

## Surveys, Spreadsheets and Wrecks : what is the Point of Pottery Analysis ?

In this short paper I offer some thoughts on the why and wherefore of pottery analysis, and on neutron activation analysis in particular, and an account of what has been achieved at the University of Manchester with Classical and Hellenistic fine wares from Old Greece, Magna Graecia and North Africa. I shall lead on to a report on a project that is still very much in progress.

Perhaps the first question one should ask oneself is why we do pottery analyses at all. Considering the expense, the effort, and the teamwork involved in setting up and carrying through a worthwhile project, do the techniques produce results that could not be achieved by simpler and cheaper means ?

Working on excavations in Southern Italy in the late 1960s and early 1970s I became interested in the trade patterns along the river valleys of Apulia and the way in which they might cast light upon relations between Greek settlers and the indigenous population of the Apulian hinterland. Having been trained as a Greek pottery specialist, the obvious vehicle with which I thought to pursue this question was the fine black and grey glazed ware manufactured in every major centre of the hellenized world, yet it did not seem that mere visual study of the pottery from different sites could distinguish their products with sufficient certainty, and so with the Oxford Research Laboratory for Archaeology and History of Art and the University College of North Wales we set up a project to examine by thin-section and by optical emission spectroscopy the black and grey glazed wares from a number of sites around the Gulf of Taranto where ancient kilns were known (Policoro, Cozzo Presepe near Metaponto, Taranto and Egnazia), using a selection of black glaze from the American excavations in the Athenian Agora as a control ; added to these was a group of sherds from Gravina, the cross-roads site some way up the Bradano valley where we had been conducting excavations and which had first given the idea for the whole project (Fig. 1). The

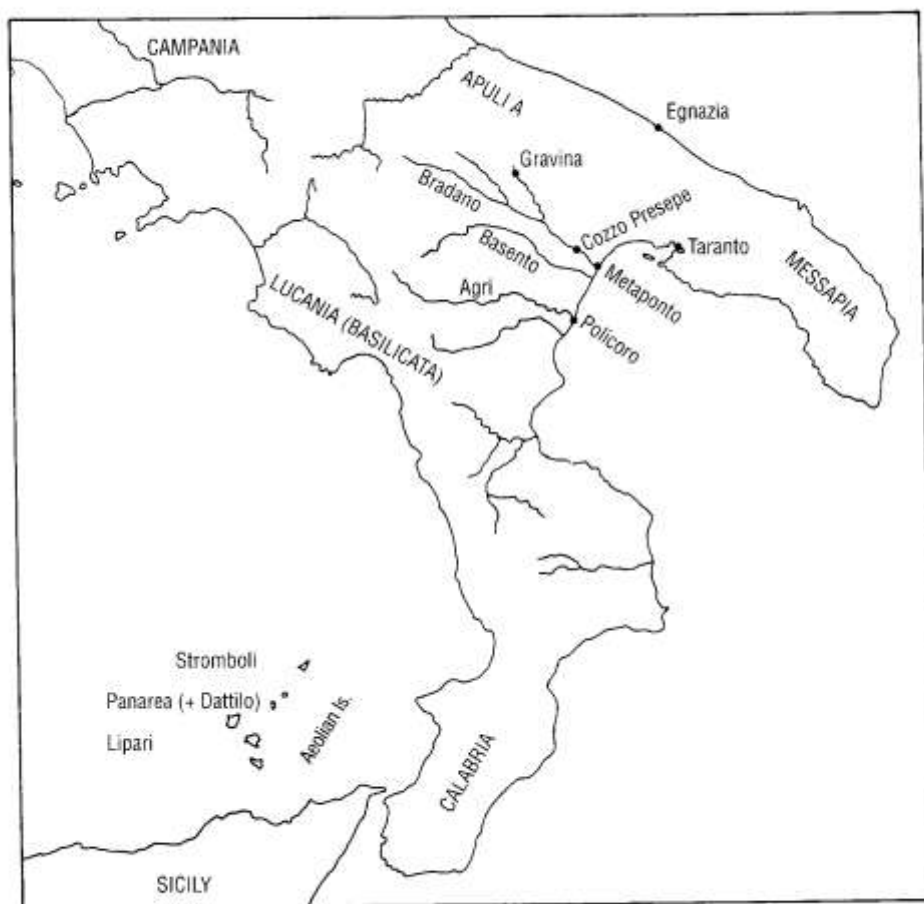


Fig. 1. Map of Southern Italy to show location of Apulian black and grey glaze ware samples and of the Dattilo wreck.

