.4cm. Width (helmet, max): 23.3cm; (cheek-guard, max): 9.8cm. Thickness: 4mm.

Notes: Montefortino-type helmet. Appears very well preserved, with both cheek-guards apparently intact.

Current Location: MAN Madrid 1999/99/9.

R94: Pair of Cheek-Guards from a Montefortino Helmet, Roman

Date: Mid-third to early second century

Find Location: Unknown

Material: Bronze

Dimensions: Width (top): 13.5cm; Height: 14.4cm. Thickness: 2mm to 2.5mm.

Mass: 350g (each)

Notes: A pair of matching cheek-guards, separated from their helmet.

Figure: 4.37

Bibliography: Junkelmann (2000), 163, cat. AG548 and AG549.

R95: Cheek-Guard from a Montefortino helmet, Roman

Date: Late first century B.C.E. to first half of first century C.E.

Find Location: Unknown

Material: Brass

Dimensions: Height: 15.2cm; Width (max): 11.7cm. Thickness: 0.8mm to 1.4mm.

Mass: 92g (single).

Notes: Single cheek-guard from the Late Republic or Early Imperial periods, produced in brass. It is quite thin, corresponding to the declining weight and manufacture standards of helmets in the first century B.C.E.

Bibliography: Junkelmann (2000), 164, AG331.

Greek/Macedonian

H1: Xiphos, Macedonian

Date: Late Classical/Early Hellenistic

Find Location: Royal Tombs at Vergina

Material: Iron

Dimensions: Length (total): 55cm, Width (guard): 10.9cm.

Mass: 300g; with reconstructed tang c. 400g

Notes: Sword is strongly waisted with the thickest portion quite close to the tip. Tang was likely originally a flat tang along the lines of H2.

Figure: 5.13

Bibliography: Markle (1982), 101. Adam-Veleni (2004), 53.

Current Location: Museum of the Royal Tombs of Aigai, BM1713.

H2: Xiphos, Macedonian

Date: Late Classical

Find Location: Veroia, Greece

Material: Iron

Dimensions: Length (total): 55cm; (blade): 46.4cm. Width (blade, max): 4.5cm; (blade, min): 3.0cm; (guard): 10.3cm

Mass: digitally reconstructed, c. 490g

Notes: ‘Sword of Beroia.’ Sword is extremely well-preserved, with elements of organic (ivory) grip and pommel surviving.

Bibliography: Tourgatsoglou (1986).

Current Location: Archaeological Museum of Veroia, Permanent Collection.

H3: Xiphos, Greek

Date: Classical?

Find Location: Ialysus, Rhodes

Material: Iron

Dimensions: Length (total): 55cm; Width (blade, max): 4.5cm; (guard):12.5cm.

Notes: Sword is badly rusted, but the general shape is intact. Blade is strongly waisted, with a shape much like H1 and H2. The tang was flat, although now obsured by rust. The British Museum lists a date of 1-400 AD; I confirmed with the Ass.t Collections Manager Ben Harridge that this is a misdating of the sword. The sword was excavated by Sir Alfred Biliotti from Rhodes with material that is either Archaic or Classical; a Classical or late Classical date seems likely.

Figure: 5.14

Current Location: British Museum 1868,1025.98.

H4: Kopis, Greek

Date: 350-325

Find Location: Thesprotia, Greece

Material: Iron

Dimensions: Length (total): 77cm; (blade): 64cm.

Notes: Found with the 'prodromi' cuirass at Thesprotia. Grave good strongly suggest the burial of a cavalryman, possibly on the site of a battle. Example of the longer form of kopis.

Bibliography: Choremis (1980).

H5: Kopis, Greek

Date: 5th-4th century

Find Location: Unknown

Material: Iron

Dimensions: Length (total): 54.6cm

Mass: 1.5lbs (c. 700g) as measured by museum.

Notes: Weapon is remarkably well preserved, with some rust. Double fuller down the length of the spine of the blade. Hilt is only partially enclosed, as opposed to the full-enclosure style seen in the Spanish falcata, or on H6.

Figure: 5.10

Current Location: Metropolitan Museum of Art, 2001.543.

H6: Kopis, Greek

Date: 5th-4th century

Find Location: Unknown

Material: Iron

Dimensions: Length (total): 56.5cm

Mass: 1.5lbs (c. 700g) as measured by museum.

Note: Weapon is remarkably well preserved, with some rust and some marks on the blade. Double fuller down the length of the spine of the blade. Longer than H5, with a similar blade-shape. Hilt is fully enclosed; the pommel may have shown a horse motif.

Figure: 5.10

Current Location: Metropolitan Museum of Art, 2001.346.

Spears and Sarisae

H7: Spearhead, *Sarisa*, Macedonian

Date: Late fourth century

Find Location: Royal Tombs at Vergina

Material: Iron

Dimensions: Length (total): 27.3cm; (socket): 8cm. Width (max): 3cm. Diameter (socket): 1.9cm. Socket wall thickness: 1-1.5mm.

Mass: 97g

Notes: Head of a *sarisa* in use by the infantry, following Connolly (2000a). Small oval-shaped spearhead with a pronounced mid-ridge. The mid-ridge is a continuation of the socket and remains hollow for much of the length of the blade of the spear, reducing weight.

Figure: 5.7

Bibliography: Andronikos (1970); Manti (1992), (1994); Markle (1977), (1978), (1982); Connolly (2000a); Sekunda (2001b); Matthew (2016)

H8: Spear Butt, *Sarisa*, Macedonian

Date: Late fourth century

Find Location: Royal Tombs at Vergina

Material: Iron

Dimensions: Length (total): 45cm; (socket): 18cm. Width (max): 4cm. Diameter (socket): 3.4cm. Socket wall thickness: 2-2.5mm.

Mass: 1,070g

Notes: Butt of the infantry *sarisa*, following Connolly (2000a). A large, flanged and heavy butt, presumably for counteracting the significant weight of the long *sarisa* haft. Probably a pair with H7.

Figure: 5.7

Bibliography: Andronikos (1970); Manti (1992), (1994); Markle (1977), (1978), (1982); Connolly (2000a); Sekunda (2001b); Matthew (2016)

H9: Spear Butt, *Sarisa*, Macedonian?

Date: Unknown, Hellenistic

Find Location: Unknown. No secure provenance.

Material: Iron

Dimensions: Length (total): 38.0cm. Width (max): 3.8cm. Diamter (socket, interior): 2.9cm.

Mass: 876g.

Notes: Heavy spear-butt, possibly for a Macedonian *sarisa*. The butt has the letters MAK painted on it. Lack of secure find location, dating or provenance make interpretation difficult, but the significant weight suggests use in a *sarisa*; lacks the flanged construction of H8.

Bibliography: Matthew (2016), 49-51; Sekunda (1992).

Current Location: Shafton Collection in the Great North Museum in Newcastle Upon Tyne, #111.

H10: Spearhead, *Xyston*, Macedonian

Date: Late fourth century

Find Location: Royal Tombs at Vergina

Material: Iron

Dimensions: Length (total): 47cm. Diameter (socket): 2.5cm.

Mass: 235g

Notes: 'Tear-drop' shaped spearhead of typical size, with pronounced mid-ridge; the socket remains hollow over the length of the blade. There is some damage to the tip and to the socket. Connolly (2000b), preferred this to H11 for use as a cavalry spearhead. Weight and form could be consistent with either a *xyston* or a *dory*. Listed by Markle (1982) as "Sarissa-head LXIX-LXXI K38." This piece was not included in Andronikos (1970).

Figure: 5.7

Bibliography: Markle (1982). Connolly (2000b).

H11: Spearhead, *Xyston*, Macedonian

Date: Late fourth century

Find Location: Royal Tombs at Vergina

Material: Iron

Dimensions: Length (total): 50cm. Diameter (socket): 2cm.

Mass: 297g

Notes: 'Tear-drop' shaped spearhead of typical size; rather longer blade and shorter socket compared to H10; moderate mid-ridge. There is some damage to edges of the blade. Weight and form could be consistent with either a *xyston* or a *dory*. Listed by Markle (1982) as "Sarissa-head LXIX-LXXI I32." This piece was not included in Andronikos (1970).

Figure: 5.7

Bibliography: Markle (1982). Connolly (2000b).

H12: Spearbutt, *Xyston*, Macedonian

Date: Late fourth century

Find Location: Royal Tombs at Vergina

Material: Iron

Dimensions: Length (total): 51cm; (socket): 23.5cm. Width (max): 6.7cm. Diameter (socket): 3.6cm.

Mass: 1,235g

Notes: Large, oval-shaped blade on a very thick socket. Overall shape like a spearhead, but it is very large, wide and with no point.

Figure: 5.7

Bibliography: Andronikos (1970); Manti (1992), (1983), (1994); Markle (1977), (1978); Connolly (2000a).

H13: Spearhead, *Dory*, Greek

Date: Eight or seventh century

Find Location: Chauchitza, Grave A, Macedonia

Material: Iron

Dimensions: Length (total): 29cm.

Notes: Long ‘tear-drop’ shaped spearhead with pronounced mid-ridge, attached by a circular-sectioned socket.

Current Location: British Museum 1919,1119.43

H14: Spearhead, *Dory*, Greek

Date: Eighth or seventh century

Find Location: Chauchitza, Macedonia

Material: Iron

Dimensions: Length (total): 23cm.

Notes: Long ‘tear-drop’ shaped spearhead. Heavily corroded and significant damage to the blades of the spear. Only the mid-ridge is substantially intact. Socket appears to be broken off but was circular in section.

Current Location: British Museum 1919,1119.44

H15: Spearhead, *Dory*, Greek

Date: Fifth century BC

Find Location: Olympia, Greece

Material: Bronze

Dimensions: Length (total): 17.78cm

Notes: Short ‘tear-drop’ shaped spearhead. In very fine condition, without significant damage. Mid-ridge is very pronounced. Attached by a circular socket with two holes for rivets.

Current Location: British Museum 1865,0720.55.

Shields

H16: Shield Facing, Greek

Date: Late fifth, early fourth century

Find Location: Olympia, Greece

Material: Bronze

Dimensions: Diameter: c. 33.8cm

Notes: Bronze shield facing for a relatively smaller shield, possible a *pelte*. Mostly intact. No thickness listed.

Bibliography: Liampi (1998), 51-52, taf. 1.1, cat. S1.

Current Location: Olympia Museum, Inv. M356.

H17: Shield Facing, Hellenistic

Date: Third century

Find Location: Dodona, Epirus, Greece.

Material: Bronze

Dimensions: Diameter: 66cm.

Notes: Fragments of a bronze-shield facing. Liampi reconstructs to obtain the above full diameter. No thickness listed.

Bibliography: Liampi (1998), 52-53, taf. 1.2, cat. S2.

Current Location: Ionnina Museum, Inv. 1951.

H18: Shield Facing, Hellenistic

Date: Late fourth, early third century

Find Location: Vegora, Florina, Greece

Material: Bronze

Dimensions: Diameter (reconstructed): c. 73.6cm. Thickness: 0.3mm

Mass: Reconstructed, c. 900g

Notes: Badly damaged fragments of a shield-facing. Diameter reconstructed by Liampi.

Bibliography: Liampi (1998), 53, taf. 1.3, cat. S3.

Current Location: Florina Museum

H19: Shield Facing, Macedonian

Date: 185-160

Material: Bronze

Inscription: ΒΑΣΙΛΕΩΣ ΦΑΡΝΑΚΟΥ

Dimensions: Width: 79.7cm x 81.4cm. Height (dome): 11.8cm. Thickness (measured at the four attachment tabs): 1.0mm; 1.27mm; 2.05mm; 2.97mm.

Notes: 'Shield of Pharnakes.' Date is connected to Pharnakes I of Pontus, following the inscription. The rectangular tabs and serrations along the edges have never been bent back, suggesting that this shield facing may never been attached to a wooden core. The shield has clearly been reconstructed, cf. current form with image in Peltz (2001).

Bibliography: Peltz (2001).

Current Location: J. Paul Getty Museum, Obj. N˚ 80.AC.60.

H20: Shield Facing, Hellenistic

Date: 159-133

Find Location: Arsenal III, Pergamum

Material: Bronze

Dimensions: Width: 65cm x 67cm. Depth: 11cm. Thickness (average): 0.4mm; (range): 0.35-0.5mm.

Mass: 1,080g (with some damage).

Notes: Significant corrosion to the shield facing, with large sections missing. The serrated edges of the shield are still visible on the reverse side of the shield, bent back as they would have been over a wood core. The museum's dating, listed above, is determined from the find-context, Arsenal III at Pergamum.

Figure: 5.9

Bibliography: Peltz (2001).

Current Location: Antikensammlung, Berlin, Indent. Nr. Y1767.

H21: Shield Facing, Greek (Archaic)

Date: Second half of the sixth century

Find Location: Unknown

Material: Bronze

Dimensions: Diameter: 81.5cm. Depth: 11.5cm. Thickness (average): 0.5mm.

Notes: Remarkably well-preserved shield-cover for an Archaic Date *aspis*. The rim is decorated by an intricate pattern of punch-dots.

Current Location: Boston Museum of Fine Arts, 1971.285.

H22: Shield Facing, Macedonian

Date: Early third century

Find Location: Sanctuary of Zeus, Dion

Material: Bronze

Inscription: ΒΑΣΙΛ[ΕΩΣ ΔΗΜΕΤΡ]ΙΟΥ

Dimensions: Diameter: 74cm.

Notes: Fragment of a shield-facing. What remains is a rectangle of bronze, presumably part of the center of such a shield-facing. Part of an inscription is visible above a 12-pointed 'Vergina' star. The shield may have been deposited when Demetrius Poliorcetes visited Dion in 294 BC.

Bibliography: Adam-Veleni (2004), 55.

Current Location: Archaeological Museum of Dion, ΜΔ 7479

Armor

Breastplates

H23: Muscle Cuirass, Hellenistic

Date: Third quarter of the fourth century

Find Location: Thesprotia, Greece

Material: Iron

Dimensions: Height: 45cm; Width (max); 38cm; (min): 33cm.

Notes: Iron muscle-cuirass, found in the same context as the kopis, H4. Horse-fittings suggest that the burial was one of a cavalryman. The cuirass has shoulder decorations mimicking the shoulder-straps of a type-IV cuirass, even including (structurally superfluous) attachment points for the shoulder-straps to be tied down. This is the only known find of an iron Hellenistic muscle cuirass of this type.

Figure: 5.21

Bibliography: Choremis (1980).

H24: Muscle Cuirass, Western Greek

Date: 350-300

Find Location: Ruvo di Puglia, Italy

Material: Bronze

Dimensions: Height: 38.5cm; Width (max): 36.5cm. Depth (both halves, on display): 27.5cm; (front plate): 12cm; (back plate):10cm.

Mass: Total: 2,502g. Front Plate: 1,186g. Back Plate: 1,316g.

Notes: Hellenistic muscle cuirass, in remarkably good condition. Rings for securing the front plate to the back plate are visible on both the right and left side, as well as the shoulders. The high waist may be indicative of a piece for a cavalryman, as in H23.

Current Location: British Museum 1873,0820.223

H25: Muscle Cuirass, Western Greek

Date: Fourth century

Find Location: Ruvo di Puglia, Italy

Material: Bronze

Dimensions: Height: 50.8cm.

Mass: 7.25lbs (3,280g)

Notes: Muscle cuirass including both front and back plate. Relatively low waist, possibly for use by an infantryman. There is heavy wear to the armor, with a significant gap in the material in the left abdomen and several smaller holes. Attachment points on the sides and shoulders still preserved.

Figure: 5.23

Current Location: British Museum 1856,1226.614

H26: Muscle Cuirass, Western Greek

Date: c. 330

Find Location: Apulia, Italy

Material: Bronze

Dimensions: Height (front plate): 41.8cm; (back plate): 52.7cm. Width (front plate, max): 34.5cm. Thickness (front plate): 1mm to 1.5mm; (back plate): 1mm to 2mm.

Mass: 3,850g (front and back together)

Bibliography: Cahn (1989), 66-7, W. 25.

H27: Muscle Cuirass, Western Greek

Date: c. 330

Find Location: Apulia, Italy

Material: Bronze

Dimensions: Height (front plate): 41.5cm; (back plate); 55cm. Width (front plate, max): 23.8cm; (back plate): 34.7cm to 35.2cm. Thickness (front plate): 1mm to 1.5mm; (back plate); 1.5mm.

Mass: Front Plate: 1,170g; Back Plate: 2,193; Total: 3,363g.

Notes: Well preserved muscle cuirass from Apulia. Rings for attaching the front to the back plates are preserved on the shoulders and the sides; the front and back plates overlap on the sides.

Bibliography: Cahn (1989), 58-60, W24C.

H29: Fragment, Muscle Cuirass, Western Greek

Date: c. 450

Find Location: Metapontum(?), Italy

Material: Bronze

Dimensions: Height: 46cm. Width: 30.2cm. Thickness: 1.1mm-1.7mm.

Notes: Piece is a fragment of the front plate of a muscle cuirass, but with substantial damage. One ring from the attachment system, on the left shoulder, survives. Cahn notes the find location is *angeblich* ('allegedly') Metaponto.

Bibliography: Cahn (1989), W9.

H29: Muscle Cuirass, Western Greek

Date: 325-300

Find Location: Southern Italy

Material: Bronze

Dimensions: Height (total): 44cm; (chest): 38cm. Diameter (neck): 14.6cm. Thickness 0.5cm.

Notes: Muscle cuirass, some damage to the lower part of the front plate, cracks down the lower part of the back plate. Short waist, much like H23, may suggest use by a cavalryman. Thickness, measured at 0.5cm (=5mm) may be measurements of the edges of the breastplate, which are thickened, rather than the rest of the armor, which appears thinner.

Bibliography: Carratelli (1996), 653.

Current Location: Florence, Collezione Ceccanti Inv. CC485,486.

H30: Vergina Cuirass, Macedonian

Date: Late fourth century

Find Location: The Royal Tombs at Vergina

Material: Iron with gold leaf.

Dimensions: Thickness: 5mm.

Note: Unique iron cuirass in the shape of a type-IV textile armor. The iron is significantly corroded; there are traces of an original white-linen cover material. Cuirass is in a single piece with hinged side-plates to allow it to be put on, rather than the normal two-piece construction of a muscle cuirass. The cuirass is heavily decorated with gold leaf. The full measurements have not been published.

Bibliography: Andronikos (1977), (1980), (1984), 140-4.. Connolly (1981), 58-9; Everson (2004), 192-3; Aldrete *et al*. (2013), 69-70.

Current Location: Museum of the Royal Tombs at Aigai/Vergina

H31: Bell Cuirass, Greek (Archaic)

Date: Eighth century

Find Location: Argos, Greece

Material: Bronze

Dimensions: Thickness: 1mm-2mm.

Mass: 3,360g

Note: Intact bell cuirass, including both front and back-plate. Quite well preserved.

Figure: 5.24

Bibliography: Courbin (1957), 340-50.

Helmets

H32: *Pilos* Helmet, Greek

Date: Fifth century

Find Location: Upper Egypt

Material: Bronze

Dimensions: Height 21cm; Diameter (base); 41cm. Thickness: 2.4mm to 2.9mm.

Mass: 725g

Notes: There has been some restoration work to the helmet. It is an older *pilos*-type. There are no attachments for cheek-guards, which were probably never present.

Figure: 5.31

Current Location: Antikensammlung, Berlin. Misc. 11910, L41.

H33: *Pilos*/*Konos* Helmet, Greek

Date: 327-275

Find Location: Ruvo di Puglia, Italy

Material: Bronze

Dimensions: Height: 41.91cm. Thickness (body): 2.9mm.

Mass: 920g.

Notes: *Pilos*/*Konos* style helmet, with a large, decorative bronze crest consisting of a pair of detachable horns. There are several punctures in the body of the helmet. Almost certainly an elite product, given the elaborate crest decorations.

Figure: 5.30

Current Location: 1873,0820.222.

H34: *Pilos/Konos* Helmet, Greek

Date: Unknown; type suggests c. third century

Find Location: Unknown, Southern Italy?

Material: Bronze

Dimensions: Height: 19.1cm; Diameter (base): 17.3cm to 19cm. Thickness: 1.4mm to 2.5mm.

Mass: 720g.

Notes: Simple *pilos/konos* type helmet, without cheek-pieces. Intact and unrestored. According to Waurick, typical of the Southern Italian style of *pilos*.

Bibliography: Waurick (1988), 438, cat. no. 49.

Current Location: Antikensammlung, Berlin, Fr.1014.

H35: *Pilos/Konos* Helmet, Hellenistic

Date: First half of the second century

Material: Bronze

Notes: Dintsis provides no measurements, but a pencil drawing. Cheek-guards for this helmet are missing, but the attachments are clearly visible.

Bibliography: Dintsis (1986), 241-2, taf. 31.2, cat. 117.

H36: *Konos* Helmet, Hellenistic

Date: First half of the second century

Material: Bronze

Notes: Dintsis provides no measurements, but a picture. The helmet appears badly damaged, and there are no cheek-guards; unclear if there were attachment points for them.

Bibliography: Dintsis (1986), 246, taf. 32.8, cat. 131.

H37: *Konos* Helmet, Hellenistic

Date: Third quarter of the second century

Material: Bronze

Dimensions: Height: 21.5cm. Thickness: 1mm to 2mm.

Mass: 826g.

Notes: Dintsis provides no measurements; measured by museum. Cheek-guards are missing but would originally have been present. There are some holes in the cap and the rim is slightly battered; but overall it is intact. An inscription on the helmet reads, "ΜΗΝΟΦΙΛΟΥ." Catling (in Vickers, *et al* (1974/5), classified this helmet as a Thracian type and dated it to the c. 5th or 4th century; I follow Dintsis identification as a third century Konos-type.

Figure: 5.32

Bibliography: Vickers, *et al* (1974/5), 34, fig 13. Dintsis (1986), 248-9, cat. 137, taf. 33.8.

Current Location: Ashmolean Museum, 1971.904.

H38: Phrygian Helmet, Hellenistic

Date: Second half of the fourth century

Material: Bronze

Dimensions: Height: 27cm; Length: 23cm; Width: 12cm.

Notes: Ornate, decorated Phrygian helmet. High crest adorned with a spiked ridge, with sphynxes depicted on the cheek-guards. Similar decorative theme to H40.

Bibliography: Dintsis (1986), 218, cat. 53.

Current Location: Louvre, Inv. Nr. C7240.

H39: Phrygian Helmet, Hellenistic

Date: c. 350

Find Location: Unknown

Material: Bronze

Dimensions: Height: 22.86cm. Thickness (body): c. 1.5mm.

