# Reconstructing history through pottery: the contribution of Roman N African cookwares

Victoria Leitch

## Introduction

This article investigates the scale and significance of the production of and trade in Roman N African cookware, to show that the study of cookwares is an essential complement to studies of tablewares and amphorae for our knowledge of trade routes, but also to demonstrate the contribution that pottery can make to wider debates about political and economic developments. Although ceramic studies are commonly used to generate distribution maps and make statements about trade, they are rarely employed to develop or challenge thinking on the Roman economy and to construct arguments about the relationship between redistribution and the market economy.[1] Rather than presenting detailed statistics on distribution,[2] the article aims to investigate the factors propelling trade in cookware and what that adds to our picture of the Roman economy. Researchers have tended to concentrate on either production or consumption sites, without analysing the link between them, which, as argued here, is fundamental for an understanding of the dynamics behind the movement of these and other goods.

Roman N African cookwares, produced in what is today Tunisia, were widely exported around the Mediterranean. Although many different shapes were produced, those destined for export constitute a fairly small and uniform group of forms when compared to the multitude of local variants. Figure 1 shows the main export types, around which this article is based.

## The value of African cookware studies

As an essential and functional commodity, pottery used for cooking is found on most sites, yet cookwares have often been neglected in excavation reports and academic studies. The majority will derive from local sources, which has led to the belief that cookwares had only local or regional distribution and have little to add to wider economic questions. Studies of cookwares have been further limited by their lack of aesthetic appeal and the difficulties in dating them, but the wide distribution of certain cookwares and their importance in qualitative and quantitative studies is increasingly being appreciated as an important economic indicator. Intensive archaeological work at sites such as Ostia, Carthage and Marseilles, using scientific techniques, has demonstrated that in the Roman period many cookwares were objects of long-distance trade; indeed, N African cookwares were exported on a larger scale than any other Roman cookwares, from the early 1st to the early 5th c. A.D. Cookwares can also shed light on social and cultural practices[3] and

1 Stone 2009; see also Lewit 2011, 318, on the lack of attention to economic questions; and Polfer 2001 on the failure to link information on productive activities to the nature of the economy.

2 I have provided (2010 and 2011a) more detailed, quantified information on the distribution of N African cookwares around the Mediterranean. Much valuable data can be gleaned from Reynolds 1995 and 2010; Hayes 1972; and the LRCW, RCRF and SFECAG conference volumes.

3 Swan 1992, 2; for instance, she has shown that new ranges of vessels introduced into Britain with *Legio VI* and its African soldiers indicate a functional difference from the British equivalent of Black Burnished Wares.



https://doi.org/10.1017/S1047759413000160 Published online by Cambridge University Press

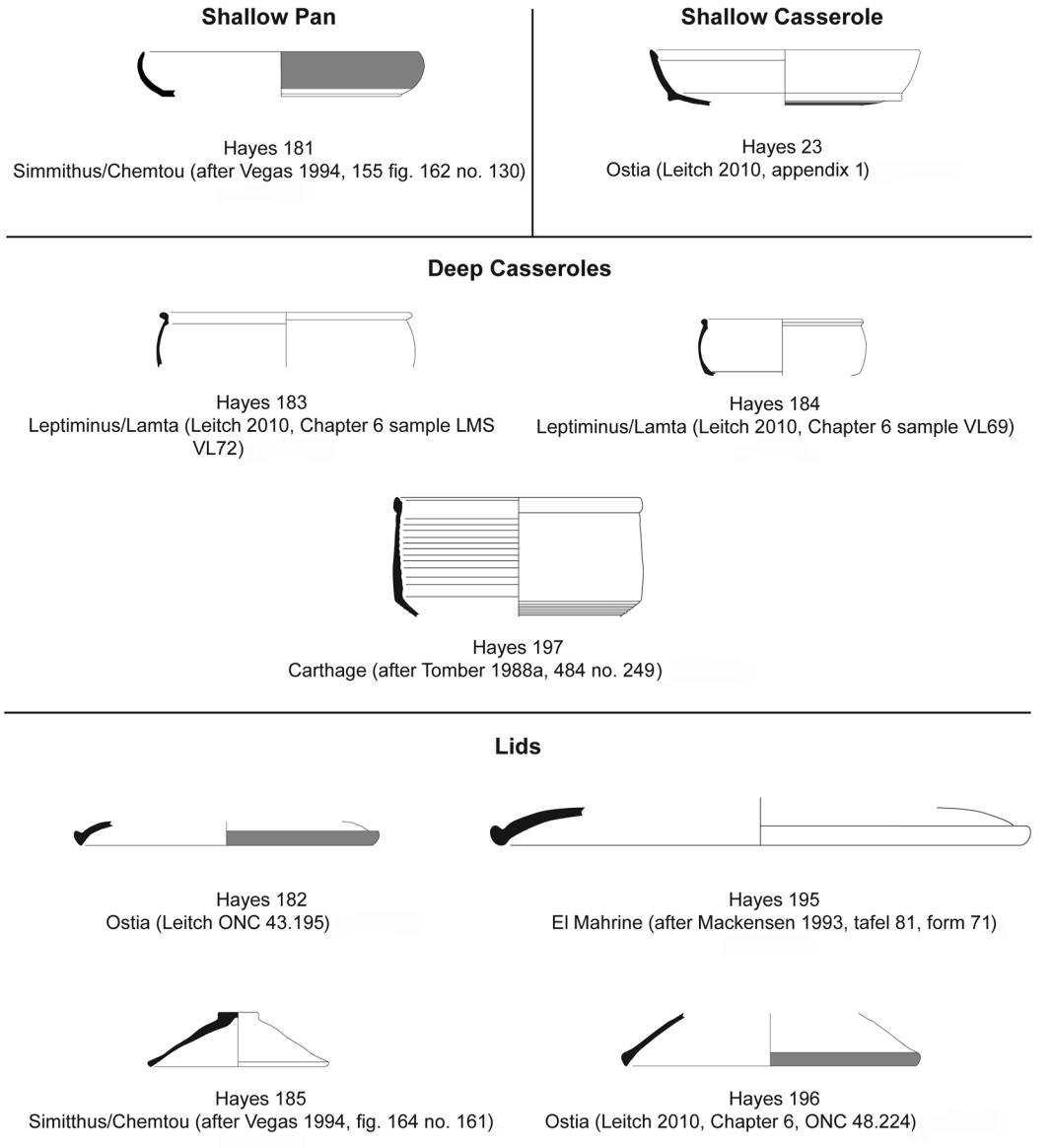


Fig. 1. Roman N African cookwares: commonly exported forms (scale approximately 1 : 8).

eating habits,[4] and their forms and fabrics can inform about production technology. Their production centres can be traced by ceramic petrology. In cases where cookwares can be shown to be traded, they can be used to address questions about distribution patterns and regional, inter-regional and long-distance exchange networks.[5] Inasmuch as their forms, finishes and decoration develop over time, they can help clarify processes of acculturation and the dissemination of ideas across regions and provinces.[6]

4 See, e.g., Bats 1988, 31-76; id. 1994, 407-24; Foss 1997, 197-218.

5 M. G. Fulford (1987, 59) has shown that both tablewares and cookwares can shed light on the movement of manufactured goods and "offer an eloquent testimony to the scale and sophistication of inter- and intra-provincial traffic."

6 Studies by M. Dietler show that ceramics can demonstrate relationships between communities

https://doi.org/10.1017/S1047759413000160 Published online by Cambridge University Press

## N African cookware production: technology, organisation and location

*Technical aspects of production*

Scientific studies have demonstrated that the particular forms combined with the naturally-occurring quartz-rich African clays did render N African cookwares superior by making them both strong and resistant to thermal shock.[7] The climatic conditions were economically advantageous: for instance, pots could be dried rapidly outdoors, allowing for a quick turnover, whereas in cooler climates shelters would have to be built and drying would take longer. Firing technology and kiln fuel is a significant factor in questions about the cost and efficiency of production, and both require more systematic investigation.[8] In parts of Roman Africa, where climatic conditions were not favourable for the cultivation of large forests, waste from olive pressings was probably the most common type of kiln fuel,[9] as evidenced in Roman levels at Leptiminus,[10] Carthage,[11] Uthina,[12] and Arbaia in the Tarhuna plateau.[13] Theophrastos mentions the use of prunings for fuel.[14] M. Ahmed suggests that olives stored for pressing may sometimes have gone rotten, providing another source of fuel.[15] In Roman Gaul,[16] on the other hand, wood fuel would have had to be cut and transported[17] and turned into charcoal,[18] which raises the possibility that African kilns were cheaper to operate, thereby lowering the final price of the ceramic product. It should be noted, however, that at the modern kiln site of Moknine, which is in the town and not on farming land, the waste from olive pressing is purchased for use as fuel, and the price is highly sensitive to the quality and quantity of the annual harvest, as well as to the distance between the olive-pressing factory and the pottery quarter.[19] The economy of this particular kind of fuel might well be affected by the location of a kiln in relation to olive farms (African Red Slip ware, for instance, was produced inland close to the oil farms[20]).

*Organisation of production*

No matter how advantageous the clays and the technical aspects of pottery production in N Africa, if these processes were not efficiently organized the advantage would quickly be lost. The success of N African cookwares must therefore have been closely linked to these organisational aspects and to the initial investment in the workshop.

---

that cut across cultural boundaries and may have more to do with shared production technology: Dietler and Herbich 1994, 459-70.

7 Peña 2007, 57; Ikäheimo 2003, 206; Leitch 2010, chapt. 3, for a detailed synthesis of all the technological aspects of N African cookwares production; Sherriff *et al.* 2002.

8 This important question has been raised by Foxhall 2007, 82; Leitch 2010, 56-59; Ahmed 2010, 268-70; Lewit 2011, 319.

9 Leitch 2010, chapt. 3; 2011a.

10 Stirling and Ben Lazreg 2001, 221-27; Mattingly *et al.* 2011, 215-16 and fig. 6.9, showing carbonized olive pits and wood at kiln site S290.

11 Hurst and Roskams 1984, 18-19 and 113.

12 Barraud *et al.* 1998, 145.

13 Ahmed 2010, 268-69.

14 Theoph., *Hist. Plant.* 5.9.6.

15 Ahmed 2010, 270.

16 E.g., at La Graufesenque: Schaad 2007, 23; Vernet 1981.

17 Henein 1997, 69. At Dakhla (Egypt) in a modern ceramic workshop using wood, to collect enough for a single firing requires 24 donkey loads (where 2 loads take 2 men 5 hours to gather).