aim of the project was twofold: first to build up composition patterns for the products of these sites, and second, to use these patterns to draw a picture of the trade routes and economic relations of the region (Prag *et al.*, 1974, especially p. 153-157). But neither technique proved subtle enough for our needs; even optical emission spectroscopy could only distinguish nine elements: it could separate Attic black glaze from the South Italian group as a whole because the former contained higher amounts of nickel and chromium, and it picked out Gnathian as a speciality ware, perhaps made of clay dug from a particular bed, but apart from some hints we found no significant distinctions between the various South Italian wares.

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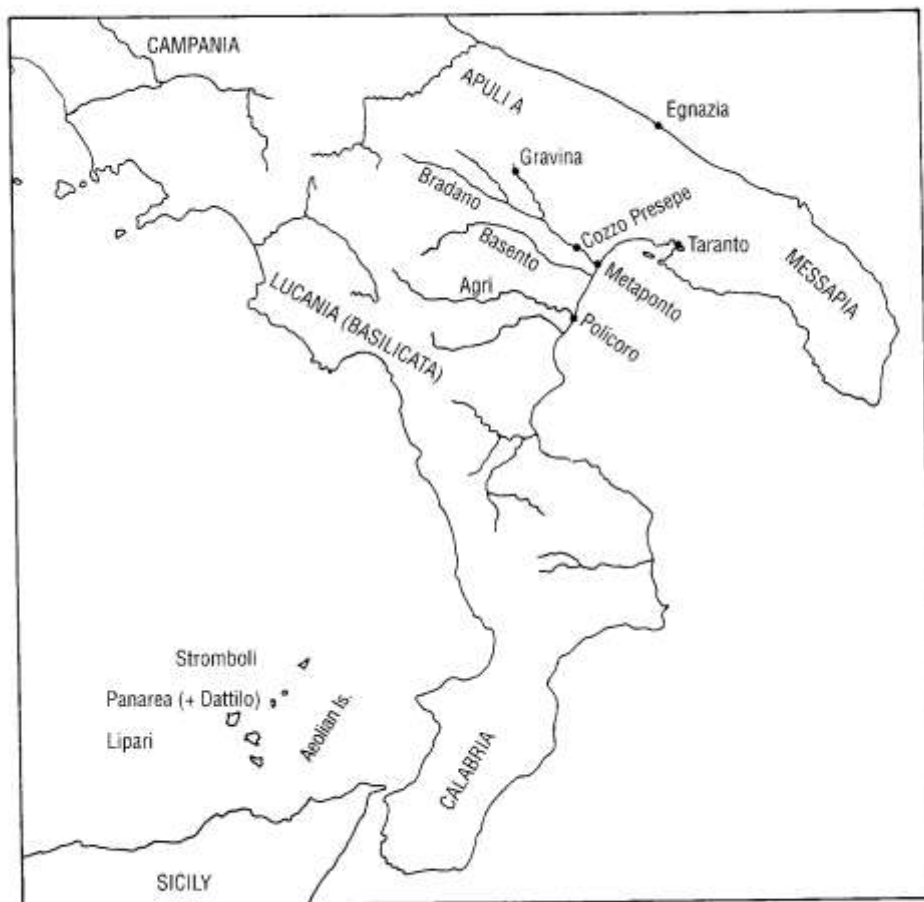


