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THE ENIGMA OF ARCHAIC EAST GREEK CERAMIC PRODUCTION: RECENT DEVELOPMENTS IN POTTERY PROVENANCING WITH NAA

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Fig. 1 Map of the Eastern Mediterranean region (redrawn by A. Simpson).

Over the past three decades the chemical analysis of pottery from the East Greek world (the Eastern Aegean region encompassing the west coast of Turkey and the Greek islands of the Dodecanese – Fig. 1) has occasioned a quantum leap in our understanding of pottery production centres, interconnections and trading patterns in the Eastern Mediterranean and Black Sea Regions. The present article provides a brief overview of the most important recent developments and advances in this area.

Until quite recently much of painted East Greek pottery from the Archaic period (7th-6th centuries BC) – often characteristically decorated with distinctive painted friezes of grazing wild goats and deer – used to be known as 'Rhodian' and was believed to have been produced on the island of Rhodes. The reason for this lies in the extensive 19th century excavations in ancient Rhodian cemeteries, which were the first to reveal in quantity well-preserved examples of this kind of pottery. A further group of East Greek pottery, characterised by fine painting on a brilliant white slip, was similarly long known as 'Naukratite', since late 19th century excavations had first yielded this impressive ware in the (East) Greek trading post of Naukratis in the Egyptian Nile Delta. As a consequence, Rhodes and Naukratis were credited with a major role in the development of Greek painted pottery, as well as generally in the mediation between Greece and the ancient Anatolian and Egyptian civilizations during this formative period of Greek history (a survey of past scholarship is given by Cook and Dupont 1998).

However – as we know at least since the realization in the late 18th century that most of the 'Etruscan' vases found in large numbers in Etruscan tombs were in fact produced in Athens – equating the place of discovery with place of production is a notoriously flawed notion. Yet how can the actual place of production of a pot be determined? In the case of 'Rhodian' and 'Naukratite' pottery, it is new archaeological discoveries in combination with chemical clay analysis that have revolutionized our picture of these wares.

Elemental analysis

Elemental analysis is one of two methods that can be used to determine the place where pottery was produced. While petrographic analysis of thin sections of pottery gives information about inclusions in the clay paste, manufacturing technique and the firing

process, elemental analysis determines the minor and trace elemental content of the clay paste itself. When dealing with finely levigated clays, and if only provenancing is the aim and not technological questions, chemical analysis is known to produce good results. Since clays have generally much higher concentrations of trace elements compared to the admixtures like quartz or calcite, an elemental analysis of a sample of powdered pottery characterises mainly the clay. Neither does the firing procedure change the composition (except sometimes for the volatile elements As and Br) nor do the depositional conditions, except in some cases for a few elements such as Ba, Ca and sometimes the alkali elements (Na, K, Rb and Cs) and P. By comparing the elemental compositions of the various samples with one another and with reference material of known provenance (especially kiln wasters or samples from extant clay beds), the measured elemental patterns point to the location of the clay beds exploited. Since ethnoarchaeological studies of modern Mediterranean potters show that most of them use clay beds in their vicinity within a radius of only a few kilometres, except in rare cases, when a raw material with special properties is required, the geographical attributions can be made with confidence.

First steps

The traditional way of tracing production places of East Greek pottery has been stylistic analysis in combination with findspots. In the course of the 20th century, a number of scholars worked out stylistic groupings and identified workshops and painters; as excavations revealed new material, assessments changed and developed, yet often remained subject to debate. Notably, the geographical location of the main production centres of the widely distributed 7th century BC 'Wild Goat' pottery and the subsequent 6th century BC figured 'Fikellura' and black-figure styles continued to present problems (cf. Cook and Dupont 1998). For this reason, new opportunities offered by science were eagerly taken up. The first steps in scientifically provenancing East Greek pottery were taken independently in the 1980s by Richard Jones (Glasgow) and Pierre Dupont (Lyon), and, on a smaller scale, Mike Hughes (British Museum) (Jones 1986; Dupont 1983; Dupont 1986; Hughes *et al.* 1988). Their analysis of pottery from Naukratis, Histria (on the Black Sea) and other sites for the first time confirmed what had been suspected for some time, namely that it was not the island of Rhodes that was the main producer of much of the 'Wild Goat' and other East Greek styles. Instead, sites in Southern Ionia (notably Miletos, one of the most powerful Greek cities in the region), as well as Northern Ionia, were responsible for a large output of painted pottery. Nor was Naukratis a major producer of fine painted wares: the full body of pottery of the 'Naukratite' style could now be dissociated from Naukratis and attributed to the island of Chios – as had by now long been suspected at least for a portion of the ware on the basis of archaeological evidence. Further production centres that were chemically 'fingerprinted' included Klazomenai and Samos, and even some of the Ionian colonies such as Histria itself. Rhodes itself, by contrast, with the exception of a few minor groups, was left almost entirely bereft of locally produced painted pottery, and no painted pottery at all emerged as truly Naukratite. As a consequence, the assessment of the artistic output and significance of the various sites, and the history of their interrelation and wider Mediterranean interconnections – from Spain, France and Italy to Libya and the Black Sea – had to be entirely rethought. Yet the results, based on a relatively small subsection of the evidence, also raised doubts and posed new questions: could it really be true that no painted pottery was produced locally at Naukratis, and that Rhodes produced so little? Where exactly were the as-yet unlocated likely North Ionian wares produced, and could they stem from the major trading city of Phokaia? What exactly was the relationship between the pottery profiles of the neighbouring major centres of Miletos and Samos? Was the local production of East Greek style pottery a widespread phenomenon in the Ionian colonies around the Black Sea?

