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BALANCING THE TRADE: ROMAN CARGO SHIPMENTS TO INDIA

Summary. There has been a continuing debate about the extent to which the Roman Empire suffered an economic imbalance in its trade with India (and more broadly the East), that is to say whether in volume or value the Roman Empire imported more than it exported. This imbalance is often thought to be manifested in the export of Roman gold and silver to India and the connected notion that other goods from the Roman Empire were seen as merely items of ballast. It is the intention of this article to place this debate in a practical context by demonstrating not only the physical need for mixed cargoes on ships sailing to India, but also the negligible amount of space taken up by the gold and silver. It is argued that in terms of volume (if not value) goods in-kind were far more significant.

The Indian Ocean and its seasonal monsoon weather patterns have enabled contact and seaborne trade to take place between various civilisations on its peripheries for millennia. At its western end the Persian Gulf and the Red Sea connect the Middle-East and the Mediterranean worlds into this sphere. Thus with the annexation of Egypt by Augustus in 30 BC the Roman Empire acquired direct access to the Red Sea and wider Indian Ocean. Egypt had already acted as a conduit for trade between the Mediterranean and Indian Ocean spheres prior to this period, and indeed many of the major routes across the Eastern Desert of Egypt and the Red Sea ports had already been established under the Ptolemies. Nevertheless, the Roman period would see a much greater level of western participation in the Indian Ocean trade than hitherto been the case (Cobb 2011, 34-78). Merchants from the Roman Empire were operating alongside those from India, Arabia, Persia and Axum, among other places.

Various goods were imported into the Mediterranean from India and other lands connected by the Indian Ocean. These included textiles like cotton and silk, aromatics and spices, animals such as parrots, as well as precious and semi-precious stones. The range and origins (or rather the ports of acquisition) of these goods are attested by our main direct literary source for this trade, the anonymous author of the *Periplus Maris Erythraei* (henceforth *PME*). This author appears to have been a Greco-Egyptian merchant who personally participated in this trade around the mid-first century AD and is generally regarded as reliable (Casson 1989, 6-8; Cribb 1992, 131-145; Turner and Cribb 1996, 318; Seland 2010, 13). In addition to the testimony of the *PME*, the import of a number of these goods, including organic material, is attested by recent archaeological excavations at the sites of Myos Hormos (modern Quseir al-Qadim) and Berenike (on the cape of Ras Banas). These were the two major ports in use on the Egyptian Red Sea coast during the Imperial period as evinced both by written testimony (Strabo 17.1.45; Pliny *NH* 6.26.102-03; Nikanor Archive - *O. Petr.* 220-304; Koptos Tariff - *OGIS* 674 = *IGRR* I. 1183 = *I. Portes* 67), and by the comparative number of material finds at these ports. At Berenike the excavators found remains such as coconut, thousands of black peppercorns (Cappers 2006, 108-09, 111-19), sandalwood (Sidebotham 2011, 240), as well as precious stones like agates, beryl, carnelian, onyx, and blue corundum (Wendrich et al 2003, 55). Similarly at Myos Hormos finds of black pepper, rice, and coconut have been uncovered (van der Veen, Cox, and Morales 2011, 227-29), as have precious stones like amethyst and jadeite (Peacock 2011, 121-124).

The various contexts in which these goods might have been used in the Roman Empire were extensive, ranging from health and cuisine, to religious worship, and these uses were often coupled with a concern for social display and status (Sidebotham 1986, 45, 176; Cobb 2013). The costs of these imports ranged widely with some spices, like pepper (costing four denarii per *libra* = 0.329kg), being comparatively cheap compared to the 150,000

sesterces (37,500 denarii) which one Roman mistress spent on a ladle made of rock-crystal (see Pliny *NH* 12.14.26-29, 37.10.29). However, generally information about the cost of imports from the Indian Ocean trade in the Roman period is limited and patchy, while data about the monetary or barter value of Roman goods in India is non-existent. Nevertheless, there have been some attempts at estimating a plausible scale of wealth being spent on these imports. One fragmentary document known as the Muziris Papyrus (mid-second century AD) records on its verso a cargo of imported ivory, cloth and nard (other goods missing from our fragmentary document were, no doubt, imported alongside these) valued at 1,154 Egyptian talents and 2,852 drachmae (almost seven million sesterces). The cargo (which we know about) weighing around 3.18 metric tonnes (*P. Vindob G 40822 Verso* – Casson 1990; Rathbone 2000). Sidebotham has used this figure in conjunction with estimated ship capacities and a statement of Strabo that each year 120 ships sailed to India from Myos Hormos to suggested that the cost of imports might have reached 17.64 billion Egyptian drachmae (equal to 17.64 billion sesterces) annually (Sidebotham 2011, 218). The problem, which Sidebotham admits, is that we cannot know if the remainder of the cargo space would have been taken up by goods of equivalent values to those mentioned in the Muziris Papyrus. Moreover, given that various estimates put Roman GDP at somewhere between 9-20 billion sesterces in the Imperial period (Scheidel and Friesen 2009), Sidebotham's figure may be an overestimation.