Mass: 529g

Notes: Some damage, but the bulk of the helmet is intact. Small exceptions to the base of the helmet to cover the top of the ear. No raised edge of cabling on the base. Weight is very light and the construction is overall quite thin. This helmet was misclassified as an Attic-type; it is actually a Phrygian type, with the knob only partially separated from the body of the helmet (see Dintsis (1986) cat.99 and cat. 100 for similar examples.)

Figure: 5.33

Current Location: British Museum: 1867,0508.206.

H40: Phrygian Helmet, Western Greek

Date: second half of the fourth century

Find Location: Unknown, Southern Italy

Material: Bronze

Dimensions: Height (total): 34cm; Length (neck-guard to brow): 24cm. Thickness: 3mm to 6mm.

Notes: Highly decorated and ornate Phrygian helmet, very well preserved. It has a high crest with a spiked metal adornment and attached cheek-guards. The back of the helmet extends somewhat to form a short neck-guard. Cheek-guards with griffin decoration. Floral motifs on the brow of the helmet.

Figure: 5.34

Bibliography: Carratelli (1996), 652.

Current Location: Florence, Collezione Ceccanti, inv. CC451.

H41: Phrygian Helmet, Hellenistic

Date: Late third or second century

Find Location: Unknown, both Rome and Lake Nemi, Italy, reported.

Material: Bronze

Dimensions: Height: 53.9cm; Length (base); 48.5cm; Width (base): 23.0cm. Thickness: 2.3mm to 6.9mm.

Notes: Damaged Phrygian helmet with a very high crest. The top knob is decorated with a bird motif and ridged decorations. The helmet construction is very thick, but badly damaged.

Bibliography: Waurick (1988), 170.

H42: Attic/Phrygian Helmet, Greek

Date: 450-400

Find Location: Lake Copias, Boeotia, Greece

Material: Bronze

Dimensions: Height: 27cm. Length: 26.5cm. Thickness (body): 1.2mm.

Notes: Classified as a Thracian (Phrygian) type helmet, but the crest is quite low for the type and the shape of the helmet bowl is more in line with Attic type helmets. The helmet has an extension to cover the back of the neck and attachment points for cheek-guards (now lost. There are perforations in the edge of the helmet for the attachment of a liner.

Figure: 5.35

Current Location: British Museum 1927,1011.1.

H43: Attic Helmet, Hellenistic

Date: Early third century

Find Location: Ochrida, Albania

Material: Bronze

Dimensions: Height: 29.5cm; Length: 26.6cm. Thickness: 0.8mm to 2mm thick.

Mass: 1,010g.

Note: Attic type helmet with a crest decoration reminiscent of a smaller, flat version of the typical forward-sloping knob of the Phrygian type. The back of the helmet extends down to cover the lower neck. One cheek-guard is preserved. Inscription on the helmet reads: ΒΑΣΙΛΕΩΣ ΜΟΝΟΥΝΙΟΥ.

Figure: 5.37

Bibliography: Waurick (1988), 441, cat. 51.

Current Location: Antikensammlung, Berlin, Misc. 11905.

H44: Attic Helmet, Hellenistic

Date: Hellenistic Period (unspecified)

Find Location: Melos, Greece

Material: Bronze

Dimensions: Height: 18.4cm; Width: 18.5cm. Thickness (at brim): 0.7mm.

Mass: 470g.

Notes: Some elements of the helmet restored. Helmet features a decorated crest and a brim-guard. Despite the relatively low weight, the decoration, including a relief of a shoulder-up figure wearing what appears to be crown at the join of the brow-guard and the crest, suggest a high-end product.

Figure: 5.38

Bibliography: Waurick (1988), 170.

Current Location: Antikensammlung, Berling, Fr.1010.

H45: Attic Helmet, Hellenistic

Date: Hellenistic Period (unspecified)

Find Location: Pergamon

Material: Bronze

Dimensions: Height: 18cm. Thickness: 0.6mm to 1.5mm.

Mass: 995g

Notes: Unrestored. Attachments for a pair of cheek-guards, now missing, are visible on the helmet. It has an additional brow-ridge, similar in style to the one on H37.

Current Location: Antikensammlung, Berlin. Misc.10481.

H46: Boeotian Helmet, Macedonian

Date: Late Classical/Early Hellenistic (Associated with Alexander's campaign in Mesopotamia)

Find Location: Tigris River

Material: Copper-Alloy

Dimensions: Height: 24cm; Length: 34cm. Thickness 1mm to 2mm.

Mass: 1,005g.

Notes: Boeotian helmet found in the Tigris river. The helmet has a wide brim, typical of the Boeotian type. There is damage to the crown and two modern holes in the side.

Bibliography: Waurick (1988), 159-61.

Current Location: Ashmolean AN1927.256.

Greaves

H47: Greaves (pair), Western Greek

Date: Late Sixth or Fifth century

Find Location: Unknown, Apulia, Italy

Material: Bronze

Dimensions: Height (right): 41.5cm; (left); 43.8cm. Thickness: 0.7mm to 1.4mm.

Mass: 609g and 677.7g.

Notes: Pair of bronze greaves, well preserved. These match Jarva (1995)'s 'anatomical' grouping, which might suggest a later date than the one above (provided by Cahn (1989)).

Bibliography: Cahn (1989), 33, W18b.

H48: Greaves (pair, umatched), Western Greek

Date: Sixth or fifth century

Find Location: Tarquinia, Italy

Material: Bronze

Dimensions: Height (left): 46.9cm; (right): 46.2cm. Thickness (left): 1.9mm; (right, edge): 4mm, (right, body): 2.5mm.

Mass: (left): 1.2kg; (right): 1.1kg; Measured with mount, can no longer be removed.

Notes: These greaves appear to not originally have been a pair. Unfortunately, they can no longer be removed from their museum mounts for independent weighing. The style of greaves both follow Jarva (1995)'s 'spiral' grouping.

Current Location: British Museum 1838,0608.82.

H49: Greaves (pair), Western Greek

Date: 550-500

Find Location: Ruvo di Puglia, Italy.

Material: Bronze

Dimensions: Height (left): 43cm; (right): 42cm. Width (left): 10cm; (right): 9.5cm. Depth (left): 14cm; (right): 13cm. Thickness (left): 2.5mm to 1.6mm; (right): 3mm to 2.1mm.

Mass: (left): 580g; (right): 623g.

Notes: Decorated greaves of the 'anatomical' style. The greaves extend to cover the kneecaps. Moderate damage to the lower and upper edge of the greaves, but both are almost entirely intact.

Current Location: British Museum 1856,122.615.

H51: Greave (single), Western Greek

Date: 500-450

Find Location: Unknown, Produced in Italy

Material: Bronze

Dimensions: Length: 45.72cm. Thickness (body): 2.2mm.

Mass: 759g.

Notes: Left greave to H51's right greave. Fairly simple greaves of the 'spiral' grouping.

Complete.

Current Location: British Museum 1881,0725.4.

H51: Greave (single), Western Greek

Date: 500-450

Find Location: Unknown, Produced in Italy

Material: Bronze

Dimensions: Length: 45.72cm. Thickness: 2.4mm to 4mm.

Mass: 773g.

Notes: Right greave to H50’s left greave. Fairly simple greaves of the ‘spiral’ grouping. Complete.

Current Location: British Museum 1881,0725.3.

H52: Greaves (pair), Western Greek

Date: c. 330

Find Location: Unknown, Apulia, Italy

Material: Bronze

Dimensions: Height (right): 41.5cm; (left): 41.2cm.

Mass: (right): 909g; (left); 738g.

Notes: Greaves formed part of a complete panoply.

Bibliography: Cahn (1989), 45, W23C.

H53: Greaves (pair), Western Greek

Date: c. 330

Find Location: Unknown, near Canosa, Apulia, Italy

Material: Bronze

Dimensions: (right): 39cm; (left): 40cm. Thickness (both): 0.8-1.3mm.

Notes: Cahn (1989) does not lift a mass for these greaves, but the thickness suggests a mass lower than H52. Greaves are of the anatomical type. Formed part of a complete panoply with H27.

Bibliography: Cahn (1989), 62, W24F.

La Tène/Gallic

Swords

G1: Gladius, Roman *or* La Tène Sword, Gallic

Date: c. 153

Find Location: Lager III, Numantia

Material: Iron

Dimensions: Length (total): 74cm; Length (blade): 63.5cm; Length (hilt): 10.5cm; Width (blade): 5.4-4.5cm

Notes: Schulten identifies this weapon as a *reiterschwert* and as an example of the *gladius hispaniensis*. The weapon is probably better understood as a Middle La Tène sword; the blades are nearly parallel and the tip somewhat rounded.

Bibliography: Schulten (1929), 209.

G2: Sword, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total): 79.7cm; (blade): 63.6cm; (hilt): 16.1cm. Width (blade): 4.1cm.

Mass: 490g

Notes: The point is missing; de Navarro notes that it would have likely been blunt.

Bibliography: de Navarro (1972), 363, n˚9

Current Location: BMH Bern, 13527

G3: Sword with sheath, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total preserved, with sheath): 88.2cm; (total, sword): 78.2cm; (blade): 63.8, (tang): 14.4cm. Width (blade): 4.1cm. Thickness (blade): 5mm.

Mass: 695g.

Notes: Sword rusted into sheath, no longer able to be removed. The sword is double-edged, but with a *losangée*, or rhombic section, rather than the more common lenticular section.

Bibliography: Lejars (2013), 152. de Navarro (1972), 364-5, n˚10.

Current Location: NMB Bienne, N˚2754.

G4: Sword, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total): 81.6cm; (blade): 66.5cm; (hilt): 15.1cm. Width (blade): 4.57cm.

Mass: 593.55g

Bibliography: de Navarro (1972), 371, n˚20.

Current Location: MCA Neuchatel, N MAR-LT-541

G5: Sword, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total): 79.9cm; (blade): 65.1cm; (hilt): 14.8cm. Width (blade): 3.95cm.

Mass: 472.36.

Notes: de Navarro notes that the point, which is not quite intact, is blunt.

Bibliography: de Navarro (1972), 373, n˚26a.

Current Location: MCA Neuchatel, N MAR-LT-109.

G6: Sword, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total): 86.4cm; (blade): 71.3cm; (hilt): 15.1cm. Width (blade): 4.05cm.

Mass: 576.93g

Notes: Tang would have disc-button, now lost. De Navarro notes good condition.

Bibliography: de Navarro (1972), 375-6, n˚32.

Current Location: MCA Neuchatel, N. MAR-LT-118.

G7: Sword, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total): 85.8cm; (blade): 68.9cm; (hilt): 16.9cm. Width (blade): 4.11cm.

Mass: 500g

Notes: Broader, tapering blade with a lenticular section. De Navarro comments on the fine quality of the weapon; blade has a 'streaky snake pattern' to the metal, suggesting pattern-welding. Point is somewhat sharp and not fully rounded off.

Bibliography: de Navarro (1972), 381-2, n˚45a.

Current Location: BHM Bern, 13575.

G8: Sword with sheath, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total): 93.6cm; (sword): 85.8cm; (tang): 16.4cm; (blade): 69.3cm. Height (guard): 2.8cm). Width (blade): 3.7cm. Thickness (blade): 4mm.

Mass: 813g (sword + sheath)

Notes: lenticular blade section, largely obscured by sheath, which can no longer be removed. Tapering tang of the usual rectangular section, would have been mounted with a disc-button.

Bibliography: Lejars (2013), 153; de Navarro (1972), 383-4, n˚47a.

Current Location: NMB Bienne N˚2756.

G9: Sword with sheath, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total): 83.0cm; (sword): 81.0cm; (blade): 64.3cm; (tang): 16.7cm. Height (guard): 2.8cm. Width (blade): 3.7cm. Thickness (blade): 4mm.

Mass: 840g (sword + sheath)

Notes: Lenticular blade section, in sheath which can no longer be removed. Blade comes to a relatively sharp point (detected by Lejars with radiography). Tang is rectangular in section with intact disc-button.

Bibliography: Lejars (2013), 154; de Navarro (1972), 384, n˚48a.

Current Location: NMB Bienne, N˚2758

G10: Sword with sheath, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total): 88.3cm; (restored): 87.0cm; (sword): 86.5cm; (blade): 69.8cm; (tang): 16.7cm. Height (guard): 2.3cm. Width (blade): 4.3cm. Thickness (blade): 6mm.

Mass: 1003g (sword+sheath, with an 8.6g guard)

Notes: Sword extracted from sheath, but both massed together by Lejars. De Navarro notes this is "a very fine" sword. Lenticular in section, with a streaky pattern on the blade that suggests pattern-welding; Lejars confirms this, noting the fibrous structure visible on the metal. The point is somewhat rounded off. The tang would have had a disc-button, now missing.

Bibliography: Lejars (2013), 154; de Navarro (1972), 384-5, n˚49a.

Current Location: NMB Bienne, N˚2759.

G11: Sword, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total): 87.8cm; (blade): 72.2cm; (tang): 15.6cm. Height (guard): 2.1cm. Width (blade): 3.9cm. Thickness (blade): 5mm.

Mass: 578.6g

Notes: Lenticular section blade with a somewhat broad tang and a sharp point. Lejars detects a fibrous structure on parts of the sword, suggesting pattern-welding. Decorative stamp above the guard.

Bibliography: Lejars (2013), 151; de Navarro (1972), 386-7, n˚51a.

Current Location: NMB Bienne, N˚2744.

G12: Sword, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total, preserved): 79.2cm; (total, restored): 82.6cm; (blade): 64.0cm; (tang, preserved): 15.2cm; (tang, restored): 18.6cm. Width (blade): 4.7cm. Thickness (blade): 5mm.

Mass: 642g.

Notes: Lenticular section blade with a pronounced point, remarkably well preserved above the pommel, where the tang is broken off. The tang is rectangular in section and came to a disc button (now lost).

Bibliography: Lejars (2013), 150; de Navarro (1972), 378-8, n˚52a.

Current Location: NMB Bienne N˚2743.

G13: Sword, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total): 83.2; (blade): 66.8cm; (tang): 16.4cm. Height (guard): 2.5cm. Width (blade): 4.6cm. Thickness (blade): 5mm.

Mass: 635.7g (with 8.2g for the guard)

Notes: Top of the tang burred for a disc-button which is not preserved. Blade is of a somewhat flat, lenticular section. Slightly wider than most blades of the type. Point is not intact, but seems to have been originally sharp.

Bibliography: Lejars (2013), 151; de Navarro (1972), 388-9, n˚53a.

Current Location: NMB Bienne, N˚2746.

G14: Sword, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total): 85.0cm; (blade): 67.9cm; (tang): 17.1cm. Height (guard): 2.9mm. Width (blade): 4.9cm. Thickness (blade): 5mm.

Mass: 661g

Notes: Lenticular blade section with broad, but not blunt tip. Tang complete and includes disc-button. Lejars notes fibrous pattern visible on the blade, suggesting pattern-welding; apparently a high quality piece, with signs of repair from damage. Bird-shaped stamp above guard.

Bibliography: Lejars (2013), 151; de Navarro (1972), 390-1, n˚55a.

Current Location: NMB Bienne N˚2748.

G15: Sword, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total): 81.9cm; (blade): 65.6cm; (tang): 14.4cm. Width (blade): 5.02cm.

Mass: 607.5g

Notes: Blade is lenticular in section, with a blunt tip. Three decorative raised lines down the center of the blade.

Bibliography: Lejars (2013), 149; de Navarro (1972), 391-2, n˚56a.

Current Location: NMB Bienne N˚2737.

G16: Sword, La Tène

Date: La Tène II (Middle La Tène)

Find Location: Thiele River, Switzerland

Material: Iron

Dimensions: Length (total): 77.7cm. Width (blade): 3.65cm. Thickness (blade, max) 5.7mm.

Mass: 410g

Current Location: British Museum, 1915,0503.1

G17: Sword, La Tène

Date: c. 320-120 (La Tène II)

Find Location: River Thames, London

Material: Iron, Copper-Alloy (remains of scabbard)

Dimensions: Length (total): 73.9cm; (blade): 59.2cm. Width (blade): 4.45cm. Thickness (blade): 4.5mm.

Mass: 448g.

Notes: Sword is in good condition; elements of the copper-alloy sheath frame remain attached. Sword is marked where it was once sharply bent and then straightened. Rectangular tang.

Bibliography: Stead (2006), 77.

Current Location: British Museum 1891,0418.8

G18: Sword with sheath, La Tène

Date: c. 300-200 (La Tène II)

Find Location: Somme-Suippe(?), France

Material: Iron

Dimensions: Length (total):67.7cm; (blade): 61.2cm; (tang): 14.2. Width (blade): 6.1cm.

Mass: 1225g (with sheath and suspension loop)

Notes: Museum uncertain about reliability of find location. Sword is rusted; bent nearly double at the halfway mark. Minimal taper suggests Middle, rather than Early La Tène, but both possible.

Current Location: British Museum ML.2952.

G19: Sword, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total): 79.5cm; (blade): 72.6; (tang): 13.9. Height (guard): 2.4cm. Width (blade): 3.7cm. Thickness (blade): 5mm.

Mass: 480g.

Notes: Lenticular blade section with a slight taper to a pronounced, sharp point. Tang is rectangular in section with a disc-button.

Bibliography: Lejars (2013), 149.

Current Location: NMB Bienne, N˚2733

G20: Sword, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total, preserved): 89.0cm; (blade, preserved): 72.9cm; (tang): 16.1cm. Width (blade): 3.8cm. Thickness (blade): 5mm.

Mass: 530g.

Notes: Blade is corroded and incomplete; missing the tip (perhaps 1cm?). Rectangular section tang with disc-button.

Bibliography: Lejars (2013), 149.

Current Location: NMB Bienne N˚2734

G21: Sword, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total): 79.5cm; (blade): 64.2; (tang): 15.3cm. Width (blade): 4.1cm. Thickness (blade): 5mm.

Mass: 437.6g

Notes: Complete but broken into two fragments. The blade-shape is *losangée* or rhombic, but becomes more lenticular down the length of the blade. Lejars notes fibrous structure, suggesting pattern welding. Blade comes to a sharp point. Tang is rectangular, with a disc button. Two notches, possibly battle-damage, are visible on the blade.

Bibliography: Lejars (2013), 149.

Current Location: NMB Bienne N˚2735.

G22: Sword, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total): 80.5cm; (blade): 64.9cm; (tang): 15.6cm. Width (blade): 4.0cm. Thickness (blade): 5mm.

Mass: 497g (including 6g for the guard).

Notes: Blade is lenticular in section. Tang is rectangular in section, disc button not preserved.

Bibliography: Lejars (2013), 150.

Current Location: NMB Bienne N˚2738.

G23: Sword, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total): 79.5; (blade): 65.5; (tang): 14.0cm. Width (blade): 5.1cm.

Thickness (blade): 6mm.

Mass: 574g

Notes: Blade is lenticular in section. Rectangular tang with disc-button still preserved.

Bibliography: Lejars (2013), 150.

Current Location: NMB Bienne N˚2739.

G24: Sword, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total): 81.6cm; (blade): 64.9cm; (tang): 16.7cm. Width (blade): 4.7cm.

Thickness (blade): 4mm.

Mass: 575g.

Notes: Blade is lenticular in section, slightly tapered with a pronounced point. Rectangular tang with the disc-button still preserved. Decorative stamp above the guard, Lejars suggests shaped like a piece of rawhide or leather.

Bibliography: Lejars (2013), 150.

Current Location: NMB Bienne N˚2740.

G25: Sword, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total): 90.7cm; (blade): 75.1cm; (tang): 15.6cm. Width (blade): 4.0cm. Thickness (blade): 5mm.

Mass: 531g

Notes: Blade is lenticular in section and tapers to a pronounced point. Tang is rectangular in section, with a simple tapering pommel; no disc button.

Figure: 6.13

Bibliography: Lejars (2013), 150.

Current Location: NMB Bienne N˚2741.

G26: Sword, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total): 88.2cm; (blade): 72.8cm; (tang): 15.4. Width (blade): 4.2cm.

Thickness (blade): 5mm.

Mass 578.3g

Notes: Blade is lenticular in section and tapers to a sharply pointed tip. Fibrous structure visible along the middle of the blade, suggesting pattern-welding. Tang is rectangular in section; the pommel is damaged. Decorative stamp above the guard.

Figure: 6.13

Bibliography: Lejars (2013), 150.

Current Location: NMB Bienne N°2742.

G27: Sword, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total): 84.3cm; (blade): 66.4cm; (tang): 17.9cm. Width (blade): 4.4cm.

Thickness (blade): 5mm.

Mass: 662.3g

Notes: Blade is lenticular in section and tapers to a sharp point. Tang is rectangular and ends with a disc button, which is preserved. Decorative stamp just above the guard.

Bibliography: Lejars (2013), 151.

Current Location: NMB Bienne N˚2745.

G28: Sword, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total): 82.5cm; (blade): 65.2cm; (tang): 17.3cm. Width (blade): 4.8cm. Thickness (blade): 5mm.

Mass: 643.1g

Notes: Blade is lenticular in section, tapering to a sharp point. Notches from impacts, probably with another sword, along the blade.

Bibliography: Lejars (2013), 151.

Current Location: NMB Bienne N˚2749

G29: Sword, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total): 83.4cm; (blade): 67.7cm; (tang): 15.7cm. Width (blade): 3.9cm. Thickness (blade): 4mm.

Mass 549g.

Notes: Blade is lenticular in section, coming to a rounded, somewhat blunt, point. Rectangular section tang with a disc button. Double-crescent decorative stamp above the guard.

Bibliography: Lejars (2013), 152.

Current Location: NMB Bienne N˚2750.

Javelins

G30: Javelin Tip, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total): 16.8cm; (blade): 9.5cm; (socket): 7.3cm. Width (blade): 3.2cm. Diameter (socket, external): 2.4cm.

Mass: 121g

Notes: Javelin tip, socketed and fixed with a rivet. Tip is ‘leaf-shaped,’ convex with a rhombic section. There is no central mid-ridge.

Bibliography: Lejars (2013), 162.

Current Location: NMB Bienne N˚2801

G31: Javelin Tip, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total): 14.0cm; (blade): 8.0cm; (socket): 6.0cm. Width (blade): 2.7cm. Diameter (socket, external): 1.9 x 2.2cm.

Mass: 94g

Notes: Javelin tip, socketed and fixed by two rivets. The socket is square, rather than round. The tip has no central rib and is rounded (possibly a result of corrosion). Socket secured by rivet (now lost) through two holes at the base.

Bibliography: Lejars (2013), 162.

Current Location: NMB Bienne N˚2803

G32: Javelin Tip, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total): 12.0cm; (blade): 7.0cm; (socket): 5.0cm. Width (blade): 2.3cm. Diameter (socket, external): 2.0cm.

Mass: 68g.

Notes: Javelin tip with a lenticular, convex section. Secured through round socket with a rivet (now lost) with two rivet holes. Point is intact, very weak mid-ridge.