18 Veal 2012.

19 Hasaki 2005, 16.

20 Lewit 2010, 320-21.

https://doi.org/10.1017/S1047759413000160 Published online by Cambridge University Press

'Mass production' is indicated at Leptiminus, the best-excavated production site in N Africa to date, where a large-scale kiln site was investigated.[21] Geophysical evidence indicates further areas with groups of kilns around the same town.[22] Sites such as Pheradi Maius and Uthina, which were producing for overseas and large regional markets, were also fairly extensive. Conversely, estates geared towards local and regional markets, such as El Maklouba and Aïn Scersciara, seem to be much smaller nucleated workshop groups, as is El Mahrine, despite its major rôle in the export of ARS. However, the situation in N Africa seems entirely different from huge fineware production sites in Gaul such as La Graufesenque,[23] where the regular use of graffiti and stamps signals a different level of organisation and greater output within a large conglomerate. Stamps or similar markers are uncommon on N African pottery generally and almost never found on N African cookwares,[24] suggesting that 'mass production' was achieved there through other organisational models. The lack of stamps may suggest direct control of the landowner, as stamps are thought in some cases to indicate contracts between a landowner and a potter. By cutting out the middleman, direct control may have led to cheaper products. It has also been convincingly argued that it was possible to achieve high-level output through multiple workshops, rather than only through large manufactories, as these used specialised work forces, were more efficient, and were better able to adapt to changes in supply and demand.[25]

One such model is standardisation — the reduction of variability through the use of a limited range of materials, routine techniques, and "little heterogeneity in composition and appearance"[26]. For ceramics, the advantages included faster production due to a simplification of the repertoire; standard forms and sizes could easily be stacked, which saved space in the kiln (economizing on fuel) and allowed more pots to be transported in a smaller space. It is significant that the typology of exported N African cookwares forms created by J. W. Hayes in 1972 has hardly expanded at all over 40 years, demonstrating the high degree of standardisation for exported forms in the 1st-4th c. (new standardized forms were also created in the 5th-6th c., but they were exported on a much smaller scale[27]). On the other hand, N African cookwares produced for local/regional distribution show more variety and can be difficult to typologize.

Organisation in the workshop also involved choices about which wares to produce together, and thus with respect to degrees of specialisation. A detailed analysis recently carried out using evidence from 39 known N African cookware production areas suggested that during the main period of production (2nd-3rd c. A.D.) N African cookwares were predominantly produced alongside amphorae;[28] this corroborates similar suggestions previously made by P. Reynolds and M. Bonifay.[29] This association with amphorae, particularly in terms of intensity of production, can be seen at the coastal sites at Zitha,

21 Stirling and Ben Lazreg 2001; Mattingly *et al.* 2011, 223-53.
22 Clarke and Robinson 2011, 89-95.
23 Polak 1998, 117-12; Schaad 2007.
24 For a stamp, see Bonifay 2004, 229. For graffiti, see Aguarod Otal 1991, 342 fig. 382 no. 343 and fig. 347 no. 343.
25 Stone and Mattingly 2011, 44.
26 Rye 1981, 196.
27 Fulford and Peacock 1984, 185 (e.g., casserole 19).
28 Leitch 2010, chapt. 4.
29 Reynolds 1995, 7-8 and 47 (he includes cookwares with coarsewares); Bonifay 2004, 69.

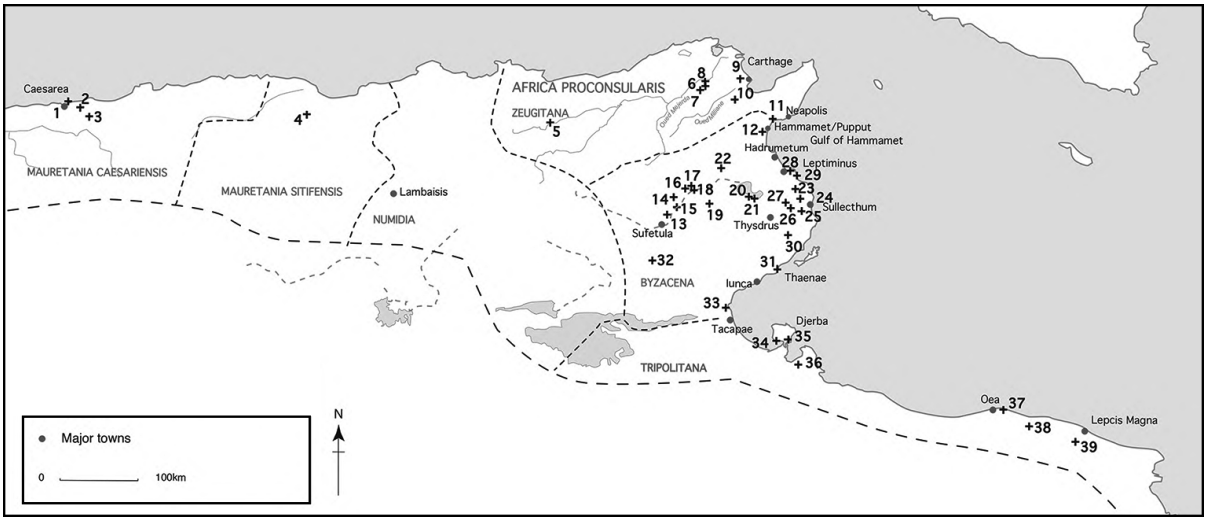


Fig. 2. Cookware production sites in N Africa, showing coastal, non-coastal urban and rural sites.

1. *Caesarea*/Cherchel
2. Tipasa
3. Draria el Achour
4. *Sitifis*/Sétif
5. *Simitthus*/Chemtou
6. El Mahrine
7. Hr el Biar
8. Borj el Jerbi
9. Carthage
10. *Uthina*/Oudhna
11. Northern Gulf Hammamet
12. *Pheradi Maius*/Sidi Khalifa
13. Madje/Hr el Guellal
14. Hr es Srira
15. Zegalass/Hr el Guellal
16. Hr Bloul
17. Sidi Marzouk Tounsi
18. Oued el Gattar
19. Sidi Saad/Hr el Guelel
20. Hr Mbarek
21. Aioune es Soltane
22. Chougafiya/Hr el Guellal
23. Moknine
24. El Maklouba
25. El Mokaïda
26. Hr ech Chekaf
27. Ras Aïed
28. *Leptiminus*/Lamta (west)
29. *Leptiminus*/Lamta (Dahar Slima)
30. Hr ech Choggaf
31. *Thaenae*/Thyna
32. *Gemellae*/Sidi Aïch
33. Oued el Akarit
34. *Haribus*/Guellala
35. Meninx
36. *Zitha*/Zian
37. *Oea*/Tripoli
38. Aïn Scersciara
39. Wadi Taraglat, Lepcis Magna

Oued el Akarit, Thaenae and Leptiminus, which probably produced N African cookwares for export. It opens up the possibility that the link with amphorae reflected decisions about output and profit, particularly in light of the fact that this link is less evident at inland sites producing chiefly for local markets.

The possible reasons behind links between the production of cookwares and amphorae have been examined from a technical point of view, the results demonstrating that it was technically possible to produce and fire N African cookwares with both ARS and amphorae.[30] However, for mass production it made greater economic sense to produce N African cookwares with amphorae as their ideal firing temperatures were lower than those of ARS, with the result that they required less fuel; ARS also required more complex forming skills, which may have necessitated a more specialised workforce.

*Location of production*

N African cookwares were produced at coastal towns, non-coastal urban and non-coastal rural sites (fig. 2). Coastal sites had direct access to maritime transport. Inland urban sites generally benefited from good road and sometimes river networks. Rural sites varied according to the importance of the agricultural estates to which they were often

30 Leitch 2010, 164-73.

https://doi.org/10.1017/S1047759413000160 Published online by Cambridge University Press

attached. Recent research suggests that N African cookware forms destined for export were produced exclusively at coastal sites during the early 1st to 5th c., whereas urban and rural sites away from the coast produced only regionally-specific forms that do not seem to have been exported.[31] These findings demonstrate the importance of well-organised maritime trade for the efficient and cheap distribution of goods, allowing low-cost N African cookwares to be profitable over long distances if they were produced close to the ports. This may have necessitated buying olive-pressing fuel from the countryside, but keeping the cost of transport low was the key to their success. By contrast, ARS, which was often produced inland in areas associated with grain and oil production,[32] had to be fired at high temperatures and needed more fuel than did N African cookwares; as a result, it was more profitable for them to be produced near the farms, despite the overland expense for transport to the ports; note also that N African cookwares and amphorae are more bulky than ARS, which would have impacted on transport costs.

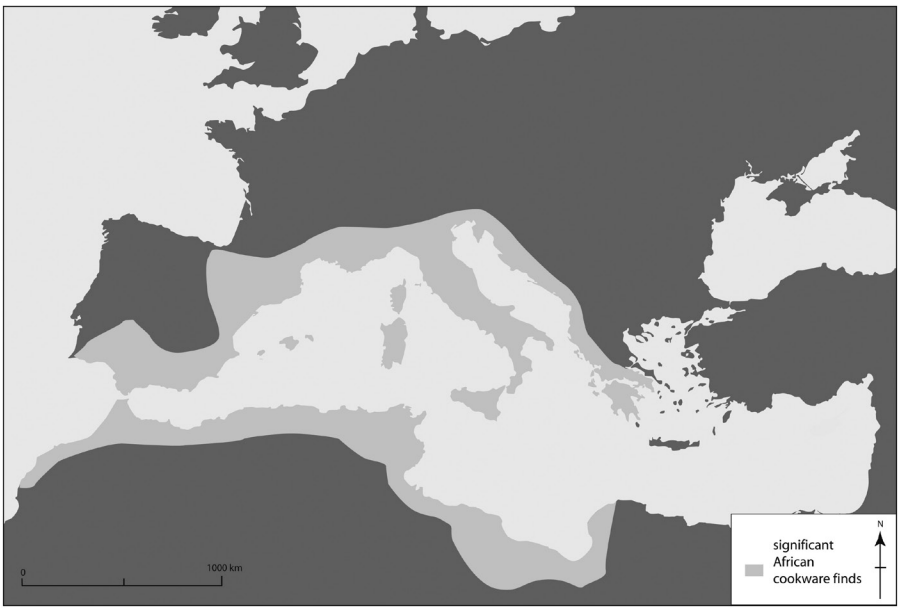


Fig. 3. General distribution of N African cookware around the Mediterranean.

**Distribution of N African cookware in the Mediterranean region**

Evidence for the efficient, mass production of N African cookwares for export is proved by the significant quantities documented across the Mediterranean.[33] Statistics on distribution, however, can tell us more than simply locations, dates and quantities, and the following discussion will focus on the connection between coastal production and distribution overseas and the importance of transport in relation to different site types and their locations (fig. 3).

The study of local and regional trade within N Africa is limited by the shortage of well-published excavations, but there is enough information to allow suggestions to be made

31 Ead. 2011a.

32 Bonifay 2004; for ARS production generally see 45-57 with map of production sites on 46, and 463 on association with grain; Mackensen 2009.

33 Leitch 2011a, especially distribution tables 10.3-10.5, with information on quantification and bibliographic information on the sites mentioned here.

https://doi.org/10.1017/S1047759413000160 Published online by Cambridge University Press

about patterns of distribution that can be developed in the future. Urban coastal sites such as Carthage,[34] Pheradi Maius,[35] Leptiminus[36] and Lepcis Magna[37] that produced N African cookwares theoretically had no need for imported cooking wares, but as trading centres they received imports from other N African coastal sites or other Mediterranean regions. This was due to the movement of commerce in other goods passing through; it does not reflect so much a demand as intensive trade. From the 5th c., goods from overseas appear in larger quantities, particularly at Carthage; they include greater quantities of amphorae and cookwares coming from the island of Pantelleria and the East,[38] which may also be a reflection of a decline in production in N Africa, certainly in terms of cookwares. Assemblages of African cookwares at urban inland sites such as Sitifis,[39] Simitthus,[40] Thugga,[41] Uthina,[42] Mactaris,[43] Ammaedara,[44] Uzita[45] and Segermes[46] display quite different compositions from urban coastal sites, with no Mediterranean cookware imports and almost no imports from African coastal sites producing the classic cookwares for export. Rural inland sites such as El Mahrine[47] and Madje/Henchir el Guellal show essentially the same pattern as the urban inland sites, with no export N African cookwares from the coast, although a knowledge of those is visible through imitations.