Whatever the scale of importation of these Indian goods, it is the means by which they were paid for which has been the subject of a great deal of debate. It has been frequently argued that the Roman Empire relied heavily upon the export of gold and silver (as coins/bullion), principally to southern India, in the belief that many Indian cultures were less willing to accept Roman wares (see for example Warmington 1928, 271-318; Miller 1969, 216-22; Raschke 1978, 672-73; Casson 1989, 30-31; P. Gupta 1991, 125). More recently

some scholars, though accepting that a certain outflow took place, downplay its significance by suggesting that the Roman Empire had sufficient supplies of bullion/coins and lost more to other regions like Central and Eastern Europe (Tchernia 1995, 1003; Young 2001, 203-04, 270-72; McLaughlin 2010, 168-69; Fitzpatrick 2011, 34, 49). Another assumption connected to this is that in either volume or value, the Roman Empire imported more than it exported, consequently suffering a trade imbalance with India, and other eastern societies. This notion has persisted both in older and more recent scholarship (see for example, West 1917, 47-48; P. Thomas 1926, 8; Warmington 1928, 293, 313-318; Rostovtzeff (revised by Fraser) 1957, 67, 97; Miller 1969, 20, 222; Raschke 1978, 632-65, 650, 669; Singh 1988, 2, 98; Casson 1989, 17-18; Thapar 2002, 243; Strauss 2007, 251, 264; Parker 2008, 183-86; Smith 2009, 97-98; Seland, 2010: 53; Fitzpatrick 2011, 31-32, 48, 53-54); although some have shown scepticism about whether such a position can be taken without detailed statistics, or any sense that the Romans conceived of the idea of a balance of trade (Sidebotham 2011, 245-49).

It is not doubted here that gold and silver (especially in the form of coinage) were exported to India. However, this article seeks to examine this issue from a different angle by looking at what this meant in terms of the practicalities involved in shipping goods to India. In particular, it is argued that the physical space required to ship gold and silver was negligible and that out of necessity most of the cargo space would have been filled up with goods in kind. In addition many of these goods were not simply items of ballast, but prized objects which had to be balanced with denser commodities like metal ingots. Moreover, it is argued from the archaeological distribution of some of these Roman goods in the Indian subcontinent that these items were widely sought after, and not mere supplements to the export of gold and silver.

THE EVIDENCE

The idea that the Roman Empire suffered an outflow of gold and silver to India can be attributed to a few comments in both western and Indian sources. The author of the *PME* (49, 56) refers to merchants being able to exchange Roman gold and silver coins (*dēnarion khrusoun khai arguroun*) at a profit with the local currency at the port of Barygaza (Bharuch – Gujarat); while at Muziris, and Bakarē from where goods are brought upriver to Nelkynda (Kerala), there was a demand for a great amount of money (*khrēmata pleista*). The latter comment seems to be supported by Tamil literature, especially the epic poems of the Sangam corpus (c. third century BC to fifth century AD). One such poem refers to Yavanas coming in their great vessels exchanging gold for pepper (Tayan-Kannanar *Agam* lines 7-11 - Sidebotham 1986, 23-24, 29, 31; Ray 1988, 313). The term Yavana by the early centuries AD is generally considered to denote peoples from the eastern Mediterranean or western Asia (Ray 1988, 312; Ball 2000, 126). These comments would seem to give the impression that gold and silver was important, but they cannot give a precise sense of scale. Furthermore the author of the *PME* seems to indicate that coins are being transported rather than non-coined bullion. He (*PME* 39, 49) does mention crafted silverware being accepted at the Barbarikon (costal area of the Sind) and Barygaza. No such silverware has so far been found in the subcontinent, but a few objects of gold have, like a golden statuette of Aphrodite at Sirkap/Taxila in Pakistan (Cambon 2011, 154), two gold finger rings in a hoard of Tiberian denarii at Vellalur (Coimbatore) and a pendant with engraved head in the style of a Greco-Roman matron at Kampelayam in Tamilnadu (Suresh 2004, 146-49; Map 1). These crafted goods would undoubtedly have fetched high prices, no doubt more than their metallic value otherwise there would have been little incentive to export them instead of ingots or coins.

