Keeping up with the Romans ?

Romanisation and copper alloys in First Revolt Palestine

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Abstract

This paper presents the chemical analysis of copper-alloy metalwork from three early first century sites in the Galilee area of modern Israel together with their interpretation and discussion. The analyses were by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES). Interesting compositional differences were found between those artefacts from Jewish sites and those from a pagan site which mirror differences already identified in the material culture assemblages. Brass, an alloy with strongly Roman associations, was found to be an alloy only present in the pagan assemblage, whereas traditional tin-bronze dominates the assemblages from Jewish sites. It is suggested that, during this very polarized period, the populations of the Galilee declared their cultural affiliations through the manipulation of the materials they used as well as the objects they manufactured and traded. Parallels offering explanations for this phenomenon were found in other material culture studies and the reasons for these 'choices' are investigated.

Introduction

The adoption of brass and the mastery of the necessary technology needed to produce it, is one of the many changes and developments in material culture that accompany the expansion of Roman influence in Western Europe (Bayley 1998: 19; Dungworth 1997). During the first century BC and pre-conquest years of the first century AD, the local tribal elites in those areas peripheral to the Roman provinces were keen to acquire Mediterranean luxury items – prestige goods – to reinforce their status at home (Millet 1990; Collis 1984: 158-180). As a consequence of this, the non-ferrous metallurgy of first century Britain and North-West Europe in general is marked by a gradual increase in the use of brass and the presence of significant trace levels of zinc in copper alloy artefacts (Bayley 1998; Dungworth 1996).

A recent study of the material culture of the towns and cities of the Galilee region of Northern Israel has shown a quite different trend during the same period - the early years of the first century running up to the Great Revolt of AD 66 (Berlin 2002). Here it appears that the increasing antagonism towards the Romans by the Jewish population (as recorded in the writings of Flavius Josephus) is reflected in material culture by the increasing exclusion of objects with clear Roman associations in assemblages from Jewish settlements. Given the close association of brass with Roman material culture and its gradual appearance in the indigenous metalwork of peripheral peoples noted above, it was felt of value to ascertain whether the same phenomenon occurred in Palestine. If it did not, then copper alloy metalwork was probably subject to the same strictures as the other aspects of material culture identified by Berlin.

Methodology

The approach adopted was to analyse copper alloy artefacts from three excavated sites in the Galilee region (Fig. 1). The sites chosen were all significant settlements (towns rather than cities) during the period of this study and, furthermore, were substantially destroyed during or shortly after the revolt and not subsequently re-occupied (Syon 1993; Adan-Beyewitz & Aviam 1997; Herbert 1994). All the material analysed came from well-dated contexts. It was, of course, crucial to have material from sites which were representative of the cultural demography of the area at the time. The excavated settlements can be divided into two groups; pagan settlements and Jewish settlements (Berlin 2002). Mixed populations are attested in the region's capital cities. Four pagan towns have been excavated; Samaria, Tel Anafa, Shiqmona and Pella. Material from Tel Anafa was selected as suitable for this study. Similarly, four Jewish towns have been excavated; Yodefat, Capernaum, Bethsaida and Gamla. Two of these sites, Yodefat and Gamla, were selected as appropriate. The account of the contemporary chronicler of the revolt, Flavius Josephus, provides much detail about the populations of the towns and cities of the Galilee, especially Yodefat and Gamla, which forms the basis of our understanding of the cultural affiliations. The archaeological criteria that define an excavated settlement as pagan or Jewish are complex, controversial and constitute a separate study themselves. Suffice to say that there are a number of features relating to the lifestyles of the inhabitants that are regarded as diagnostic. Such features include the presence or absence of pig bones and the presence or absence of 'special-function' architecture in domestic buildings, especially stepped pools or mikvaot (Herbert 1994: 22; Berlin 2002). This combination of textual and archaeological data has allowed a reasonably firm distinction to be drawn between Jewish and pagan settlements. None of the mixed cities were studied because the aim of the project was to look for differences between assemblages from each of the main cultural groups. The material from Gamla was particularly useful for this study, coming from a site where a substantial amount of Roman military copper alloy objects had been excavated. These military artefacts have recently been analysed as part of a separate project (Ponting forthcoming a), but provide a useful body of material that is unquestionably Roman. The number of copper alloy artefacts from each site is not large, numbering at best in the 20's and 30's, furthermore, the pieces that were in good enough condition to allow sampling was a fairly small subset. Consequently, all the objects in each excavated group, which were from appropriate contexts, and which were in a condition to warrant sampling, were sampled. Thus the sampled assemblage is about as representative as the archaeology will allow.