Bibliography: Lejars (2013), 162.

Current Location: NMB Bienne N˚2804

G33: Javelin Tip, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total): 12.5cm; (blade) 7.5mm; (socket): 5.0cm. Width (blade, preserved): 1.2cm; (blade, restored): 2.2cm. Diameter (external, socket): 1.7cm.

Mass: 44g.

Notes: Javelin tip with a convex section; the tip is damaged and bent over on the edges. Lejars notes further signs of repair, presumably for the final damage. The tip is socketed, fixed by a single rivet (partially preserved) through a round socket. Socket runs through the blade, creating a strong mid-ridge.

Bibliography: Lejars (2013), 162.

Current Location: NMB Bienne N˚2805

G34: Javelin Tip, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total): 16.4; (blade): 8.0cm; (socket); 8.4cm. Width (blade): 2.2cm. Diameter (socket, external): 2.1cm.

Mass: 110g

Notes: Javelin tip with a convex, lenticular section; no strong mid-ridge but the central hull is relatively thick. Attachment to haft via circular socket, affixed by rivets (lost), through two rivet-holes.

Bibliography: Lejars (2013), 163.

Current Location: NMB Bienne N˚2807

G35: Javelin Tip, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total): 17.4cm; (blade): 8.0cm; (socket): 9.6cm. Width (blade): 2.5cm. Diameter (socket, external): 2.0cm.

Mass 98g.

Notes: Javelin tip with convex blade and lenticular section. Moderate mid-ridge. Tip is rounded, possibly worn or corroded. Attached by a circular socket with 2 rivets (present), through a pair of holes to the base of the side of the socket.

Bibliography: Lejars (2013), 163.

Current Location: NMB Bienne N˚2808

G36: Javelin Tip, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total): 23.7cm; (blade): 10.0cm; (socket): 13.7cm. Width (blade): 2.5cm. Diameter (socket, external): 1.8cm.

Mass: 158g.

Notes: Javelin tip with a convex and rhombic section, with a sharp point and a relatively weak mid-ridge. Unusually heavy, due to being very long. Attached by a circular socket with a pair of nails (present), through a pair of holes to the base of the side of the socket.

Bibliography: Lejars (2013), 163.

Current Location: NMB Bienne N˚2811

G37: Javelin Tip, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total): 25.5cm; (blade): 17.5cm; (socket): 8.0cm. Width (blade): 3.0cm. Diameter (socket, external): 1.9cm.

Mass: 128g

Notes: Javelin tip with a convex blade and rhombic section, with a visible but only slightly raised mid-ridge. Attached by a circular socket with by nails or rivets (missing) through a pair of holes at the base.

Bibliography: Lejars (2013), 164.

Current Location: NMB Bienne N˚2818

G38: Javelin Tip, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total): 24.0cm; (blade): 16.0cm; (socket): 8.0cm. Width (blade): 3.0cm. Diameter (socket, external): 1.8cm

Mass: 105g

Notes: Javelin tip with a narrow, convex blade with a rhombic section. Attached by a circular socket, with two holes for a pair of nails (one lost, other broken off) at the base. Relatively weak mid-ridge.

Bibliography: Lejars (2013), 165.

Current Location: NMB Bienne N˚2837.

G39: Javelin Tip, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total): 17.3cm; (blade): 6.5cm; (socket): 10.8cm. Width (blade): 2.3cm. Diameter (socket, external); 2.0cm.

Mass: 119g

Notes: Javelin tip with a convex blade, rhombic section. The blade has a relatively high mid-ridge. The socket is, unusually, octagonal in shape.

Bibliography: Lejars (2013), 206.

Current Location: NMB Bienne, N˚6924

G40: Javelin (or spear) Tip, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total): 31.5cm; (blade): 11.5cm; (socket): 20.0cm. Width (blade): 3.2cm.

Diameter (socket, external): 2.0cm.

Mass: 203g

Notes: Like G41 and G42, listed by Lejars as a 'fer de lance' but the type classification (VIb) is one for 'les fers de javelot a douille longque,' suggesting use as a javelin. The javelin head is, as per the classification, long and narrow, with a pronounced mid-ridge. The section of the socket is circular, but the tip and the base of the blade have rectangular sections.

Bibliography: Lejars (2013), 206

Current Location: NMB Bienne N˚2809.

G41: Javelin (or spear) Tip, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total): 34.8cm; (blade): 12.0cm; (socket); 22.8cm. Width (blade): 2.2cm. Diameter (socket, external): 1.8cm.

Mass: 174g.

Notes: Like G40 and G42, listed by Lejars as a 'fer de lance' but the type classification (VIb) is one for 'les fers de javelot a douille longque,' suggesting use as a javelin. As per the designation, the socket is very long. The blade is also quite long, with a convex section.

Bibliography: Lejars (2013), 206.

Current Location: NMB Bienne N˚2810

G42: Javelin (or spear) Tip, La Tène

Date: Middle La Tène

Find Location: La Tène, Switzerland.

Material: Iron

Dimensions: Length (total): 41.1cm; (blade): 21.0cm; (socket): 20.1cm. Width (blade): 4.5cm. Diameter (socket, external): 2.0cm.

Mass: 269g

Notes: Like G40 and G41, listed by Lejars as a 'fer de lance' but the type classification (VIb) is one for 'les fers de javelot a douille longque,' suggesting use as a javelin. The blade is biconvex, with a circular-section socket; the fixing nails are not preserved.

Bibliography: Lejars (2013), 163.

Current Location: NMB Bienne N˚2815.

Spears

G43: Spearhead, La Teǹe

Date: Late La Tène I

Find Location: Ciumeşţi, Romania

Material: Iron

Dimensions: Length (total): 22cm. Width (blade): 2.5cm. Diameter (socket): 1.7cm.

Notes: Spearhead, with a triangular shape. Weak mid-ridge; blade overall has a rhombic section. Socket is circular in section, significantly damaged.

Bibliography: Rusu (1969).

G44: Spearhead, La Teǹe

Date: 250-150 (La Tène II)

Find Location: Unknown (possibly Marson, France)

Material: Iron

Dimensions: Length (total); 32.6cm. Width (blade) 5.67cm. Diameter (socket): 2.01cm. Thickness (blade0: 5.7mm.

Mass: 206g

Notes: Spearhead with a 'tear-drop' shape. Strong mid-ridge which merges into the circular socket. Blade is chipped, parts of the socket are lost. Secured by two rivets in the socket, one of which is visible, the other is lost.

Current Location: British Museum ML.1501

G45: Spearhead, La Tène

Date: Late second century (Middle La Tène)

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total, preserved): 54.6cm; (blade): 30.0cm; (socket): 24.6cm. Width (blade): 4.2cm. Diameter (socket, external): 1.8cm.

Mass: 296g

Notes: Dating follows type (IIC). Spearhead has a convex blade, with a strong mid-ridge. Some damage to the blade; Lejars suggests this damage may not have been ancient. Socket is rhombic on the blade, but rounded towards the base.

Bibliography: Lejars (2013), 163.

Current Location: NMB Bienne N˚2812.

G46: Spearhead, La Tène

Date: Late second century (Middle La Tène)

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 34.4cm; (blade): 20.5cm; (socket): 13.9cm. Width (blade): 4.3cm.

Diameter (socket, external): 2.0cm.

Mass: 200g.

Notes: Dating follows type (IIC). Spearhead with a convex blade and a pronounced mid-ridge. Attached by a circular socket.

Bibliography: Lejars (2013), 163.

Current Location: NMB Bienne N˚2813.

G47: Spearhead, La Tène

Date: Late second century (Middle La Tène)

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 35.5cm; (blade): 25.0cm; (socket): 10.5cm. Width (blade): 3.4cm.

Diameter (socket, external), 1.9cm.

Mass: 147g.

Notes: Dating follows type (IIC). Spearhead with a convex blade and a pronounced mid-ridge. Some damage to the side of the blade. Circular socket secured by two nails, which are both preserved.

Bibliography: Lejars (2013), 163.

Current Location: NMB Bienne N˚2814

G48: Spearhead, La Tène

Date: Late second century (Middle La Tène)

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 30.9cm; (blade): 19.5cm; (socket): 11.4cm. Width (blade): 3.3cm.

Diameter (socket, external): 1.8mm.

Mass: 142g.

Notes: Dating follows type (IIC). Spearhead with a convex blade and a pronounced mid-ridge.

The socket is oval shaped (possibly crushed?), fixed by nails (not preserved).

Bibliography: Lejars (2013), 163.

Current Location: NMB Bienne N˚2816.

G49: Spearhead, La Tène

Date: Late second century (Middle La Tène)

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 28.6cm; (blade): 19.0cm; (socket): 9.6cm. Width (blade): 3.4cm. Diameter (socket, external): 1.75cm.

Mass: 128g.

Notes: Dating follows type (IIC). Spearhead with a convex blade and a pronounced mid-ridge. Lejars notes that the point is unusually thick. The opening of the socket at the base is oval (possibly originally circular), but shifts to a rhombic, diamond shape as it rises up the blade. The two fixing nails are preserved. Overall a remarkably well-preserved specimen, despite the low weight.

Bibliography: Lejars (2013), 163.

Current Location: NMB Bienne N˚2817

G50: Spearhead, La Tène

Date: Late second century (Middle La Tène)

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 30.5cm; (blade): 17.5cm; (socket): 13.0cm. Width (blade): 2.8cm. Diameter (socket, external): 2.0cm.

Mass: 160g.

Notes: Dating follows type (IIC). Spearhead with a convex blade and a pronounced mid-ridge. Lejars notes a thick point. Circular socket with space for two nails (not preserved).

Bibliography: Lejars (2013), 164.

Current Location: NMB Bienne N˚2820

G51: Spearhead, La Tène

Date: Late second century (Middle La Tène)

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 40.8cm; (blade): 36.1cm; (socket): 4.7cm. Width (blade): 6.5cm. Diameter (socket, external): 2.2cm.

Mass: 284g.

Notes: Dating follows type (Va). Spearhead with an elongated biconvex blade-shape, with a strong mid-ridge. The socket is oval in section. There are two decorative ribs running over the pair of holes for the nails or rivets (not preserved). Relatively long blade for a fairly short socket.

Bibliography: Lejars (2013), 164.

Current Location: NMB Bienne N˚2821.

G52: Spearhead, La Tène

Date: Late third to early second century (Middle La Tène)

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 24.3cm; (blade): 39.1cm; (socket): 4.5cm. Width (blade): 7.5cm.

Diameter (socket, external): 1.5cm.

Mass: 115g.

Notes: Dating follows type (IIIC). Spearhead with a somewhat elongated biconvex blade-shape, with a pronounced, but relatively low mid-ridge. Circular socket at the base with space for 2 nails (not preserved), which becomes rhombic in section as it rises over the blade.

Bibliography: Lejars (2013), 164.

Current Location: NMB Bienne N˚2822.

G53: Spearhead, La Tène

Date: Late second century (Middle La Tène)

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 45.0cm; (blade): 39.1cm; (socket): 5.9cm. Width (blade): 8.9cm.

Diameter (socket, external): 2.1cm.

Mass: 295g

Notes: Dating follows type (VC). Spearhead with a somewhat elongated biconvex blade-shape, with a moderate but still visible mid-ridge. The socket is circular at the base, with holes for two nails, only one of which is preserved. The socket becomes rhombic in section as it rises over the blade.

Bibliography: Lejars (2013), 164.

Current Location: NMB Bienne N˚2823.

G54: Spearhead, La Tène

Date: Mid-third century (Middle La Tène)

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 22.5cm; (blade): 17.5cm; (socket): 5.0cm. Width (blade): 7.9cm. Diameter (socket, external): 2.0cm.

Mass: 151g.

Notes: Dating follows type (IIB). Spearhead with a convex blade-shape, with a pronounced mid-ridge. Socket is circular at the base with holes for two rivets (one partially preserved), but becomes rhombic in section as it rises over the blade.

Bibliography: Lejars (2013), 164.

Current Location: NMB Bienne N˚2824

G55: Spearhead, La Tène

Date: Late fourth to late second century (Early/Middle La Tène)

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 21.2mm; (blade): 16.2cm; (socket): 5.0cm. Width (blade): 3.6cm. Diameter (socket, external): 2.0cm.

Mass: 132g.

Notes: Dating follows type (IA). Spearhead with a convex blade-shape with a moderately pronounced mid-ridge. Lejars notes the point is thick. Socket is circular in section over the entire length. Mid-ridge is somewhat wide for a fairly narrow blade.

Figure: 4.14

Bibliography: Lejars (2013), 164.

Current Location: NMB Bienne N˚2826.

G56: Spearhead, La Tѐne

Date: Late fourth to late second century (Early/Middle La Tѐne)

Find Location: La Tѐne, Switzerland

Material: Iron

Dimensions: Length (total): 24.7cm; (blade): 20.2cm; (socket): 4.5cm. Width (blade): 3.1cm. Diameter (socket, external): 2.2cm.

Mass: 122g.

Notes: Dating follows type (IA). Spearhead with a convex and quite thin blade-shape, with a moderately pronounced mid-ridge. Lejars notes a thick point. The socket is circular in section at the base, but rhombic over the blade. There are two holes for nails (not preserved).

Figure: 4.14

Bibliography: Lejars (2013), 164.

Current Location: NMB Bienne N˚2827

G57: Spearhead, La Tène

Date: Late second century (Middle La Tène)

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 38.8cm; (blade): 32.8cm; (socket): 6.0cm. Width (blade): 32.8cm. Diameter (socket, external); 1.8cm.

Mass: 224g.

Notes: Dating follows type (ID). Spearhead, with a quite wide, convex blade-shape with a relatively low mid-ridge. Some damage on the edges of the blade. Socket is circular in section at the base, but rhombic over the blade. Space for two nails, neither preserved.

Bibliography: Lejars (2013), 164.

Current Location: NMB Bienne N˚2828

G58: Spearhead, La Tène

Date: Late second century (Middle La Tène)

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 46.3cm; (blade): 40.8cm; (socket): 5.5cm. Width (blade): 7.5cm. Diameter (socket, external): 2.0cm.

Mass: 259g

Notes: Dating follows type (ID). Spearhead with a quite wide, convex blade-shape with a relatively low mid-ridge. Socket is circular in section at the base, but rhombic over the blade. Two nails (preserved.

Bibliography: Lejars (2013), 165.

Current Location: NMB Bienne N˚2829.

G59: Spearhead, La Tène

Date: Mid-third century (Middle La Tène)

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 28.6cm; (blade): 23.2cm; (socket): 5.4cm. Width (blade): 7.4cm. Diameter (socket, external); 2.0cm.

Mass: 174g.

Notes: Dating follows type (IIB). Spearhead with a convex blade-shape and a relatively high mid-ridge. Spearhead is more rounded in shape. Socket is rhombic in section along the entire length, with space for two nails (one preserved). Blade is damaged, with a notch and puncture on one side; damage not severe.

Bibliography: Lejars (2013), 165.

Current Location: NMB Bienne N˚2830.

G60: Spearhead, La Tène

Date: Late second century (Middle La Tène)

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 34.2cm; (blade): 29.5cm; (socket): 4.7cm. Width (blade): 7.2cm. Diameter (socket, external): 1.9cm.

Mass: 211g.

Notes: Dating follows type (ID). Spearhead with a convex blade-shape and relatively low mid-ridge. The socket is circular at the base, but rhombic in section over the blade. Holes for two nails, both partially preserved. Lejars notes the point is thick.

Bibliography: Lejars (2013), 165.

Current Location: NMB Bienne N˚2832.

G61: Spearhead, La Tène

Date: Late second century (Middle La Tène)

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 34.3cm; (blade); 28,8cm; (socket): 5.5cm. Width (blade): 6.2cm. Diameter (socket, external): 1.8cm.

Mass: 188g.

Notes: Dating follows type (ID). Spearhead with a convex blade-shape with a moderate mid-ridge. Lejars notes a thick point. Socket is circular at the base, but rhombic in section over the blade. Holes for two nails, both preserved. Small notches in the blade edge, otherwise complete.

Bibliography: Lejars (2013), 165.

Current Location: NMB Bienne N˚2833.

G62: Spearhead, La Tène

Date: Late second century (Middle La Tène)

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 31.6cm; (blade): 26.0cm; (socket): 5.6cm. Width (blade): 6.2cm. Diameter (socket, external): 1.8cm.

Mass: 162g.

Notes: Dating follows type (ID). Spearhead with a convex blade-shape with a moderate mid-ridge, emphasized by a pair of decorative grooves along the edges of it. Socket is circular at the base but rhombic along the blade, with space for two nails, one preserved. Blade is damaged with several notches on the upper portion; small parts of the lower blade are missing, but the piece of substantially complete.

Bibliography: Lejars (2013), 165.

Current Location: NMB Bienne N˚2834.

G63: Spearhead, La Tène

Date: Late fourth to late second century (Early/Middle La Tène)

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 25.4cm; (blade): 19.0cm; (socket): 6.4cm. Width (blade): 5.3cm. Diameter (socket, external): 1.7cm.

Mass: 125g.

Notes: Dating follows type (IA). Spearhead with a convex blade-shape and a moderate mid-ridge. Socket is circular at the base but rhombic along the blade, with space for two nails, both preserved. Small notch on one side of the blade about a quarter of the length from the bottom.

Bibliography: Lejars (2013), 165.

Current Location: NMB Bienne N˚2835.

G64: Spearhead, La Tène

Date: Late fourth to late second century (Early/Middle La Tène)

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 24.6cm; (blade): 19.8cm; (socket): 4.8cm. Width (blade): 4.5cm. Diameter (socket, external): 1.8cm.

Mass: 103g.

Notes: Dating follows type (IA). Spearhead with a convex blade-shape and a moderate mid-ridge. Socket is somewhat rounded at its base, but rhombic over the blade, with space for two rivets (not preserved).

Bibliography: Lejars (2013), 165.

Current Location: NMB Bienne N˚2836.

G65: Spearhead, La Tène

Date: Late fourth to late second century (Early/Middle La Tène)

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 22.2cm; (blade): 15.2cm; (socket): 7.0cm. Width (blade): 3.4cm. Diameter (socket, external): 1.6cm.

Mass: 91g.

Notes: Dating follows type (IA). One of the lighter examples from La Tène. Spearhead with a convex blade-shape and a moderate mid-ridge. Socket is circular at the base, but rhombic over the blade, with two rivet-holes joined by a single metal rivet (preserved).

Bibliography: Lejars (2013), 165.

Current Location: NMB Bienne N˚2839.

G66: Spearhead, La Tène

Date: Late fourth to late second century (Early/Middle La Tène)

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 26.3cm; (blade): 14.9cm; (socket): 11.4cm. Width (blade): 3.8cm. Diameter (socket, external): 1.8cm.

Mass: 151g.

Notes: Dating follows type (IA). Spearhead with a biconvex blade and a fairly moderate mid-ridge. Socket is round at the base but rhombic over the blade, with two holes joined by a single rivet.

Bibliography: Lejars (2013), 165.

Current Location: NMB Bienne N˚2840.

G67: Spearhead, La Tène

Date: Late second century (Middle La Tène)

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 40.3cm; (blade): 35.0cm; (socket): 5.3cm. Width (blade); 6.5cm. Diameter (socket, external): 2.0cm.

Mass: 173g.

Notes: Dating follows type (VC). Spearhead with a biconvex blade-shape and a moderate mid-ridge. Blade is very long and strongly tapered, with an asymmetrical cutout on the base of the blade. Socket section is circular at the base but rhombic over the blade, with space for two nails (one preserved).

Bibliography: Lejars (2013), 165.

Current Location: NMB Bienne N˚2842.

G68: Spearhead, La Tène

Date: Late second century (Middle La Tène)

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 39.3cm; (blade): 34.0cm; (socket): 5.3cm. Width (blade): 7.7cm. Diameter (socket, external): 2.0cm.

Mass: 198g.

Notes: Dating follows type (VC). Spearhead with a biconvex blade-shape and a moderate mid-ridge. Asymmetrical cutout on one side of the blade. Socket is circular at the base, but rhombic over the blade, with space for two nails (both preserved).

Bibliography: Lejars (2013), 165.

Current Location: NMB Bienne N˚2843.

G69: Spearhead, La Tène

Date: Late fourth to late second century (Early/Middle La Tène)

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 17.2cm; (blade): 9.9cm; (socket): 7.3cm. Width (blade): 4.0cm. Diameter (socket, external): 2.4cm.

Mass: 121g.

Notes: Dating follows type (IA). Spearhead with a convex blade-shape with a strong mid-ridge. Socket is circular at the base, but becomes rhombic over the blade. Space for two nails (both preserved).

Bibliography: Lejars (2013), 162.

Current Location: NMB Bienne N˚2802.

G70: Spearhead, La Tène

Date: Late fourth to late second century? (Early/Middle La Tène)

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total, preserved): 28.3cm; (blade, preserved); 22.4cm, (socket): 5.9cm.

Mass: 112.7g preserved.

Notes: Type identification (IA) and resulting date-range tentative due to heavy damage to the blade, making it unclear what the original blade-shape was.

Bibliography: Lejars (2013), 206.

Current Location: NMB Bienne N˚6922.

G71: Spearhead, La Tène

Date: Late second century (Middle La Tène)

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 39.2cm; (blade): 25.0cm; (socket): 14.2cm. Width (blade): 4.8cm. Diameter (socket, external): 2.0cm.

Mass: 162g.

Notes: Date follows type (IIC). Spearhead with a convex blade-shape and a pronounced mid-ridge. Some damage on the edge of the blade, but overall complete. Socket is oval shape, with space for two nails, both preserved.

Bibliography: Lejars (2013), 164.

Current Location: NMB Bienne N˚2819.

G72: Spearhead, La Tène

Date: Late second century (Middle La Tène)

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 40.1cm; (blade): 24.5cm; (socket): 15.6cm. Width (blade): 3.7cm.

Diameter (socket, external): 1.8cm.

Mass: 201g.

Notes: Date follows type (IIC). Spearhead is damaged but has a convex blade-shape with a pronounced mid-ridge.

Bibliography: Lejars (2013), 206.

Current Location: NMB Bienne N˚6921.

G73: Spearhead, La Tène

Date: Early second century (Middle La Tène)

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 27.7cm; (blade): 21.3cm; (socket): 6.4cm. Width (blade): 3.3cm. Diameter (socket, external), 1.7cm.

Mass: 115g.

Notes: Date follows type (IV). Spearhead with a convex blade-shape and a relatively low mid-ridge; the mid-ridge extends somewhat beyond the edge of the blade into a ‘bayonet’ point. Some damage to the edges of the blade, but on the whole intact.

Bibliography: Lejars (2013), 206.

Current Location: NMB Bienne N˚6923

G74: Spearhead, La Tène

Date: Early second century (Middle La Tène)

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 19.0cm; (blade); 10.2cm; (socket): 8.8cm. Width (blade): 3.0cm. Diameter (socket, external); 1.8cm.