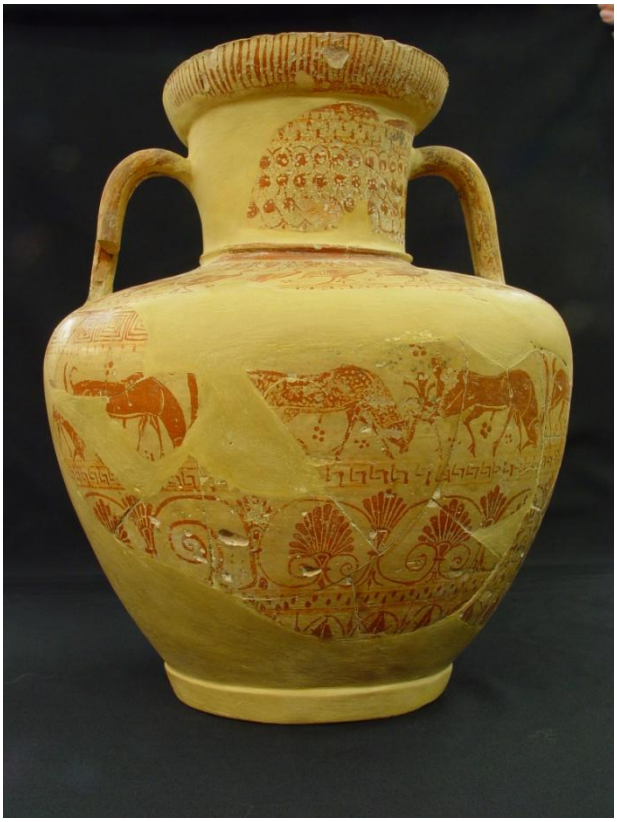

Fig. 2 Archaic East Greek amphora decorated in the 'Fikellura' style, excavated in Tell Dafana, Egypt, and produced in Miletos (NAA group D, Mommsen). London, British Museum GR 1888.2-8.46a). Photograph © Trustees of the British Museum.

Recent developments

To answer some of these questions, a new collaborative initiative was developed in the early 1990s. It has at its core an extensive programme of Neutron Activation Analysis (NAA) in the laboratory of Hans Mommsen at the Helmholtz-Institut für Strahlen-und Kernphysik of the Rheinische Friedrich-Wilhelms-Universität Bonn. Carried out in collaboration with a number of archaeologists (including since 2004 the British Museum) it focuses on pottery from new excavations at major East Greek sites such as Miletos and Ephesos and places further afield – notably on the Black Sea coast, Sicily and Egypt (Naukratis

and Tell Dafana) – known to have been in contact with East Greece, as well as selected groups of existing material from old fieldwork (Akurgal *et al.* 2002; Kerschner *et al.* 2002; Mommsen *et al.* 2006a; Mommsen *et al.* 2006b; Mommsen *et al.* 2008; Posamentir *et al.* 2009; and the various contributions in Schlotzhauer and Villing 2006). Over the past two decades, the work has created an extensive database of many thousands of analysed samples forming several hundred pottery groupings and covering the pottery output of the main regions of the ancient Mediterranean world and neighbouring areas, each additional sample increasing the likelihood that further new samples can readily be paired and provenanced.

The analysis method used is Neutron Activation Analysis (NAA), a long-established method that has recently ceded ground to organisationally less demanding technologies, but that remains one of the most reliable methods on account of its high sensitivity for trace elements, low measurement uncertainties, and large number (up to 30) of minor and trace elements measured. For the analysis at Bonn (cf. Mommsen in Schlotzhauer and Villing 2006), samples of 80mg are typically taken from a pot with a pointed sapphire (corundum) drill and are analysed for their elemental weight concentration values, using an in-house pottery standard calibrated with the well-known Berkeley pottery standard. The samples' elemental patterns are compared against the total databank using univariate or multivariate statistical data evaluation procedures which filter out samples that are statistically similar – if we imagine each sample as a point in a multidimensional concentration space with one dimension for each measured concentration value, then samples of similar composition can be visualized as forming clusters of points within this space.