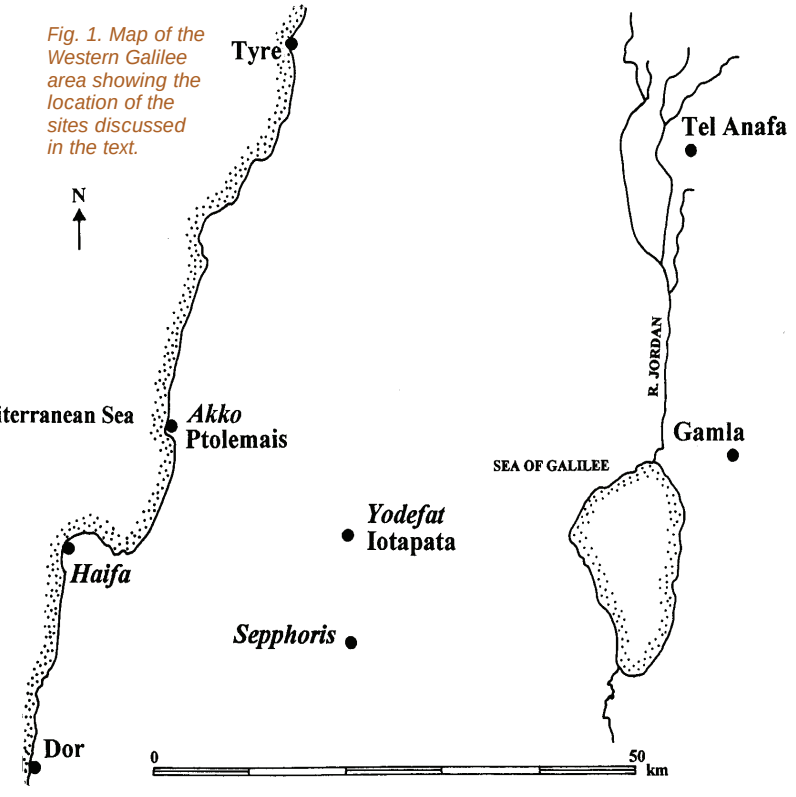


Fig. 1. Map of the Western Galilee area showing the location of the sites discussed in the text.

The analytical technique adopted for this project was Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES). This technique is highly sensitive, measuring minute traces of contaminants down to fractions of a part per million, and so is ideal for investigating the contamination of local bronzes by brass or other zinc containing alloys. This sensitivity also allows for the study of other trace elements that are solely related to the geochemistry of the ores smelted and/or the smelting technology used. The unquestionable likelihood that the metals of these artefacts have been repeatedly recycled means that it would be hopeless to attempt to attribute any object to a particular source. Nevertheless, it is often possible to 'characterise' an alloy and ascribe it to a compositional group that may, or may not, correspond to an archaeologically useful feature, such as style or site location. The operating parameters of the ICP instruments used are presented in the reports on the individual assemblages (Ponting forthcoming b, c, d). Likewise, the analytical data for the artefacts from each site are presented in the appropriate reports.

Results and discussion

For all of the three settlements sampled, the majority of the artefacts (70.3 % overall – 52 pieces) were made from a moderate to low tin-bronze (mean of 6.4 % tin). Un-alloyed copper was used for 24.3 % (18 pieces) of the artefacts, whilst brass accounted for only 5.4 % (4 pieces).

Only one site, Tel Anafa, had any brass artefacts (zinc contents between 17 % and 21 %), whilst all three had objects of bronze and copper (Fig. 2). The brass objects from Tel Anafa are all decorative rather than utilitarian; two fibulae, a bracelet fragment and a cosmetic spatula (Ponting forthcoming c). At Yodefat, bronze and copper made up equal proportions of the twenty objects analysed (ten of each metal). Gamla showed the highest proportion of bronze (86.8 % – 33 pieces) with the remainder of un-alloyed copper. Tel Anafa and Gamla had broadly similar proportions of un-alloyed copper (18.8 % and 13.2 % respectively).