Mass: 75g.

Notes: Date follows type (IV). Very small spearhead with a ‘bayonet’ point, convex blade-shape and a relatively high mid-ridge. One of the lightest of the La Tène examples. Socket is circular with space for two nails (once is which is preserved).

Bibliography: Lejars (2013), 162.

Current Location: NMB Bienne N˚2806.

G75: Spearhead, La Tène

Date: 300-150 (Middle La Tène)

Find Location: Unknown, France?

Material: Iron

Dimensions: Length (total): 38.75cm. Width (max): 3.2cm. Diameter (socket, external), 1.78cm.

Mass: 138g.

Notes: Date range by museum above is consistent with type (IB). Spearhead has an elongated convex blade-shape, with a moderate mid-ridge. Socket is circular at the base, becoming more rhombic along the blade.

Figure: 4.14

Current Location: British Museum ML.2403.

G76: Spearhead, La Tène

Date: 200-50 (Middle/Late La Tène)

Find Location: River Thames, London (exact location unknown).

Material: Iron, with copper-alloy decorative plates.

Dimensions: Length (total): 30.2cm. Width (max): 7.13cm. Diameter (socket, external): 1.93cm.

Mass: 146g.

Notes: Date range somewhat late for the type (IB), but the find-location is in Britain. Spearhead has a weakly convex blade-shape with a very strong mid-ridge. Socket is circular in shape. Copper-alloy decorative plates adorn the blades of the spearhead on either side of the mid-ridge on the lower half. There is significant damage on one blade, and a smaller hole corroded in the other.

Current Location: British Museum 1938,0504.1.

G77: Spear Butt, La Tène

Date: Middle La Tène?

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 7.8cm; (point): 4.3cm; (socket): 3.5cm. Width (point): 7x7mm. Diameter (socket, external): 1.0cm.

Mass: 17.9g.

Notes: Spear Butt. Round socket with a rectangular-section butt-spike extending down.

Bibliography: Lejars (2013), 174.

Current Location: NMB Bienne N˚2945.

G78: Spear Butt, La Tène

Date: Middle La Tène?

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total, preserved): 5.5cm. Diameter (socket, external): 1.8cm.

Mass: 21g

Notes: Spear Butt, incomplete. Circular section socket-type. One fixing nail is preserved; the base of the point is broken off.

Bibliography: Lejars (2013), 174.

Current Location: NMB Bienne N˚2942.

G79: Spear Butt, La Tène

Date: Middle La Tène?

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total, preserved): 6.7cm; (total, est): 5.8cm. Diameter (socket, external): 2.0cm.

Mass: 22g.

Notes: Spear Butt, mostly complete, but badly corroded. Circular section socket-type.

Bibliography: Lejars (2013), 207.

Current Location: NMB Bienne N˚6929.

G80: Spear Butt, La Tène

Date: Middle La Tène?

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 4.9cm. Diameter (socket, external): 1.8cm; (base, external): 1.4cm

Mass: 40g.

Notes: Spear Butt, flat-bottomed with no spike. Circular-section with two hole for the attachment nails (lost).

Bibliography: Lejars (2013), 174.

Current Location: NMB Bienne N˚2943.

G81: Spear Butt, La Tène

Date: Middle La Tène?

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 7.6cm. Diameter (base, external): 2.0cm

Mass: 45g.

Notes: Spear Butt, driven in by a single nail projecting out of the base. Cicular in section on the top, but hexagonal at the base.

Bibliography: Lejars (2013), 172.

Current Location: NMB Bienne N˚2916.

G82: Spear Butt, La Tène

Date: Middle La Tène?

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 7.2cm; (base): 3.3cm. Diameter (base, external): 2.1cm

Mass: 46g.

Notes: Spear butt with a conical base, driven in by a single up-ward facing nail; no ferrule.

Bibliography: Lejars (2013), 172.

Current Location: NMB Bienne N˚2917.

G83: Spear Butt, La Tène

Date: Middle La Tène?

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 6.9cm; (base): 2.9cm. Diameter (base, external): 2.1cm.

Mass: 47g.

Notes: Spear butt with a conical base, driven in by a single up-ward facing nail; no ferrule.

Bibliography: Lejars (2013), 171.

Current Location: NMB Bienne N˚2913.

G84: Spear Butt, La Tène

Date: Middle La Tène?

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 7.8cm; (base) 2.1cm. Diameter (base, external): 2.2cm.

Mass: 47g.

Notes: Spear butt with a conical base, driven in by a single up-ward facing nail; no ferrule.

Bibliography: Lejars (2013), 171.

Current Location: NMB Bienne N˚2914.

G85: Spear Butt, La Tène

Date: Middle La Tène?

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 9.1cm; (base) 3.5cm. Diameter (base, external): 2.1cm.

Mass: 55g.

Notes: Spear butt with a conical base, driven in by a single up-ward facing nail; no ferrule.

Bibliography: Lejars (2013), 171.

Current Location: NMB Bienne N˚2915.

G86: Spear Butt, La Tène

Date: Middle La Tène?

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 7.6cm; Diameter (external): 2.4cm.

Mass: 72g.

Notes: Spear butt, hollow conical socket attached by a nail through a hole; hole present, nail not preserved.

Bibliography: Lejars (2013), 173.

Current Location: NMB Bienne N˚2941.

G87: Spear Butt, La Tène

Date: Middle La Tène?

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total):10.2cm; (base): 3.0cm; (ferrule): 1.1cm. Width (base): 2.3cm.

Diameter (ferrule): 2.5cm.

Mass: 82g (including 7g ferrule).

Notes: Spear butt with a conical base driven in by a single upward facing nail, with a circular section ferrule.

Bibliography: Lejars (2013), 172.

Current Location: NMB Bienne N˚2922.

G88: Spear Butt, La Tène

Date: Middle La Tène?

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total):10.1cm; (base): 5.1cm; (ferrule): 1.1cm. Width (base): 2.1cm.

Diameter (ferrule): 2.4cm.

Mass: 91g (including 7g ferrule).

Notes: Spear butt with an octagonal base driven in by a single upward facing nail, with a ferrule.

Bibliography: Lejars (2013), 172.

Current Location: NMB Bienne N˚2923.

G89: Spear Butt, La Tène

Date: Middle La Tène?

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 17.2cm; (base): 10.0cm; (socket): 7.2cm. Width (base): 1.5cm. Diameter (socket, external): 1.9cm.

Mass: 102g.

Notes: Spear butt, socketed. Socket only runs for the first 7.2cm of the length; the rest of non-hollow, with grooves like fullers giving it a pyramidal shape. It is secured through a single-rivet through two holes (partially preserved).

Bibliography: Lejars (2013), 174.

Current Location: NMB Bienne N˚2944.

G90: Spear Butt, La Tène

Date: Middle La Tène?

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 11.3cm; (base): 4.5cm; (ferrule): 1.0cm. Width (base): 2.4cm.

Diameter (ferrule): 2.8cm.

Mass: 123g (including 6g ferrule).

Notes: Spear butt with an octagonal base driven in by a single upward facing nail, with a ferrule.

Bibliography: Lejars (2013), 172.

Current Location: NMB Bienne N˚2919.

G91: Spear Butt, La Tène

Date: Middle La Tène?

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 15.0cm; (base): 5.9cm; (ferrule): 9mm. Width (base): 2.5cm.

Diameter (ferrule): 2.6cm.

Mass: 135g (including 8g ferrule).

Notes: Spear butt with an octagonal base driven in by a single upward facing nail, with a ferrule.

Bibliography: Lejars (2013), 172.

Current Location: NMB Bienne N˚2918.

G92: Spear Butt, La Tène

Date: Middle La Tène?

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 17.1cm; (base): 6.5cm; (ferrule): 1.3cm. Width (base): 2.4cm.

Diameter (ferrule): 2.7cm.

Mass: 153g (including 7g ferrule).

Notes: Spear butt with an octagonal base driven in by a single upward facing nail, with a ferrule.

Bibliography: Lejars (2013), 172.

Current Location: NMB Bienne N˚2921.

G93: Spear Butt, La Tène

Date: Middle La Tène?

Find Location: La Tène, Switzerland

Material: Iron

Dimensions: Length (total): 15.6cm; (base): 4.9cm; (ferrule): 1.9cm. Width (base): 2.4cm.

Diameter (ferrule): 2.8cm.

Mass: 154g (including 15g ferrule).

Notes: Spear butt with an octagonal base driven in by a single upward facing nail, with a ferrule.

Ferrule is unusually large.

Bibliography: Lejars (2013), 172.

Current Location: NMB Bienne N˚2920.

Shields

G94: Shield Boss, La Tène

Date: c. 225-175 (based on type)

Find Location: Gournay-sur-Aronde

Material: Iron

Dimensions: Height (hull, recorded): 5.6cm. Measurements from scale diagram: Length (wing): 3.52cm; (hull) 13.8cm. Width (wing, min.): 2.35cm.

Notes: Example of Brunaux and Rapin Group IIC boss type; only the height of the hull is reported in their catalog. Boss is quite small, with small, concave wings. Two holes for rivets sit very close to the hull (one partially preserved, one lost). The boss is complete.

Bibliography: Brunaux and Rapin (1988), 177, cat. n˚2584.

G95: Shield Boss, La Tène

Date: c. 275-200 (based on type)

Find Location: Gournay-sur-Aronde

Material: Iron

Dimensions: Height (hull, recorded): 4.2cm. Measurements from scale diagram: Length (wing): c. 1.88cm; (hull): c. 14.1cm.

Notes: Example of Brunaux and Rapin Type IIIA boss type; only the height of the hull is reported in their catalog. Boss is quite small, with very small, rounded wings. Two holes for rivets sit in the middle of the wings, one preserves the top of the rivet. Boss is undamaged.

Bibliography: Brunaux and Rapin (1988), 174, cat. n˚755.

G96: Shield Boss, La Tène

Date: 185-125 (based on type)

Find Location: Gournay-sur-Aronde

Material: Iron

Dimensions: Height (hull, recorded): 13.8cm. Measurements from scale diagram: Length (total): 47.4cm; (wing): 18.5cm. Height (wing): 13.8cm.

Notes: Example of Brunaux and Rapin type VI; only the height of the hull is reported in their catalog. Significant damage: one wing is broken off into a fragment and a significant amount of the central hull is missing. The boss is very large, requiring four rivet holes (instead of the usual two); one rivet near the center of the wing, while another is on the very edge. None of the rivets are preserved.

Bibliography: Brunaux and Rapin (1988), 177, cat. n˚2706-7.

G97: Shield Boss, La Tène

Date: c. 275 - 180 (based on type)

Find Location: Gournay-sur-Aronde

Material: Iron

Dimensions: Height (hull, recorded): 8.2cm. Measurements from scale diagram: Length (hull): 15.25; (wing): 5.4cm.

Notes: Example of Brunaux and Rapin type IIA; only the height of the hull is reported in their catalog. The boss is moderate in size, with elongated oval wings. Two holes for rivets sit in the middle of the wings, neither rivet is preserved. Boss is slightly bent, but otherwise in good condition.

Bibliography: Brunaux and Rapin (1988), 173, cat. n˚22.

G98: Shield Boss, La Tène

Date: c. 175-75 (based on type)

Find Location: Gournay-sur-Aronde

Material: Iron

Dimensions: Height (hull, recorded): 15.5cm.

Notes: Example of Brunaux and Rapin type VII; only the height of the hull is reported in their catalog. The boss is 'butterfly' shaped, with a moderate hull, but very large outward-curving wings. The heads of two rivets, one in the center of each wing, are preserved. Boss is slightly bent, but otherwise appears to be in excellent condition.

Bibliography: Brunaux and Rapin (1988), 174, cat. n˚497.

G99: Shield Boss, La Tène

Date: 250-150 (Middle La Tène)

Find Location: Grave 1, Connatre, Champagne-Ardenne, France

Material: Iron

Dimensions: Length: 20.3cm. Width (wings): 11.3cm; (hull, max): 12.2cm. Height (hull, approx..): 5.9cm. Thickness c. 2mm at edge.

Mass: 298g.

Notes: Iron boss with rounded wings. Almost complete but was in many fragments, now repaired with plaster. Heavily corroded. Type IIA in Brunaux and Rapin's typology, but fairly large for that type.

Current Location: British Museum ML1659.

G100: Shield Boss, La Tène

Date: 250-150 (Middle La Tène)

Find Location: Campagne-Ardenne, France.

Material: Iron

Dimensions: Length (total): 22.5cm; (hull): 8.8cm. Width (right wing): 8.73cm; (left wing): 9.37cm. Height (hull): 6.39. Nail head diameter: 26cm.

Mass: 335g.

Notes: One break, between the right wing and the hull, has been repaired with plaster. There are decorative grooves at the edge of the hull. Two rivets held the boss to the shield; the heads of these are preserved, along with part of the shank of one. Type IB in Brunaux and Rapin's typology.

Current Location: British Museum ML.2873.

G101: Shield Boss, La Tène

Date: c. 225-100 (Middle La Tène)

Find Location: La Tène

Material: Iron

Dimensions: Length (total, preserved): 27.4cm; (flange): 10.8cm. Height (hull): 11.0cm.

Mass: 174g, damaged.

Notes: Dating follows type (V). Original length perhaps c. 32cm. Perhaps half of the boss in total is missing. Only part of one flange and the hull remains. One rivet survives, along with part of the maniple, allowing for the thickness of the original wooden core (now lost), to be assessed (c. 9mm thick).

Bibliography: Lejars (2013), 171.

Current Location: NMB Bienne N˚2902.

G102: Shield Boss, La Tène

Date: c. 275-100 (Middle La Tène)

Find Location: La Tène

Material: Iron

Dimensions: Length (total): 26.4cm; (wing): 9.0cm. Height (hull): 10.8cm.

Mass: 195.6g (including 4.2g for the rivets).

Notes: Dating follows type (V). Shield boss with trapezoidal wings. Boss is complete, but the handle is missing. Both rivets preserved.

Bibliography: Lejars (2013), 171.

Current Location: NMB Bienne N˚2903.

G103: Shield Boss, La Tène

Date: c. 225-100 (Middle La Tène)

Find Location: La Tène

Material: Iron

Dimensions: Length (total): 29.0cm; (wing): 10.0cm. Height (hull): 8.2cm.

Mass: 197g.

Notes: Dating follows type (V). Complete shield boss, with trapezoidal wings; one rivet completely preserved, the other slightly damaged. The rivets allow the thickness of the original wooden shield (now lost) to be estimated (c. 9mm). The rivets are decorated with a starburst pattern not seen on the other examples. The maniple is missing.

Bibliography: Lejars (2013), 171.

Current Location: NMB Bienne N˚2904.

G104: Shield Boss, La Tène

Date: c. 225-100 (Middle La Tène)

Find Location: La Tène

Material: Iron

Dimensions: Length (total, preserved): 20.8cm; (wing): 7.6cm. Height (hull): 10.3cm.

Mass: 180g.

Notes: Dating follows type (V). Shield boss with trapezoidal wings; one wing is nearly entirely lost, the other bent. There is a large crack in the hull. A rivet is preserved, allowing for the thickness of the original wooden shield (now lost) to be estimated (11mm). The maniple is missing.

Bibliography: Lejars (2013), 171.

Current Location: NMB Bienne N˚2905.

G105: Shield Boss, La Tène

Date: c. 275-100 (Middle La Tène)

Find Location: La Tène

Material: Iron

Dimensions: Length (total): 35.1cm; (wing); 12.1cm. Height (hull): 10.0cm.

Mass: 217g

Notes: Dating follows type (I). Shield boss with rectangular wings; the right and left edges have a scalloped design. There are two large primary rivets in the center of the wings, along with pairs of secondary nails in each of the far corners of the wings. There is some minor damage to the right wing, and a crack in the leg, but the boss is by and large complete.

Bibliography: Lejars (2013), 171.

Current Location: NMB Bienne N°2906.

G106: Hull of a Shield Boss, La Tène

Find Location: La Tène

Material: Iron

Dimensions: Length (total, preserved): 11.7cm; Height (hull): 10.2cm.

Mass: 167g

Notes: Type (and dating by type) impossible to determine. Only the hull of the boss remains; the fragment shows traces of damage and repair, with a rivet fixed in the base of the hull.

Bibliography: Lejars (2013), 171.

Current Location: NMB Bienne N˚2907.

G107: Shield Maniple, La Tène

Date: Middle(?) La Tène?

Find Location: La Tène

Material: Iron

Dimensions: Length (total): 15.2; (stem): 10.4. Width (stem): 8mm; (wings): 3.7 and 3.8cm. Thickness (stem): 2mm.

Mass: 10.9g.

Notes: Maniple, composed of a stem and a pair of small wings with complex curving designs at each end, which contain the rivet holes to connect with a boss. There are two groups of three decorative grooves on the stem. Overall, the maniple seems to be a high-quality piece. Complete.

Bibliography: Lejars (2013), 170.

Current Location: NMB Bienne N˚2895.

G108: Shield Maniple, La Tène

Date: Middle(?) La Tène?

Find Location: La Tène

Material: Iron

Dimensions: Length (total): 13.9cm; (stem): 10.5cm. Width (stem): 5mm; (wings): 5.2 and 5.7cm. Thickness (stem): 2mm.

Mass: 14.1g

Notes: Maniple is curved (possibly bent), with semi-circular wings which contain the rivet holes to connect with a boss. Two pairs of decorative grooves on the stem.

Bibliography: Lejars (2013), 170.

Current Location: NMB Bienne N˚2896.

G109: Shield Maniple, La Tène

Date: Middle(?) La Tène?

Find Location: La Tène

Material: Iron

Dimensions: Length (total): 12.5cm; (stem): 9.1cm. Width (stem): 6mm; (wings): 3.2 and 3.3cm. Thickness (stem): 1mm.

Mass: 6.3g

Notes: Maniple, composed of a stem with a pair of simple wings on the end which house the rivet holes to connect to the boss. Some damage (small cracks) to the wings, otherwise complete.

Bibliography: Lejars (2013), 170.

Current Location: NMB Bienne N˚2897.

G110: Shield Maniple, La Tène

Date: Middle(?) La Tène?

Find Location: La Tène

Material: Iron

Dimensions: Length (total): 14.3cm; (stem): 10.2cm. Width (stem): 5mm; (wings): 7.0 and 7.5cm. Thickness (stem): 3mm.

Mass: 15.9g

Notes: Maniple, composed of a stem with a pair of semi-circular wings on the end; the wings are quite large with rivet holes in the center.

Bibliography: Lejars (2013), 170.

Current Location: NMB Bienne N˚2898.

G111: Shield Maniple, La Tène

Date: Middle(?) La Tène?

Find Location: La Tène

Material: Iron

Dimensions: Length (total): 15.2cm; (stem): 10.4cm. Width (stem): 8mm; (wings): 3.7 and 3.8cm. Thickness (stem): 2mm.

Mass: 18.9g

Notes: Maniple, composed of a stem with a pair of complex and fairly ornate wings which house the rivet holes to connect to the boss. The grip is slightly thicker in the center.

Bibliography: Lejars (2013), 170.

Current Location: NMB Bienne N˚2899.

G112: Shield Maniple, La Tène

Date: Middle(?) La Tène?

Find Location: La Tène

Material: Iron

Dimensions: Length (total, preserved): 12.8cm; (total, est.): 13.0cm; (stem): 9.6cm. Width (stem): 9mm; (wing): 5.6cm. Thickness (stem): 2mm.

Mass: 8.16g

Notes: Maniple. Incomplete; a large part of the left-wing is missing and there is minor damage to the right wing. The wings have a complex curving design.

Bibliography: Lejars (2013), 170.

Current Location: NMB Bienne N˚2900.

G113: Shield Maniple, La Tène

Date: Middle(?) La Tène?

Find Location: La Tène

Material: Iron

Dimensions: Length (total): 16.3cm; (stem); 11.5cm. Width (stem): 9mm; (wings): 2.7 and 3.0cm. Thickness (stem): 3mm.

Mass: 24.5g

Notes: Maniple, composed of a stem (curved or bent), with rectangular wings which have flourishes on the edges and decorative grooves. Complete.

Bibliography: Lejars (2013), 170.

Current Location: NMB Bienne N˚2901.

G114: Complete Shield, La Tène

Date: Middle(?) La Tène?

Find Location: La Tène

Material: Iron

Dimensions: Length (total): 110cm. Width (preserved): 50.7cm; (restored): c.52-54cm. Thickness (max): 8.2cm.

Mass: Connolly reconstructs the shield at c. 6-7kg (4kg wood, 2kg leather, 250g iron).

Notes: Shield, including wooden elements, dredged from the site of La Tène. Heavily damaged. Gassmann (2007) shows that it was constructed out of a pair of planks hewn from the same tree, rather than the multilayered plywood construction of the Roman *scutum*.

Bibliography: Gassman (2007). Connolly (1981), 119. Lejars (2013), 163.

Armor

Mail

G115: Fragments of Mail Shirt, La Tène

Date: Late La Tène I

Find Location: Ciumeşti, Romania

Material: Iron

Dimensions: Diameter (rings): 8.5mm to 9.2mm; Thickness (wire): 0.8mm to 1.8mm. Some rings were much finer, with diameters between 7.2mm and 7.5mm, wire thickness 1.2mm to 1.4mm.

Notes: Remains of a mail tunic included in a warrior burial with spearhead (G43) and decorated helmet (G118). The mail tunic included elaborate decorative metal studs for affixing the shoulder-doubling of the armor. Some of the rings are irregularly shaped and there is considerable variation in ring size. Ring construction is four-in-one, but end-abutted, rather than riveted.

Bibliography: Rusu (1969).

G116: Mail Shirt, Iron Age Britain

Date: c. Late La Tène I

Find Location: Kirkburn, England

Material: Iron

Dimensions: Tunic: 92cm to 85cm long; 48cm wide when folded in burial deposit. Ring Diameter: 8.2mm to 9.2mm. Thickness (wire): 1.5mm to 1.9mm.

Notes: Nearly complete mail shirt deposited as part of a warrior burial. The rings are in a four-in-one pattern but are end-abutted rather than riveted. The form of the shirt is different than Roman mail, featuring a tube-and-yoke style construction (like a type-IV cuirass), rather than shoulder-doubling.

Bibliography: Stead (1991), 54-7.

G117: Armor Rings, La Tène

Date: Late La Tène II or Early La Tène III

Find Location: Tiefenau near Bern, Switzerland.

Material: Iron

Dimensions: Diameter (rings): 1.3cm. Thickness (wire): 1mm.

Notes: Concretion of rings, now restored. The rings are quite large. The fragment has an unusual link-joining pattern of six-in-one (each ring joined to six adjacent rings.

Bibliography: Müller (1986).