In addition to the literary testimony, around 6,000 Roman denarii and well over 1,000 aurei (perhaps around 10,000 if the nineteenth-century reports on the lost Kottayam hoard are

correct) have been discovered as part of hoards (mainly), stray-finds or in excavations in the Indian subcontinent. These finds are particularly concentrated in the Coimbatore district of southern India and around the Krishna River in central-eastern India (Turner 1989; MacDowall 1991 and 1996; Suresh 2004; Map 2). Some scholars have cited the presence of these coins as an indicator of a Roman trade imbalance with India (Miller 1969, 216-17; Raschke 1978, 632-35). However, this position is difficult to defend as these coin finds can only constitute evidence for their presence and distribution, not the overall volume of gold and silver coins exported, nor its relation to the amount and value of goods in kind which were exported alongside them. Also it cannot take account of the extent to which non-coined bullion was exported (Sidebotham 1986, 46; Sidebotham 2011, 245; Young 2001, 205). Moreover, the dates at which these coins were exported (around 65% of the identifiable denarii and aurei were minted under Julio-Claudian emperors) are subject to a great deal of debate on the basis of their state of wear, distribution and patterns within the hoard finds (Cobb 2011, 229-258; Turner 1989; MacDowall 1991 and 1996; Suresh 2004; Burnett 1998, 182; J. Meyer 2007, 60). Ultimately these coin finds can only indicate that they were prized, and not necessarily purely as bullion, but also potential items of gift exchange, and items to be converted into jewellery, like necklaces, as a number of examples attest (Suresh 2004, 77-81; Sidebotham 2011, 246).

PLINY'S FIGURES

Perhaps the most frequently cited basis for arguing that the Roman Empire suffered an imbalance of trade with India and the East are two comments by Pliny the Elder:

‘And it will not be amiss to set out the whole of the voyage from Egypt, now that reliable knowledge of it is for the first time accessible. It is an important

subject, in view of the fact that in no year does India absorb less than fifty million sesterces of our empire's wealth, sending back merchandise to be sold with us at a hundred times its prime cost.' (Pliny *NH* 6.26.101 – trans. Rackham 1942).

'But the title 'happy' belongs still more to the Arabian Sea, for from it come the pearls which that country sends us. And at the lowest reckoning, India, China, and the Arabian peninsula take from our empire 100 million sesterces every year - this is the sum which our luxuries and our women cost us.' (Pliny *NH* 12.41.84 – trans. Rackham 1945).

These figures usually elicit two broad responses, either their rejection as fallacious or their acceptance as plausible numbers, potentially based on administrative records. This contention is exacerbated by the fact that it is not possible to be precise about what the figures refer to. Warmington (1928, 275-76) noted the debate among his contemporaries about whether these figures represented both overland and seaborne commerce with India or just the pearl trade alone. He felt that they represented only the seaborne trade via the Indian Ocean, and that the numbers concerned the trade deficit not the total cost of imports. More recently Young (2001, 210) speculated that these figures could potentially be based on the tax receipts the government collected at Alexandria after merchant paid the 25% tax (*tetarte*) on imported Indian Ocean goods. Unfortunately, no such records have yet to come to light, and this notion is complicated by the fact that the *tetarte* seems to have been collected in-kind (Rathbone 2000, 47). It seems reasonable to suggest that the first statement refers to trade via the Indian Ocean, give that it is made in the context of Pliny's description of routes taken and schedules adhered to by merchants going from Alexandria to India and back (*NH* 6.26.101-106).

Whether Pliny would be a credible witness to this purported “outflow” of wealth has also been subject to fierce debate. Some have felt that because Pliny served as a procurator and was closely associated with the court of Vespasian he may have had access to such figures (Miller 1969, 223-24; Frank 1940, 282; McLaughlin 2010, 13, 160). In contrast, Raschke (1978, 634-35, 767 n.530) regarded them as entirely spurious, and doubted Pliny’s competence in such matters. Attempts to prove or discredit Pliny’s figures with reference to any knowledge or understanding he may have gleaned from his career rest on improvable assumptions and are probably best avoided. Since he is not explicit about the sources of information for these claims, their reliability will remain an unresolved issue.

Recently these figures have tended to be regarded as fitting into a broader moralising *topos* common in ancient sources about the negative effects of spending wealth on *luxuria* (Raschke 1978, 605, 634-35; Sidebotham 1986, 46; Young 2001, 205; Sidebotham 2011, 246; Fitzpatrick 2012, 32). This seems correct given frequent complaints (exaggerated or not) about the dissipation of the elites’ *patrimonia*, especially on women’s finery, which Tiberius purportedly complained was the cause of the outflow of wealth to foreigners and enemies (Tacitus *Ann.* 3.53; see also Seneca *NQ* 1.17.8-9; Juvenal 6.464-66, 509). However, moralising or not these comments need not be seen as disingenuous, but probably represent anxiety about the social stability of the elite, rather than the economic welfare of the Roman Empire. Indeed, much of the money spent by consumers in the Roman Empire on these goods would remain in the hands of merchants, financiers, and the government through taxes (Young 2001, 203-04; Sidebotham 2011, 245-29). Such moralising need not automatically undermine the sources’ credibility (Millar 2006, 279-80). In fact, Parker (2008, 183-84) argues that Pliny’s first statement (*NH* 6.26.101) is actually neutral in tone. He suggests in the light of the Muziris Papyrus (see above) and the comments of Strabo’s (*Geog.* 2.5.12) about 120 vessels sailing annually to India that Pliny’s figures look plausible (Parker 2008, 186). In

addition to this, Fitzpatrick (2011, 31) suggests that 100 million sesterces would only represent 1% of Roman GDP (of an estimated 10 billion sesterces).