The results of the analyses therefore fit with the model proposed above. The only brass objects occur on the single pagan site, making up 25 % of the total assemblage. Whilst admittedly the sample numbers remain small, the samples do account for nearly all the available excavated metalwork from each site and so must be reasonably representative of the metalwork in use during the period. Additionally, if we see the use of brass as a companion to bronze rather than copper and largely reserved for decorative purposes, then the sum of the percentages of brass and bronze at Tel Anafa (81.3 %) is very close to the percentage of bronze alone at Gamla (86.8 %). The situation at Yodefat is clearly different, with equal copper and bronze.

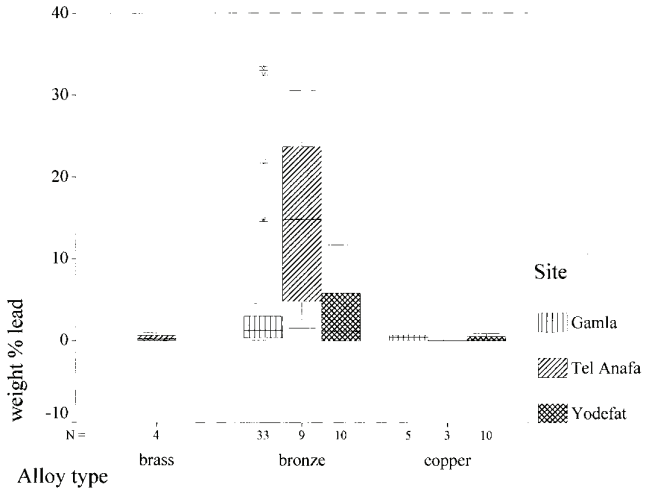


Fig. 2. Box-and-Whisker plot showing the lead contents of the three main alloys from the three sites studied. The median values are represented by the heavy line (i.e. the 50 % quartile or middle value if all the values are placed in ascending order). The box represents the inter-quartile ranges (i.e. the range between the upper and lower quartiles, representing the middle 50 % of values). The whiskers show the range of values (up to 1.5 times the inter-quartile range). Values beyond this range (outliers) are shown by separate points. Outliers are marked 'O', extremes are marked '' according to the criteria outlined in the SPSS statistical computer package.*

The brass items from Tel Anafa are all made of a generally good quality, high zinc cementation brass with little contamination by other elements, which is a trait shared with most first century Roman brasses. The single exception to this is the brass bracelet fragment, which contains a little over 1 % of tin and almost 1 % of lead. However, such small amounts can also be seen in some contemporary Roman brasses and are in no way inconsistent with these.

Cementation is the name of the process used in antiquity to manufacture brass and is quite different from the simple mixing of metals used to make bronze (Craddock 1995: 294-302). Because zinc metal boils at a lower temperature (907 ^{o}C) than that required for smelting (approx. 1100 ^{o}C) (unlike tin and most other metals), the process is essentially solid-state, where zinc vapour diffuses directly into copper metal. The process involved finely divided copper metal being packed into a closed crucible with charcoal and calcined zinc carbonate ore (smithsonite). The crucible was then placed in a furnace and heated to between 930 and 1000 ^{o}C. If the temperature were any lower the zinc ore would not reduce and produce vapour, any higher and the copper/brass would melt reducing the surface area and therefore severely limiting the amount of zinc that the metal would absorb. Experimental work has also shown that brass produced by this process will contain a maximum zinc content of 28 % (Haedecke 1973). If scrap metal were being used in the cementation process, then the presence of any lead or tin in the copper would restrict the absorption of zinc. Consequently, early Roman brasses tend to be relatively 'clean' and free of significant tin and lead contamination. The relatively high zinc contents and lack of tin or lead in the Tel Anafa brass objects is therefore consistent with first century Roman brasses from both Israel (Ponting & Segal 1998) and from Europe (Craddock & Jackson 1995; Bayley 1998).