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2. Policoro/Taranto/Egnazia, all from south-eastern Apulia — but see group 3.
3. S. Angelo Vecchio/Cozzo Presepe/Gravina : these must be products of Metaponto, in contrast to (2), which are not exclusively of Tarentine manufacture because kilns have been found at Policoro and at Egnazia : so where the archaeological and chemical evidence combine to suggest that group (3) are the products of a single centre, the coming together of pottery from different sites which bracket Metaponto geographically to form group (2) must reflect a geological homogeneity.
4. Two sherds from S. Angelo Vecchio, which *look* different too, suggesting they are imports from another (as yet unknown) source : it is too easy to assume that everything found at a known pottery-producing site was locally made.
5. A group from Carthage and La Rabta in Tunisia (where fourth/third-century BC kilns are known), which although they again *look* different from each other are this time chemically identical — in other words they are made from the same clay but in different workshops. This is important when it comes to assessing results, for it shows that however sophisticated one's chemical/scientific analyses may be, there are still occasions when the experienced human eye can do better : I had already noticed a particular fabric from Metaponto, used for cups and other fine pieces, which could easily be separated by eye because of its distinctive colouring, but which chemical analyses failed to pick out because it was merely the result of a firing quirk on the part of the potters, not of chemical composition (e.g. Prag *et al.*, 1974, p. 184). As an archaeologist and a pottery specialist I find this heartening : Dr Richard Jones has referred elsewhere in this seminar to pottery as « a human activity », and it is too easy in our enthusiasm for creating new techniques with which to seek out the minutiae of ancient manufacturing processes to forget the actual people who made and used the pots. In the end it is they whom we are trying to understand, not just their products and their detritus.
6. Two sherds from Carthage and four from Motya previously assumed to be Attic but chemically distinct ; they are finer than the « Carthaginian » fabric (group 5), but not as fine as Attic (group 1). It is suggested that these are of Sicilian manufacture, local imitations of Attic, perhaps exported to Carthage (Wolff *et al.*, 1986, p. 256). It is interesting that Morel (1982, p. 45), had already suggested that many so-called « Attic » sherds are in fact local imitations — only more analyses will give us the answer. As we shall see, it is important now to define these particular sherds further as *west* Sicilian (which is not necessarily the same as for example the products of the great colonies of south and east Sicily, nor the Lipari Isles).

There were also two unfired sherds from Motya that seem to go with the Carthage fabric (group 5) : the suggestion here is that because they were

never fired the trace elements remain less concentrated and thus give misleading readings (Wolff *et al.*, 1986, p. 255). In theory there was easy access for the Motyans to local clay beds, so they had no need to import clay, unless it came across as ballast and/or the potters were Carthaginians who preferred to use the familiar clays from home.

But more of this problem in a moment. First, let us stay on the Italian mainland. These distinctions in the South Italian fabrics (which are based on too few samples to be wholly trustworthy) were further refined in a double analysis of a larger sample by Colston and others based on 25 elements (Colston, 1985; Colston, *et al.*, 1986). These analyses yielded the following groupings:

1. Taranto (3 sub-groups):

- a. A distinct Gnathian group, which could be distinguished from other Tarentine black glaze in five elements: chromium, caesium, calcium, rubidium and antimony (optical emission spectroscopy had given lower manganese and higher nickel, calcium and magnesium, not all of which are susceptible to neutron activation analysis). Significantly, the group included some pieces identified as ordinary black glaze by the archaeologist (myself) — probably wrongly so, for of course sherds from the undecorated parts of a Gnathian vase are indistinguishable to the eye from ordinary black glaze.
- b. and c. Two groups of black glaze: perhaps one is from another speciality ware, presumably the undecorated parts of red-figure vases, while the other is « standard » black glaze.

2. Policoro (17 samples): there may be two groups here, but they are not very distinct, and could simply be the effect of errors in the analysis; in fact the group includes five sherds from Taranto, so either the clays of the region are very homogeneous, or the distinctions attempted are too subtle.

3. Pizzica and Cozzo Presepe, both outliers of the Greek colony at Metaponto and to be seen as typical products of the Metapontine kilns: in terms of composition they are close to the pottery from Policoro, but apparently distinct from it. (The two sherds from Gravina which had fallen with the Metaponto group in the Wolff analyses were not retested for this project, nor was the material from Egnazia).