Nevertheless, it is questionable whether these arguments are supportable, given that there is no certainty about what Pliny's figures represent nor about whether they refer to the overall cost of imports, the trade deficit (i.e. cost of imports minus the value of exports), or the amount of money spent within the Empire on such goods? It is important to note Pliny speaks in terms of sesterces (brass) rather than silver denarii or gold aurei. Thus it cannot be assumed that he necessarily has the outflow of gold and silver in mind (Sidebotham 1989, 36-37; Millar 2006, 280). Ultimately, due to uncertainty over what Pliny's figures represent or his sources of information they cannot be used to argue that the Roman Empire suffered a trade deficit or haemorrhaged large quantities of gold and silver in its trade with India.

THE PRACTICALITY OF COINAGE/BULLION EXPORT

Despite rejecting the notions that Pliny's figures represent a trade deficit or a large-scale outflow of gold and silver it is still worth considering the practical implication of transporting 50 million sesterces in the equivalent of aurei (Roman gold coins) or denarii (Roman silver coins). The purpose of this exercise is to demonstrate that gold or silver would have taken up a negligible amount of space in a ship's cargo hold. These calculations are done on the basis of denarii and aurei as thousands have been found in India (while bullion in the form of ingots or bars understandably has not), and because the author of the *PME* mentions gold and silver being exported either in the form of money (*dēnarion*, *chrēma*, *chrēmata*) or as crafted-wares. The methodological approach utilised here is similar to that employed by Millar (2004, 93-94) when he calculated the labour and capacity needed to transport taxes to Rome.

Taking Pliny's figure that India absorbs 50 million sesterces from the Roman Empire this would be the equivalent of 12.5 million denarii or 500,000 aurei. On the basis that a

freshly minted denarius notionally weighed 3.9 grams (g) prior to AD 64, and then assuming 12.5 million of these were exported to India, their weight would equal 48.75 metric tonnes (t). Again on the same principle, a freshly minted aureus (pre-AD 64) weighed 8g and thus 500,000 of these would weigh 4t. The reduction in weight of the aureus and denarius (and also purity for the latter), would further reduce the overall weight of transporting these coins; though almost no post-AD 64 denarii are present in India (see Turner 1989, 26; MacDowall 1991, 149; MacDowall 1996, 89). It is worth bearing in mind that these coins would have been largely acquired from those within circulation (they would on average have a slightly reduced weight due to wear), and would have potentially posed a significant organisational challenge to those financing and conducting their export to India (Cobb 2011, 267-69).

The vessels used by merchants from the Roman Empire in the Indian Ocean trade were similar to those used in the Mediterranean, as is clear from the archaeological, pictorial, and written evidence (see Sidebotham 1996, 315-17; Sidebotham 2011, 197; Blue 2009, 6; Blue, Hill and Thomas 2012, 91). Most Greco-Roman ships sailing in the Mediterranean had a capacity of around 68-181 metric tonnes (or 75-200 tons), although the dimension of the southern harbour at Berenike, which could accommodate ships of up to 19-22m wide and 60-61m in length, suggests those using this port were larger than average (Sidebotham 2011, 195-96; Strauss 2007, 100-02). Even at the lower end of the spectrum in terms of ship capacity (68t) and highest estimate of silver being transported (48.75t), one ship could theoretically accommodate this amount of denarii; though, obviously to do so would be absurd. If we take Strabo's (*Geog.* 2.5.12) figure of 120 ships sailing to India from Myos Hormos each year and pick the lower ship capacity (68t), with the upper estimate for the weight of silver being transported (48.75t), then, on average, only 0.6% of the total cargo capacity on each ship would have been utilised (see Table 1) or less than one cubic metre of space. By comparison Gill (1991, 39-40) has shown how 1,130 silver *phialai*, each weighing

100 drachmae (431g), could be stacked into a cubic metre of space and be would be worth around 113,300 Attic drachmae (= c. 125,000 denarii in weight equivalence). This exercise is, of course, theoretical and it should be stressed again that it is not assumed Pliny's 50 million figure represents the annual value of gold and silver exported. However, it does highlight that most of the cargo space would, of necessity, have been taken up by goods in kind or alternatively non-saleable ballast like boulders or amphorae filled with sand. The former is attested in the incense trade with Arabia as seen from the basalt boulders found at Myos Hormos and Berenike (Peacock, Williams, and James 2007, 28-70), and the latter was sometimes practised in the Mediterranean (Peña 2007, 80-81).