The penetration of N African cookwares in the Iberian peninsula seems to begin early and to finish late. For example, at Valentia (La Almoina) the evidence for the earliest known N African cookware exports has been dated between 5 B.C. and A.D. 5.[48] At Malaca and the Vila-Roma site at Tarragona the cooking ware trade (and other Tunisian pottery) continued into the Late Roman period.[49] At the site of Alicante-Benalúa we even see exports well into the mid-6th c., but this is an exception.[50] Inland areas also received N African cookwares, thanks to good communications networks and the movement of other goods alongside which the cookwares travelled; they include *Colonia Patricia* (Corduba) in Baetica, an area important both for olive-oil production and for mining,[51]

Ports in southern Gaul receive the largest quantities of N African cookwares, as in contexts of the late 2nd-early 3rd c. at Marseilles,[52] and at Fréjus, where N African cookwares

34 E.g., Bonifay 2004, 67 and 230-45; Fulford and Peacock 1984. Hayes 1976 and 1978; Tomber 1988.
35 Ben Moussa 2007, 133-37.
36 Dore 1992, 136-44 and 154 (summary).
37 Pentiricci *et al.* 1998, figs. 1-5.
38 Reynolds 2010, 106; and see infra n.78.
39 Guéry 1985, pls. XXI, XXXI and XL-XLI.
40 Vegas 1994, 146 and 155.
41 De Vos *et al.* 2005, 481-94.
42 Bonifay 2004, 242-43, 306 and 309; Barraud *et al.* 1998.
43 Picard and Bourgeois 1977, Appendix 188.
44 Baratte *et al.* 2009, 185-86.
45 Bonifay 2004, 452.
46 Poulsen 2000, 234-37 and 242.
47 Mackensen 1993, 436 with pls. 80-82.
48 Albiach *et al.* 1998, 155, fig. 14 nos. 60328.69 (Hayes 196), 60455.9 (Hayes 23), 60455.26 (Ostia II, 314).
49 Navarro Luengo *et al.* 1997, 84.
50 Reynolds 2010, 20; id. 1995, 203.
51 Carillo Diaz-Pinés and Murillo Redondo 1994, 1301 and 1316.
52 Moliner 1996, 239 and 244-45.

are dominant amongst imported cookwares.[53] Inland sites, when urban and well-connected by riverine routes, also received N African cookwares, even at a considerable distance from the sea, as in the case of *Lugdunum* (Lyon) where N African cookwares occupied a surprising 10% share of the cooking wares,[54] reflecting the special nature of the trade going to the capital by river.[55]

Roman Italy shows similar trends to the Iberian peninsula and Gaul, with N African cookwares found predominantly in coastal sites and ports. At Ostia, N African cookwares represent a 30% share of the cooking wares, rising to a full 90% in the 3rd c.[56] At nearby Portus, N African cookwares occupy a 55% share of the cooking wares as late as the 6th c.[57] At the Palatine East, in the late 3rd c. A.D. N African cookwares were by far the dominant imported cooking ware.[58] Albintimilium,[59] Corti,[60] Luni,[61] Cosa[62] and the villas of Settefinestre[63] and Sperlonga[64] all show N African cookware imports, though local cooking wares also made up a significant share of the market. The distribution systems on the Adriatic side, however, were clearly different, no doubt affected by the natural boundary of the Apennines.[65] In central Italy the drop-off in the penetration of N African cookwares is very sharp, suggesting different networks from those of the coast, or that Italian cooking wares (which include imitations of N African cookware forms) were good enough to dampen demand; late 2nd- to 4th-c. deposits at the villa at Lugnano in Teverina (Umbria), for instance, did not contain any N African cookwares at all.[66]

The evidence from islands demonstrates their rôle as redistribution centres and *entrepôts*. This opened them up to trading opportunities in other goods, including N African cookwares. The Balearic islands,[67] Sardinia,[68] Sicily[69] and Malta[70] are all producing more evidence of this kind.

In the Fazzan, about 700 km due south of *Oea*, in Garamantian territory well to the south of the Roman frontier, only a handful of N African cookwares has been found,[71] undoubtedly hindered by the difficulties of transporting goods across the desert. From the

53 Aujaleu *et al.* 2009.
54 Bonnet *et al.* 2003, 161 and 167.
55 Rougé 1965; 1966, 444. He argues that small ships went directly up the Rhône and paid customs in kind at Lugdunum, explaining the high volume of trade at that site.
56 Anselmino *et al.* 1986, 56-64; Ikäheimo 2003, 216-17 for summary.
57 Coletti 1998, 403.
58 Ikäheimo 2003, 212 and Table 18.
59 Olcese 1993, 154, 156-57, fig. 23, and 180 fig. 27.
60 Massabo 1999, 118-20 and pl. 15, nos. 7-11.
61 Frova 1973.
62 Dyson 1976, 161-67.
63 Ricci 1986, 84-85.
64 Saguì 1980, 524 fig. 9.
65 Albarella *et al.* 1993, 202.
66 Monacchi 1990.
67 Buxeda I Garrigos *et al.* 2005, 228.
68 Ikäheimo 2003, 218.
69 Ampolo *et al.* 1971.
70 I thank A. Bonanno, N. Vella and M. Anastasi (University of Malta) and S. Sultana (National Museum in Valetta) for giving me permission to look at the material in the museum and stores.
71 Mattingly 2010.

E Mediterranean, there are almost no N African cookware finds; Argos[72] and Corinth[73] had no N African cookwares and Gortyn produced but two sherds.[74] Sidi Khrebish in Cyrenaica did have a few N African cookwares but was largely dominated by cooking ware imports from Greece.[75] The evidence indicates that N African cookwares was never part of organized trade to the E Mediterranean, which is interesting in light of the fact that very few African amphorae penetrated eastern markets (unlike ARS),[76] demonstrating that these two wares, often produced in the same workshops, also followed similar distribution networks.

It is interesting to consider other low-value items following similar W Mediterranean distribution patterns. For instance, at Carthage there is evidence for the import of bricks and tiles from Pozzuoli, serving as ballast for return voyages[77] and demonstrating the close connection between coastal production and distribution overseas. The pan-Mediterranean distribution of Pantellerian cooking wares reflects the strategic importance of that island on Mediterranean shipping routes: those wares were exchanged for essential foodstuffs as well as traded in their own right due to high performance characteristics.[78] A further case in point is the Roman millstone trade: D. P. S. Peacock has demonstrated through petrographic analyses that they were widely traded from their place of origin, perhaps in grain-carrying ships.[79]

**Factors controlling the distribution of African cookware**

The distribution of N African cookwares indicates a close relationship with maritime trade: a large percentage of exported N African cookwares was sold in the coastal cities to which it was traded and never had a chance to enter markets further inland, although they did reach some well-connected inland urban sites, and even some rural areas. That said, N African cookwares that were exported were produced only at coastal sites, and in the W Mediterranean their penetration inland is considerably less than at coastal sites, which indicates a dependence on cheap maritime transport and a corresponding high degree of sensitivity to price.

Improvements in maritime technology (e.g., bilge pumps, cranes, larger ships and harbours) were additional factors in enabling greater quantities of goods to move long distances at reduced cost.[80] The issue of the cost of transport is much debated. A cost comparison index was developed by R. P. Duncan-Jones, based on figures from Diocletian's Prices Edict for maximum haulers' rates over sea, river and land. It suggested ratios of

72 Abadie-Reynal 2007, 186.
73 Slane 1990, 4.
74 Di Vita and Martin 1997, 359.
75 Riley 1979-80, 248.
76 Bonifay 2004, 456
77 Peacock 1984a, 242-46.
78 Peacock 1984b, 8-10; Montana *et al*. 2007, 457-58 and fig. 3 for a distribution map of Pantellerian cooking wares.
79 Peacock 1980.
80 Scheidel (2011) argues that maritime trade was helped by new technology but was largely the result of wider political and economic developments; Wilson (2011a and 2011b) agrees but places a greater emphasis on the importance of the technological improvements. In both cases, the benefits to N African cookwares trade were great. For further comment on increased tonnage, see Pomey 2011, 50-51.

1 : 4.9 : 28.[81] Yet the view that land transport was avoided because of its higher relative cost is an oversimplification which does not take into account issues such as the movement of goods for rent payments, military requisitions or tribute, on which N African cookwares may have 'piggybacked' for free; nor does it explain why the Romans spent so much time and money improving the road system.[82] Indeed, the distribution of Gaulish sigillata was not affected by sea transport or even the distance overland from the production centres; instead, it was directed by military supply routes and relationships between merchants and production sites. The "complementary nature of land, sea and river transport"[83] needs to be underlined: rather than viewing the different methods of transport as in competition with one another, we should see transport by water as a link to transport by road, with benefits for a wider network of consumers. N African cookwares, however, was not part of official or military trade. Thus the organisation of their transport, especially inland, may have been somewhat *ad hoc*, which would ultimately explain why they were not exported from inland sites in Africa and why their penetration inland in Mediterranean regions was limited.

*The rôle of the army*

Military outposts were often on the fringes of the empire where goods that the soldiers were accustomed to back home (e.g., wine, olives, fish sauce) could not always be obtained locally. This must have stimulated exchange and caused the development of new trade routes.[84] P. Salama's argument that, from the outset, communications networks were not simply for connecting military posts but for the economic exploitation of the territory and the creation of *routes d'exportation*[85] explains how the distribution of N African cookwares benefited from the new routes and greater merchant activity; some of the merchants may have been in the employment of the military,[86] though others were clearly independent free agents.[87]

The finewares of La Graufesenque supplied the garrisons of the Rhine and Britain.[88] At Vindolanda in the late 1st c. A.D., soldiers whose origins lay in the area of the Netherlands were supplied with olive oil from Baetica and wine from Italy.[89] The fortress of Caerleon has produced Baetican oil amphorae, while an amphora with a *titulus pictus* referring to *Amineum* wine from Campania is dated to the late 1st-early 2nd c. A.D.[90] We find imitation N African cookwares at York, where African soldiers were stationed; although not evidence of a trade route from N Africa, it does demonstrate the importance of specific ceramic supplies for the army.[91] N African cookwares are also found at the settlement near Bu Njem[92] in the Libyan desert; although present in small numbers before the fort was built, they increase after its construction when more supplies were travelling to the fort.

81 Duncan-Jones 1974, 368.
82 Laurence 1998, 129 and 137.
83 Ibid. 143.
84 Tomber 1993, 144.
85 Salama 1951, 42.
86 Whittaker 1983, 180.
87 Bowman 1998.
88 Middleton 1980, 190.
89 Marlière and Torres Costa 2005, 229-31.
90 Nonnis and Ricci 2007, 198-99; Tchernia 1986.
91 Swan 1992.
92 Rebuffat 1976-77, 65 and 67.