Thus we now have three broad geographical groups: it is interesting that where the Taranto pottery could apparently be further subdivided into the « standard » black glaze and two speciality wares, the Policoro and Metaponto (Cozzo) groups each included one sherd that had been identified by the archaeologist (myself) as Gnathian: if such a small sample has any validity, then this suggests that at these sites speciality wares were not made from special (or at any rate chemically distinctive) clays. More testing is

needed to answer this question, but the mere fact that one can now pose it shows how far the whole approach and the techniques have been refined.

But of course the « good » or experienced or single-minded pottery person working within museums (or excavations) can distinguish numerous fabrics without the need for scientific aids — yet to develop that skill needs years of experience, continuous practice, and probably a special flair with which one is born. It is something that is relatively easy to do with figured or even patterned vases, although there are grey areas where a non-subjective test would be useful : for example it is not always easy to distinguish the pottery of Euboea or Boeotia or the poorer Attic black-figure from each other.

With plain wares the cut-off point comes much earlier, as we have seen with the black glaze from Carthage, and as I learned during three seasons trying to identify the pottery found during the survey of the territory of Megalopolis carried out by the British School at Athens : after the 1982 season I felt that I could with some confidence distinguish Attic, Corinthian, Laconian and Argive black glaze (and the distinctions led to some interesting economic implications — for instance, why should Corinthian black glaze turn up so far from home in a place with which the Corinthians had no special economic or political ties ? Did the people of Megalopolis buy their large black glaze vases only from Argos ? See further Prag, 1985, p. 56-57). But by the next season I felt very confused — and could therefore justify the time, trouble and expense of the neutron activation analysis project which we had already devised (and whose validity my colleagues in the science laboratories had questioned : if I could readily distinguish the fabrics by eye, why go to the labour and expense of a neutron activation analysis project ?). Now I could justify it on the grounds that first, it was difficult always to get sufficient practice or preparation before going out into the field ; second, because this was a *survey* the answers were in theory needed quickly ; third and probably most important, the quality of the material was very poor, again because this was a survey ; while finally despite this the circumstances of a survey called for further refinement — archaeologists and historians are becoming increasingly interested in the « microeconomies » of particular villages or settlements as much as in the economies of whole cities and states. Compare also Morel's comment in *Céramique Campanienne* on the « skyphoi en sinuïsoïde atténué », which he notes as coming from very diverse provenances (Sicily/Carthage, Campania, Latium, northern Italy, and possibly Athens), but where (he suggests) more detailed analysis would enable one to attribute particular groups to definite sources : I imagine he means stylistic or visual analysis, but chemical analysis could be even more specific (Morel, 1981, p. 309 (Espèce 4360)).

Therefore we have collected or are collecting samples from sites in Magna Graecia (Fig. 1) and Old Greece (Fig. 3), to build up a database of geochemical



Fig. 3. Map of Old Greece showing findspots of black glaze ware (and Byzantine) samples.

«fingerprints»: the pottery from Magna Graecia I have already discussed, and I shall return to it; that from Old Greece which has already been analysed falls into the following groups:

1. Athens.
2. North-east Peloponnese: Corinth, Argos, Halieis.
3. North-west Peloponnese: Elis, Olympia (which comes up as a jumble, as one would expect — in other words it did not produce its own fine pottery: worshippers brought their own, or bought imports from places such as Elis).



4. Central Peloponnese : a. Sparta (Menelaion) — a very nice clear group ;  
b. Megalopolis — a Byzantine kiln-group, which stands alone chemically as well as archaeologically in this context.

Other material from Old Greece which has already been sampled and which is awaiting analysis includes two groups from Euboea (Chalkis and Eretria), and two from across the Euripos in Boeotia, Tanagra and Akraiphnion (I do not discuss here the work being carried out under the direction of Dr Elizabeth French on Bronze Age pottery from sites in the Argolid and elsewhere in Greece, Crete, Cyprus and Troy, nor the analyses on related Bronze Age material from the Levant).