EXPORTS FROM THE ROMAN EMPIRE

With such a negligible amount of cargo space taken up by gold or silver what goods were carried by ships sailing to India from the Egyptian Red Sea ports? The archaeological and written evidence reveals a significant variety, ranging from foodstuffs and wine, drugs, dyes, spices, textiles, crafted products of metal, stone, and glass, along with precious stones and coral. There is not sufficient space here to discuss all these exports in depth, but some of the evidence for them is laid out in Table 2. However, it is worth discussing the export of wines, glass-wares, and crafted metal-wares, in more detail as there is some archaeological evidence for their distribution in India. It is argued that these items were desired in their own right and were not carried merely as space-fillers for ships sailing to India with gold and silver.

Wine

This product was clearly a significant export to India, with the idea of Indians having a crazed desire for wine even manifesting itself in some western sources (Curtius Rufus 8.9.30; Lucian *Nigrinus* 5; *Charition* – *POxy.* 413). Complementary to this, and without the

ethnographic bias, one Sangam poem speaks of sweet and cool wines brought to southern India by splendid Yavana ships (*Purananuru* 56.18-21). This popularity is seemingly confirmed by the author of the *PME* (49, 56) who reports that Italian, Laodikean (Syrian), and Arabian wines were particularly in demand at Bargaza (and fine wines for the royal court), and that wine generally was desired at Muziris and Bakarē. Desire for these specific types seems to be reflected in ostraka recording the transport of goods to Myos Hormos and Berenike. Namely the Nikanor archive (c. first half of first century AD), a collection of business receipts detailing the transport of goods to these ports (see Tait 1930; Rathbone 1983); and also the customs receipts from Berenike (mid-first century AD) which mention Italian (46 separate times) and Laodikean (21 separate times) wines most frequently (see Bagnall, Helms, and Verhoogt 2000). The discovery of a shipwreck at Fury Shoals, a little north of Berenike, further adds to this picture. Of the 34 amphorae examined, 20 have been identified as Campanian in origin, and appear to have “pozzolanic” wine stoppers, suggesting these were not reused amphorae, but probably contained Italian wine. Another shipwreck at Abu Fendera (a few hundred kilometres south of Berenike) shows a broad range of amphorae, including four of Italian origin, eight Alexandrian (AE4), another six to eight Egyptian amphorae (AE3), alongside a single rim of a Dressel 20c olive oil amphorae from Spain (Blue, Hill and Thomas 2012, 94-96).

Roman amphorae have been reported at over 50 sites across the Indian subcontinent (Suresh 2004, app. 3; Ray 2010, 10; Tomber 2008, 126-27; Sidebotham 2011, 233 n.119); although recent re-examination of some of the vessels has seen a number of them being reclassified as Late Antique Mesopotamian torpedo-jars (Tomber 2007, 972; Tomber 2009, 43-44, 50-51). This includes sites that may well be connected to places of significance mentioned in the *PME* and in the *Geography* of Claudius Ptolemy. Among these sites are Hathab (Astacampra – *PME* 43) in the Gulf of Khambhat where finds of Roman amphorae

and terracotta figurines of ‘Hellenistic inspiration’ have been discovered (Pramanik 2004, 139); Kamrej (Kammoni – *PME* 43; Kammanes – Claud. Ptol. *Geog.* 7.1) with sherds of a Late Roman Amphora 1 and an amphora from Aqaba (Gupta et al 2004, 30; Tomber 2005, 100-01); Alagankulam (Salour - Claud. Ptol. *Geog.* 7.1) where Roman amphorae and Terra Sigillata sherds have been found (Nagaswamy 1995; Tomber 2008, 138-39); parts of the ‘peninsula’ coast of the Kanara with good anchorages but plagued by pirates (Kheronēsos - *PME* 53; Claud. Ptol. *Geog.* 7.1), of which the site of Balergudda has revealed a body sherd paralleling finds at Berenike on the basis of petrological analysis (Gupta and Aruni 2005, 51); and Arikamedu (Podoukē – *PME* 60) near Pondicherry where Koan, Rhodian, Knidian and Egyptian amphorae have been found alongside large numbers of Dressel 2-4 “black-sands” type, as well as some Dressel 6 and 20 used of olive oil and Dressel 22 reused for garum (Suresh 2004, 105; Tomber 2008, 137; Will 1996, 318-19; Will 2004, 326-28).