Helmets

G118: Decorated Iron Helmet, La Tène

Date: Late La Tène I

Find Location: Ciumeşti, Romania

Materials: Iron, bronze decoration

Dimensions: Thickness (current, with rust): 2mm to 2.5mm; (original, est.): 1.5mm.

Notes: Found in the same deposit as spearhead (G43) and mail (G115). Decorated iron helmet with a metal bird affixed at the crest. The bird is made from very thin copper-alloy plate (0.4-0.8mm), and is hollow. The bird's wings are attached via hinges, and would have flapped while the rider was moving on horseback (cf. the rider with a bird-helmet on the Gundestrup Cauldron). The helmet itself is of an iron La Tène 'Montefortino' type, badly damaged. The impression from a (probably copper-alloy) panel, now lost, above the cheek-guard is preserved (much like G119); much of one cheek-guard is lost, the other is missing completely. There are numerous holes and fractures in the bowl of the helmet. As with most La Tène 'Montefortino' helmets, the crest of the helmet is topped by a knob which is a separate hollow piece affixed to the crest.

Figure: 6.22

Bibliography: Rusu (1969).

G119: ‘Montefortino’ Iron Helmet, La Tène

Date: Fourth century

Find Location: Umbria, Italy

Material: Iron, with bronze decoration

Dimensions: Height: 20.3cm; Width: 21cm; Thickness: 2.4mm to 2.9mm.

Mass: 725g.

Notes: Helmet has been significantly restored. The crest-knob is, typical for La Tène ‘Montefortino’ types, appears to be a separate element, affixed through a hole in the crest. The helmet is decorated by copper-alloy plating applied above the cheek-guard and adorned with snaking line patterns, both on the cheek-guard, above it, and over the brow of the helmet. The bowl of the helmet descends down slightly further in the back to provide protection for the neck.

Bibliography: Schaaff (1988), 514-5, cat. K103. Connolly (1981), 121.

Current Location: Antikensammlung, Berling, Misc. 11910, L78.

G120: ‘Coolus’ Coppy-Alloy Helmet, La Tène

Date: (Museum Date): 120-50; (Paddock): Third to second century

Find Location: Marne River, Coolus, France.

Material: Copper Alloy

Dimensions: Length (total, external): 24.7cm; (internal): 21.3cm. Width (external): 18.0cm; (internal): 21.3cm. Height: 13.7cm. Thickness: 0.5mm.

Mass: 598g.

Notes: Coolus-type helmet; Paddock (1993) classes this as a Type 1 Coolus helmet. Helmet is in copper-alloy with a slight neck-guard in the back. Just above the rim of the helmet, there are several lines of decorative punched dots. Helmet lacks cheek-guards, may never have had any. Like all Coolus-types, lacks top-knob.

Bibliography: Paddock (1993), 675.

Current Location: British Museum ML 1734.

G121: 'Coolus' Copper-Alloy Helmet, La Tène

Date: Pre-200

Find Location: River Po, near Cremona

Material: Copper-Alloy

Dimensions: Length (external): 24.0cm; (internal): 14.7cm. Width (external): 19.0cm; (internal): 18.2cm. Thickness: (rim): 4mm; (bowl): 0.8-1mm. Height: 15.5cm.

Notes: Type III Coolus helmet, in Paddock (1993)'s typology. Paddock associates this type with Gallic settlement in the Po River valley and bases his *terminus ante quem* of c. 200 on this. Cheek plates and the hinge-plates that would have secured them are both missing. Significant damage, including two large holes in the helmet bowl. Well made, but thin compared to contemporary Roman/Italian helmet types.

Bibliography: Paddock (1993), 680.

Current Location: Museo Civico Cremona.

G122: 'Coolus' Copper-Alloy Helmet, La Tène

Date: 50-150 C.E.

Find Location: Unknown, England?

Material: Copper-Alloy

Dimensions: Length (including neck-guard): 30.2cm. Width: 17.0cm. Height: 16.5cm.

Mass: 514g

Notes: Later form of the Copper-Alloy La Tène 'Coolus' helmet. The helmet has a peaked cap with a long, flat neck-guard on the back. Decorations on the neck-guard and above the ears are La Tène in style.

Current Location: British Museum 1872,1213.2.

Iberian/Celtiberian

I1: La Tène Sword, Celtiberian(?)

Date: 300-100

Find Location: Cerro de las Cabezas, Spain

Material: Iron

Dimensions: Length (total): 70.2; Width (max): 4.2cm; Thickness (max): 6mm.

Mass 410g

Notes: Imported Sword of the Late La Tène II or early La Tène III type, found in Southern Spain. Sword is rusted, with some material loss on the blade, but intact and complete. The disc-button which would have ended the pommel is lost.

Current Location: MAN Madrid 10482.

I2: Antenna Sword, Celtiberian

Date: Fourth or third century

Find Location: Necrópolis de la Osera, Avila, Spain

Material: Iron

Dimensions: Length (total): 49.8cm; (blade): 40.5cm; (Hilt): 9.2cm. Width (blade): 4cm; (guard): 5cm; (hilt): 2.4cm; (pommel): 4cm.

Mass: 350g

Notes: Blade is waisted with an angular, rather than curved profile. It has a metal hilt (rather than a tang), with a twin-antenna pommel. Quesada Sanz (1997c), type VI.

Current Location: MAN Madrid 1986/81/I/153/19A

I3: Antenna Sword, Celtiberian

Date: Third century

Find Location: Necrópolis de Acrobriga, Monreal de Ariza, Spain.

Material: Iron

Dimensions: Length (total): 44cm. Width (max): 6cm.

Mass: 410g

Notes: Celtiberian find-context. Sword has some damage on the tip. Slightly waisted, with an angular blade-shape. It has a metal hilt (rather than a tang), with a twin-antenna pommel. Quesada Sanz (1997c), type VI.

Current Location: MAN Madrid 1940/27/ARC/2455

I4: Antenna Sword, Celtiberian

Date: Fourth or third century

Find Location: Necrópolis de la Osera, Avila, Spain

Material: Iron

Dimensions: Length (total):41cm; (blade): 30.5cm; (hilt): 10.2cm. Width (blade, max): 3.9cm; (hilt, max): 4.7cm.

Mass: 430g

Notes: Blade is only slightly waisted, in quite good condition. It has a metal hilt, with decorations, and a twin-antenna pommel. Quesada Sanz (1997c), type VI.

Figure: 6.25

Current Location: MAN Madrid 1986/81/VI/200/2

I5: Falcata, Iberian

Date: Museum note: 'Possible 2nd-4th century' presumably B.C.E.

Material: 'steel' with wooden handle (restored?)

Find Location: Unknown

Dimensions: Length (total): 53.2cm; (blade): 43.2cm. Width (blade): 6.7cm.

Mass: 473.4g

Current Location: Metropolitan Museum of Art, 32.75.260

I6: Falcata, Iberian

Date: Fourth or third century

Find Location: Unknown

Material: Iron

Dimensions: Length (total): 53.1cm; (blade): 41.6cm; (hilt): 11.5cm. Width (blade): 5.8cm; (hilt): 6.2cm. Thickness (blade): 8mm; (hilt): 1.8cm.

Mass: 510g

Notes: Falcata with a fully enclosed hilt. The pommel is decorated with a feline motif. Blade is single-edged and forward curving, with a double-fuller running along the back edge.

Figure: 6.24

Current Location: MAN Madrid 2003/114/51

I7: Falcata, Iberian

Date: Fourth or third century

Find Location: Unknown

Material: Iron

Dimensions: Length (total): 58cm; (blade): 47cm; (hilt): 11cm; (guard): 6.5cm. Width (blade): 3.5-6.0cm; (Hilt): 2.5-6.5cm. Thickness (blade): 0.2-0.6mm; (hilt): 1.8cm.

Mass: 740g.

Notes: Some corrosion to the tip of the weapon. Blade is single-edged and forward curving. Fully enclosed hilt, with an animal motif on the pommel. Fuller runs the length of the back edge.

Figure: 6.24

Current Location: MAN Madrid 10475

I8: Falcata, Iberian

Date: Fourth or early third century

Find Location: Cerro del Santuario, Basti, Spain

Material: Iron

Dimensions: Length (total): 60cm; (blade): 47cm: (hilt): 12.5cm. Width (blade): 3.9-6.4cm.

Mass: 530g

Notes: Corrosion over the entire blade, but the weapon is almost entirely complete. Blade is single-edged and forward-curving. The hilt may have been fully enclosed, but the guard is now partially lost. Horse-head shaped decorative motif on the pommel. Fullers running the back edge of the sword.

Current Location: MAN Madrid 1969/68/155/14

I9: Falcata, Iberian

Date: Fifth to third century

Find Location: Unknown

Material: Iron

Dimensions: Length (total): 52.8cm (blade): 42.8cm; (hilt): 10cm. Width (blade): 5.7cm; (hilt): 4.7cm.

Mass: 390g

Notes: Corrosion over the entire blade, but the weapon is almost entirely complete. Blade is single-edged and forward curving. The hilt may have been fully enclosed, but the guard is now partially lost. Fullers running the back edge of the sword.

Figure: 6.24

Current Location: MAN Madrid 2003/114/52

I10: Falcata, Iberian

Date: Fifth to third century

Find Location: Unknown

Material: Iron

Dimensions: Length (total): 52.5cm; (blade): 41.2cm; (hilt): 11.3cm. Width (blade): 5.3cm; (hilt): 5.7cm. Thickness (blade): 7mm; (hilt): 1.4cm.

Mass: 530g

Notes: Corrosion over the entire blade, but the weapon is almost entirely complete. Blade is single-edged and forward curving. The hilt may have been fully enclosed, but the guard is now partially lost. Fullers running the back edge of the sword.

Current Location: MAN Madrid 2003/114/55.

Soliferrea

I11: *Soliferreum*, Iberian

Date: Fourth or third century

Find Location: Necrópolis de los Collados, Penibetica, Spain

Material: Iron

Dimensions: Length (listed, bent): 72.5cm; (point): 7.2cm.

Mass: 220g

Notes: Fragments of a *soliferreum*, tip preserved but some of the full length missing. Some corrosion on the length of the weapon.

Current Location: MAN Madrid 10645

I12: *Soliferreum*, Iberian

Date: Late third to early first century

Find Location: Campamento de la Cerca, Aguilar de Anguita, Spain.

Material: Iron

Dimensions: None given.

Mass: 90g

Notes: Chronologically late example of a *soliferreum*, significantly damaged and incomplete. Perhaps 30-40cm of the iron haft of the weapon is preserved; the tip is also lost.

Current Location: MAN Madrid 1940/27/AA/1786

I13: *Soliferreum*, Iberian

Date: Fifth to early fourth century

Find Location: Necrópolis de El Atillo, Aguilar de Anguita, Spain

Material: Iron

Dimensions: Length (listed, bent), 54cm; Thickness (max): 1.2cm

Mass: 400g

Notes: *Soliferreum* split into two fragments. The length measurement provided in the museum information is simply a measurement from one end to the other of the longest fragment. Preserved elements appear to be c. 160cm long; tip is missing. If the original weapon was c. 195cm long and had a tip, it might have massed c. 550g or more.

Figure: 6.33

Current Location: MAN Madrid 1940/27/AA/19

I14: *Soliferreum*, Iberian

Date: Fifth or fourth century

Find Location: Necrópolis de El Altillo, Aguilar de Anguita, Spain

Material: Iron

Dimensions: Length (listed, bent): 63cm; (tip): 7.3cm. Thickness (haft): 1cm; (tip): 0.4 x 1.8cm.

Mass: 600g

Notes: Original, unbent length c. 190cm. *Soliferreum*, apparently complete, intentionally bent at three points.

Figure: 6.32

Current Location: MAN Madrid 1940/27/AA/3

Shields

I15: Boss, *Caetra*, Celtiberian

Date: Fifth or early fourth century

Find Location: Necrópolis de El Cuarto, Griegos, Spain

Material: Bronze, Iron

Dimensions: Diameter: 33.5cm x 37.0cm; Thickness: 2mm.

Mass: Estimated (very approximately), c. 1224g.

Notes: A large shield boss of Quesada Sanz (1997b), type IA. It has been mounted on a wooden board for preservation and display, from which it cannot be removed. The boss itself consists of a central dome, which would have covered the hand and the grip, over a flat circular metal sheet. And additional set of attachments are rivets through to allow for a strap for the shield to be hung when not in use. The boss is decorated and would have been an elite product.

Figure: 6.28

Bibliography: Quesada Sanz (1997b), 508-11.

Current Location: MAN Madrid, 1976/40/1.

I16: Boss, *Caetra*, Celtiberian

Date: Late fourth to second century

Find Location: Necrópolis de Viñas de Portuguí, Burgo de Osma-Ciudad de Osma, Spain

Material: Iron

Dimensions: Diameter (max): 16.2cm; (min): 11.7cm. Depth (dome): 3.5cm. Thickness: 2mm.

Mass: 127.05g

Notes: Iron shield boss of Quesada (1997b), type IIIA. It is a circular iron shield boss, consisting of a hemispherical dome, which would have covered the hand and the grip, with a fairly small flat base, about 2cm wide, ringing the bottom of the dome. The base has space for four rivets, the heads of three of which are preserved, equally spaced around the perimeter. A single puncture hole is visible in the dome of the boss. The metal is somewhat deformed, but the boss is overall intact.

Figure: 6.30

Current Location: MAN Madrid 24499.

I17: Boss, *Caetra*, Celtiberian

Date: Fourth to third century

Find Location: Necrópolis de Quintanas de Gormaz, Gormaz, Spain

Material: Iron

Dimensions: Diameter (max, outer flanges): 23cm; (min, inner hub): 5.7cm. Height (hub, dome): 6cm. Thickness: 1mm.

Mass: 193.67g

Notes: Iron shield boss of Quesada (1997b), type IIA. Radial boss with a central dome and 12 radial flanges, each of which terminates in a disk. The dome is relatively low and has a puncture in the center, along with a '+' decoration inscribed. All of the radial flanges are bent, but only two are broken. They terminate in disks with space for a rivet to attach them to the shield.

Figure: 6.29

Current Location: MAN Madrid: 1919/2/6.

I18: Maniple, *Caetra*, Celtiberian

Date: Mid-fourth century

Find Location: Necrópolis de los Collados, Almedinilla (Cordoba), Spain.

Material: Iron

Dimensions: Length (wing): 6.4cm; (handle); 10cm. Diameter (handle): 2.5cm.

Mass: 31.29g (est. original: c. 55g)

Notes: Part of an iron maniple for a *caetra*, Quesada (1997b), type IIA. What remains is most of the handle and one of the wings, along with a ring for attaching a shoulder-strap for carrying the shield when not in use. A single rivet in the remaining wing is preserved. The maniple would have originally had a second wing.

Current Location: MAN Madrid 10505

I19: Maniple, *Caetra*, Celtiberian

Date: Early to mid-fourth century

Find Location: Tomb 155, Cerro del Santuario, Basti, Spain

Material: Iron

Dimensions: Length (preserved): 20cm.

Mass: 37.7g (est. original: c. 65g)

Notes: Part of an iron maniple for a *caetra*, Quesada (1996b), type IIIA. The maniple preserves most of the handle and all of one of the two wings; the other wing is completely missing. Roughly half of the preserved length is made up of one of the wings, which has a hole for a rivet, now lost.

Current Location: MAN Madrid 1969/68/155/20

I20: Maniple, *Caetra*, Celtiberian

Date: Early to mid-fourth century

Find Location: Tomb 155, Cerro del Santuario, Basti, Spain

Material: Iron

Dimensions: Length (preserved): 15cm.

Mass: 57.87g

Notes: Part of an iron maniple for a *caetra*, type-classification not possible. The only fully preserved element is the handle itself, both wings are nearly entirely missing. The handle is quite thick and heavy, despite limited preservation.

Current Location: MAN Madrid 1969/68/155/21

I21: Maniple, *Caetra*, Celtiberian

Date: Early to mid-fourth century

Find Location: Tomb 155, Cerro del Santuario, Basti, Spain

Material: Iron

Dimensions: Length (preserved): 14.7cm

Notes: Part of an iron maniple for a *caetra*, type-classification not possible. Most of the handle and a small part of one wing are preserved.

Current Location: MAN Madrid 1969/68/155/22

I22: Maniple, *Caetra*, Celtiberian

Date: Early to mid-fourth century

Find Location: Tomb 155, Cerro del Santuario, Basti, Spain

Material: Iron

Dimensions: Length (preserved): 8cm.

Mass: 20.58g

Notes: Part of an iron maniple for a *caetra*, type-classification not possible. Most of a handle and part of one of the wings is preserved in two fragments. The first fragment is the join between one of the wings and the handles; it is not clear how large the wing would have originally been. The second fragment is part of the handle; original length also uncertain.

Current Location: MAN Madrid 1969/68/155/23

I23: Ring Assembly, *Caetra*, Celtiberian

Date: Late sixth to early fourth century

Find Location: Sepultura 12, Necrópolis del Val, Alpanseque, Spain

Material: Iron

Dimensions: Height: 3.8cm. Length: 6.3cm. Diameter (ring): 5.1cm.

Mass: 27.79g

Notes: Ring assembly for the 'telamon' shoulder strap of a *caetra*, Quesada Sanz (1997b) type VI. Could have been paired with a smaller type V or I maniple, or with a handle made of organic material; larger maniples can include such ring assemblies as part of the wings. One of what would have been at least two ring assemblies survives, consisting of a fastener attached to the shield to hold the ring, and the ring itself. The fastener is missing the second connection to the shield board and is, perhaps, 3/4ths complete. With two such assemblies in their original form, the total mass may have been c. 60-65g.

Current Location: MAN Madrid 1940/27/ALP/11.

Armor

I24: Pectoral, Iberian/Roman?

Date: Mid-second century

Find Location: Numantia

Material: Bronze

Dimensions Diameter: 17cm.

Notes: Circular copper-alloy plate with 25 evenly spaced holes for attachment onto a textile or leather backing or harness. There is a rectangular metal plate attached to the rim and supported by a reinforcing strip which does not seem to be part of the original item. The plate is decorated by a central knob and a series of 17 grooves in concentric circles. The exact suspension system of the plate is unclear. While the plate has been associated with the Roman pectoral (Schulten (1927), Bishop and Coulston (2006), 63), it might also have been part of a Celtiberian disc-harness. The style of decoration (concentric ring designs with a central knob) is consistent (e.g. I28) with Celtiberian pieces, although these are chronologically much earlier.

Figure: 4.32

Bibliography: Schulten (1927), pl. 44.19, 50. Bishop and Coulston (2006), 63-4.

I25: Iron Disc Pectoral, Iberian

Date: Fourth century

Find Location: Necrópolis de la Osera, Avila, Spain

Material: Iron

Dimensions: Diameter: 26cm. Thickness 3mm.

Mass: 470g

Notes: Iron disc pectoral, paired with I26, probably as front and back plates in a harness. It has a series of perforations around the edges to serve as the attachment points for some sort of backing (cf. I24). Only minor damage to the plate, a small notch on the right side.

Current Location: MAN Madrid 1986/81/VI/350/10

I26: Iron Disc Pectoral, Iberian

Date: Fourth century

Find Location: Necrópolis de la Osera, Avila, Spain

Material: Iron with bronze rivets.

Dimensions: Diameter: 26cm. Thickness 3mm.

Mass: 470g

Note: Iron disc pectoral, paired with I25, probably as front and back plates in a harness. It has a series of perforations around the edges to serve as attachment points for some sort of backing. Some damage to the edges (three larger gouges). Some of the bronze rivets in the perforations are preserved.

Current Location: MAN Madrid 1986/81/VI/350/11.

I27: Bronze Disc, Iberian

Date: Fourth century

Find Location: Necrópolis de la Carretera, Aguilar de Anguita, Spain

Material: Bronze

Dimensions: Diameter: 15.8cm; Thickness 1.2mm.

Mass: 140g

Notes: Bronze disc, possibly an element in a disc-harness. The disc is copper-alloy with silver leaf in a wheel design with a central knob. There are seven perforations around the central knob where rivets would have joined it to an textile or leather backing. Possibly a shoulder or thigh-guard as part of a disc-harness, as with the smaller elements of I28.

Current Location: MAN Madrid 1940/27/AA/76

I28: Disc Harness, Iberian

Date: Fifth or early fourth century

Find Location: Necrópolis de El Altillo, Aguilar de Anguita, Spain

Material: Bronze

Dimensions: Total Height: 44cm. Diameter (front plate): 18cm.

Notes: Complete Disc harness, consisting of a front plate, a back plate, two smaller shoulder discs. A pair of circular discs hang down from the front plate, and a pair of oval discs hang from these. Pairs of perforations in the rims of each disc provide for the elements to be connected. The decoration on the large discs consists of five knobs (one central, the others evenly spaced around it), surrounded by concentric circular depressions. The smaller discs have only one central knob, surrounded by concentric circular grooves, very similar to I24.

Current Location: MAN Madrid 1940/27/AA/314.

BIBLIOGRAPHY

Adam, A.-M. and S. Fichtl. "Les Celtes dans les guerres hellénistiques: le cas de la Méditerranée orientale." In *Pratiques et identitiés culturelles des armées hellénistiques du monde méditerranéen*, edited by J.-C. Couvenhes, S. Crouzet and S. Péré-Noguès, 117-128. Bordeaux: de Boccard, 2011.

Adam-Veleni, P. "Arms and Warfare Techniques of the Macedonians." In *Alexander the Great, Treasures from an Epic Era of Hellenisim*, edited by D. Pandermalis, 47-64. New York: Onassis, 2004.

Aldrete, G.S., S. Bartell, and A. Aldrete. *Reconstructing Ancient Linen Body Armor: Unraveling the Linothorax Mystery*. Baltimore: John Hopkins University Press, 2013.

Ameling, W. *Karthago: Studien zu Militär, Staat und Gesellschaft.* München, C. H. Beck, 1993.

Anderson, J. K. *Ancient Greek Horsemanship*. Berkeley: University of California Press, 1961.

Anderson, J. K. "Philopoemen's Reform of the Achaean Army." *CP* 62, no. 2 (1967): 104-106.

Anderson, J.K. *Military Theory and Practice in the Age of Xenophon*. Berkeley: University of California Press, 1970.

Andronikos, M. "Sarissa." *BCH* 94 (1970): 91-107.

Andronikos M. "Vergina: The Royal Graves in the Great Tumulus." *AAA* 10 (1977): 1-72.

Andronikos, M. "The Royal Tombs at Aigai (Vergina)." In *Philio of Macedon*, edited by M. Hatzopoulos and L. D. Loukopoulos, 188-231. Athens: Ekdotike Athenon S.A., 1980.

Andronikos, M. *Vergina: The Royal Tombs and the Ancient City*. Athens: Ekdotike Athenon S.A., 1984.