The rôle of the military in the exchange of N African cookwares is in part about the direct supply of N African cookwares to military garrisons who had cash wages to spend, but it is perhaps better connected to the trade routes that the supply lines created and the long-lived markets along those routes.[93]

*The rôle of the* annona

Ensuring the imperial capital and the armies were fed required intervention by the state.[94] The *annona*, the procurement and distribution system developed to answer this need, is outlined in the *Codex Theodosianus*.[95] N Africa played an important part in this system, supplying mainly grain from the late 1st c. down to the end of the empire[96] but also oil from the Severan period[97] as well as small quantities of wine.[98] From the 3rd c., the *annona* became a compulsory obligation, implying administered trade, but this did not necessarily affect private trade, some of which continued to be carried on the ships that transported *annona* supplies.[99] The *annona* required a highly organized structure for collection, transport and redistribution (as is reflected in the uniform repertoire of amphora forms at Monte Testaccio mainly coming from Byzacena and Tripolitana[100]). Because the state did not own a merchant fleet until the time of Commodus, this activity was predominantly a private enterprise.[101] There were advantages for shipowners who transported the *annona* grain as they were exempt from port taxes on any other goods they carried from the 3rd c. onwards.[102] The other goods included oil, fish products,[103] ARS and N African cookwares, which were already being traded before the 3rd c.[104] but now in increased numbers thanks to the growth of agricultural production at large villa estates. Landowners who controlled the bulk of long-distance trade mixed their *annona* products with non-state provisions,[105] and this diverse range of goods stimulated new demands as they were redistributed not just from Portus and Ostia but from other ports which were receiving the huge agricultural surpluses of Africa.[106]

Before the foundation of Constantinople, the *annona* involved only trade to Rome. Although the *annona* stimulated trading relations between Rome and the provinces,[107] products such as N African cookwares travelled to many other ports too, and not necessarily by way of Rome and its harbour. Similarly, T. Lewit has shown that Phocaean Red Slip, produced in a part of Asia Minor that did not generally supply the *annona*, was independently successful in eastern markets, while, conversely, Egypt and Sicily, which did supply

93 Tchernia 2011a, 134-40.
94 Erdkamp 2005, 175.
95 Rickman 1980, 173-97 and Appendix 174 on N Africa; Sirks 2008.
96 Fulford and Peacock 1984, 256-58.
97 Revilla Calvo 2007, 277-80, recently underlined by archaeological evidence of N African amphorae at Monte Testaccio.
98 Warmington 1954, 60.
99 Lo Cascio 2007b, 641.
100 Revilla Calvo 2007, 279.
101 Garnsey 1983, 121-22; Reynolds 1995, 107.
102 Erdkamp 2005, 178; Garnsey 1983, 128; Tomber 1993.
103 See Botte 2009 for an excellent summary of fish production and distribution around the Mediterranean.
104 Mattingly 1988, 53; Reynolds 1995, 108; Rougé 1981, 71; Tomber 1993, 143.
105 Tchernia 2011a, 143; Whittaker 1983, 165-66.
106 Erdkamp 2005, 330; Peacock 1982, 158-59.
107 Remesal Rodríguez 2007, 317.

https://doi.org/10.1017/S1047759413000160 Published online by Cambridge University Press

*annona* products, did not export tablewares widely.[108] Thus, the importance of the *annona* should not be over-exaggerated, and we must continue to seek other explanations.

*The rôle of urban centres*

Urban centres[109] would have been involved in commercial activities, producing goods and services to sell not only to the urban population but also to the rural who had surplus cash to spend, thanks to increased productivity that was in part stimulated by the need to produce a surplus to sell in order to obtain cash to pay taxes.[110] The investments of the élites in extensive building programmes and productive facilities generated further wealth and employment, signalling economic growth,[111] and such centres became venues for "conspicuous consumption".[112] Inland cities, well connected by river or road, also created new trade routes, because they were important administrative centres or perhaps were connected to activities such as mining. In Tarraconensis, the inland urban sites of Pompaelo and Caesaraugusta, along the Ebro river, were receiving a wide range of N African cookwares.[113] Port towns were particularly significant consumers[114] and the N African cookware evidence shows this distinction, with much greater quantities concentrated in port towns such as Tarragona, Marseilles, Telo Martius and Ostia (even if the latter was a special case because directly connected to Rome and the *annona*).

*The rôle of merchants*

Merchants would have sought information about demand before making their purchases; the pottery they purchased from workshops reflected what they were confident they could sell.[115] Pliny mentions long-distance pottery trade for productions that had acquired a good reputation,[116] stressing the importance of the superior technical aspects (as is the case with our N African products). C. R. Whittaker distinguished between *mercatores* who were private entrepreneurs and *negotiatores* who were tied agents, but the sources do not allow us to separate them and some may have served both rôles.[117] N. Morley added *navicularii*, suggesting that some merchants were also shipowners (evidenced by the same name appearing on an anchor and an amphora stopper from the Dramont A wreck[118]). Merchants were exempt from the lustral trade tax, and this encouraged their involvement.[119] There is some evidence for the involvement of merchants in the movement of ceramics: inscriptions in the Rhine and Moselle valleys at Neckar and Lyon suggest that they generally managed several products, such as ceramics, salt, wine and textiles.[120]

---

108 Lewit 2011, 324, though P. Reynolds (pers comm.) warns that the *annona* system in the East was very complex and it is difficult to say how much the export market was directly affected by it.
109 Morley (2007, 578) estimates that 12% of the population lived in large urban centres, to which Wilson (2011c) adds many other smaller urban hubs.
110 Hopkins 1980; id. 1995-96.
111 Stone and Mattingly 2011, 32.
112 Morley 2007, 578.
113 Reynolds 2010, 56-57 and Table 13 for figures on imports from Tunisia to the region; cf. Leitch 2011b for distribution map.
114 Wilson *et al.* 2012.
115 Ben Moussa 2007, 223.
116 Plin., *NH* 35.161: … *per maria terras ultro citro portantur, insignibus rotae officinis*.
117 Whittaker 1983, 172.
118 Morley 2007, 584.
119 Whittaker 1983, 166; *CTh* 11.12.3 (A.D. 365).
120 Pucci 1983, 117; Raepsaet-Charlier and Raepsaet 1988; Schlippschuh 1974, 61-65.

Studies of Gaulish sigillata suggest that several practices may have operated, from contracts between potters and merchants for pre-ordered goods, to sale on the open market. G. Dannell suggests that *mercatores* organised and paid for the movement of goods, which carried an element of risk but potentially the highest profits. The preeminence of *mercatores* compared to potters is reflected in the lack of status potters seem to have enjoyed.[121] If we try to relate this evidence to N Africa, we can suggest that it was a private individual, whether a *mercator* or a *negotiator*, who organized the transport of cookwares from workshop to market, and either the *mercator* or landowner who paid for this.[122] At the ports, the cookwares may have been bought by merchants and/or *navicularii* who added this private trade to their *annona* shipments (cf. the mixed contents of the Cabrera III wreck[123]). Marble inscriptions at Ostia in the early 2nd c. show that *navicularii Africani* were living in that town.[124] Such communities of merchants are known elsewhere[125] and show the importance of middlemen in the distribution process; O. Salomies' onomastic study[126] also points to their presence. Some of the *mercatores* may have commanded entire shiploads, or, when they acted as *negotiatores*, the shipment may have belonged to a single landowner. In other situations merchants put their goods on ships owned by another party, with the result that the hold may have contained goods from several different merchants.[127]

In the Late Roman period, merchants may have been agents for the Church. Like the landowning classes, the Church often owned its own merchant ships, acting like the major estates.[128] The Church may even have been directly involved in some pottery production: an inscribed polisher recently identified as a product from the ARS production centre of Sidi Marzouk Tounsi[129] reads *ex of(f)icina Quod/vultdei Tzacunis/Cresce(n)s pugi/l(l)um fecit*. A. Wilson and J. Adams have suggested that Tzacunis is a variant spelling of Diaconis ('deacon'), and that because Quodvultdeus is named as a deacon this may have been an ecclesiastical workshop.[130] However, some of the produce of the Church was probably bypassing the commercial market to provide charity to the poor. This may to some degree have disrupted the dynamics of N African cookwares production and trade.

*The impact of crisis and political change*

The evidence gathered so far suggests that the extensive Roman trade networks were a consequence of the structural organisation and political stability of the empire, centred around the "inner sea". Importantly, this allowed reduced transport costs for maritime trade.[131] This may suggest that any change to the favourable conditions would have had a detrimental effect on commerce, yet the "3rd-c. crisis", considered by some to have been

121 Dannell 2002, 240.
122 Lo Cascio 2007a, 10, who suggests both owners and/or merchants took on this responsibility; J. Paterson (1998, 159-60) favours the independent merchant in this rôle. However, A. Tchernia (2011a, 25) notes that some Baetican oil amphorae at Monte Testaccio bear the names of owner-merchants who organized the export of their own, and other producers', products.
123 Bost *et al.* 1992, 28-31; for cargo composition, 182-83.
124 DeLaine 2004, 170.
125 Wilson *et al.* 2012, for reference to Tyrian merchants at Puteoli.
126 Salomies 2002, 150-51.
127 Morley 2007, 584.
128 Whittaker 1983, 168; e.g., Bishop Patiens of Lyon and John the Almoner at Alexandria.
129 Mackensen 1993, 83 and 474; 2009, 25.
130 A. Wilson and J. Adams, pers. comm.
131 Scheidel 2011, 22.

https://doi.org/10.1017/S1047759413000160 Published online by Cambridge University Press

a demographic and economic reality, does not appear to have impacted upon the steady success of N African cookwares between the 2nd and 4th c.[132] This runs contrary to the perceived hiatus in the distribution of ARS wares in the 3rd c.[133] It was probably linked to the fact that the two wares were produced in different production centres and followed quite different distribution patterns. Many other scholars, however, downplay the impact of the 3rd-c. crisis,[134] which seems to have been less felt in Africa, even if in the later 3rd c. the production site at Leptiminus was in decline, while cookwares produced in the Carthage zone underwent slight changes in form, suggestive of changes in the ownership or organisation of the workshops.

In the later Roman period there was a general downturn in exchange between provinces, and regional and local distributions became relatively more common. The increasing control of estates by the Church from the 5th c., with its own *negotiatores,* also probably removed some open market activity,[135] and this may have affected tertiary goods such as our cookwares, as the poor became the main beneficiaries of Church estates at the expense of the market.[136] But Whittaker does not see this "closed trade" as a sign of decline,[137] and well into the 4th c. the trade in N African cookwares was still active, even if it was changing. After the Vandal conquest and the end of the *annona* in Africa, there was a loosening of control in all types of production.