Besides the site of Arikamedu, the origins of these imported Roman amphorae have also been narrowed down at Nevasa in western India (Maharashtra) where 63 sherds have been unearthed. Examination of a number of them indicates they were made from the “black-sands” fabric typical of Campania (Gupta, Williams, and Peacock 2001, 11-14). The layers in which they were found date between 25 BC to the early second century AD, but Williams and Peacock (2005, 140-48), argue that they probably date prior to AD 79 due to the damage done to the Campania wine industry by the eruption of Vesuvius. The site of Chaul (Sēmulla – *PME* 53) has also revealed Roman amphorae of the Dressel 2-4 variety paralleling finds at Nevasa, Junnar and also Qana’ in Yemen (Gogte et al 2006, 73-76). Furthermore, among the thousands of amphorae found at modern Pattanam (ancient Muziris – *PME* 54, 56) Dressel 2-4 types are particularly notable and stylistic identifications suggests that those originating from the areas of Kos, Campania and Cilicia were common, though other sherds which

appear to be from Spain, Gaul, Egypt and Rhodes have also been identified (Shajan et al 2008; Cherian 2011a).

The widest distribution of these Roman amphorae, on the basis of current evidence, is in the north-western Indian subcontinent, with more limited distributions in southern India (Ray 2010, 10; Suresh 2004, 100-01). This has led Tchernia (1997, 23-39) to argue that in the northwest regions merchants from the Roman Empire relied more heavily on barter, while in the south gold and silver were required to pay for goods. It should be noted, however, that while the northwest may currently reveal a wider distribution of finds many of these sites have only revealed small numbers, whereas the greatest number of Roman amphorae sherds so far found come from the southeastern port of Arikamedu (over 500, see Wheeler, Gosh, and Deva 1946, Will 2004) and the southwestern port of Pattanam (over 6,000, see Cherian et al 2009, 236-40; Cherian 2011a, 5; Sidebotham 2011, 191).

Indeed, given the importance of Pattanam (Muziris) and its connections to a variety of trade networks, the presence of so many amphorae should give pause for thought about the scale in which wine was being consumed not only at this site, but also the areas to which some of these products may have been transshipped. There is evidence for finds of Early Historic Jars (Wheeler Type 24) and Rouletted Ware suggesting connections with Arikamedu and more broadly southeast India. Yemenite, Parthian/Sassanian and Nabataean ceramics indicate connections with West Asia, besides the many thousands of amphorae and well over 100 Terra Sigillata sherds which show a connection with the Mediterranean world (Cherian 2009-10, 154-55; Cherian, Selvakumar and Shajan 2007, 3-4; Cherian et al 2009, 237; Shajan et al 2004, 312-17; Shajan et al 2008; Tomber 2008, 143; Abraham 2009, 18, 21; Selvakumar, Shajan, Tomber 2009, 35-36).

It may be that the wider distribution in the northwest reflects greater exposure to the legacy of Greco-Bactria and Indo-Greek kingdoms, and greater exposure to Hellenic culture

(Rasckhe 1978, 632), as seen in the Dionysiac ritual scenes on Buddhist friezes at Gandhara in northern Pakistan (Brancaccio and Liu 2009, 224-32); while in the south the demand may have been limited to urban elites (Suresh 2004, 107). These patterns may well change with increasing archaeological work being undertaken in India, but what is clear is that it should not be assumed that a greater volume of wine was being traded in the northwest of India, only that it appears to have been distributed more widely.

Glassware and Raw Glass

The author of the *PME* (39, 49, 56) states that glassware was in demand at Barbarikon, while only raw glass is mentioned for Barygaza, Muziris and Bakarē. However, contrary to this silence high-quality Roman glassware has been found distributed across the Indian subcontinent. In the northwest at the site of Taxila/Sirkap (Pakistan), a number of Roman glass-wares, including a fragment from a Julio-Claudian cameo skyphos have been discovered (Whitehouse 1989a, 95). At Begram (Afghanistan) around 150 Roman glass objects have been found, such as a tall goblet with beehive design (Egyptian parallels) and painted and decorated glass with classical scenes. These were sealed together with other objects in two rooms in first century AD, and given their Alexandrian origins these pieces seem to have come via the Indian Ocean (Whitehouse 1989a, 94-96; Whitehouse 1989b, 151-57; 222; Mehendale 2010, 131-35, 40). The objects from Taxila and Begram were possibly carried inland from the port of Barbarikon, since all cargo was carried upriver to the king of “Scythia” (*PME* 38-39; Stern 1991, 114; Whitehouse 1989a, 95; Mehendale 2011, 140).

In southeast India at the port of Arikamedu Syro-Palestinian ribbed bowls similar to those at Taxila and Dharanikota have been discovered (Stern 1991, 117; Wheeler, Ghosh, and Deva 1946, 102); again indicating that these glasswares came via the Indian Ocean. In central and western India probable Roman blue glass beads and bangles have been found at

Brahmapuri, Nevasa, and Bhokardan; while fragments of Roman glass have also been found at Paithan, Nevasa and Ter (Gupta, Williams, and Peacock 2001, 15; Singh 1988, 87-88). The site of Pattanam (Muziris) in southern India has revealed fragments of pillared Roman bowls, some showing parallels with finds at Arikamedu (Cherian, Selvakumar and Shajan 2007, 7; Cherian 2010, 271-72; Cherian 2011b). At Ter (Deccan) two rims of a glass cup and a bottle (early-first century AD) have been found, the latter being similar to one discovered at Taxila/Sirkap (Stern 1991, 115).