Anson, E.M. "Macedonia's Alleged Constitutionalism." *CJ* 84, no. 4 (1985): 303-316.

Anson, E.M. "The Evolution of the Macedonian Army Assembly (330-315 B.C.)." *Historia* 40, no. 2 (1991): 230-247.

Aperghis, M. "Population – Production – Taxation – Coinage." In *Hellenistic Economies*, edited by Z. H. Archibald, J. Davies, V. Gabrielsen and G. J. Oliver, 69-102. London: Routledge, 2001.

Aperghis, M. *The Seleukid Royal Economy: The Finances and Financial Administration of the Seleukid Empire*. Cambridge: Cambridge University Press, 2004.

Arendt, H. *On Violence*. New York: Harcourt, Brace & World, 1969.

Arribas, A. *The Iberians*. London: Thames and Hudson, 1964.

Badian, E. *Foreign Clientelae (264-70 B.C.)*. Oxford: Clarendon Press, 1958.

Badian, E. *Roman Imperialism in the Late Republic.* Ithaca: Cornell University Press, 1968.

Badian, E. *Publicans and Sinners: Private Enterprise in the Service of the Roman Republic*. Ithaca: Cornell University Press, 1972.

Badian, E. "Figuring out Roman Slavery." *JRS* 72 (1982): 164-169.

Bagnall, R. and B. Frier. *The Demography of Roman Egypt*. Cambridge: Cambridge University Press, 1994.

Bar Kochva, B. *The Seleucid Army: Organization and Tactics in the Great Campaigns*. Cambridge: Cambridge University Press, 1976.

Barber, E. W. *Prehistoric Textiles: The Development of Cloth in the Neolithic and Bronze Ages, with Special Reference to the Aegean*. Princeton: Princeton University Press, 1991.

Barber, E. W. *Women's Work: The First 20,000 Years, Women Cloth and Society in Early Times*. New York, W. W. Norton & Company, 1994.

Barton, C. *Roman Honor: The Fire in the Bones*. Berkeley, University of California Press, 2001.

Bealer, A. W. *The Art of Blacksmithing*. New York: Funk & Wagnalls, 1969.

Bell, M. J. V. "Tactical Reform in the Roman Republican Army." *Historia* 14, no. 4 (1965): 404-22.

Beloch, K. J. *Die Bevölkerung Der Griechisch-Roemischen Welt*. Leipzig: Dunker & Humblot, 1886.

Beloch, K. J. *Griechische Geschichte*. Vol 4. Berlin: Walter de Gruyter, 1925.

Bernard, P, *et al*. "Campagne de Fouille 1978, à Aï Khanoum (Afghanistan)." *Bulletin de L'École Française D'Extrême Orient* 68 (1980): 5-116.

Beresford, J. *The Ancient Sailing Season*. Leiden: Brill, 2013.

Billows, R. *Kings and Colonists: Aspects of Macedonian Imperialism*. Leiden: Brill, 1995.

Bishop, M. C. "The Evolution of Certain Features." In *Roman Military Equipment: The Accoutrements of War, Proceedings of the Third Roman Military Equipment Research Seminar,* edited by M. Dawson, 109-39. Oxford: BAR International Series, 1987.

Bishop, M. C. and J. C. N. Coulston. *Roman Military Equipment: From the Punic Wars to the Fall of Rome*. 2nd ed. Oxford: Oxbow, 2006.

Blackman, D. "The Athenian Navy and Allied Naval Contributions in the Pentecontaetia." *GRBS* 10 (1969): 179-216.

Blair, C. *European Armour, circa 1066 to circa 1700*. London: B.T. Batsford, 1958.

Blundell, S. *Women in Ancient Greece*. Cambridge: Harvard University Press, 1995.

Bockius, R. "Ein Römisches Scutum Aus Urmitz, Kreis Mayen-Koblenz: Zu Herkunft und Verbreitung Spindelförmiger Schildbuckelbeschläge im Gebiet Nördlich der Alpen." *Archäeologisches Korrespondenzblatt* 19 (1989): 269-82.

Bol, P. *Antike Bronzetechnik: Kunst und Handwerk antiker Erzbildner*. München: Verlag C.H. Beck, 1985.

Bond, S. *Trade and Taboo: Disreputable Professions in the Roman Mediterranean*. Ann Arbor: University of Michigan Press, 2016.

Borel, A. N. "Mercenaires galates d'Antigonos Gonatas: problèmes de numismatique et de démographie." In *Pratiques et identitiés culturelles des armées hellénistiques du monde méditerranéen*, edited by J.-C. Couvenhes, S. Crouzet and S. Péré-Noguès, 193-202. Bordeaux: de Boccard, 2011.

Borza, E. *In the Shadow of Olympus: The Emergence of Macedon*. Princeton: Princeton University Press, 1990.

Bosch Gimpera, P. "Los celtas y la civilización céltica de la Península Ibérica." *Boletín de la Real Sociedad Española de Excursiones* 19 (1921): 248-301.

Boschung, D. "Überlegungen zum Denkmal des Aemilius Paullus in Delphi." In *Rome et ses Provinces: Genèse & diffusion d'une image du pouvoir, hommages à Jean-Charles Balty,* edited by C. Evers and A. Tsingarida. Brussels: Le Livre Timperman, 2001.

Bowie, K. A. "Unraveling the Myth of the Subsistence Economy: Textile Production in Nineteenth-Century Northern Thailand." *Journal of Asian Studies* 51, no. 4 (1992): 797-823.

Branigan, K. *Copper and Bronze Working in Early Bronze Age Crete*. Lund: Studies in Mediterranean Archaeology, 1968.

Bray, L. "'Horrible, Speculative, Nasty, Dangerous': Assessing the Value of Roman Iron." *Britannia* 41 (2010): 175-185.

Bringmann, K. "The King as Benefactor: Some Remarks on Ideal Kingship in the Age of Hellenism." In *Images and Ideologies: Self Definition in the Hellenistic World*, edited by A. W. Bulloch *et al.*, 7-24. Berkeley: University of California Press, 1993.

Brunaux, J.-L. *Les Gaulois: Sanctuaires et Rites*. Paris: Editions Errance, 1986.

Brunaux, J.-L. *Guerre et Religion en Gaule: Essai D'Anthropologie Celtique*. Paris: Editions Errance, 2004.

Brunaux, J.-L. and B. Lambot. *Armement et Guerre chez les Gaulois*. Paris: Editions Errance, 1987.

Brunaux, J.-L, and A. Rapin. *Gournay II: Boucliers et Lances Dépôts et Trophées*. Paris: Editions Errance, 1988.

Brunt, P.A. *Italian Manpower: 225 B.C. – A.D. 14*. Oxford: Oxford University Press, 1971.

Buchwald, V. F. *Iron and Steel in Ancient Times*. Copenhagen: Det Kngelige Danske Videnskabernes Selskab, 2005.

Burns, M. T. "The Homogenisation of Military Equipment under the Roman Republic." In *Romanization? Digressus Supplement I*. London: Institute of Archaeology, University College London, 2003.

Burton, P.J. "*Clientela* or *Amicitia?* Modeling Roman International Behavior in the Middle Republic (264-146 BC)." *Klio* 85 (2003): 333-369.

Cahn, D. *Waffen und Zamzeug*. Basel: Antikenmuseum, Basel, 1989.

Capponi, N. *Victory of the West: The Great Christian-Muslim Clash of the Battle of Lepanto*. Cambridge: Da Capo Press, 2006.

Carratelli, G. *The Western Greeks*. Milan: Bompiani, 1996.

Casson, L. *Ships and Seamanship in the Ancient World*. Princeton: Princeton University Press, 1971.

Casson, L. and J. R. Steffy. *The Athlit Ram*. College Station, TX: Texas A&M University Press, 1991.

Castro, M.C.F. *Iberia in Prehistory*. Oxford: Blackwell, 1995.

Chanoitis, A. *War in the Hellenistic World: A Social and Cultural History*. Malden: Blackwell, 2005.

Chapman, E. *A Catalogue of Roman Military Equipment in the National Museum of Wales*. Oxford: Archaeopress, 2005.

Cheshire, E. "*Cuir Bouilli* armour." In *Why Leather? The Material and Cultural Dimensions of Leather,* edited by S. Harris and A. J. Veldmeijer, 41-76. Leiden: Sidestone press, 2014.

Choremis, A. "Μετάλλινος ὁπλισμὸς ἀπὸ τὸν τάφο στό Προδρόμι Θεσπρτίας." *Athens Annals of Archaeology* 13 (1980): 3-21.

Cianfarani, V. *Antiche civilta d'Abruzzo*. Rome: De Luca Editore, 1969.

Clark, J. H. *Triumph in Defeat: Military Loss and the Roman Republic*. Oxford: Oxford University Press, 2014.

Clarysse, W. and E. Lanciers. "Currency and the Dating of Demotic and Greek Papyri from the Ptolemaic Period." *Ancient Society* 20 (1989): 117-132.

Clarysse, W. and D. J. Thompson. *Counting the People in Hellenistic Egypt*. Cambridge: Cambridge University Press, 2006.

Coarelli, F. "L'ara di Domizio Ahenobarbo e la cultura artistica in Roma nel II sec. AC." *Dialoghi di Archeologia* 2 (1968): 302-68.

Cohen, A. *The Alexander Mosaic: Stories of Victory and Defeat*. Cambridge: Cambridge University Press, 1997.

Connolly, P. *Greece and Rome at War*. London: Macdonald Phoebus, 1981.

Connolly, P. "Notes on the Development of Breastplates in Southern Italy." In *Italian Iron-Age Objects in the British Museum*, 117-125. London: British Museum Publications Ltd, 1986.

Connolly, P. "Pilum, Gladius and Pugio in the Late Republic." *JRMES* 8 (1997): 41-57.

Connolly, P. "Experiments with the Sarissa – The Macedonian Pike and Cavalry Lance – A Functional View." *JRMES* 11 (2000a): 103-112.

Connolly, P. "The Reconstruction and Use of Roman Weaponry in the Second Century BC." *JRMES* 11 (2000b): 43-46.

Cook, M. L. "Timokrates' 50 Talents and the Cost of Ancient Warfare." *Eranos* 88 (1990): 69-97.

Cornell, T.J. *The Beginnings of Rome: Italy and Rome from the Bronze Age to the Punic Wars (c. 1000 – 264 BC)*. London: Routledge, 1995.

Corvisier, J.-N. and W. Suder. *La population de l'Antitiquité Classique*. Paris: Presses Universitaires de France, 2000.

Courbin, P. "Une Tombe Géometrique d'Argos" *BCH* 81 (1957): 322-386.

Coussin, P. *Les Instutitions Militaires et Navales*. Paris: Les Belles Lettres, 1932.

Craddock, P. "The Metallurgy and Composition of Etruscan Bronze." *Studi Etruschi* 52 (1984): 229-259.

Craddock, P. *Early Metal Mining and Production*. Washington, D.C.: Smithsonian Institution Press, 1995.

Crawford, M. H. *Coinage and Money under the Roman Republic: Italy and the Mediterranean Economy*. Berkeley: University of California Press, 1985.

Crawford, M. H. *Roman Republican Coinage*. 2 vols. Cambridge: Cambridge University Press, 1987.

Curchin, L.A. *Roman Spain: Conquest and Assimilation*. London: Routledge, 1991.

D'Amato, R. *Arms and Armour of the Imperial Roman Soldier: From Marius to Commodus 112 BC – AD 192*. London: Frontline Books, 2009.

Dana, D. “Les Thraces dans les armées hellénistiques: essai d’histoire par le noms.” In *Pratiques et identitiés culturelles des armées hellénistiques du monde méditerranéen,* edited by J.-C. Couvenhes, S. Crouzet and S. Péré-Noguès, 87-115. Bordeaux: de Boccard, 2011.

David, J.-M. *La Romanisation de l’Italie*. Paris: Aubier, 1994.

Davies, L. “Cuir Bouilli.” In *Conservation of Leather and Related Materials*, edited by M. Kite and R. Thomson, 94-102. London: Routledge, 2005.

Davoli, P. and C. Miks. “A New ‘Roman’ Sword from Soknopaiou Nesos (El-Fayyum, Egypt).” *ISAW Papers 9* (2015).

De Ligt, L. “The Population of Cisalpine Gaul in the Time of Augustus.” In *People, Land and Politics: Demographic Developments and the Transformation of Roman Italy 330 BC – AD 14,* edited by L. De Ligt and S. J. Northwood, 139-86. Leiden: Brill, 2008.

De Ligt, L. *Peasants, Citizens and Soldiers: Studies in the Demographic History of Roman Italy, 225 BC – AD 100*. Cambridge: Cambridge University Press, 2012.

De Navarro, J. M. *The Finds from the Site of La Tène I: Scabbards and the Swords Found in Them*. 2 vols. Oxford: Oxford University Press, 1972.

De Sanctis, G. *Storia dei Romani*. Vol 3. Florence: La Nouva Italia: 1956.

De Souza, P. *Piracy in the Graeco-Roman World*. Cambridge: Cambridge University Press, 1999.

Déchelette, J. *Second âge du fer ou époque de La Tène*. Vol. 4 of *Manuel d’archéologie préhistorique celtique et gallo-romaine*. Paris: Picard, 1927.

Derow, P, A. Erskine and J. Quinn. *Rome, Polybius and the East*. Oxford: Oxford University Press, 2015.

DeWitt, N.J. “Pseudolus and Hannibal’s Elephant.” *CP* 36, no. 2 (1941): 189-190.

Deyber, A. *Les Gaulois en Guerre: Stratégies, tactiques et techniques Essai d’histoire militaire (II^{e}/I^{er} siècles av. J.-C.)*. Paris: Editions Errance, 2009.

Di Cosmo, N. “State Formation and Periodization in Inner Asian History.” *Journal of World History* 10, no. 1 (1999): 1-40.

Dickenson, T. and H. Härkle. *Early Anglo-Saxon Shields*. London: Society of Antiquaries of London, 1992.

Dintsis, P. *Hellenistiche Helme*. Rome: Giorgio Bretschneider Editore, 1986.

Dobson, M. *The Army of the Roman Republic: The Second Century BC, Polybius and the Camps at Numantia, Spain*. Oxford: Oxbow, 2008.

Donlan, W. "The Relations of Power in the Pre-State and Early State Polities." In *The Development of the Polis in Archaic Greece*, editd by L. G. Mitchell and P. J. Rhodes, 39-48. London: Routledge, 1997.

Duncan-Jones, R. *Structure and Scale in the Roman Economy*. Cambridge: Cambridge University Press, 2002.

Eadie, J. W. "The Development of Roman Mailed Cavalry." *JES* 57 (1967): 161-73.

Eckstein, A. M. *Moral Vision in* The Histories *Of Polybius*. Berkeley: University of California Press, 1995.

Eckstein, A. M. *Mediterranean Anarchy, Interstate War and the Rise of Rome*. Berkeley: University of California Press, 2006.

Eckstein, A.M. *Rome Enters the East: from Anarchy to Hierarchy in the Hellenistic Mediterranean*. Malden: Blackwell Publishing, 2008.

Eichberg, M. *Scutum: : Die Entwicklung einer italisch-etruskischen Schildform von den Anfängen bis zur Zeit Caesars*. Frankfurt am Main: Peter Lang, 1987.

Elton, H. *Warfare in Roman Europe AD 350-425*. Oxford: Clarendon Press, 1996.

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

Erdkamp, P. *Hunger and the Sword: Warfare and Food Supply in Roman Republican Wars (264 – 30 B.C.* Amsterdam: J. C. Gieben, 1998.

Erdkamp, P. *The Grain Market in the Roman Empire: A Social, Political and Economic Study*. Cambridge: Cambridge University Press, 2005.

Erdkamp, P. "Polybius and Livy on the Allies in the Roman Army." In *The Impact of the Roman Army (200 BC – AD 476)*, edited by L. de Blois and E. Lo Cascio. Leiden: Brill, 2007.

Erdkamp, P. "Manpower and Food Supply in the First and Second Punic Wars." In *A Companion to the Punic Wars*, edited by D. Hoyos, 58-76. Malden: Wiley-Blackwell, 2011.

Erskine, A. "Polybius Among the Romans: Life in the Cyclops' Cave." In *Imperialism, Cultural Politics and Polybius*, edited by C. Smith and L. M. Yarrow, 17-32. Oxford: Oxford University Press.

Erskine, A. "How to Rule the World: Polybius Book 6 Reconsidered." In *Polybius and His World: Essays in Memory of F. W. Walbank*, edited by B. Gibson and T. Harrison, 231-245. Oxford: Oxford University Press, 2013.

Evans, J.K. "Resistance at Home: the Evasion of Military Service in Italy During the Second Century B.C." In *Forms of Control and Subordination in Antiquity*, edited by T. Yuge and M Doi, 121-140. Leiden: Brill, 1988.

Everson, T. *Warfare in Ancient Greece: Arms and Armour from the Heroes of Homer to Alexander the Great*. Stroud: Sutton Publishing, 2004.

FAO. *Food Composition Tables for the Near East*. Rome: Food and Agricultural Organization of the United Nations, 1982.

Feugère, M. *Les Armes des Romains: de la République à l'Antiquité tardive*. Paris: Editions Errance, 1993.

Feugère, M. *Les Casques Antiques*: *Visages de la guerre de Mycènes à l'Antiquité tardive*. Paris: Editions Errance, 1994a.

Feugère, M. "L'équipement militaire d'époque républicaine en Gaule." *JRMES* 5 (1994b): 3-23.

Fischer-Bovet, C. *Army and Society in Ptolemaic Egypt.* Cambridge: Cambridge University Press, 2014.

Flint-Hamilton, "Legumes in Ancient Greece and Rome: Food, Medicine or Poison." *Hesperia* 68, no. 3 (1999): 371-395.

Foulkes, C. *The Armourer and his Craft: From the XIth to the XVIth Century*. New York: Benjamin Blom, 1929.

Foxhall, L. "The Dependent Tenant: Land Leasing and Labour in Italy and Greece." *JRS* 80 (1990): 97-114.

Foxhall, L. and H.A. Forbes. "Σιτομετρεία: The Role of Grain as a Staple Food in Classical Antiquity." *Chiron* 12 (1982): 40-90.

Frank, T. "Roman Census Statistics from 225 to 28 BC" *CP* 19 (1924): 329-41.

Frank, T. *An Economic Survey of Ancient Rome*. Vol. 1. Baltimore: John Hopkins University Press, 1933.

Fraser, P. M., and T. Rönne. *Boeotian and West Greek Tombstones*. Lund: C. W. K. Gleerup, 1957.

Frier, B. "Demography." In *CAH*², edited by A. Bowman, P. Garnsey and D. Rathbone, 11:787-816. Cambridge: Cambridge University Press, 2000.

Fronda, M.P. *Between Rome and Carthage: Southern Italy during the Second Punic War*. Cambridge: Cambridge University Press, 2010.

Fuentes, N. "The Mule of a Soldier." *JRMES* 2 (1991): 65-99.

Gabba, E. "Rome and Italy in the Second Century BC." In *CAH*² vol. 7.2, edited by A.E. Astin, F.W. Walbank, M.W. Federiksen, R.M. Ogilvie, 197-243. Cambridge: Cambridge University Press, 1989.

Gabrielsen, V. *Financing the Athenian Fleet: Public Taxation and Social Relations*. Baltimore: John Hopkins University Press, 1990.

Gällnö, S. "(In)visible Spinners in the Documentary Papyri from Roman Egypt." In *Making Textiles in Pre-Roman and Roman Times: People, Places, Identities,* edited by M. Gleba and J. Pásztokai-Szeőke, 161-170. Oxford: Oxbow, 2013.

Gallivan, P. and P. Wilkins. "Familial Structures in Roman Italy: A Regional Approach." In *The Roman Family in Italy: Status, Sentiment, Space*, edited by B. Rawson and P. Weaver, 239-255. Oxford: Clarendon Press, 1997.

Garnsey, P. and G. Woolf. "Patronage of the Rural Poor in the Roman World." In *Patronage in Ancient Society,* edited by A. Wallace-Hadrill, 153-170. London: Routledge, 1989.

Gassmann, P. "Nouvelle approche concernant les datations dendrochonologiques du site éponyme de La Tène (Marin-Epagnier, Suisse)." *Annual Review of Swiss Archaeology* 90 (2007): 75-88.

Gat, A. *War in Human Civilization*. Oxford: Oxford University Press, 2006.

Gleba, M. *Textile Production in pre-Roman Italy*. Oxford: Oxbow, 2008), 171-8.

Gleba, M. and U. Mannering, eds. *Textiles and Textile Production in Europe: From Prehistory to AD 400*. Oxford: Oxbow Books, 2012.

Grainger, J. D. *Hellenistic and Roman Naval Wars, 336-31 BC*. Barnsley: Pen and Sword, 2011.

Grant, M. *The Hellenistic Greeks: From Alexander to Cleopatra*. London: Weidenfeld & Nicolson, 1982.

Greene, K. "Technological Innovation and Economic Progress in the Ancient World: M. I. Finley Reconsidered." *Economic History Review* 53, no. 1 (2000): 29-59.

Griffith, G. T. *The Mercenaries of the Hellenistic World*. Cambridge: Cambridge University Press, 1935.

Griffith, G. T. "ΜΑΚΕΔΟΝΙΚΑ: Notes on the Macedonians of Philip and Alexander." *Proceedings of the Cambridge Philological Society* 4 (1956/7): 3-10

Gruen, E.S. "Greek Πίστις and Roman Fides." *Athenaeum* 60 (1982): 50-68.

Gunther, S. *"Vectigalia nervos esse rei publicae" Die indirekten Steuern in der Romischen Kaiserzeit von Augustus bis Diokletian*. Wiesbaden: Harrasowitz Verlag, 2008.

Guy, P. R. "The Daily Food Intake of the African Elephant, *Loxodonta Africana* Blumenbach, in Rhodesia." *Arnoldia* 7 (1975): 1-8.

Hansen, M. H. *The Shotgun Method: The Demography of the Ancient Greek City State Culture*. Columbia, MO: University of Missouri Press, 2006.

Harari, N. Y. "Strategy and Supply in Fourteenth-century Western European Invasion Campaigns." *JMH*64, no. 2 (2000): 297-333.

Harding, J.D.W., and W. Gillies. "Introduction: Archaeology and Celticity." In *Celtic Connections*, vol 2., edited by W. Gillies and D.W. Harding, 1-14. Edinburgh: University of Edinburgh, 2005.

Hardy, R. *Longbow: A Social and Military History*. New York: Bois d'Arc Press, 1992.

Harris, W. V. *War and Imperialism in Republican Rome: 327-70 B.C.*. Oxford: Oxford University Press, 1979.

Harrison, R.J. *Spain at the Dawn of History: Iberians, Phoenicians and Greeks*. London: Thames and Hudson, 1988.