Changes in amphora production need particularly to be considered in view of the link between amphorae and N African cookwares. In the olive-oil industry the entire process, from cultivation to bottling, now took place on agricultural estates, whereas previously the oil had been transported from the estates probably in skins,[138] then bottled in amphorae at ports like Leptiminus (where oil amphorae and N African cookwares were produced together *before* the Vandal conquest). New amphora production sites appeared in the Ksour Essaf region, some 15 km from the coast, which D. Peacock and colleagues see as a sign of decentralization.[139] (Of course, some sites in rural areas, such as Zegalass/Henchir el Guellal, Sidi Saad/Henchir el Guellall, Henchir ech Choggaf and El Mokaïda, had been producing amphorae in the 2nd-4th c., but these were probably restricted to regional circulation.) The new ceramic production sites, attached to estates, became active in the second quarter of the 5th c.; some sites also produced N African cookwares, but they were circulated only locally, as seen at Henchir ech Chekaf and Ras Aïed. Other late ceramic production, for all classes, is found in central Byzacena, between Kairouan and Sufetela.[140] Late ARS C vessels and lamps travelled with agricultural products in skins and barrels to the ports for export. Further evidence for change comes in the general increase in imported wares at Carthage.[141] Significantly, N African cookwares were less and less frequently exported by this date, suggesting that elements of this re-organisation, and the end

132 Giardina 2007, 763.
133 Fentress and Perkins 1988; Fentress 2004.
134 Carrié and Rousselle 1999, making use of Egyptian papyri to downplay the crisis.
135 Whittaker 1983, 179.
136 Giardina 2007, 768.
137 Whittaker 1983, 180.
138 Marlière and Torres Costa 2007.
139 Peacock *et al.* 1989, 199-200.
140 Peña 1998, 213.
141 Fulford and Peacock 1984.

of the *annona* system, were not favourable for their production or marketing. M. Bonifay,[142] P. Reynolds[143] and M. Fulford[144] agree that the period A.D. 440-475 was one of relative economic stagnation in Africa: the disintegration of political unity led to greater transaction costs; and when ceramic production sites moved inland, merchants were no longer able to make sufficient profit on low-value, price-sensitive cookwares to continue shipping them. In the 5th-6th c. there was an increase in piracy,[145] which made distribution by boat more costly and risky.[146]

All the same, ceramic workshops opened up in the later period near fish-processing installations along the coast of *Byzacena* at Leptiminus.[147] This confuses the theory that the movement of production sites inland caused the end of cookware production because of increased transport costs. Certainly the move of production sites away from the coast may have been the most significant factor in the decline in cookware production, but there must have been additional reasons why the coastal sites producing amphorae for fish products did not produce cookwares for export. The explanation should be connected to a decline in the overall volume of goods shipped overseas, squeezing African cookwares out of the market when their success had relied principally on cheap transport, economies of scale and demand. What is surprising is that ARS continued to be exported down to the 7th c., appearing little affected by the decline of Roman organisational systems. T. Lewit put this down to strong private trade and continued consumer interest in this high-quality tableware, particularly in the E Mediterranean, where ARS traditionally had a market and where agriculture flourished in late antiquity.[148] Nuancing this, Reynolds points out that ARS was never a major import in the East; though perhaps boosted by the grain trade in the 6th-7th c., it was not as significant as Late Roman C finewares (and Late Roman D in the Levantine region).[149] The higher prices commanded by ARS vessels probably meant that they were more resilient to increases in transport costs, unlike the low-priced cookwares.

**African cookware as a proxy for economic trends**

Using pottery as a proxy can help trace the intensity and direction of the trade of primary goods.[150] Since African cookwares were mainly produced on the same sites as amphorae, it might follow that they were distributed together, giving us the opportunity to use them as a proxy for certain amphora-borne goods. Yet it is not clear to what extent this relationship existed outside Africa: limited evidence from shipwrecks suggests that they were transported together overseas, but for onward distribution the situation may have been different. N African cookwares are not distributed with amphora-borne goods in the Vinalopó valley, for instance,[151] and there appears to be no special relationship with amphorae from the survey evidence in the *département* of Var.[152] It seems, therefore, that

142 Bonifay 2004, 481.
143 Reynolds 1995, 112.
144 Fulford 1983, 11.
145 de Souza 1999, 225.
146 Scheidel 2011, 27.
147 Dore 1992, 155.
148 Lewit 2011, 327-30.
149 Reynolds, pers. comm.
150 Greene 1992, 58.
151 Reynolds 1993, 13.
152 Leitch 2011b; Brun 1999.

https://doi.org/10.1017/S1047759413000160 Published online by Cambridge University Press

there is little purpose in using N African cookwares as a proxy for trade in other goods, since the data are not clear or adequate, but what we know about their production technology and workshops and their distribution patterns does allow them to serve as a proxy for more general economic trends.

*Models of exchange*

The literature on Roman economic models is immense. I do not propose to create a new model for the economy based around evidence for the production and distribution of N African cookwares, for that would be to give them an exaggerated importance and assume that economic trends for one product can be exchanged for another. Instead, a selection of existing economic models will be tested against the evidence for N African cookwares to see what, if any, contribution N African cookwares can make to theories on the Roman economy.

The "consumer city" of M. I. Finley and R. P. Duncan-Jones,[153] and an economy based on the production, redistribution and consumption of agricultural produce, with little opportunity for trade other than in luxury items for the imperial élite, is now generally out of favour with archaeologists as it does not account for the massive movement over long distances of common, low-priced goods such as ceramic wares.[154] In this regard N African cookwares can help suggest where we should question and modify existing economic models.

P. F. Bang's theories emphasize the limitations of the economy during the Imperial period, when deficiencies in information and the domination of aristocratic agrarian interests affected the market and made it anything but sophisticated and regular.[155] He points out the difficulties with transport that meant "supply and demand were not easily paired".[156] The imitation of N African cookwares when demand for those cookwares outstripped available supplies demonstrates this point.[157] The dearth of N African cookwares at inland and rural sites outside Africa is probably connected to the difficulties and costs of transporting them. Bang envisions an economic model based on a loose system of networks that varied greatly in their strength and intensity, with no government policies to push market integration, meaning that the economy remained a fragmented but still well-functioning market régime, on the model of a modern "bazaar".[158] This, he considers, accounts for the Roman ability to cope with irregularities, and it allowed trade to be carried out privately and distributed in mixed loads. M. Silver, however, criticises Bang's understanding of the bazaar and underlines the importance of the ancient Roman system of institutions, oaths and public contractual rituals that underpinned and allowed for a well-organized market economy.[159] Bang's principal arguments for a "bazaar" economy are:
1) the parcelling of capital by merchants;
2) low standardisation of products;

153 Duncan-Jones 1974; Finley 1973.
154 Greene 1986, 14-16.
155 Bang 2006, 59.
156 Ibid. 61.
157 Spain: Aquilué Abadías 1987, 52; Sánchez-Sánchez 1995, 264 and 267. France: Mauné *et al.* 2006, 216; Pellecuer and Pomeredes 1991. Italy: Ikäheimo 2005. Britain: Keppie 1989, 58-60; Swan 1992.
158 Bang 2006, 78.
159 Silver 2009, 429.

3) opportunistic speculation; and
4) the formation of segmented social networks.[160]

The first point might be demonstrated through mixed, sometimes small, cargoes that may have been divided between several merchants — though merchants would also spread their loads on several ships to minimise risk in the event of a shipwreck, and mixed-product cargoes do not necessarily imply the involvement of more than one merchant. Still, this does not account for the large numbers of homogeneous forms and fabrics on some Mediterranean sites that point to large shipments from single production sites. N African cookwares are a model of standardisation, just as other ceramic tablewares and containers (amphorae, dolia), tiles, bricks, millstones, marble, and so on all became increasingly standardized from the Early Imperial period. Opportunistic speculation may have occurred in marketing as merchants sought to monopolise local cookware markets, which, given how cheap N African cookwares were to produce, gave them the ability to compete with local wares. It is also likely that merchants trading these wares belonged to communal networks, often with familial bonds, that stretched by way of the ports to different urban centres and even rural areas around the Mediterranean world, even if the main pattern of African cookwares going to coastal W Mediterranean sites suggests that the social networks were in some cases highly organized and not as fragmented and loose as Bang implies. Overall, the evidence of N African cookwares fits poorly with Bang's model. Several essential elements are missing: a recognition of the importance of state-driven trade through the supply of the *annona*, the existence of a partially integrated market that centred around the 'inner' Mediterranean core, and the importance of political unity that favoured low-cost, organized maritime trade.[161]

P. Horden and N. Purcell's *Corrupting Sea* tends to look at commerce ecologically. They see the empire as a "tessellation of spaces", a landscape of different local circumstances.[162] In their view, the different micro-ecologies and erratic climatic conditions made agriculture and self-sufficiency in the Mediterranean problematic and unpredictable, which led to the creation of alternative productions and new exchange networks to maintain the equilibrium. The Mediterranean was the key component in this wider level of exchange.[163] Bang counters this vision by pointing out that it does not take account of social and cultural demands, and that élites had no interest in creating an "ecological equilibrium", no more than the fact that it would not have been possible, even with Rome's new communications networks, perfectly to balance the needs of one region with another through the exchange of complementary goods.[164] This is correct, and the widespread imitation of N African cookwares[165] demonstrates where the demand for these goods could not in fact be met, perhaps because the merchants in certain areas were not part of African trade networks, or because they did not have the right information to direct supplies where they were called for. However, this does not negate Horden and Purcell's basic point, which ties in with W. Scheidel's "inner" Mediterranean concept, that the Romans created new exchange mechanisms that encouraged growth and prosperity.

160 Bang 2006, 80.
161 Scheidel 2011.
162 Horden and Purcell 2000, 80.
163 Ibid. chapts. 4-6 and 9 in particular.
164 Bang 2006, 57.
165 See n.157.

https://doi.org/10.1017/S1047759413000160 Published online by Cambridge University Press

P. Temin has championed the idea that the empire was a market economy.[166] He sees an inter-connected market system as the main force behind it. Yet he oversimplifies the process and negates the importance of peasant farming households, which, he believes, frequently remained outside these mechanisms. M. Silver has pointed out that farmers also rented out animals and sold their products and services for cash.[167] Indeed, there is evidence that peasants bought imported pottery: N African cookwares have been found in shepherds' huts in the plain of La Crau (dépt. Bouches-du-Rhône), close to the trade route of the Fossae Marianae and the Rhône,[168] as well as at the modest farm of Pla de l'Aïgo in a mountainous zone in Perpignan.[169] The main markets in towns and coastal areas were probably interconnected in an organised manner, but local/regional markets had their own dynamics, often separate from the larger centres, probably largely as a result of the cost of overland transport. This can be seen in the movement of N African cookwares within Africa: local and regional exchange of N African cookwares was very active, but these non-classic forms never became part of the wider export market because of the high cost of transporting them to ports.

K. Hopkins argued that trade was largely stimulated by taxation and the need for producers to cash their surplus to pay their taxes,[170] a model that is also consistent with the payment of taxes in kind. Tacitus (*Agr.* 18) reports that many Britons paid cash for grain so as to pay tax in kind. E. Lo Cascio underlines the complexity of the situation, with widespread trading, in cash and in kind, before taxation assumed great importance.[171] Still, their focus generally is perhaps too heavily on agriculture. At Leptiminus, for example, we see a town experiencing moderate growth through investment in non-agricultural production (e.g., cookwares) at a time when taxes needed to be paid and the demand for goods in Rome met.[172]

K. Greene looks for alternative explanations for increased trade through the growth of consumerism, instrumental in the development of the economy. He proposes that the surplus wealth created from essential production was used to increase production for private sale; he also sees artisanal industries such as ceramics as being designed to create more profit.[173] The consumer was driving production through specific demands, resulting from increased mobility and communications created by trade routes to military garrisons, links between multiple estates owned by a single landowner, or links between town and country through taxation.[174] In the case of N African cookwares, the demand was not based on necessity[175] — they could always be produced locally, even if not always of high quality; instead, they were a consumer item, the demand for which was culturally driven, and their success is connected to increased consumerism.