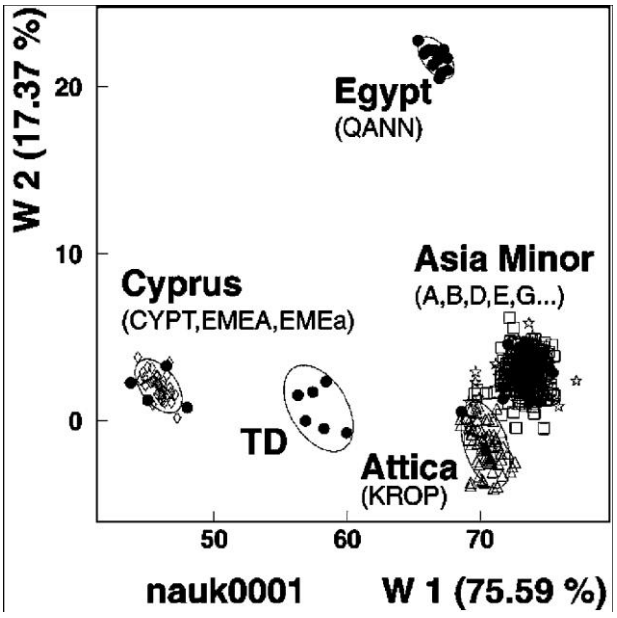

Fig. 3 Result of a discriminant analysis (DA) calculation of 600 samples assuming 5 clusters. Plotted are the discriminant functions W1 and W2 which cover 93 % (76 + 17) of the between-group variance. The ellipses are the 2σ boundaries of the groups. The Egyptian cluster QANN is well separated from clusters originating from other regions. © Hans Mommsen.

The precision of these calculations at Bonn has been improved in two main ways compared to earlier practice, first by taking into account the varying experimental measuring errors for each concentration value by normalizing the distances to the error. A second refinement concerns the effect of temper/inclusions, such as sand, which cause all concentration values to be lowered by a constant 'dilution factor'. Elements that are often part of 'diluents' such as Ca or Na are at first excluded during the search for groups. Furthermore, correcting for dilutions in the calculations - by a best relative fit with regard to the centre value of two points or of a point and an already formed group of samples with similar composition – reduces the spreads (root mean square deviations) of the sum pattern formed, and hence helps to avoid erroneous positive correlations and overlapping group patterns. Applying the method to East Greek (and other) pottery over nearly two decades has demonstrated the success of the method in creating 'sharp' clusters of samples produced with the same clay paste, even if occasional partial overlaps still cannot be eradicated entirely.

New insights into the production and consumption of East Greek pottery

Space does not allow a full report on the new archaeological and historical insights gained so far through this work, which has allowed the rich pottery production of the East Greek region and its wide distribution to be mapped with increasing precision, but details can be found in a number of recent publications (notably Akurgal *et al.* 2002; Kerschner *et al.* 2002; Mommsen *et al.* 2006a; Mommsen *et al.* 2006b; Mommsen *et al.* 2008; Posamentir *et al.* 2009; and the various contributions in Schlotzhauer and Villing 2006), and only a few particular cases are picked out in the following.

In general, the area of Klazomenai and Teos has emerged as a main centre of North Ionian pottery production and Miletos as a main center in South Ionia (Fig. 2). Among the more surprising results was, perhaps, the realization that some regions and centres – notably the Aeolian region, but also the area around Ephesos – were responsible for the production of pottery in a surprisingly wide range of different styles which otherwise would not have been grouped together in a stylistic analysis. East Greek style pottery was also found to have been produced in the diaspora of Greek settlements outside East Greece proper; among the many regional workshops to have been chemically 'fingerprinted' several can be attributed to colonies and trading in the Black Sea region but also in Egypt. Hence, Naukratis emerged as home to a Greek potter's workshop after all, though its output looks rather different from what was once believed to be 'Naukratite': technically accomplished but not particularly sophistically decorated vessels that were produced from the local Nile silt clay, which the Greek potter(s), however, levigated exceptionally finely (without chaff inclusions as would have been common for local Egyptian potters) and covered with a beige/pink slip much like they would have done back home in East Greece. Attribution of the elemental pattern determined for samples of these vessels (Fig. 3) to local clay beds in the Nile Delta is indicated by

its re-appearance not only in a variety of later, characteristically local, vessels, but also in several examples of later local kiln-furniture (Fig. 4). By contrast, some of the painted pottery incorporating Egyptian or Egyptianising motifs into their decoration were shown, contrary to expectations, to merely have been imported into Egypt from East Greece.

Fig. 4 Fragment of Hellenistic kiln furniture excavated at Naukratis, Egypt, and produced locally (NAA group QANN, Mommsen). London, British Museum GR Photograph © Trustees of the British Museum.

Important are, finally, also the wider implications of these findings. They increasingly suggest that the painted pottery output of a site does not always match its historical significance, and that painted pottery cannot be taken straightforwardly as an indicator of e.g. the degree of a site's external trade links. Some of the least-expected results have perhaps emerged from the analyses of coarse household wares such as pottery grinding bowls (mortaria) which in part emerged as Cypriot products and which point to a wide-ranging trade even for such seemingly mundane pottery. The picture of East Greek pottery production and consumption and Eastern Mediterranean interconnections in general has thus been thrown into much sharper relief than could have been dreamt of some 30 years ago, yet much also still remains hazy. To answer the many remaining questions, scientific clay provenancing will undoubtedly continue to play a major role in future.

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