All pottery sampled in the Manchester laboratory is being catalogued onto a computer-spreadsheet (Multiplan), and the results of the analyses entered on a database program compatible with the spreadsheet and with the commonly used word-processing packages (dBase III+). The aim of this is not merely that we should be able to retrieve and collate all our own information efficiently, but also that it can readily be run against « new » sites, often in response to requests for help from archaeologists elsewhere ; to ensure full compatibility all results are now converted to match the standard established by Perlman and Asaro at Brookhaven (Perlman and Asaro, 1969).

The problems of identifying poor samples, which I described in the context of pottery from archaeological surveys, apply even more to the finds from shipwrecks. Although from an archaeological point of view the excavator has to deal not with the potential scatter and intrusion of surface survey, but with a neatly enclosed context, he is left with two fundamental questions to answer that are not so different from those that face the survey archaeologist : first, what was the ship carrying, and second, where had it come from, where had it called ?

Because much of the cargo is often organic, pottery analysis can come to the fore in identifying the source of the amphorae that form the containers (two such projects are presently in hand at the Manchester laboratory). Fine wares, however, were usually only for the captain's table.

An exception to this rule is the Dattilo ship : this late fifth or fourth-century wreck, lying off the rock of Dattilo, beside Panarea, one of the smaller of the Lipari or Aeolian Islands north of Sicily (between Stromboli and Lipari itself — see Fig. 1), was first located in the late 1970s ; it was surveyed in 1986 by Oxford University Marine Archaeological Research (MARE) under its director Mensun Bound, and since 1987 MARE has been carrying out excavation of the wreck in collaboration with the Archaeological Superintendency for Messina and in association with the World Ship Trust (see e.g. Bound, 1989a, 1989b, on which much of the following account is based ; both have further bibliography).



The ship sank in the submerged crater of an active volcano. Conditions of excavation were (to put it mildly) difficult, because volcanic vents all round the ship give off heat (sometimes making the water too hot to work in), as well as sulphur dioxide and hydrogen dioxide gas, which forms a weak sulphuric and sulphurous acid solution that stings and irritates the exposed skin of the divers. Much of site is covered in very deep soft volcanic mud and sand, but often this is itself covered by a brown ferrous concretion, pierced with finger-sized holes where the gases forced their way through before it had completely hardened. According to preliminary reports it is not clear if this concretion is natural or the result of a reaction between the volcanic emissions and material from the wreck (Bound, 1989b, 203), but it also contains many of the artefacts. It is so hard that the only way to extract the finds is with hammer and cold chisel (and it says something for the skill of the excavators that only one pot is recorded as having been damaged during extraction, and that was one which was unexpectedly buried a few centimetres beneath another) (Bound, 1989b, 210, no. 2, fig. 19A).

The cargo is very homogeneous, and apparently consists entirely of fine pottery, seemingly all fine black glaze wares of the fourth or possibly late fifth century BC: skyphoi, one-handlers, bowls, miniature bowls (dishies), table amphorae, jugs, lids, lekanides, and « padlock » lamps. Aside from this only a few fragments of wood, the base and two sherds of a coarse ware amphora (of uncertain type), a few olive pips(?), and some lead rings from the rigging are all that has been recovered so far.

The pottery is now all badly encrusted and/or water-worn: the clay looks red-orange (how much this is the effect of the ferrous concretion is hard to tell), fine-grained, hard and cohesive; the glaze (where it has survived) is lustrous, sometimes with a metallic sheen, and can be of high quality. At least one skyphos-base has an added red wash. Many shapes have (according to the excavator) close parallels on fifth and fourth-century land-sites on Lipari, but so far no-one has come forward with a positive identification of the fabric (Professor B.A. Sparkes is to publish the pottery, but at the time of writing he has not yet had the opportunity to study it). There is much dispute about its place of manufacture — and thus over the route and perhaps the nationality of the ship; suggestions have included Attic, South Italian and Sicilian. It seemed an obvious case where neutron activation analysis, backed by a databank of geochemical fingerprints of different fabrics, might come to the rescue. In fact this feeling was mutual, and it happened that having read of the Dattilo excavation I approached the director, Mensun Bound, just as he was about to ask us to help. As a collaboration it is proving exciting.