Stern (1991, 119-22) has argued that the large number of fragments of glass vessels found in the north-western compared to the southern Indian subcontinent may corroborate the picture presented by the *PME*. However, the circumstances of the Begram find were especially fortuitous, since so many objects had been collect together for deliberate storage. Moreover trying to determine relative volumes of trade to different regions in India is hampered by the fact that older archaeological reports in India tended to focus on the recording and publishing of whole or nearly intact vessels, with thousands of smaller sherds having probably been discarded (C. Meyer 1992, 73-74).

Crafted Metalwares

Copper, tin and lead are said to have been in demand at Barygaza, Muziris and Bakare (*PME* 49, 56), and such items were undoubtedly important for reasons of ballast and stowage (see below) as well as being tradable commodities. Archaeological finds across India have also revealed that crafted metals, especially bronzewares, were in some demand. Such bronzewares include a plaque of Atlas found at Taxila (Khandalavala 1992, 329), a statuette of Harpokrates wearing the crowns of Upper and Lower Egypt at Begram (Mehendale 2011, 140-41), a handle with a figure of Eros at Baroda/Vadodara in Gujarat (Singh 1988, 72), thirteen objects stylistically identified as Roman at Brahmapuri (Maharashtra), which include

a fragmentary sieve for straining wine (De Puma 1991, 95), two mirrors at Ter (Deo 1991, 41), and a figure sitting on a chair with a thunderbolt in his left hand, with the legend ROMAE on the pedestal at Nilgiris in Tamilnadu (Suresh 2004, 126).

There seems to have been some appreciation for Greco-Roman artworks and imagery, a notion complemented by the fact that a number of Roman coins (and imitation Roman coins) found in India had been converted into jewellery (Suresh 2004, 77-81). That these types of goods were transported on Roman ships is also suggested from two bronze bowls and a bronze javelin head discovered alongside Roman amphorae from the shipwreck at Abu Fendera. There is good reason to think this was a “Roman” ship due to finds of iron anchors similar in style to those found in the Mediterranean, as well as lead sheet and copper nails paralleling finds at Myos Hormos and Berenike (Blue, Hill and Thomas 2012, 96-98). Of course, the destination of these objects or their intended purpose cannot be determined.

Summary

The archaeological evidence suggests that wine and crafted goods were received across the Indian subcontinent (see Map 1 and Map 2). A well-developed series of overland, riverine and sea-routes allowed the indigenous populations of India to move goods across the subcontinent and from eastern to western coasts (Ray 1991, 60; Ray 1996b, 354-55; Ray 1996a, 4; 2010, 9-10). These trade networks coupled with the fact that many of these goods were found inland should counter the notion that the presence of crafted-Roman goods indicates personal possessions of Roman merchants resident in India. Instead, it is clear that they were items demanded in their own right. Indeed, a number of the Sangam poems refer to various finely crafted Yavana vases and lamps (*Maimekalai* 19.1.45; *Mulleippattu* 5.49, 85; *Nedunalvadei* 101-03; *Perumpanarruppatai* 311-19).

The relative number of finds of different items should not necessarily be used as an absolute indicator of significance. Comparison of archaeological material between different sites in India is extremely problematic due to inconsistencies in the quality and nature of earlier excavations in different regions, and the extent to which some material has been published (Suresh 2004, 21). This hinders any attempt to determine the volume at which certain goods were exported to different regions from the archaeological evidence. However, the distribution of finds from the current evidence at least allows us to appreciate the extent to which these goods were being received in different parts of India. Clearly many of these items were widely appreciated and any ships sailing to India from the Egyptian Red Sea coast are likely to have had a mix of these goods in their holds. Conversely, it should not be assumed that coins or bullion were always present as items of exchange. Pausanias (*Description of Greece* 3.12.3) states that traders exchanged their wares with the Indians without using money, while Persius imagines craggy pepper and cumin seeds being exchanged for Italian merchandise under an eastern sun (*Satires* 5.54-55).