166 Temin 2001.
167 Silver 2009, 431.
168 Badan, Brun and Congès 1995.
169 Fabre *et al*. 1999.
170 Hopkins 1980, 101-5; id. 1995-96.
171 Lo Cascio 2007b, 646.
172 Stone and Mattingly 2011, 56, for a discussion on the relevance of Hopkins' model to Leptiminus.
173 Greene 2008, 69.
174 Ibid. 74 and 77.
175 Ibid. Greene considers necessary staples as "consumption" products, as opposed to "consumer" products which were commercially driven.

K. Dark investigated the theory of a proto-industrial Roman economy through a set of criteria, but still stressed the point that this can exist happily alongside a traditional agricultural economy.[176] His criteria were:
1) a money-based market;
2) clusters of rural, craft-based production aiming at markets beyond the area;
3) the use of urban centres for redistribution;
4) the use of traditional technologies; and
5) the use of standardisation.[177]
N African cookwares fit well into this model. They achieved mass production not through industrial type 'factories' but through well-organised, nucleated workshops producing standard products, both in towns and in the countryside, which argues against the theory of the consumer city. Although this production was "stimulated and controlled" by the needs of the state, Dark highlights the importance of production at the civilian level to support smaller towns. Leptiminus with its fishing, farming, ceramic production, and metalworking is a case in point.[178] Perhaps what also needs emphasising is the interconnectedness of the empire that allowed long-distance markets to flourish.

D. J. Mattingly's economic model is perhaps the best overall: rather than forcing the evidence into one specified type (tending typically towards either primitive or modern models), he suggests that the Roman imperial economy was a set of plural economies, with interconnected but separate functions and markets. He divides them into three main groups:
1) the imperial economy that was empire-wide and driven by monetization, taxation and the movement of supplies for the army and the *annona*;
2) the provincial economy that was localized around major towns and characterized by the distribution of local products; and
3) the extra-provincial economy that was empire-wide and involved the free-market movement of goods and the demand and consumption of imported items.[179]
His model accounts for state-organized long-distance trade and connectivity but equally acknowledges the presence of the free market working on an inter- and intra-provincial scale.

The huge presence of African oil amphorae at Rome, explained by the "imperial economy", offers an explanation for the massive export of N African cookwares to the capital as a result of subsidized transport costs: N African cookwares would have been transported both directly from N Africa to Rome and as return cargoes from Rome to different parts of the empire.[180] The internal provincial economy is well demonstrated by the movement of African cookwares within Africa: for instance, there is evidence for the export of N African cookwares from Leptiminus to Jerba,[181] and we find stylistic connections stretching broadly across Africa, demonstrating the idea of the "separate but interconnected" nature

176 Dark 2001, 20.
177 Ibid. 21.
178 Mattingly *et al.* 2011.
179 Id. 2007, 221. See also id. *et al.* 2011, 261-66.
180 The increased tonnage of ships in this period is also testament to the increase in traffic, allowing for the easy transport of ceramics that could fit into gaps between primary goods on large ships: Tchernia 2011b.
181 Mattingly *et al.* 2011, 252.

https://doi.org/10.1017/S1047759413000160 Published online by Cambridge University Press

of provincial trade. The presence of a free-market, extra-provincial economy is suggested by both the homogeneous African cargoes on wrecks off the south of France and the mixed cargoes in the Balearic Islands; these demonstrate trading networks outside the imperial distribution system that was centred on Rome, and explain the broad presence of African cookwares outside Italy. This may have been the main method of distribution of N African cookwares.

**Concluding discussion**

This study has examined both the production technology of and trade in N African cookwares. Both are fundamental to an understanding of their success and economic impact, which cannot be attributed to any single factor: N African cookwares were a product not only of their natural environment, which offered good quality, cheap materials, but also the specific political and economic systems into which they were incorporated and the commercial dynamics of those systems. This mirrors the situation with ARS, the success of which was a result of a "particular cluster of exceptional stimuli existing in combination".[182]

The initial success and growth of the cookware industry may have been connected to their high-quality technical composition. However, investment in workshops (both a sign of and a result of economic growth[183]) and the efficient organisation of production and standardisation, enabling them to be produced on a massive scale, may ultimately have been more important, along with the coastal location of production sites, giving them direct access to maritime trade networks.

These wares were first distributed in the Iberian peninsula, not in Italy, which puts the emphasis on commercial rather than state-driven trade (essentially directed to Rome). In the peak period of production and trade, N African cookwares seem to have been produced and distributed in the W Mediterranean. Their penetration was mostly at W Mediterranean coastal sites and well-connected urban areas inland which saw traffic in other goods directed towards them. Still, in some cases N African cookwares reached rural areas, which demonstrates not only involvement of the peasantry in commercial trade, but also the extent of Roman trade networks. Although N African cookwares relied on trade networks created for the distribution of state supplies and the subsidized transportation along those routes, their extensive movement beyond imperial supply lines shows that they were also integrated into commercial networks within and outside Africa that played a fundamental rôle in exchange mechanisms.[184]

The decline of the trade in cookwares in the late 4th to early 5th c. came more or less simultaneously in the Iberian peninsula and Italy. This suggests that the reasons for its decline were connected to wider imperial developments rather than changes in individual networks within particular provinces. Reasons for the decline include demographic change, political upheaval, and the relocation of production sites within Africa. They demonstrate the complexity of the structural elements underpinning Roman production and

182 Lewit 2011, 318.
183 Stone and Mattingly (2011, 55) underline the link between investment in workshops and economic growth at Leptiminus.
184 Mattingly 1988, 34-35, 52 and 56.

trade.[185] Ultimately, however, it was their dependence on N African amphora production, the low transaction costs of maritime trade under a unified empire, and the need to mass-produce owing to their low value that were factors in their decline and eventual demise, as growing instability in the 4th and 5th c. undermined those support mechanisms, which would be further damaged by the Vandal invasions.

Perhaps a major perceived change for those living in the Late Roman period was the decline of mass-produced consumer goods and the end of imperially controlled trade. The subsequent increase in private trade caused a splintering of networks, which had varied and sometimes adverse affects on the flow of goods. The decline in the trade of N African cookwares from the late 4th to the 5th c. anticipated the later changes and the gradual downturn in Mediterranean trade, demonstrating their value as a sensitive gauge for charting the course of the Roman economy.

Although no single product is sufficient to re-create the historical landscape, this investigation shows the considerable impact of these wares across Mediterranean markets; it also shows that pottery can be used to challenge existing theories and provide evidence to strengthen or refute proposed economic models, which must, however, must be treated as loose structures in need of continual testing and re-evaluating.

victoriamleitch@googlemail.com School of Archaeology and Ancient History, University of Leicester

**Acknowledgements**

This article is based on work carried out for my doctoral thesis. I am very grateful to Andrew Wilson for his support and direction of my research at Oxford University, and to Michel Bonifay who offered many useful insights and much-needed advice. This article has also greatly benefited from the advice of readers, particularly Paul Reynolds. The writing was carried out during my Fellowship held at the British School at Rome, and I would like also to extend my thanks to the School and its director, Christopher Smith.

**Bibliography**

Abadie-Reynal, C. 2007. *La céramique romaine d'Argos* (Athens).

Aguarod Otal, C. 1991. *Cerámica romana importada de cocina en la Tarraconense* (Zaragoza).

Ahmed, M. A. M. 2010. *Rural settlement and economic activity: olive oil and amphorae production on the Tarhuna plateau during the Roman period* (Ph.D. diss., University of Leicester).

Albarella, U., V. Ceglia and P. Roberts 1993. "S. Giacomo degli Schiavono (Molise): an early fifth century AD deposit of pottery and animal bones from central Adriatic Italy," *PBSR* 61, 157-230.

Albiach, R. *et al.* 1998. "La cerámica de época de Augusto procedente del relleno de un pozo de Valentia, Hispania Tarraconensis," in *SFECAG. Actes du Congrès d'Istres* 139-66.

Ampolo, C. *et al.* 1971. "La villa del Casale a Piazza Armerina. Problemi, saggi stratigrafica e altre ricerche," *MEFR* 83, 141-281.

Anselmino, L. *et al.* 1986. "Ostia. Terme del Nuotatore," in A. Giardina (ed.), *Societa romana e impero tardoantico* 3 (Rome) 45-82.

Aquilué Abadias, J. 1987. *Las cerámicas africanas de la ciudad romana de Baetulo (Hispania Tarraconensis)* (BAR S337; Oxford).

Aujaleu, A., M. Pasqualini and M. Savanier 2009. "Un quartier de Forum Iulii Ier-VIe s. ap. J.-C.: quartier des Moulins, ancien terrain Valmier (Fréjus, Var)," in J. Bérato and P. Excoffon (edd.), *Revue du Centre Archéologique du Var* (Fréjus) 81-122.

185 For arguments connected to transformations in the 5th c., cf. Reynolds 2010, 85 and 146, seeing decline as connected to the Vandal invasions, and Bonifay 2011, 733, who points to decline earlier than the Vandal upheavals due to demographic change and other economic factors.

Badan, O., J.-P. Brun and G. Congès 1995. "Les bergeries romaines de la Crau d'Arles. Les origines de la transhumance en Provence," *Gallia* 52, 263-310.

Bang, P. F. 2006. "Imperial bazaar: towards a comparative understanding of markets in the Roman empire," in id., M. Ikeguchi and H. G. Ziche (edd.), *Ancient economies, modern methodologies* (Bari) 51-88.

Baratte, F., F. Bejaoui and Z. Ben Abdallah 2009. *Recherches archéologiques à Haïdra* (CollEFR 18/3).

Barraud, D. *et al*. 1998. "L'industrie céramique de l'Antiquité tardive," in H. B. Hassen and L. Maurin (edd.), *Oudhna (Uthina). La redécouverte d'une ville antique de Tunisie* (Ausonius Mémoires 2) 139-67.

Bats, M. 1988. *Vaisselle et alimentation à Olbia de Provence* (RANarb suppl. 18).

Bats, M. 1994. "La vaisselle culinaire comme marqueur culturel: l'exemple de la Gaule méridionale et de la Grande Grèce (IV-1 s. av. J.-C.)," in Binder and Courtin 1994, 407-24.

Ben Moussa, M. 2007. *La production de sigillées africaines. Recherches d'histoire et d'archéologie en Tunisie septentrionale et centrale* (Barcelona).

Binder, D. and J. Courtin (edd.) 1994. *Terre cuite et société. La céramique, document technique, économique, culturel* (Juan-les-Pins)

Bonifay, M. 2004. *Etudes sur la céramique romaine tardive d'Afrique* (BAR S1301; Oxford).

Bonifay, M. 2011. "La céramique, indicateur de l'économie du basin méditerranéen du IIe au VIIe s.," *JRA* 24, 723-34.

Bonnet, C. *et al*. 2003. "Mobilier céramique du IIIe siècle à Lyon. Le cas de trois sites de la ville basse," in *SFECAG. Actes du Congrès de Saint-Romain-en-Gal*, 145-81.

Bost, J.-P. *et al.* 1992. *L'épave Cabrera III (Majorque)* (Paris).

Botte, E. 2009. *Salaisons et sauces de poissons en Italie du sud et en Sicile durant l'Antiquité* (Coll. Centre Jean Bérard 31; Naples).

Bowman, A. K. 1998. *Life and letters on the Roman frontier: Vindolanda and its people* (London).

Brun, J.-P. 1999. *Carte archéologique du Var* (Paris).

Buxeda I Garrigos, J. (ed.) 2005. *Late Roman coarse wares, cooking wares and amphorae in the Mediterranean* (BAR S1340; Oxford).