The major problems we anticipated in sampling pottery from this particular wreck were possible leaching not just from salt water, but also from

the ferrous concretion. It happened that the effects of leaching had already been considered in two other studies in Manchester.

The first concerned the effect of washing pottery in nitric acid to remove lime encrustations, a common excavation practice : when tested on the Bronze Age coarse wares from Tell Iktanu in the Jordan Valley that had been treated with dilute (6%) nitric acid it apparently had no significant effect on the element concentrations (Unpublished : pers. comm., Dr Kay Prag and Dr G.W.A. Newton).

By contrast, analysis of Roman and Islamic coarse wares from wet sites in Cyrenaica suggested that they took up sodium from the brackish deposits in which they were buried, at the rate of 5 p.p.m. per year (0.5% per 1000 years), on a linear slope (Krywonos *et al.*, 1982, especially p. 70-71). However, these are relatively open-textured, unpainted coarse wares, not close-grained, glazed fine pottery like that found on the Dattilo ship. On certain land-based sites this factor might prove useful for dating pottery, although it must be said that recent tests of fine ware sherds from ordinary, dry contexts do not suggest that changes in concentrations of trace-elements necessarily reflect changes in the levels of clay-beds being exploited by the potters, which might otherwise have led to neutron activation analysis providing potential information on the dating as well as the provenance of pottery (as I mooted in Prag, 1985, p. 57-58 ; cf. Fillières *et al.*, 1983, p. 61, table 2).

However, in the case of the pottery from the Dattilo wreck leaching of sea-water seems not to be a problem, but leaching from the ferrous concretion certainly is. In some cases it adheres very firmly to the surface of the pottery, and at a fresh break it can sometimes be seen with the naked eye to penetrate well into the body of the sherd.

Seventeen « representative » sherds from the ship selected by the excavator were analysed ; they came from skyphoi, one-handled cups, shallow bowls, and a lekythos. The fabric varied from very hard, fine orange or orange-brown clay with remains of good black glaze (sometimes thick and dull or crazed), to a hard pink with traces of grey in it and a thick, flaking metallic glaze, or a soft pinkish clay with brownish glaze, or again a hard fine grey clay with traces of dull glaze (Bound, 1989b, p. 206-217, figs. 7-22). In some instances I noted fine inclusions in the clay. To me they looked like a cross-section of black glaze fabrics, probably from sites in Magna Graecia.

Not surprisingly, the most striking aspect of the analyses was that they showed the sherds to be exceptionally high in iron : roughly half contained between 4% and 8% (around 5% would be regarded as normal), while the other half gave readings of between 9% and 27%. The great variation could readily be explained by the fact that vases of the same shape were often found stacked inside each other (e.g. the skyphoi shown in Bound, 1989a, fig. 5), and thus the protected parts were less likely to be affected by the

encrustation, while the one piece that gave the very high 27% reading was less well levigated than the others, with air-spaces in the clay. Nonetheless iron clearly had to be set aside in the analysis of the results; once that had been done (and the sherd that gave the 27% reading extracted, since it was felt that this was so extreme that it might distort the readings for the other elements), the Dattilo sherds produced a nice, tight group, but one which did not match any other fabric on the Manchester database. Any possible subdivisions within the group do not appear to correspond with noticeable differences of fabric.

So they are not Attic, nor from Apulia or southern Basilicata, and do not match the western Sicilian samples from Motya. Perhaps this is not surprising, and most logically the source should be found in one or more sites in northern or eastern Sicily, or even more probably in Lipari itself. We do not hold any Sicilian material in Manchester suitable for analysis; it will now be necessary to find either sherds or compatible analyses of black glaze pottery of known Sicilian provenance in order to provide the answer to last port of call of the Dattilo ship. At least we can be pretty sure that the concretion is indeed iron, though we have now received a sample for analysis to confirm it; the geological conditions that produced it still need explaining (Bound, 1989b, p. 217).