Harter-Uibopuu, K. "Money for the *Polis*. Pobulic Administration of Private Donations in Hellenistic Greece." In *Political Culture in the Greek City after the Classical Age*, edited by O. M. van Nijf and R. Alston, 119-39. Leuven: Peeters, 2011.

Hatzopoulos, M. *Macedonian Institutions Under the Kings*. 2 vols. Paris: De Boccard, 1996.

Hatzopoulos, M. B. *L'organisation de L'armée Macédonienne sous les Antigonides: Problèmes Anciens et Documents Nouveaux*. Athens: Boccard, 2001.

Healy, J. F. *Mining and Metallurgy in the Greek and Roman World*. London: Thames and Hudson, 1978.

Hess, A.C. "The Battle of Lepanto and its Place in Mediterranean History." *Past & Present* 57 (1972): 53-73.

Higham, R. D. "The Social Position of Leatherworkers." In *Conservation of Leather and Related Materials*, edited by M. Kite and R. Thomson, 82-87. London: Routledge, 2005.

Hin, S. "Counting Romans." In *People, Land and Politics: Demographic Developments and the Transformation of Roman Italy, 300BC – AD 14*, edited by L. de Ligt and S. J. Northwood, 187-238. Leiden: Brill, 2008.

Hodges, H. *Artifacts: An Introduction to Early Materials and Technology*. London: Duckworth, 1989.

Hoffman, M. *The Warp-Weighted Loom: Studies in the History and Technology of an Ancient Implement*. Oslo: Robin and Russ Handweavers, 1964.

Hopkins, K. *Conquerors and Slaves*. Cambridge: Cambridge University Press, 1978.

Horden, P. and N. Purcell. *The Corrupting Sea: A Study of Mediterranean History*. Malden: Blackwell Publishing, 2000.

Horsnaes, H. W. *The Cultural Development in North Western Lucania c. 600 – 273 BC*. Rome: L'Erma di Bretschneider, 2002.

Horvat, J. "Roman republican Weapons from Šmihel in Slovenia." *JRMES* 8 (1997): 105-120.

Horvat, J. "The Hoard of Roman Republican Weapons from Grad near Šmihel." *Arheološki Vestnik* 53 (2002): 117-192.

Hoyos, D. *Hannibal's Dynasty: Power and Politics in the Western Mediterranean, 247-183 BC*. London: Routledge, 2003.

Hoyos, D. *Truceless War: Carthage's Fight for Survival 241 to 237 B.C.* Leiden: Brill, 2007.

Hoyos, D. *The Carthaginians*. London: Routledge, 2010.

Hoyos, D. *Mastering the West: Rome and Carthage at War*. Oxford: Oxford University Press, 2015.

Huss, W. *Geschichte der Karthager*. München, C. H. Beck: 1985.

Illinois Greek Club, trans. *Aeneas Taticus, Asclepiodotus and Onasander*. Cambridge: Harvard University Press, 1928.

James, S. *The Atlantic Celts: Ancient People or Modern Invention*. Madison: University of Wisconsin Press, 1999.

Jarva, E. *Archaiologia on Archaic Greek Body Armour*. Rovaniemi: Pohjois-Suomen Historiallinen Yhdistys, 1995.

Jongman, W. *The Economy and Society of Pomeii*. Amsterdam: J. C. Gieben, 1988.

Juhel, P. "The Regulation Helmet of the Phalanx and the Introduction of the Concept of Uniform in the Macedonian Army at the End of the Reign of Alexander the Great." *Klio* 91 (2009): 342-355.

Juhel, P. and D. Temelkoski. "Fragments de "Boucliers macédoniens" au nom du roi Démétrios trouvés à Staro Bonče (République de Macédoine). Rapport préliminaire et présentation épigraphique." *ZPE* 162 (2007): 165-180.

Juhel, P. and D. Temelkoski. "Découverte de nouveaux 'boucliers macédoniens' en Pélagonie (République de Macédoine). Aspects archéologiques et réflexions historiques." In *Pratiques et identitiés culturelles des armées hellénistiques du monde méditerranéen* edited by J.-C. Couvenhes, S. Crouzet and S. Péré-Noguès, 177-192. Bordeaux: do Boccard, 2011.

Junkelmann, M. *Die Legionen des Augustus: Der römische Soldat im archäologischen Experiment*. Mainz am Rhein: Verlag Philipp von Zabern, 1986.

Junkelmann, M. *Römische Helme*. Mainz am Rhein: Verlag Philip von Zabern, 2000.

Kallet-Marx, R. M. *Hegemony to Empire: The Development of Roman Imperium in the East from 148 to 62 B.C.*. Berkeley: University of California Press, 1996.

Kähler, H. *Der Fries vom Reiterdenkmal des Aemilius Paullus in Delphi*. Berlin: Verlag Gebr Mann, 1965.

Kähler, H. *Seethiasos und Census*. Berlin: Verlag Gebr Mann, 1966.

Kahrstedt, U. *Geschichte der Karthager von 218-146*. 3 vols. Berlin: Weidmann, 1913.

Keaveney, A. *Rome and the Unification of Italy*. 2nd ed. Exeter: Bristol Phoenix Press, 2005.

Keay, S.J. *Roman Spain*. London: British Museum Publications, 1988.

Keeley, L. H. *War Before Civilization: The Myth of the Peaceful Savage*. Oxford: Oxford University Press, 1996.

Kehoe, D. P. *The Economics of Agriculture on Roman Imperial Estates in North Africa*. Gottingen: Vanderhoeck & Ruprecht, 1988.

Kent, P. "Reconsidering *socii* in Roman Armies Before the Punic Wars." In *Processes of Integration and Identity Formation in the Roman Republic,* edited by S.T. Roselaar, 71-84. Leiden: Brill, 2012.

Kent, P. "The Roman Army's Emergence from Its Italian Origins." PhD diss., University of North Carolina, 2012b.

Keppie, L. *The Making of the Roman Army: From Republic to Empire*. London: BT Batsford, 1984.

Kimming, W. "Ein Keltenschild aus Ägypten." *Germania* 24 (1940): 106-111.

Kisler, J. M. *War Elepehants*. Westport, CT: Praeger, 2006.

Kisyov, J. "Le tumulus n˚ I de Chernozem-Kaloyanovo." In *L'Épopée des rois thraces: des guerres médiques aux invasions celtes 476 – 278 av. J.-C,* edited by J.-L. Martinez, A. Baralis, N. Mathieux, T. Stoyanov and M. Tonkova, 76-87. Paris: Musee du Louvre, 2015.

Kite, M. and R. Thomson. *Conservation of Leather and Related Materials*. London: Routledge, 2005.

Kmetič, D., J. Horvat and F. Vodopivec. ""Metallographic examinations of the Roman Republican weapons from the hoard from Grad near Šmihel." *Arheološki Vestnik* 55 (2004): 291-312.

Kostoglou, M. *Iron and Steel in Ancient Greece*. Oxford: John and Erica Hedges Ltd, 2008.

Kromayer, J. and G. Veith. *Heerwesen und Kriegsführung der Griechen und Römer*. München, C.H. Beck, 1928.

Kron, G. "Agriculture." In *A Companion to Food in the Ancient World*, edited by J. Wilkins and R. Nadeau, 160-72. Malden: Wiley Blackwell, 2015.

Kuttner, A. "Some New Grounds for Narrative: Marcus Antonius' Base (The Ara Domitii Ahenobarbi) and Republican Biographies." In *Narrative and Event in Ancient Art*, edited P. J. Holliday, 198-229. Cambridge: Cambridge University Press, 1993.

Lancel, S. *Carthage*. Paris: Fayard, 1992.

Landers, J. *The Field and the Forge: Population, Production and Power in the Pre-Industrial West*. Oxford: Oxford University Press, 2003.

Lattimore, S. *The Marine Thiasos in Greek Sculpture*. Los Angeles: Institute of Archaeology, University of California, 1976.

Launaro, A. *Peasants and Slaves: The Rural Population of Roman Italy (200 BC to AD 100)*. Cambridge: Cambridge University Press, 2011.

Launey, M. *Recherches sur les Armées Hellénistiques.* Paris: De Boccard, 1949.

Lazenby, J. F. *Hannibal's War: A Military History of the Second Punic War*. Warminster: Aris and Philips, 1974.

Lazenby, J. F. *The First Punic War: A Military History*. Stanford: Stanford University Press, 1996.

Lazenby, J. F. "Rome and Carthage." In *The Cambridge Companion to the Roman Republic,* edited by H. I. Flower, 225-41. Cambridge: Cambridge University Press, 2004.

Lebergott, S. *Pursuing Happiness: American Consumers in the Twentieth Century*. Princeton: Princeton University Press, 1993.

Lee, J. W. *A Greek Army on the March: Soldiers and Survival in Xenophon's* Anabasis. Cambridge: Cambridge University Press, 2008.

Lejars, T. "L'armement des Celtes en Gaule du Nord à la fin de l'époque gauloise." *Revue archéologique de Picardie* (1996), 96.

Lejars, T. *La Tène: La Collection Schwab (Bienne, Suisse). La Tène, Un Site, Un Mythe 3*. 2 vols. Lusanne: Cahiers d'archéologie romande, 2013.

Lendon, J.E. "The Rhetoric of Combat: Greek Military Theory and Roman Culture in Julius Caesar's Battle Descriptions." *CA* 18, no. 2 (1999): 273-329.

Lendon, J. E. *Soldiers and Ghosts: A History of Battle in Classical Antiquity*. New Haven: Yale University Press, 2005.

Leuze, O. "Die Kämpfe um Sardinien und Korsika im ersten punischen Krieg" *Klio* 10 (1910): 406-44.

Liampi, K. *Makedonische Schild*. Bonn: R Habelt, 1998.

Liberati, A. M. "L'esercito di Roma nell'età delle guerre puniche. Riconstruzioni e plastici del Museo della Civiltà Romana di Roma." *JRMES* 8 (1997); 25-40.

Lintott, A. *The Constitution of the Roman Republic*. Oxford: Clarendon Press, 1999.

Liu, J. "Clothing Supply for the Military. A look at the Inscriptional Evidence." In *Wearing the Cloak: Dressing the Soldier in Roman Times*, edited by M.-L Nosch, 19-28. Oxford: Oxbow, 2012.

Lo Cascio, E. "The Size of the Roman Population: Beloch and the Meaning of the Augustan Census Figures." *JRS* 84 (1994): 23-40.

Lo Cascio, "La popolazione dell-'Egitto Romano." In *La démographie Historique Antique*, edited by M. Bellancourt-Valdher and J. N. Corvisier, 133-70. Arras: Artois Presses Université, 1999a.

Lo Cascio, "Popolazione e Risore Agricole Nell 'Italia Del II Secolo A.C." In *Demografia, Sistemi Agrari, Regimi Alimentari Nel Mondo Antico, Atti del Convegno Internazionale di Studi (parma 17-19 ottobre 1997*), edited by D. Vera, 217-245. Bari: Edipuglia, 1999b.

Lo Cascio, E. "Recruitment and the Size of the Roman Population from the Third to the First Century BCE." In *Debating Roman Demography*, edited by W. Scheidel, 111-37. Leiden: Brill, 2001.

Lo Cascio, E. "Roman Census Figures in the Second Century BC and the Property Qualifications of the Fifth Class." In *People, Land and Politics: Demographic Developments and the Transformation of Roman Italy, 300 BC-AD14*, edited by L. De Ligt and S. J. Northwood, 239-56. Leiden: Brill, 2008.

Lo Cascio, E and P. Malanima. "Cycles and Stability: Italian Population before the Demographic Transition (225BC-AD 1900). *Rivista di Storia* 21 (2005): 5-40.

Loomis, W. T. *Wages, Welfare Costs and Inflation in Classical Athens*. Ann Arbor: University of Michigan Press, 1998.

Lorrio, A.J. and G.R. Zapatero. "Celtiberians: Archaeology of the Celts in Iberia." In *Celtic Connections*, vol 2., edited by W. Gillies and D.W. Harding, 33-55. Edinburgh: University of Edinburgh, 2005.

Lovén, L. L. *The Imagery of Textile Making: Gender and Status in the Funerary Iconography of Textile Manufacture in Roman Italy and Gaul*. Göteborg: University of Göteburg, 2002.

Lovén, L. L. "Female work and Identity in Roman Textile Production and Trade: A Methodological Discussion." In *Making Textiles in pre-Roman and Roman Times: People, Places, Identities,* edited by M. Gleba and J. Pásztokai-Szeőke, 109-125. Oxford: Oxbow: 2013.

Low, P. "Looking for the Language of Athenian Imperialism." *JHS* 125 (2005): 93-111.

Luik, M. ""Republikanische Pilumfunde vom 'Talamonaccio'/Italien." *Archäologisches Korrespondenzblatt* 30 (2000): 269-277.

Lush, D. "Body Armour in the Phalanx of Alexander's Army." *AW* 38, no 1 (2007): 15-37.

Luttwak, E. *The Grand Strategy of the Roman Empire*. Baltimore: John Hopkins University Press, 1976.

Ma, J. "Fighting *Poleis* of the Hellenistic World." In *War and Violence in Ancient Greece*, edited by H. van Wees, 337-376. London: Duckworth, 2000.

Mackay, C. S. *Ancient Rome: A Military and Political History*. Cambridge: Cambridge University Press, 2004.

Mahan, A. T. *The Influence of Sea Power Upon History, 1600-1783*. Boston: Little, Brown and Company, 1890.

Mandall, S. "The Isthmian Proclamation and the Early Stages of Roman Imperialism in the Near East." *CB* 65 (1989): 89-94.

Mandall, S. "Roman Dominion: Desire and Reality." *Ancient World* 22 (1991): 37-42.

Manning, W. H. *Catalogue of the Romano-British Iron Tools, Fittings and Weapons in the British Museum*. London: British Museum Publications Limited, 1985.

Manti, P. "The Cavalry Sarissa." *AW* 8 (1983): 73-80.

Manti, P. "The Sarissa of the Macedonian Infantry." *AW* 23 (1992): 31-42.

Manti, P. "The Macedonian Sarissa Again." *AW* 25 (1994): 79-86.

Markle, M. "The Macedonian Sarissa, Spear and Related Armor." *AJA* 81, no. 3 (1977): 323-339.

Markle, M. "Use of the Sarissa by Philip and Alexander of Macedon." *AJA* 84, no. 4 (1978): 483-497.

Markle, M. "Macedonian Arms and Tactics under Alexander the Great." In *Macedonia and Greece in Late Classical and Early Hellenistic Times*, edited by B. Barr-Sharrar and E. N. Borza, 87-112. Washington D.C.: National Gallery of Art, 1982.

Markle, M. "A Shield Monument from Veria and the Chronology of Macedonian Shield Types." *Hesperia* 68, no. 2 (1999): 219-254.

Matthew, C. A. *An Invincible Beast: Understanding the Hellenistic Pike-Phalanx at War*. Barnsley: Pen & Sword, 2016.

Mattingly, H. "The First Age of Roman Coinage." *JRS* 35 (1945): 65-77.

Maule, Q. F. and H.RW. Smith. *Votive Religion at Caere: Prolegomena*. Berkeley: University of California Press, 1959.

McCall, J. B. *The Cavalry of the Roman Republic*. London: Routledge, 2002.

McEvedy, C and R. Jones. *Atlas of World Population History*. New York: Puffin, 1978.

Meiggs, R. *Trees and Timber in the Ancient Mediterranean World*. Oxford: Clarendon Press, 1982.

Meyer, E. "Das römische Manipularheer, sine Entwicklung und seine Vorstufen." *Kleine Schriften II* (1924): 193-329.

Michel, A. "Skin Deep: an Outline of the Structure of Different Skins and How it Influences Behavior in Use. A Practitioner's Guide." In *Why Leather? The Material and Cultural Dimensions of Leather*, edited by S. Harris and A. J. Veldmeijer, 23-40. Leiden: Sidestone Press, 2014.

Mielzcarek, M. *Cataphracti and Clibanarii: Studies on the Heavy Armoured Cavalry of he Ancient World*. Lodz: Oficyna Naukowa, 1993.

Millar, F. "The Problem of Hellenistic Syria." In *Hellenism in the East: The Interaction of Greek and non-Greek civilizations from Syria to Central Asia after Alexander*, edited by A. Kuhrt and S. Sherwin-White, 110-34. London: Duckworth, 1987.

Miller, S. *The Tomb of Lyson and Kallikles: A Painted Macedonian Tomb*. Mainz am Rhein: Philipp von Zabern, 1993.

Millett, P. "Patronage and its Avoidance in Classical Athens." In *Patronage in Ancient Society*, edited by A. Wallace-Hadrill, 15-48. London: Routledge, 1989.

Milne, J. G. "The Aes Grave of Central Italy." *JRS* 32 (1942): 27-32.

Mixter, J. R. "The Length of the Macedonian Sarisa during the Reigns of Philip II and Alexander the Great." *AW* 23 (1992): 21-29.

Moore, J. G. "Mobility and Strategy in the Civil War." *Military Affairs* 24 (1960): 68-77.

Moreno, P. *Apelles: The Alexander Mosaic*. Trans. D. Stanton. Milan: Skira Editore, 2001.

Morley, N. *Metropolis and Hinterland: The City of Rome and the Italian Economy 200 B.C. – A.D. 200*. Cambridge: Cambridge University Press, 1996.

Morrison, J. S. "*Hyperesia* in Naval Contexts in the Fifth and Fourth Centuries BC." *JHS* 104 (1984): 48-59.

Morrison, J. S. and J. F. Coates. *The Athenian Trireme: The History and reconstruction of an Ancient Greek warship*. Cambridge: Cambridge University Press, 1986.

Morrison, J. S. and J. F. Coates. *Greek and Roman Oared Warships*. Oxford: Oxbow, 1996.

Moss, G. "Watering the Roman Legion." Master's Thesis, University of North Carolina at Chapel Hill, 2015.

Mould, Q. “The home-made shoe, a glimpse of a hidden but most ‘affordable.’ Craft.” In *Everyday Products in the Middle Ages: Crafts, Consumption and the Individual in Northern Europe c. AD 800-1600*, edited by G. Hansen, S. P. Ashby and I Baug, 125-142. Oxford: Oxbow, 2015.

Mouritsen, H. *Italian Unification: A Study in Ancient and Modern Historiography*. London: Institute of Classical Studies, 1998.

Müller, F. “Das Fragment eines keltischen Kettenpanzers von Tiefenau bei Bern.” *Archäologie der Schweiz,* 9 (1986), 116-123.

Munzer, F. *Römische Adelsparteien und Adelsfamilien*. Stuttgart: Carl Ernst Poeschel Verlag, 1920.

Murray, W. M. *The Age of the Titans: The Rise and Fall of the Great Hellenistic Navies*. Oxford: Oxford University Press, 2012.

Mutz, A. “Deutung eines Eisenfundes aus dem spätrepublikanischen Legionslager Cáceres el Viejo (Spanien).” *Jahreberichte aus Augst und Kaiseraugst* 7 (1987):323-30.

Naiden, F. S. “Spartan Naval Performance in the Decelean War.” *JMH* 73, no. 3 (2009): 729-44.

Neeson, L. *Untersuchungen zu den direkten Staatsabgaben der römischen Kaiserzeit (27 v. Chr. – 284 n. Chr.)*. Bonn: Rudolf Habelt Verlag, 1980.

Nicolet, C. *Tributum, recherches sur la fiscalite′directe sous la republicque romaine.* Bonn: Rudolf Habelt Verlag, 1976.

Nicols, J. *Civic Patronage in the Roman Empire*. Leiden: Brill, 2014.

Noreña, C. “Urban Systems in the Han and Roman Empires.” In *State Power in Ancient China and Rome*, edited by W. Scheidel, 181-203. Oxford: Oxford University Press, 2015.

North, J. A. “The Development of Roman Imperialism.” *JRS* 71 (1981): 1-9.

Oakeshott, E. *The Archaeology of Weapons: Arms and Armour from Prehistory to the Age of Chivalry*. Woodbridge: Boydell Press, 1960.

Oakeshott, E. *The Sword in the Age of Chivalry*. London: Lutterworth Press, 1964.

Oakley, S. P. *A Commentary on Livy, Books VI-X*. Oxford: Clarendon Press, 1998.

Ogilvie, R. M. *A Commentary on Livy: Books 1-5*. Oxford: Clarendon Press, 1965.

Ognenova, L. "Les cuirasses de bronze trouvées en Thrace." *BCH* 85 (1961): 501-538.

Olson, S. D., trans. *The Histories, Volume VI: Books 28-39. Fragments*. Cambridge: Harvard University Press, 2012.

Oron, A. "The Athlit Ram bronze casting reconsidered: scientific and technical re-examination." *Journal of Archaeological Science* 33 (2006): 63-76.

Overy, R. *Why the Allies Won*. New York: W. W. Norton & Company: 1995.

Paddock, J. M. "The Bronze Italian Helmet: the Development of the *Cassis* from the Last Quarter of the Sixth Century B.C. to the Third Quarter of the First Century A.D." Doctoral Thesis, University of London, 1993.

Pantermales, D. "Βασιλέ[ως Δημητρ]ίου" in *Myrtos: Mneme Ioulias Vokotopoulou*, xvii-xxii. Thessaloniki: Hypourgeio Politismou - Aristoteleio Panepistemio Thessalonikes, 2000.

Parker, A. J. *Ancient Shipwrecks of the Mediterranean & the Roman Provinces*. Oxford: Tempus Repartum, 1992.

Parker, G. *The Army of Flanders and the Spanish Road, 1567-1659: The Logistics of Spanish Victory and Defeat in the Low Countries' War*. 2nd edition. Cambridge: Cambridge University Press, 2004.

Paton, W. R. *Polybius: The histories, Books 1-2*. Revised by F. W. Walbank and C. Habicht. Cambridge: Harvard University Press, 2010.

Patterson, J. R. "What Crisis? Rural Change and Urban Development in Imperial Appennine Italy." *PBSR* 55 (1987: 115-146.

Peltz, U. "Der Makedonische Schild aus Pergamon der Antikensammlung, Berlin." *Jahrbuch der Staatlichen Museen zu Berlin* 43 (2001): 331-343.

Pfeilschifter, R. "The Allies in the Republican Army and the Romanization of Italy." In *Roman by Integration: Dimensions of Group Identity in Material Culture and Text*, edited by R. Roth and J. Keller, 27-42. Portsmouth: Journal of Roman Archaeology, 2007.

Picard, G. and Colette Charles-Picard, *Daily Life in Carthage at the Time of Hannibal*. Translated by A. E. Foster. New York: Macmillan, 1961.

Pitassi, M. *The Navies of Rome*. Woodbridge: Boydell Press, 2009.

Pitassi, M. *The Roman Navy: Ships, Men and Warfare 350 BC – AD 475*. Barnsley: Seaforth Publishing, 2012.