The lead contents of the copper alloys presents some interesting variations (Fig. 2). Lead is only present in significant amounts (above 2 or 3 %) in bronze objects, and this phenomenon is true for all three sites. Lead was commonly added to bronze alloys that were going to be used for casting because it lowers the viscosity and melting point of the alloy (Young 1967) and bronze tended to be the preferred alloy for casting. Brass, whether cast or hammered, generally contains negligible lead for the reasons discussed above. Un-alloyed copper was rarely used for casting in this period, often being used for hammered objects where the metal's superior ductility was an advantage. Un-alloyed copper was also used for artefacts that were to be tinned or fire-gilded, where any alloying components would interfere with the plating process (Meeks 1993: 255; Oddy 1985). Furthermore, the addition of excessive amounts of lead to bronze has been identified as a characteristic of Late Hellenistic and Roman metallurgy (Craddock 1985). Whilst lead is added to most bronze used for casting from the middle of the second millenium BC (Craddock 1985: 61), the amounts are seldom more than 10 % or so. Roman and Late Hellenistic cast bronzes consistently contain 20 % or more. It is therefore of interest to the theme of this paper that it is the bronzes from the pagan site of Tel Anafa that contain markedly higher levels of lead than either of the Jewish sites.

There are therefore two separate compositional features that mark the copper alloy objects from Tel Anafa out as different from the objects from Gamla and Yodefat. Most notably there are no brass objects from either Yodefat or the Gamla civilian assemblage. Secondly, the lead contents of the Tel Anafa

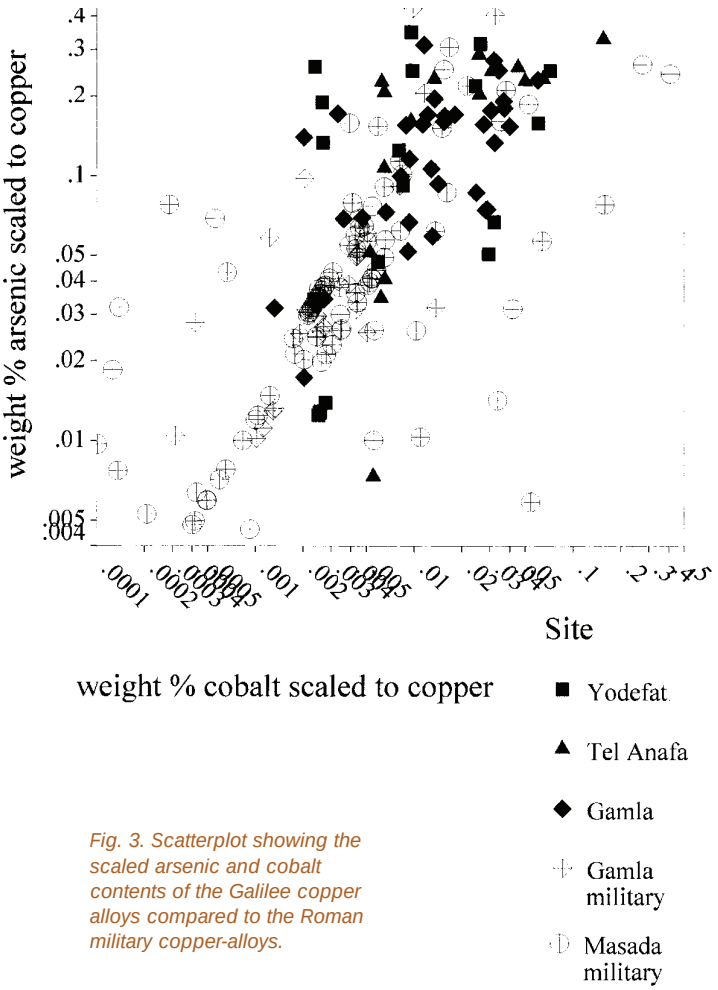


Fig. 3. Scatterplot showing the scaled arsenic and cobalt contents of the Galilee copper alloys compared to the Roman military copper-alloys.

bronzes are also markedly higher than those found in the bronze objects from the other two sites. Both these characteristics relate to the major elements in the alloys, constituents that were manipulated by the artisans according to their requirements and traditions. The minor and trace elements, however, were not subject to conscious manipulation by the artisans because their presence was seldom noticed and only recognized where they had some impact on working properties. Even in such cases, the symptom caused by the presence of the impurity was rarely attributed to trace contaminants and was usually regarded as some special characteristic of the copper or bronze itself. Thus the minor and trace elements in an alloy can sometimes provide important information about the metals used, largely independent of conscious human manipulation, and potentially providing clues about the smelting and alloying technology as well as ore characterization.