Carillo Diaz-Pinés, J. and J. Murillo Redondo 1994. "Un vertedero con céramica africana de cocina en Colonia Patricia," *L'Africa romana* 11, 1301-19.

Carrié, J.-M. and A. Rousselle 1999. "L'empire romain en mutation des Sévères à Constantin," *Nouvelle histoire de l'Antiquité* 10, 192-337.

Clarke, S. and D. Robinson 2011. "Geophysical survey," in D. Stone, D. J. Mattingly and N. Ben Lazreg (edd.), *Leptiminus (Lamta), report no. 3. The field survey* (JRA Suppl. 87) 91-120.

Coletti, C. 1998. "Ceramiche comuni dai contesti di Porto (VI e VII secolo)," in L. Saguì (ed.), *Ceramica in Italia: VI-VII secolo. Atti del Convegno in onore di John W. Hayes* (Florence) 410-17.

Dannell, G. 2002. "Law and practice: further thoughts on the organisation of the potteries at La Graufesenque," in M. Genin and A. Vernhet (edd.), *Céramiques de La Graufesenque et autres productions d'époque romaine, Nouvelles recherches* (Montpellier) 211-42.

Dark, K. 2001. "Proto-industrialization and the economy of the Roman empire," in M. Polfer (ed.), *L'artisanat romain: évolutions, continuités et ruptures (Italie et provinces occidentales)* (Montagnac) 19-29.

de Souza, P. 1999. *Piracy in the Graeco-Roman world* (Cambridge).

De Vos, M., S. Polla and E. Gliozzo 2005. "Pottery from rural settlements around Dougga," in Buxeda I Garrigos 2005, 481-94.

DeLaine, J. 2004. "Designing for a market: '*medianum*' apartments at Ostia," *JRA* 17, 146-76.

Dietler, M. and I. Herbich 1994. "Ceramics and ethnic identity: ethnoarchaeological observations on the distribution of pottery styles and the relationship between social contexts of production and consumption," in Binder and Courtin 1994, 459-72.

Di Vita, A. and A. Martin 1997. *Gortina* II: *Pretorio: il materiale degli scavi Colini 1970-1977* (Padua).

Dore, J. N. 1992. "First report on the pottery," in N. Ben Lazreg and D. J. Mattingly, *Leptiminus (Lamta): a Roman port city in Tunisia. Report no. 1* (JRA Suppl. 4) 115-56.

Duncan-Jones, R. P. 1974. *The economy of the Roman Empire: quantitative studies* (Cambridge).

Dyson, S. 1976. *Cosa: The utilitarian pottery* (MAAR 33).

Erdkamp, P. 2005. *The grain market in the Roman Empire* (Cambridge).

Fabre, V., V. Forest and J. Kotarba 1999. "Dépôts cultuels domestiques dans la ferme d'époque romaine du Pla de l'Aïgo (Caramany, Pyrénées-Orientales)," *RANarb* 32, 271-92.

Fentress, E. 2004. "Accounting for ARS: fineware and sites in Sicily and Africa," in J. F. Cherry and S. E. Alcock (edd.), *Side-by-side survey: comparative regional studies in the Mediterranean world* (Oxford) 147-62.

Fentress, E. and P. Perkins 1988. "Counting African red slip ware," in A. Mastino (ed.), *L'Africa Romana* 5 (Sassari) 205-14.
Finley, M. I. 1973. *The ancient economy* (London).
Foss, P. W. 1997. "Watchful lares: Roman household organisation and the rituals of cooking and eating," in R. Laurence and A. Wallace-Hadrill (edd.), *Domestic space in the Roman world: Pompeii and beyond* (JRA Suppl. 22) 197-218.
Foxhall, L. 2007. *Olive cultivation in ancient Greece* (Oxford).
Frova, A. 1973. *Scavi di Luni* II. *Relazione preliminare delle campagne di scavo 1972-1973-1974* (Rome).
Fulford, M. G. 1983. "Pottery and the economy of Carthage and its hinterland," *Opus* 2, 5-14.
Fulford, M. G. 1987. "Economic interdependence among urban communities of the Roman Mediterranean," *World Arch.* 19, 58-75.
Fulford, M. G. and D. P. S. Peacock 1984. *Excavations at Carthage: the British Mission*. I,2. *The Avenue du Président Habib Bourguiba, Salammbo: the pottery and other ceramic objects from the site* (Sheffield).
Garnsey, P. 1983. "Grain for Rome," in id., Hopkins and Whittaker 1983, 118-30.
Garnsey, P., K. Hopkins and C. R. Whittaker (edd.) 1983. *Trade in the ancient economy* (London).
Giardina, A. 2007. "The transition to late antiquity," in Scheidel, Morris and Saller 2007, 743-68.
Greene, K. 1986. *The archaeology of the Roman* economy (London).
Greene, K. 1992. *Roman pottery: interpreting the past* (Berkeley, CA).
Greene, K. 2008. "Consumption and consumerism in the Roman empire," *JRA* 21, 64-82.
Guéry, R. 1985. *La nécropole orientale de Sitifis* (Paris).
Harris, W. V. and K. Iara (edd.) 2011. *Maritime technology in the ancient economy: ship-design and navigation* (JRA Suppl. 84).
Hasaki, E. 2005. "The ethnoarchaeological project of the potters' quarter at Moknine, Tunisia, seasons 2000, 2002," in *Africa. Nouvelle série: séances scientifiques* (Tunis) 127-70.
Hayes, J. W. 1972. *Late Roman pottery* (London).
Hayes, J. W. 1976. "Pottery: stratified groups and typology," in J. Humphrey (ed.), *Excavations at Carthage conducted by the University of Michigan* vol. 1 (Ann Arbor, MI) 47-123.
Hayes, J. W. 1978. "Pottery report 1976," in J. Humphrey (ed.), *Excavations at Carthage conducted by the University of Michigan* vol. 3 (Ann Arbor, MI) 23-98.
Henein, N. 1997. *Poterie et potiers d'Al-Qasr* (Cairo).
Hopkins, K. 1980. "Taxes and trade in the Roman Empire (200 BC-AD 400)," *JRS* 70, 101-25.
Hopkins, K. 1995-96. "Rome, taxes, rents and trade," *Kodai* 6-7, 41-75.
Horden, P. and N. Purcell 2000. *The corrupting sea: a study of Mediterranean history* (Oxford).
Humphrey, J. H. (ed.) 2009. *Studies on Roman pottery of the provinces of* Africa Proconsularis *and* Byzacena *(Tunisia)* (JRA Suppl. 76).
Hurst, H. R. and S. P. Roskams 1984. *Excavations at Carthage: the British Mission* I.1. *The Avenue du Président Habib Bourguiba, Salammbo. The site and finds other than pottery* (Sheffield).
Ikäheimo, J. P. 2003. *Late Roman African cookware of the Palatine East excavations, Rome: a holistic approach* (BAR S1143; Oxford).
Ikäheimo, J. P. 2005. "To imitate or to specialize? African imports and the production of domestic cookwares in Rome AD 50-550," in P. Attema, A. Nijboer and A. Zifferero (edd.), *Communities and settlements from the Neolithic to the Early Medieval period* (BAR S1452; Oxford) 390-96.
Kehoe, D. P. 2007. "The Early Roman Empire: production," in Scheidel, Morris and Saller 2007, 543-69.
Keppie, L. J. F. 1989. "The fate of the Ninth Legion: a problem for the eastern provinces?" in D. H. French and C. S. Lightfoot (edd.), *The eastern frontier of the Roman empire* (BAR S553; Oxford) 247-55.
Laurence, R. 1998. "Land transport in Roman Italy: costs, practice and the economy," in Parkins and Smith 1998, 129-48.
Leitch, V. 2010. *Production and trade of Roman and Late Roman African cookwares* (D.Phil., Univ. of Oxford).
Leitch, V. 2011a. "Location, location, location: characterizing coastal and inland production and distribution of Roman African cooking wares," in D. Robinson and A. I. Wilson (edd.), *Maritime archaeology and ancient trade in the Mediterranean* (Oxford) 167-92.
Leitch, V. 2011b. "Harbour to desert, emporium to sanctuary: trade in North African cookwares," in *Proc. XVII Congresso Int. di Archeologia Classica* (http://151.12.58.75/archeologia/bao_document/articoli/2_LEITCH.pdf).
Lewit, T. 2011. "Fineware production and trade: the puzzle of supra-regional exporters," *JRA* 24, 313-32.

Lo Cascio, E. 2007a. "La vita economica e sociale delle città romane nella testimonianza del Satyricon," in L. Castagna and E. Lefèvre (edd.), *Studien zu Petron und seiner Rezeption* (Berlin) 3-14.
Lo Cascio, E. 2007b. "The Early Roman Empire: the state and the economy," in Scheidel, Morris and Saller 2007, 619-49.
Mackensen, M. 1993. *Die spätantiken Sigillata- und Lampentöpfereien von El Mahrine (Nord-Tunesien)* (Munich).
Mackensen, M. 2009. "Technology and organisation of ARS ware production-centres in Tunisia," in Humphrey 2009, 17-44.
Marlière, E. and J. Torres Costa 2005. "Tonneaux et amphores à Vindolanda: contribution à la connaissance de l'approvisionnement des troupes stationnées sur le mur d'Hadrien (II)," in A. Birley and J. Blake (edd.), *Vindolanda: the excavations 2003-2004* (Bardon Mill) 214-36.
Marlière, E. and J. Torres Costa 2007. "Transport et stockage des denrées dans l'Afrique romaine: le rôle de l'outre et du tonneau," in Mrabet and Remesal Rodríguez 2007, 85-106.
Massabò, B. 1999. *Dalla villa al villaggio: Corti: scavo di un sito archeologico di età romana e altomedievale lungo il metanodotto del Ponente ligure* (Genoa).
Mattingly, D. J. 1988. "Oil for export? A comparison of Libyan, Spanish and Tunisian olive oil production in the Roman empire," *JRA* 1, 33-56.
Mattingly, D. 2007. "Supplying Rome and the empire: some conclusions," in E. Papi (ed.), *Supplying Rome and the empire* (JRA Suppl. 69) 219-27.
Mattingly, D. (ed.) 2010. *The archaeology of Fazzan,* vol. 3: *excavations of C. M. Daniels* (London).
Mattingly, D. J. *et al*. 2011. "Economy," in Stone, Mattingly and Ben Lazreg 2011, 205-72.
Mauné, S. *et al.* 2006. "Consommation et approvisionnement culinaires dans la région de Béziers au 3e s: l'exemple de la villa de Lieussac (Montagnac, Hérault)," in S. Mauné and M. Genin (edd.), *Du Rhône aux Pyrénées: aspects de la vie matérielle en Gaule Narbonnaise (fin du 1er s. av. J.-C. – 6e s. ap. J.-C.)* (Montagnac) 201-26.
Middleton, P. 1980. "La Graufesenque: a question of marketing," *Athenaeum* 58, 186-91.
Moliner, M. 1996. "Les céramiques communes à Marseille d'après les fouilles récentes," in M. Bats (ed.), *Les céramiques communes de Campanie et de Narbonnaise: la vaisselle de cuisine et de table* (Cahiers du Centre Jean Bérard 19; Naples) 237-55.
Monacchi, D. 1990. "Lugnano in Taverina. Locale Poggio Gramignano — Saggi di scavo di una villa rustica romana," *NSc* 40-41, 5-35.
Montana, G. *et al.* 2007. "Pantellerian ware: a comprehensive archaeometric review," *Archaeometry* 49, 455-81.
Morley, N. 2007. "The Early Roman Empire: distribution," in Scheidel, Morris and Saller 2007, 570-91.
Mrabet, A. and J. Remesal Rodríguez (edd.) 2007. In Africa et in Hispania: *études sur l'huile africaine* (Barcelona).
Navarro Luengo, I., L.-E. Fernández Rodríguez and J. Suárez Padilla 1997. "Cerámicas comunes de época tardorromana y bizantina en Málaga," *Figlinae Malacitanae. La producción de cerámica romana en los territorios malacitanos* (Málaga) 79-93.
Nonnis, D. and C. Ricci 2007. "Supplying the Roman army. La *legio II Augusta* in Britannia: il contributo dei materiali iscritti," in E. Papi (ed.), *Supplying Rome and the empire* (JRA Suppl. 69) 193-208.
Olcese, G. 1993. *Le ceramiche comuni di Albintimilium. Indagine archeologica e archeometrica sui materiali dell'area del Cardine* (Florence).
Parkins, H. and C. Smith (edd.) 1998. *Trade, traders and the ancient city* (London).
Paterson, J. 1998. "Trade and traders in the Roman world: scale, structure and organisation," in Parkins and Smith 1998, 149-67.
Peacock, D. P. S. 1980. "The Roman millstone trade: a petrological sketch," *World Arch.* 12, 43-53.
Peacock, D. P. S. 1982. *Pottery in the Roman world: an ethnoarchaeological approach* (London).
Peacock, D. P. S. 1984a. "Ceramic building materials," in Fulford and Peacock 1984, 242-46.
Peacock, D. P. S. 1984b. "Petrology and origins," in Fulford and Peacock 1984, 6-28.
Peacock, D., F. Bejaoui and N. Ben Lazreg 1989. "Roman amphora production in the Sahel region of Tunisia," in *Amphores romaines et histoire économique* (CollEFR 114) 179-222.
Pellecuer, C. and H. Pomeredes 1991. "La céramique commune 'Brune Orangée Bitteroise': une production languedocienne des IIe-IIIe s. ap. J.-C.," *SFECAG. Actes du congrès de Cognac* 365-83.
Peña, J. T. 1998. "The mobilization of state olive oil in Roman Africa: the evidence of late 4th-c. ostraca from Carthage," in *Carthage papers* (JRA Suppl. 28) 117-238.
Peña, J. T. 2007. *Roman pottery in the archaeological record* (Cambridge).
Pentiricci, M. *et al.* 1998. La villa suburbana di uadi er-Rsaf (Leptis Magna): il contesto ceramico di età antonina," *LibAnt* n.s. 4, 41-98.