The question of one cargo remains, although it is not usually seen as such — whether potter's clay was carried considerable distances by sea, or by land — and there is an important difference. Most archaeologists can cite cases of modern « ethnographic » potters importing clay — I have heard of it in Aegina and in Libya, to quote but two; it is part of ceramic folklore that china clay was carried as ballast round the world from the Far East to Cornwall before Cornish potters realized they had it on their doorstep. Before one dismisses the notion of long-distance movement of raw clay out of hand it is important not to impose modern transport costs and conditions onto ancient economies; it is worth remembering that Roman official figures show that it cost as much to carry a cargo of grain from one end of the Mediterranean Sea to the other as to cart it 75 miles by land.

The analyses of sherds and clays from Motya and Carthage mentioned above (Wolff *et al.*, 1986, p. 255), seemed to imply that Motyan potters imported clay from Carthage — though Wolff himself did not believe this in view of the ready access which they seemed to have had to the local clay beds across the causeway at Birgi on the Sicilian mainland and elsewhere nearby — yet that is what the analyses imply. Wolff argued that the Motyans would only want to import clay under these circumstances if it was safer or cheaper to do so than to get it locally, or if it was better clay; yet no hostile forces controlled the Motyan hinterland, and he thought that the pots produced in Carthage itself were « no technical wonders, certainly possessing

no attributes that others might find desirable ». However, this posits that the same clays must always produce similar pots, which certainly does not follow, as samples from Carthage and La Rabta analysed in his own project showed (group 5 on p. 120 above). It also sets aside consideration of the trade carried out between Motya and Carthage. If Sicily supplied Carthage with for example grain, then what did those corn-ships carry on the return journey? Unless there was another bulk cargo, then they must have sailed in ballast. It would be interesting to know what that ballast was. Perhaps (and here I speculate) just as in Cornwall many centuries later clay was the most convenient ballast, one which could be put to good use at the destination, and thus turn in a small profit for the master (Dr Wolff and I have agreed to disagree on this point: I have taken the liberty of expanding the arguments which he expressed in summary form in his publication from the letters we have exchanged on the subject).

More work, not just in analyses, but in cross-disciplinary contact between historians, archaeologists and chemists might answer such questions. The problem is typical of those in which we become involved: we often raise as many questions as we answer, and if left in isolation such questions will remain sterile, and never bear fruit.

I may, indeed surely I have overlooked work done by others that may even cover these same topics and areas; but there is a problem of communication, and not just in pottery analysis. We are all busy people, with interests in many aspects of the ancient world — I cannot be alone in never finding time to read my way through the work of others in journals and in conference reports. Even when all this information becomes instantly available on international computer networks, whether through PACT or a similar organization, I really doubt whether one would ever be able to make full use of it. There will simply be too much of it in too diverse a form (the bane of any information retrieval system), and all too easily one will never find the opportunity to use it.

And I am very glad of it. The excitement of my research is twofold: the discoveries I can make, or help to make, about the ancient world and the people who lived in it is one side; the other is to work with other scholars from other disciplines and other countries, and to exchange not just facts but ideas and methods of work. If I just wanted facts I could sit in a library, a laboratory or in front of a computer terminal. Because I need more than that I came to Ravello.

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It will be clear from the names mentioned in the course of this paper that the work which I describe has been and continues to be very much a combined effort: to all of them I owe warm thanks, and to Jonathan Tomlinson and Stephen Foy who carried out the most recent analyses, as well as to Margaret Broughton for drawing the maps. But my particular gratitude must go to the late Dr V.J. Robinson and Dr S.M.A. Hoffmann for their constant collaboration, help, and advice, without which none of this would happen at all, and to Mensun Bound for his enthusiastic cooperation and his ready willingness to share his discoveries at Dattilo with us.

## ADDENDUM

In the time since this paper was given at Ravello, much of the work proposed has been completed, largely as a PhD thesis in the University of Manchester by Dr Jacqui Scott. It is to be published by J. SCOTT, N. KOUROU and A.J.N.W. PRAG, *The Provenance of Greek Black Glaze Pottery: A Study by Neutron Activation Analysis* in the International Series of British Archaeological Reports.

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