In the case of the copper alloys from these three Galilean sites, the distributions of the minor and trace elements are fairly uniform. Surprisingly, the bronze and un-alloyed copper objects from Tel Anafa contain no significant traces of zinc, as may be expected if bronze and brass were being worked together. This, indeed, is the case for Late Pre-Roman Iron Age material in Britain (Dungworth 1996: 408) where zinc-contaminated bronzes become common, alongside proper cementation brasses. Thus we have to look for a different model, one where bronze and copper production is not in close enough proximity to brass production to allow contamination. One such model might be that the brass items were brought into Tel Anafa through trade contacts with the Romanised cities whereas bronze and copper continued to be worked on sites re-using scrap metal that had been circulating in the area for generations before any Roman contact. This model is certainly in agreement with the other Roman aspects of Tel Anafas' material culture such as the import of red-slipped table vessels and mould-made lamps (Berlin 2002). It would also seem likely that the import of brass objects was still a relatively new phenomenon tied into the increasing presence of the Roman army in the region. Consequently it was not yet common enough for any brass objects to be recycled and therefore contaminate future copper alloy production. Alternatively, the high value and exotic appeal of the alloy may have led to different treatment and disposal of broken or damaged pieces.

The consistent distribution of the trace elements in all the copper alloy objects across the three sites lends some support to this discussion. When the trace element concentrations in the Galilean copper alloy objects are compared to those in Roman copper alloy artefacts there are some interesting differences. Figure 3 shows the arsenic and cobalt concentrations of the copper alloys from the three sites together with those measured in the Roman military copper alloy objects from Gamla and the contemporary siege site of Masada (Ponting & Segal 1998). All the data used here have been scaled to the copper in order to remove any dilution problems caused by the varying amounts of alloying components and to therefore make the data comparable. The plot shows that the Galilee copper alloys generally contain greater concentrations of both arsenic and cobalt, elements that are correlated and geochemically related to the types of copper ore originally smelted. Separation of the two groups is not total and there is considerable overlap of the Roman material that is probably explained by the recycling of local copper alloys by the Roman army. Nevertheless, the Galilee copper alloys have a reasonably tight distribution, a feature that is also demonstrated when the data are presented as box-and-whisker plots. Figure 4 shows the Box-and-Whisker plots for arsenic (a) and cobalt (b) and clearly shows the differences in the distribution of

Fig. 4a

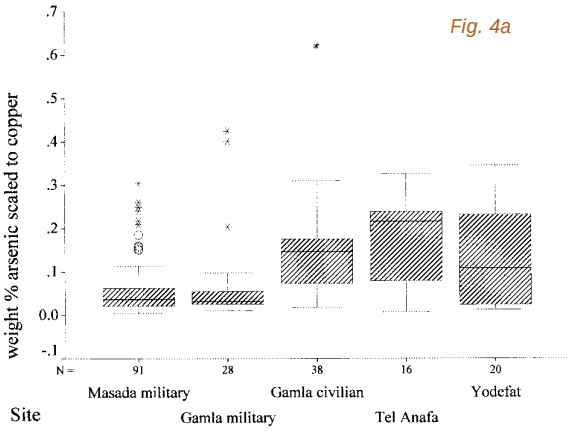
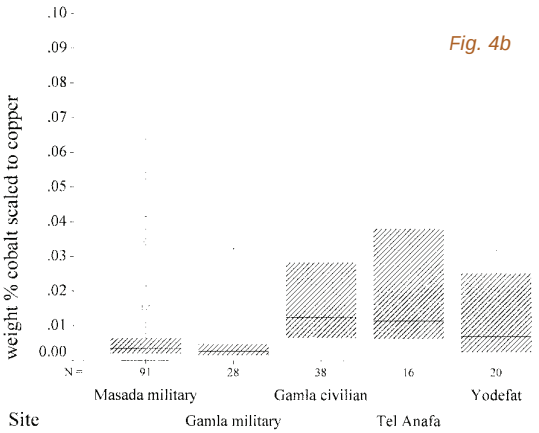


Fig. 4. a) Box-and-Whisker plot of the scaled arsenic contents of the Galilee copper-alloys compared to the Roman military copper-alloys. b) Box-and-Whisker plot of the scaled cobalt contents of the Galilee copper-alloys compared to the Roman military copper-alloys. See caption to Fig. 2 for explanation.