Pleiner, R. *The Celtic Sword*. Oxford: Clarendon Press, 1993.

Pontrandoflo, A. and A. Rouvert. *Le Tombe Dipinte Di Paestum*. Modena, Franco Cismo Panini, 1992.

Prestwich, M. *Armies and Warfare in the Middle Ages: The English Experience*. New Haven: Yale University Press, 1996.

Primas, M. "Grab 119 von Giubiasco und die Romanisiergung der Poebene." In *Festschrift zum 50jähringen Bestehen des Institutes fur Ur- und Frühgeschichte der Leopold-Franzens-Universität Innsbruck*, 473-83. Bonn: In Komission bei R. Habelt, 1992.

Pritchard, D. M. *Public Spending and Democracy in Classical Athens*. Austin: University of Texas Press, 2015.

Quesada Sanz, F. "*Gladius hispaniensis:* an Archaeological View from Iberia." *JRMES* 8 (1997a): 251-70.

Quesada Sanz, F. "Montefortino-type and related helmets in the Iberian Peninsula: a study in archaeological context." *JRMES* 8 (1997b): 151-66.

Quesada Sanz, F. *El Armamento Ibérico. Estudio tipológico, geográfico, functional, social y simbólico de las armas en la Cultura ibérica (siglos VI-I a.C.)*. Montagnac: Editions Monique Mergoil, 1997c.

Quesada Sanz, F. "Patterns of Interaction: 'Celtic' and 'Iberian' weapons in Iron Age Spain." In *Celtic Connections*, vol 2, edited by W. Gillies and D.W. Harding, 56-78. Edinburgh: University of Edinburgh, 2005.

Quesada Sanz, F. *Armas de la Antigua Iberia: De Tartesos a Numancia*. Madrid, La Esfera de los Libros, 2010.

Quesada Sanz, F. "The Braganza Brooch Warrior and his Weapons: The Peninsular Context." In *La Fibula Braganza*, edited by A. Perea, 137-156. Madrid: Ediciones Polifemo, 2011.

Raaflaub, K. "Homer to Solon: the Rise of the Polis, the Written Sources." In *The Ancient Greek City-State: Symposium on the occasion of the 250th Anniversary of the Royal Danish Academy of Sciences and Letters, July 1-4 1992*, edited by M. H. Hansen, 41-105. Copenhagen, Det Kongelige Danske Videnskabernes Selskab, 1993.

Raaflaub, K. "Democracy, Power and Imperialism in Fifth-Century Athens." In *Athenian Political Thought and the Reconstruction of American Democracy*, edited by J. P. Euben, J. R. Wallach and J. Ober, 103-148. Ithaca: Cornell University Press, 1994.

Raaflaub, K. "Born to be Wolves? Origins of Roman Imperialism." In *Transitions to Empire: Essays in Greco-Roman History, 360-146 B.C., in honor of E. Badian*, edited by R. W. Wallace and E. M. Harris, 273-314. Norman, OK: University of Oklahoma Press, 1996a.

Raaflaub, K. "Equalities and Inequalities in Athenian Democracy." In *Demokratia: A Conversation on Democracies, Ancient and Modern*, edited by j. Ober and C. Hedrick, 139-174. Princeton: Princeton University Press, 1996b.

Raaflaub, K. "Soldiers, Citizens and the Evolution of the Early Greek *Polis*." In *The Development of the Polis in Archaic Greece*, edited by L. G. Mitchell and P. J. Rhodes, 49-59. London: Routledge: 1997.

Raaflaub, K. "From Protection and Defense to Offense and Participation: Stages in the Conflict of the Orders." In *Social Struggles in Archaic Rome: new Perspectives on the Conflict of the Orders*, edited by K. A. Raaflaub, 185-222. 2nd ed. Malden: Blackwell, 2005.

Rathbone, D. "Villages, Land and Population in Greco-Roman Egypt." *PCPS* 36 (1990): 103-42.

Rawson, E. "The Literary Sources for the Pre-Marian Army." *PBSR* 39 (1971): 13-31.

Rawson, E. "The Antiquarian Tradition: Spoils and Rperesentations of Foreign Armour." In *Roman Culture and Society: Collected Papers*. Oxford: Clarendon Press, 1991.

Redde, M. *L'Armée Romaine en Gaule*. Paris: Editions Errance, 1996.

Reid, J.S. "Problems of the Second Punic War: III. Rome and her Italian Allies." *JRS* 5 (1915): 87-124.

Reinach, S. "L'épée den Brennus." *L'Anthropologie* 17 (1906): 343-356.

Remouchamps, A. E. *Griechische Dolch- und Schwertformen: Ein Beitrag zur chronologie der Europäischen Bronzezeit*. Leiden: Brill, 1926.

Rey, F. "Weapons, Technological Determinism and Ancient Warfare." In *New Perspectives on Ancient Warfare*, edited by G. G. Fagan and M Trundle, 21-56. Leiden: Brill, 2010.

Rich, J. W. "The Supposed Manpower Shortage of the Later Second Century B.C." *Historia* 32, no 3 (1983): 287-331.

Rich, J.W. "Treaties, Allies and the Roman Conquest of Italy." In *War and Peace in Ancient and Medieval History*, edited by P. de Souza, and J. France, 51-75. Cambridge: Cambridge University Press, 2008.

Richardson, J.S. *The Romans in Spain*. Malden: Blackwell, 1996.

Richardson, J. S. *Hispaniae: Spain and the Development of Roman Imperialism: 218 – 82 B.C.*. Cambridge: Cambridge University Press, 2004.

Rickman, G. *The Corn Supply of Ancient Rome*. Oxford: Clarendon Press, 1980.

Robbins, F. E. "The Cost to Athens of Her Second Empire." *CP* 13, no. 4 (1918): 361-388.

Robinson, H. R. *The Armour of Imperial Rome*. London: Arms and Armour Press, 1975.

Rougé, J. *Ships and Fleets of the Ancient Mediterranean*. Middletown: Wesleyan University Press, 1981.

Roselaar, S. T. *Public Land in the Roman Republic: A Social and Economy History of Ager Publicus in Italy, 396-89 B.C.* Oxford: Oxford University Press, 2010.

Rostoker, W. and E. R. Gebhard. "The Sanctuary of Poseidon at Isthmia: Techniques of Metal Manufacture." *Hesperia* 49 no. 4 (1980): 347-363.

Rosenstein, N. "Republican Rome." In *War and Society in the Ancient and Medieval Worlds: Asia, the Mediterranean, Europe and Mesoamerica*, edited by K. S. Raaflaub and N. S. Rosenstein, 193-216. Cambridge: Harvard University Press, 1999.

Rosenstein, N. *Rome at War: Farms, Families and Death in the Middle Republic*. Chapel Hill, NC: University of North Carolina Press, 2004.

Rosenstein, N. "Integration and the Armies of the Middle Republic." In *Processes of Integration and Identity Formation in the Roman Republic*, edited by S.T. Roselaar, 85-103. Leiden: Brill, 2012.

Roth, J. P. *The Logistics of the Roman Army at War (264 B.C. – A.D. 235)*. Leiden: Brill, 1999.

Roth, J. P. *Roman Warfare*. Cambridge: Cambridge University Press, 2009.

Rowland, R. "Rome's Earliest Imperialism." *Latomus* 42 (1983): 749-762.

Roymans, N. *Tribal Societies in Northern Gaul: An Anthropological Perspective.* Amsterdam: Universiteit van Amsterdam, 1990.

Rusu, M. "Das Keltische Fürstengrab von Ciumeşti in Rumänien" *Bericht der Romisch-Germanischen Komission*, 50 (1969): 267-297.

Sage, M. *The Republican Roman Army: A Sourcebook.* New York: Routledge, 2008.

Saller, R.P. *Personal Patronage Under the Early Empire*. Cambridge: Cambridge University Press, 1982.

Saller, R. P. *Patriarchy, Property and Death in the Roman Family*. Cambridge: Cambridge University Press, 1994.

Saller, R. P. "Framing the Debate over Growth in the Ancient Economy." In *The Ancient Economy*, edited by W. Scheidel, and S. von Reden, 251-269. New York: Routledge, 2002.

Salmon, E. T. *Roman Colonization under the Republic.* Ithaca: Cornell University Press, 1970.

Salmon, E. T. *The Making of Roman Italy*. Ithaca: Cornell University Press, 1982.

Schaaff, U. "Keltische Eisenhelme aus vorrömischer Zeit." *Jahrbuch des Römisch-Germanischen Zentralmuseums* 21 (1974): 149-204.

Schaaff, U. "Keltische Helme." In *Antike Helme*, 293-317. Mainz: Verlag des Römisch-Germanischen Zentralmuseums, 1988.

Scheidel, W. "Quantifying the Sources of Slaves in the Early Roman Empire." *JRS* 87 (1997): 156-69.

Scheidel, W. *Death on the Nile, Disease and the Demography of Roman Egypt*. Leiden: Brill, 2001b.

Scheidel, W. "Progress and Problems in Roman Demography." In *Debating Roman Demography*, edited by W. Scheidel, 1-81. Leiden: Brill, 2001a.

Scheidel, W. "Human Mobility in Roman Italy I: The Free Population." *JRS* 94 (2004): 1-26.

Scheidel, W. "Human Mobility in Roman Italy II: The Slave Population." *JRS* 95 (2005): 64-79.

Scheidel, W. “A Model of Real Income Growth in Roman Italy.” *Historia* 56, no 3 (2007a): 322-46.

Scheidel, W. “Demography.” In *The Cambridge Economic History of the Greco-Roman World*, edited by W. Scheidel, I. Morris and R. P. Saller, 38-86. Cambridge, Cambridge University Press 2007b.

Scheidel, W. “Roman Population Size: The Logic of the Debate.” In *People, Land and Politics: Demographic Developments and the Transformation of Roman Italy, 300BC – AD 14*, edited by L. De Ligt S. J. Northwood, 17-70. Leiden: Brill, 2008.

Scheidel, W. “Italian Manpower.” *JRA* 26 (2013): 677-88.

Schulten, A. *Numantia: Die Ergebnisse der Ausgrabungen 1905-1912. Band III. Die Lager des Scipio*. München: F. Bruckmann A.-G., 1927.

Schulten, A. *Numantia: Die Ergebnisse Der Ausgrabungen 1905-1912*. *Band IV. Die Lager bei Renieblas*. München: F. Bruckmann A.-G., 1929.

Schwartz, A. *Reinstating the Hoplite: Arms, Armour and the Phalanx Fighting in Archaic and Classical Greece*. Stuttgart: Franz Steiner Verlag, 2009.

Scullard, H. H. *The Etruscan Cities and Rome*. Ithaca: Cornell University Press, 1967.

Sekunda, N. “Hellenistic Warfare.” In *Warfare in the Ancient World*, edited by J. Hackett. London: Sidgwick & Jackson Ltd, 130-135. 1989.

Sekunda, N. *Seleucid and Ptolemaic Reformed Armies 168 – 145 BC*. 2 vols. Stockport: Montvert Publications, 1994/5.

Sekunda, N. *Greek Hoplite 480 – 323 BC*. Oxford: Osprey, 2000.

Sekunda, N. *Hellenistic Infantry Reform in the 160’s BC*. Lodz: Oficyna Naukowa MS, 2001.

Sekunda, N. “The Sarissa.” *Acta Universitatis Lodziensis* 23 (2001): 13-41.

Sekunda, N. “Land Forces.” In *The Cambridge History of Greek and Roman Warfare*, edited by P. Sabin, H. van Wees and M. Whitby, 325-356. Cambridge: Cambridge University Press, 2007.

Sekunda, N. “Neocretans.” In *Pratiques et identitiés culturelles des armées hellénistiques du monde méditerranéen*, edited by J.-C. Couvenhes, S. Crouzet and S. Péré-Noguès. 75-85. Bordeaux: de Boccard, 2011.

Sekunda, N. *The Antigonid Army*. Gdansk: Akanthina, 2013.

Shepard, R. *Ancient Mining*. London: Institution of Mining and Metallurgy, 1993.

Sherwin-White, A. N. "Rome the Aggressor." *JRS* 70 (1980): 177-181.

Sherwin-White, A. N. *Roman Foreign Policy in the East: 168 B.C. – A.D. 1*. London: Duckworth, 1984.

Sherwin-White, S. and A. Kuhrt. *From Samarkhand to Sardis: A New Approach to the Seleucid Empire*. Berkeley: University of California Press, 1993.

Shochat, Y. *Recruitment and the Progamme of Tiberius Gracchus*. Brussels: Latomus, 1980.

Siebert, G. "Quartier de Skardhana: la fouille." *BCH* 112.2 (1987): 629-42

Sim, D. "Roman Chain-mail: Experiments to Reproduce the Techniques of Manufacture." *Britannia* 28 (1997): 359-371.

Sim, D. and J. Kaminski. *Roman Imperial Armour: The Production of Early Imperial Military Armour*. Oxford: Oxbow, 2012.

Sim, D. and I. Ridge. *Iron for the Eagles: The Iron Industry of Roman Britain*. Stroud: Tempus, 2002.

Snodgrass, A.M. *Arms and Armour of the Greeks*. Ithaca: Cornell University Press, 1967.

Snowdon, M. "Beyond *Clientela*: The Instrumentality of *Amicitia* in the Greek East." In *Foreign* Clientelae *in the Roman Empire: A Reconsideration*, edited by M. Jehne and F.P. Polo, 209-224. Stuttgart: Franz Steiner Verlag, 2015.

Solier, Y, G. Rancoule, and M. Passelac. "La nécropole de 'Les Peyros' (VI siècle av JC) à Couffoulens (Aude)" *Revue Archéologique de Narbonnaise* Suppl. 6 (1976), 1-53.

Spurr, M. S. "Agriculture and the *Georgics*." In *Virgil*, edited by I. McAuslan and P. Walcot, 69-93. Oxford: Oxford University Press, 1990.

Stary, P. F. "Urspung und Ausbreitung der eisenzeitlichen Ovalschilde mit spindelfoࡨmigem Schildbuckel." *Germania* 59 (1981a): 286-307.

Stary, P. F. *Zur eisenzeitlichen Bewaffnung und Kampfesweise in Mitellitalien: (ca. 9. bis 6. Jh. v. Chr.).* Mainz Am Rhein: Philip von Zabern, 1981b.

Stary, P.F. “Keltische Waffen auf der Iberischen Halbinsel.” *Madrider Mitteilungen* 23 (1982): 114-144.

Stary, P.F. *Zur eisenzeitlichen Bewaffnung und Kampfesweise auf der Iberischen Halbinsel*. Berlin: Walter de Gruyter, 1994.

Staverly, E.S. “Rome and Italy in the Early Third Century.” In *CAH*^{2}, vol. 7.2, edited by F.W. Walbank, A.E. Astin, M.W. Frederiksen, and R.M Ogilvie, 420-455. Cambridge: Cambridge University Press, 1989.

Stead, I. M. *Iron Age Cemetaries in East Yorkshire: Excavations at Burton Fleming, Rudson, Garton-on-the-Wolds and Kirkburn.* London: English Heritage, 1991.

Stead, I.M. *British Iron Age Swords and Scabbards*. London: British Museum Press, 2006.

Steinby, C. *The Roman Republican Navy: From the sixth century to 167 B.C.* Helsinki: Societas Scientiarum Fennica, 2007.

Stephenson, I. P. and K. R. Dixon. *Roman Cavalry Equipment*. Stroud: Tempus, 2003.

Stilp, F. *Mariage et Suovetaurilia: Etude sur le soi-disant “Autel de Domitius Ahenobarbus.”* Rome: Giorgio Bretschneider Editore, 2001.

Stolle, F. *Der römische Legionar und sein Gepack (Mulus Marianus)*. Strassburg: Verlag von Karl J. Trübner, 1914.

Strootman, R. “Kings and Cities in the Hellenistic Age.” In *Political Culture in the Greek City after the Classical Age*, edited by O. M. van Nijf and R. Alston, 141-55. Leuven, Peeters, 2011.

Sukumar, R. *The Asian Elephant: Ecology and Management*. Cambridge: Cambridge University Press, 1989.

Sumner, G. *Roman Military Dress*. Stroud: The History Press, 2009.

Taleb, N.N. *The Black Swan: The Impact of the Highly Improbable*. New York: Random House, 2007.

Tarn, W. W. “The Fleets of the First Punic War.” *JHS* 27 (1907): 48-60.

Tarn, W. W. *Hellenistic Military & Naval Developments*. Cambridge: Cambridge University Press, 1930.

Taylor, M.J. "Finance, Manpower and the Rise of Rome. Ph.D. Dissertation, University of California, Berkeley, 2015.

Taylor, M. J. "The Battle Scene on Aemilius Paullus's Pydna Monument: A Reevaluation." *Hesperia* 83, no. 3 (2016): 559-576.

Taylor, M. J. "State Finance in the Middle Republic: A Reevaluation." *AJP* 138, no. 1 (2017): 143-180.

Temin, P. *The Roman Market Economy*. Princeton: Princeton University Press, 2013.

Thiel, J. H. *Studies on the History of Roman Sea-Power in Republican Times*. Amsterdam: North-Holland Publishing Company, 1946.

Thiel, J. H. *A History of Roman Sea-Power Before the Second Punic War*. Amsterdam: North Holland Publishing Company, 1954.

Tipps, G. K. "The Battle of Ecnomus." *Historia* 34, no. 4 (1985): 432-465.

Touratsoglou, L. "Τὸ ξῖφος τῆς Βεροιας: Συμβολὴ στὴ Μακεδονικὴ ὁπλοποιία τῶν ὕστερων Κλασσικῶν Χρὸνων." In *Ancient Macedonia IV*, 611-51. Thessaloniki: Institute for Balkan Studies, 1968.

Trautmann, T. R. *Elephants and Kings: An Environmental History*. Chicago: University of Chicago Press, 2015.

Travis, H. and J. Travis. *Roman Body Armour*. Stroud: Amberley Publishing, 2011.

Treister, M. *The Role of Metals in Ancient Greek History*. Leiden: Brill, 1996.

Tusa, S. and J. Royal. "The landscape of the naval battle at the Egadi Islands (241 B.C.)." *JRA* 25 (2012): 7-48.

Tylecotem R. F. *The Early History of Metallurgy in Europe*. London: Longman, 1987.

Ulbert, G. "Das Schwert und die eisernen Wurfgeshoßspitzen aus dem Grab von Es Soumâa." In *Die Numider: Reiter und Könige nördlich der Sahara*, edited by. H. G. Horn and C. B. Rüger, 333-338. Köln: Kunst und Altertum am Rhein, 1979.

Ulbert, G. *Carceres el Viejo: Ein spatrepublikanisches Legionslager in Spanisch-Extremadura*. Mainz am Rhein: Verlag Philipp von Zabern, 1985.

Ulrich, R. B. *Roman Woodworking*. New Haven: Yale University Press, 2007.

Van Minnen, P. *Roman Hermopolis: A study of the Social and Economy History of an Egyptian Town in the First Four Centuries AD.* Amsterdam: Geiben, 1999.

Van der Vliet, E. Ch. L. "Pride and Participation. Political Practice, Euergetism and Oligarchisation in the Hellenistic *Polis*." In *Political Culture in the Greek City after the Classical Age*, edited by O. M. van Nijf and R. Alston, 155-184. Leuven: Peeters, 2011.

Verbruggen, J.F. *The Art of War in Western Europe during the Middle Ages, from the Eight Century to 1340*. Woodbridge: Boydell Press, 1997.

Vickers, M., A.C. Brown and H.W. Catling, "Recent Acquisitions by the Ashmolean Museum, Oxford." *Archaeological Reports* 21 (1974/5): 29-39.

Vincente, J. D., M. P. Punter and B. Ezquerra. "La catapulta tardo-republicana y otro equipamiento militar de 'La Caridad' (Caminreal, Teruel)." *JRMES* 8 (1997): 167-199.

Von Goller, M. "Römische Waffen." *Der römische limes in Österreich* 2 (1900): 85-132.

Von Reden, S. *Money in Ptolemaic Egypt: From the Macedonian Conquest to the End of the Third Century BC*. Cambridge: Cambridge University Press, 2007.

Wagner, D. "Ancient Carburization of Iron to Steel: A Comment." *Archeomaterials* 4 (1990: 111-117.

Walbank, F. W. *A Historical Commentary on Polybius*. Vol 1. Oxford: Clarendon press, 1957.

Walbank, F. W. *Polybius, Rome and the Hellenistic World: Essays and Reflections*. Cambridge: Cambridge University Press, 2002.

Wallinga, H. T. *The Boarding Bridge of the Romans: Its Construction and its Function in the Naval Tactics of the First Punic War*. Groningen: J. B. Wolters, 1956.

Waltz, K. N. "The Origins of War in Neorealist Theory." *Journal of Interdisciplinary History* 18, no. 4 (1988), 615-628.

Warmington, B. H. *Carthage*. Harmondsworth: Penguin, 1964.

Waterer, J. W. *Leather and the Warrior*. Northampton: Museum of Leathercraft, 1981.

Waurick, G. "Die Schutzwaffen im numidischen Grab von Es Soumâa." In *Die Numider: Reiter und Könige nördlich der Sahara*, edited by H. G. Horn and C. B. Rüger, 305-35. Köln: Kunst und Alterum am Rhein, 1979.

Waurick, G. "Helme der hellenistchen Zeit und ihre Vorläufer." In *Antike Helme*, 151-180. Mainz: Verlag des Römisch-Germanischen Zentralmuseums, 1988.

Watson, G. R. *The Roman Soldier*. Ithaca: Cornell University Press, 1969.

Wilkes, J. *The Illyrians*. Malden: Blackwell, 1992.

Williams, D. "The Braganza Gold Brooch: Its Maker, Iconography and Use." In *La Fibulga Braganza*, edited by A. Perea, 127-135. Madrid: Ediciones Polifemo, 2011.

Wiseman, T. P. "Legendary Genealogies in Late-Republican Rome." *Greece and Rome* 21, no. 2 (1974): 153-164.

World Health Organization. *Energy and Protein Requirements: Report of a Joint FAO/WHO/UNU Expert Consultation*. WHO Technical Report series, no 724. Geneva: WHO, 1985.

Wright, J. "The Transformations of Pseudolus." *TAPA* 105 (1975): 403-416.

Wrightson, G. "To Use or Not to Use: The Practical and Historical Reliability of Aslepiodotus's 'Philosophical' Tactical Manual." In *Ancient Warfare: Introducing Current Research*, edited by G. Lee, H. Whittaker and G. Wrightson, 64-93. Newcastle on Tyne: Cambridge Scholars Publishing, 2015.

Zhmodikov, A. "Roman Republican Heavy Infantrymen in Battle (IV-II Centuries B.C.)." *Historia* 49, no. 1 (2000): 67-78.