MIXED CARGOES AS A NECESSITY

Mixed cargoes were the norm in long distance trade in the Roman Mediterranean, not only because of demand but also because they helped spread economic risk (Morley 2007a, 31, 39-43; Wilson 2009, 214). It is clear that this was also the case for those exporting goods to India (see Table 2). However, besides these economic concerns there are also important practical considerations as well. In an earlier article for this journal McGrail (1989) laid out the importance not only of the need for ballast, but also for the correct stowage of goods in any merchant vessel to ensure stability in strong winds and buoyant conditions. He noted that it is not just the volume of the constituent elements of the cargo or its weight that matters, but also the relationship of weight to density. That is to say, how many cubic metres (m³) of

space an item takes up per metric tonne (t) of weight (m^3/t). The inverse of cargo density is known as the stowage factor which is used to convert known weights of cargo into stowed volumes and thus the position and centre of mass can be calculated (ancient mariners worked on the basis of experience). If a ship is loaded with materials with a high stowage factor (i.e. low cargo density) it is necessary to compensate by including a consignment of material with a low stowage factor. The aim is to compile a mix of cargo that results in a safe freeboard (the vertical distance between the highest watertight deck and the water line) and a reasonable metacentric height (the vertical distance between ship's centre of gravity and the metacentre – the point at which, on a hypothetical line, the centre of buoyancy and gravity intersect). To ensure stability a ship needed to have a positive but not excessive metacentric height so that it will right itself in buoyant conditions (McGrail 1989, 353-57).

Many of the items that were traded as exports, including wine, olive oil, grain, clothing and textiles, spices/dyes and glass have a high stowage factor (above 1 – i.e. more than 1m^3 is taken up per tonne of weight). These would have to be balanced out by low-stowage factor (i.e. below 1) materials like metals and stones (See Table 3; also McGrail 1989, 356), which probably explains why tin, copper and lead were exported to all the major Indian ports mentioned in the *PME*. This may also potentially be reflected in the lead ingots found alongside Roman amphorae in shipwrecks at Bet Dwarka (Gulf of Kachchh, Gujarat, see Gaur, Sundaresh, and Tripathi 2006, 117-127) and possibly Abu Fendera (Blue, Hill and Thomas 2012, 94-96). The requirements to balance these factors meant that goods like wine or olive oil should not, as some have claimed (see Warmington 1928, 265, 315; McLaughlin 2010, 74; Fitzpatrick 2011, 50), be seen merely as items of ballast in the trade with India. The fact that many of these items could not have acted as simple ballast, coupled with their widespread distribution across India, indicates goods demanded in their own right, not merely as supplements to bullion exports. Some vessels (Roman or otherwise), may have exchanged

a portion of their cargo at ports along the East African or Arabian coast prior to sailing on to India. However, the need for correct stowage and balancing of goods would remain.

CONCLUSION

The question of whether the Roman Empire suffered a haemorrhage of gold and silver to pay for its imports from India should be reconsidered in the light of the factors discussed here. Certainly aurei and denarii were exported to India, but Pliny's figures cannot be used to suggest that this was in the value of 50 million sesterces annually. Even if they could, on average, the likely cargo space taken up in Roman (or other) merchant ships would have been negligible (0.6% or less on the calculations shown in Table 1). Most of this space had to be taken up by goods in kind, which consisted of items such as crafted glass and metals, textiles, minerals/spices, coral and wines. Many of these items were not carried as ballast, but, in fact, had to be balanced out by commodities like metals in form of ingots. Also many of these items seem to have been in wide demand as the distribution of finds in the Indian subcontinent indicates, and should be seen as goods sought after in their own right, rather than simply as "space-fillers". Nothing certain can be stated about the relative overall export value of gold and silver compared to these goods, as there is no detailed price data for this period in India. However, in terms of volume (if not value) these goods in kind should be seen as much more significant than gold and silver.

This conclusion is not only of significance to Roman trade with India but raises a number of implications for the nature of trade in the Mediterranean world. That such a wide range of goods in kind were demanded across the Indian subcontinent necessitated their assembly in Egypt by those engaged in the organisation of trade via the Red Sea. This links in to a wider debate about the level of integration by trade of different regions in the Mediterranean (for a range views on this debate, see Duncan-Jones 1990; Woolf 1992; Finley

1999; Temin 2001; Morley 2007b). The evidence examined has certainly shown that while Egypt produced a number of goods destined for India, such as glassware, wine and dyes (for the latter see notably, P.CtYBR inv. 624 – Peppard 2009), so too did various other regions of the Mediterranean. This is seen in the export of wine from Italy, Kos, Knidos, Rhodes, Gaul and Spain (olive oil and garum from this region too), glassware from Syro-Palestinian, and red coral from the areas around the south coast of France and Sicily (Pliny *NH* 32.11.21), and possibly Spanish lead (Ray 1991, 59).

The consequence of this is that some level of connection between different regional trading spheres in the Mediterranean must have existed to allow these goods to be assembled in Egypt for export. Indeed, there is evidence that it was not only the Alexandria/Egypt social and political elite who were financing and organising the trade with India, but that other communities from the Mediterranean world were involved in varying capacities (Cobb 2011, 120-29; for arguments about the significance of Italian involvement, see Tchernia 1997). The complexities of such organisational, logistical and financial investments seems to further underscore the argument that such Roman goods were not merely “space-fillers” alongside gold and silver, but were highly sought after commodities in India.

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