Fig. 4b



these elements between the Galilee and Roman metalwork.

Furthermore, the greater tendency for the Roman distribtions to include relatively large numbers of outliers and extreme values is also demonstrated, a feature responsible for the overlap apparent in the scatterplot. Significantly, the brass objects from Tel Anafa all have low levels of cobalt, yet the arsenic concentrations divide the four objects into two distinct groups. Both of the fibulae contain negligible amounts of both cobalt and arsenic, whereas the cosmetic implement and the bracelet contain significant (>0.2 %) levels of arsenic. The suggestion must be that the fibulae are likely to be Roman military products, whereas the other items may represent Near Eastern brass production. It is therefore worthwhile noting that both fibulae are aucissa types, a form known to be particularly favored by the Roman army (Feugère 1985).

Conclusion

Berlin's identification and study of the features of Galilean material culture used to signal cultural identity and affiliation have provided the starting point for a more technologically orientated study. The use of brass by the pagan population of the Galilee was in line with other groups on the periphery of and in contact with Roman culture, as demonstrated in Britain (Bayley 1998) and Gaul (Hamilton 1996). The fact that the Jewish population deliberately chose not to 'buy into' this, and treated objects of brass with the same disdain that they showed to red-slipped pottery and mould-made lamps, suggests that brass was viewed as a distinctly Roman product.

Social scientists have shown that certain groups who live in areas of culturally mixed populations will deliberately adopt 'identity-signaling' features. Such features are almost always material rather than behavioral (Stevenson 1989: Moore 1987). There appears to be no set rule to this; people chose to reject or adopt those features around them that they feel advertise their cultural affiliation. As Berlin puts it, "people will make a statement with whatever they can, when they feel the need to do so." (Berlin 2002).

This observation reinforces the assertions made by Bayley (1998) that the manufacture, working and use of brass is, in some quite fundamental way, linked to Rome in the minds of the members of populations peripheral to the Roman provinces. Furthermore, the presence of significantly higher levels of lead in the Tel Anafa bronzes than in the bronzes from the Jewish sites suggests a difference in approach to casting technology. The use of highly leaded bronze is consistent with most Late Hellenistic and Roman cast metalwork (Craddock 1985; Beck *et al*. 1985), whereas the use of, at most, the smallest amount of lead necessary to improve the alloy's casting properties is a feature of earlier Near Eastern metallurgy (Moorey 1994: 263). This, again, points to significant differences in the attitudes of the two populations, one that suggests differences in approaches to technology as well as material culture.

Interestingly, the trace element distributions indicate that both groups were drawing on a generally homogeneous copper alloy supply pool. In fact two of the brass objects from Tel Anafa have levels of arsenic (when scaled) consistent with the local Near Eastern copper and therefore suggests that local copper was being used to produce brass, a suggestion that has been aired elsewhere (Ponting forthcoming a). The small size of the sample obviously necessitates caution in interpreting these results and more data will be needed before such statements can be substantiated.

Furthermore, this project demonstrates that the study of the selection, modification or exclusion of every type of material used to manufacture material culture is an important tool in the study of past societies.

Acknowledgmenpts

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References

Adan-Bayewitz, D. & Aviam, M. 1997. Jotapata, Josephus and the siege of 67: preliminary report on the 1992-94 seasons. *Journal of Roman Archaeology* 10, 131-165.

Bayley, J. 1998. The production of brass in antiquity. In: P. Craddock (ed) *2000 years of zinc and brass*, 7-26. (=British Museum Occasional Paper 50, 2nd edition).