Picard, G.-C. and A. Bourgeois 1977. "Sondage II sous la mosaique 10 dite au boucliers: le four de potier," in G.-C. Picard (ed.), *Recherches franco-tunisiennes à Mactar: La maison de Vénus* (Paris) 97-126.

Polak, M. 1998. "Old wine in new bottles. Reflections on the organization of the production of terra sigillata at La Graufesenque," in J. Bird (ed.), *Form and fabric: studies in Rome's material past in honour of B. R. Hartley* (Oxford) 115-22.

Polfer, M. 2001. "L'archéologie de l'artisanat et le débat sur la nature de l'économie romaine: quelques réflexions critiques," in id. (ed.), *L'artisanat romain: évolutions, continuités et ruptures (Italie et provinces occidentales)* (Luxembourg) 7-18.

Pomey, P. 2011. "Les conséquences de l'évolution des techniques de construction navale sur l'économie maritime antique: quelques exemples," in Harris and Iara 2011, 39-55.

Poulsen, E. 2000. "Trade and communication: the pottery aspect," in P. Ørsted (ed.), *Africa Proconsularis. Regional studies in the Segermes valley of northern Tunisia* vol. 3 (Aarhus) 225-91.

Pucci, G. 1983. "Pottery and trade in the Roman period," in Garnsey,Hopkins and Whittaker 1983, 105-17.

Raepsaet-Charlier, M.-T. and G. Raepsaet 1988. "Aspects de l'organisation du commerce de la céramique sigillée dans le Nord de la Gaule aux IIe et IIIe siècles de notre ère. II: négociants et transporteurs. La géographie des activités commerciales," *MBAH* 7.2, 45-69.

Rebuffat, R. 1976-77. "Bu Njem 1972," *LibAnt* 13-14, 37-78.

Remesal Rodríguez, J. 2007. "Oleum afrum e hispanum," in Mrabet and Remesal Rodríguez 2007, 315-28.

Revilla Calvo, V. 2007. "Les amphores africaines du IIème et IIIème siècles du Monte Testaccio (Rome)," in Mrabet and Remesal Rodríguez 2007, 269-98.

Reynolds, P. 1993. *Settlement and pottery in the Vinalopó valley (Alicante, Spain): AD 400-700* (BAR S588; Oxford).

Reynolds, P. 1995. *Trade in the western Mediterranean AD 400-700: the ceramic evidence* (BAR S604; Oxford).

Reynolds, P. 2010. *Hispania and the Late Roman Mediterranean: ceramics and trade* (London).

Ricci, A. 1986. "Cosa e i suo territorio (Etruria). Il contesto di Settefinestre," in A. Giardina (ed.), *Società romana e impero tardoantico,* vol. 4. *Le merci, gli insediamenti* (Rome) 83-87.

Rickman, G. 1980. *The corn supply of ancient Rome* (Oxford).

Riley, J. A. 1979-80. "Industrial standardization in Cyrenaica during the second and third centuries AD: the evidence from locally manufactured pottery," *LibStud* 11, 73-78.

Rougé, J. 1965. "Les relations de Lyon et de la mer, à propos de CIL XIII, 1942," in *Actes du 89e Congrès des Sociétés Savantes* (Lyon) 137-52.

Rougé, J. 1981. *Ships and fleets of the ancient Mediterranean* (Middletown, CT).

Rye, O. S. 1981. *Pottery technology: principles and reconstruction* (Washington, DC).

Saguì, L. 1980. "Ceramica africana della villa di Tiberio a Sperlonga," *MEFRA* 92, 471-544.

Salama, P. 1951. *Les voies romaines de l'Afrique du Nord* (Alger).

Salomies, O. 2002. "People in Ostia. Some onomastic observations and comparisons with Rome," in C. Bruun and A. Gallina Zevi (edd.), *Ostia e Portus nelle loro relazioni con Roma* (ActInstRomFinl 27) 161-92.

Sánchez-Sánchez, M. 1995. "Producciones importadas en la vajilla culinaria romana del Bajo Guadalquivir," *Ceràmica comuna romana d'època altoimperial a la Península Ibérica. Estat de la questió* (Monografies Emporitanes 8) 251-79.

Schaad, D. 2007. *La Graufesenque (Millau, Aveyron)* vol. 1 (Pessac).

Scheidel, W. 2011. "A comparative perspective on the determinants of the scale and productivity of Roman maritime trade in the Mediterranean," in Harris and Iara 2011, 21-37.

Scheidel, W., I. Morris and R. Saller (edd.) 2007. *The Cambridge economic history of the Greco-Roman world* (Cambridge).

Schlippschuh, O. 1974. *Die Händler im römischen Kaiserreich in Gallien, Germanien und den Donauprovinzen Rätien, Noricum und Pannonien* (Amsterdam).

Sherriff, B. L. *et al*. 2002. "The source of raw materials for Roman pottery from Leptiminus, Tunisia," *Geoarchaeology* 17.8, 835-61.

Silver, M. 2009. "Historical otherness, the Roman bazaar, and primitivism: P. E. Bang on the Roman economy," *JRA* 22, 421-43.

Sirks, J. B. 2008. *Food for Rome: the legal structure of the transportation and processing of supplies for the imperial distributions in Rome and Constantinople* (Amsterdam).

Slane, K. 1990. *Corinth: the sanctuary of Demeter and Kore, the Roman pottery and lamps* (Princeton, NJ).
Stirling, L. and N. Ben Lazreg 2001. "A Roman kiln complex (site 290): preliminary results of excavations," in Stirling, Mattingly and Ben Lazreg 2001, 219-35.
Stirling, L., D. Mattingly and N. Ben Lazreg (edd.) 2001. *Leptiminus (Lamta), Report no. 2* (JRA Suppl. 41).
Stone, D. 2009. "Supplying Rome and the empire: the distribution of stamped amphoras from Byzacena," in Humphrey 2009, 127-50.
Stone, D. and D. J. Mattingly 2011. "Moderate economic growth in a port city: investment and workshops at Leptiminus," *Facta* 5, 31-64.
Stone, D., D. J. Mattingly and N. Ben Lazreg 2011. *Leptiminus (Lamta), Report no. 3. The field survey* (JRA Suppl. 87).
Swan, V. 1992. "Legio VI and its men: African legionaries in Britain," *JRomPotStud* 5, 1-34.
Tchernia, A. 1986. *Le vin d'Italie romaine: essai d'histoire économique d'après les amphores* (BEFAR 261).
Tchernia, A. 2011a. *Les Romains et le commerce* (Naples).
Tchernia, A. 2011b. "L'utilisation des gros tonnages," in Harris and Iara 2011, 83-88.
Temin, P. 2001. "A market economy in the early Roman empire," *JRS* 91, 169-81.
Tomber, R. 1988. "Pottery from the 1982-83 excavations," in J. Humphrey (ed.), *The circus and Byzantine cemetery at Carthage* vol. 1 (Ann Arbor, MI) 437-519.
Tomber, R. 1993. "Quantitative approaches to the investigation of long-distance exchange," *JRA* 6, 142-67.
Veal, R. 2012. "From context to economy: charcoal as an archaeological interpretative tool. A case study from Pompeii, 3rd c. B.C. to A.D. 79," in I. Schrüfer-Kolb (ed.), *More than just numbers? The role of science in Roman archaeology* (JRA Suppl. 91) 19-52.
Vegas, M. 1994. "Céramiques," in F. Rakob (ed.), *Simitthus* II. *Der Tempelberg und das römische Lager* (Mainz) 142-243.
Vernet, A. 1981. "Un four de la Graufesenque (Aveyron): la cuisson des vases sigillés," *Gallia* 39, 26-43.
Warmington, B. 1954. *The North African provinces from Diocletian to the Vandal conquest* (Cambridge).
Whittaker, C. R. 1983. "Late Roman trade and traders," in Garnsey, Hopkins and Whittaker 1983, 163-80.
Wilson, A. I. 2011a. "Developments in Mediterranean shipping and maritime trade," in D. Robinson and A. I. Wilson (edd.), *Maritime archaeology and ancient trade in the Mediterranean* (Oxford) 33-60.
Wilson, A. I. 2011b. "The economic influence of developments in maritime technology in antiquity," in Harris and Iara 2011, 211-34.
Wilson, A. I. 2011c. "City sizes and urbanisation in the Roman Empire," in A. K. Bowman and A. I. Wilson (edd.), *Settlement, urbanisation and population* (Oxford Studies in the Roman Economy 2).
Wilson A. I., K. Schörle and C. Rice 2012. "Roman ports and Mediterranean connectivity," in S. Keay (ed.), *Rome, Portus and the ports of the Roman Mediterranean* (London) 367-91.