Beck, F., Menu, M., Berthoud, T. & Hurtel, L. 1985. Métallurgie des Bronzes. *Recherches Gallo-Romaines* I, 69-140. Paris.

Berlin, A. 2002. 'Romanization in Pre-Revolt Galilee'. In: *The First Jewish Revolt: Archaeology, History, and Ideology*. Routledge.

Collis, J. 1984. *The European Iron Age*. Batsford.

Craddock, P.T. 1985. Three thousand years of copper alloys: from the Bronze Age to the Industrial Revolution. In: P. England & L. van Zelst (eds) *Application of Science in Examination of Works of Art*, 59-67. Boston.

Craddock, P.T. 1995. *Early Metal Mining and Production*. Edinburgh.

Craddock, P.T. & Jackson, R. 1995. The Ribchester Hoard: a descriptive and technical study. In: B. Rafferty (ed) *Sites and sights of the Iron Age: essays on fieldwork and museum research presented to Ian Mathieson Stead*, 75-102. Oxford: Oxbow.

Dungworth, D. 1996. The production of copper-alloys in Iron Age Britain. *Proceedings of the Prehistoric Society* 62, 399-421.

Dungworth, D. 1997. Roman copper alloys: analysis of artefacts from northern Britain. *Journal of Archaeological Science* 24, 901-910.

Feugère, M. 1985. Les fibules en Gaule Méridionale. *Revue archaeologique de Narbonnaise* supp. 12, CNRS, 312-331.

Haedecke, K. 1973. Gleichgewichtsverhältnisse bei der Messingherstellung nach dem Galmeiverfahren. *Erzmetall* 26, 229-233.

Hamilton, E. G. 1996. *Technology and Social Change in Belgic Gaul: Copper Working at the Titelberg, Luxembourg, 125 B.C. – A.D. 300*. (=MASCA Research Papers in Science and Archaeology, Vol. 13). Philadelphia.

Herbert, S. C. 1994. *Tel Anafa I, i; final report*. Journal of Roman Archaeology Supplimentary Series 10.

Meeks, N. 1993. Surface characterisation of tinned bronze, high-tin bronze, tinned iron and arsenical bronze In: S. LaNiece & P. T. Craddock (eds) *Metal Plating and Patination: Cultural, technical and historical developments*, 247-275. Butterworth, Oxford.

Millet, M. 1990. *The Romanization of Britain*. Cambridge.

Moore, H. 1987. Acculturation, diffusion and migration as social-symbolic processes. In: I. Hodder (ed.) *Archaeology as Long Term History*, 85-104. Cambridge.

Moorey, P.R.S. 1994. *Ancient Mesopotamian Materials and Industries*. Oxford.

Oddy, W.A. 1985. Gold in Antiquity: aspects of gilding and assaying. *Journal of the Royal Society of Arts* 80, 730-742.

Ponting, M.J. & Segal, I. 1998. ICP-AES analyses of Roman military copper-alloy artefacts from the excavations of Masada, Israel. *Archaeometry* 40, 109-123.

Ponting, M.J. forthcoming a. Roman military copper-alloy artefacts from Israel: questions of organisation and ethnicity. *Archaeometry*.

Ponting, M.J. forthcoming b. 'The Chemical analysis of a selection of the Gamla metalwork'. In: D. Syon, Excavations at Gamla, *Atiqot, Journal of the Israel Antiquities Authority*.

Ponting, M.J. forthcoming c. 'Chemical analysis of copper-alloy metalwork from the Roman contexts'. In: S. Herbert (ed), *Tel Anafa Vol. 3*. Journal of Roman Archaeology Supplementary Series.

Ponting, M.J. forthcoming d. 'Chemical Analysis of the Copper Alloys from the Early Roman Period'. In: M. Aviam (ed), *Excavations at Yodefat*. University of Rochester.

Stevenson, M.G. 1989. Sourdoughs and Cheechakos: The formation of identity-signaling social groups. *Journal of Anthropological Archaeology* 8, 270-312.

Syon, D. 1993. The coins from Gamla. *Israel Numismatic Journal* 12, 34-55.

Young, J. 1967. *The Addition of Lead to Alloys in the Late Bronze Age*. PhD diss. London: Institute of Archaeology.