From Artefacts to Anomalies: Papers inspired by the contribution of Arnold Aspinall

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The Bigger picture: provenance analysis, regional synthesis and medieval pottery

For Arnold Aspinall

Paul Spoerry
Cambridgeshire County Council Archaeological Field Unit
Cambridgeshire Archaeology
Cambridgeshire County Council
15 Trafalgar Way
Bar Hill
Cambridge
CB3 8SQ

1 Introduction

This paper is intended to celebrate Arnold's contribution in artefactual provenance studies through elemental analysis of ceramics, as experienced by myself. It is a personal account, specific to myself, but no doubt resonant for many who were set on their way in research by Arnold. My involvement in analytical chemistry and physics has been staccato; since my Doctorate it has never been central to my own employment, yet it is through the clear, firm, open and positive introduction to the subject that I gained from Arnold, that I have been able to return to scientific provenance analysis during my career, see it for what it is, and use it to answer real archaeological problems.

I must state now that, unlike many of you here, my path has taken me away from seats of learning for much of the last two decades, and I now perform the role of 'Head of Business' for an archaeological fieldwork contractor. Somehow I manage to combine this with an on-off involvement with artefacts as a medieval ceramics specialist. It is in the latter sub-discipline that my experience is most affected by the guidance of Arnold in earlier times.

2 Ancient History

I studied for the four-year Bachelor of Technology Sandwich degree course at Bradford between 1981 and 1985 and, chose options in artefactual analysis. I think Arnold realised early on that I was most successful in practicals and project work, less so theory and memorising for examinations. For my 'year out' Arnold guided me through several months leading resistivity surveys in the Scottish Borders (but that is another story) and this was followed by six more months in Tweeddale, excavating on medieval sites, previously identified through the geophysics. I returned to Bradford, much more an archaeologist, but utterly without a clue as to what I should do for an undergraduate dissertation.

In the meantime former colleagues in southern Scotland had contacted Arnold about a problem they had providing provenance for the ubiquitous medieval pottery type of the region 'Scottish White Gritty ware'. Arnold convinced me that it was my destiny to tackle this material, but that just doing a 'routine' NAA analysis programme might not be unique enough and instead I should attempt to provenance fired ceramics by their magnetic properties which to his knowledge had not been done before. Even I could see there was a fundamental problem with this plan, it being that magnetic properties in deposits are mostly a result of Iron Oxides within the material, which are entirely changed, and hugely enhanced, through the process of heating. Nonetheless, being young and enthusiastic I produced a dissertation based on this unique research tool, within which I did try to account for magnetic changes in ceramics through heating, providing useful data from experimental re-firings, but which failed to demonstrate any meaningful results at all in terms of the classification and grouping of Scottish White gritty ware. This experience taught me a number of lessons. Firstly, that I did indeed enjoy and thrive on project-based research. Secondly, that if archaeological questions are to be answered, you are unlikely to achieve this straight away through novel scientific applications and thirdly, that I could not always believe everything that Arnold said.

3 South, by Southwest

This experience had, however, been a very positive one and so it was that, through Arnold's recommendations a few months later I found myself appointed as Research Assistant in Archaeological Sciences, signed up for a Higher Degree, at the newly re-structured Higher Education establishment that within a few years became Bournemouth University. Here my subject matter was, again, principally medieval pottery, this time of the Wessex region. The brief for my doctoral research was again provenance study, but fortunately this time we were setting up a new laboratory using an old tool, Atomic Absorption Spectroscopy. The external moderator for the science component of this project was Arnold, although geographical distance precluded his close involvement. On the face of it he therefore did not have a substantial input into my Doctoral Thesis, but in reality the lessons I had learnt from him regarding good science and the enjoyment that could be gained from the application of scientific tools to answer applied problems was invaluable.

(Slide, contemporary photos)

The first paper I published as an archaeologist, and the first produced from my doctoral research, was given in 1987 at the Glasgow Archaeological Science conference. My title was 'Problem-Specific Provenance; A case study from medieval Wessex. For my purposes here I will ignore entirely the results of my research at that time, but instead I focus on the lesson, the ethos, of the paper.

"To reap the full benefits of directing science and archaeology towards a common goal, equal energy must be spent on both aspects. In essence, one must allow each half of the study to regulate the progress of the other, giving credit to all findings based on objective criteria rather than mere historical or scientific tradition."

I wrote those words nineteen years ago and they are still, as good an evocation of the Bradford department's ethos under Arnold, as I can provide.

Despite all good intentions once I had completed my Doctoral research I felt rather negative about my contributions in both Science and Archaeology. My research project and Thesis demonstrated very effectively how cumbersome AAS, and for that matter NAA, was as an analytical tool, just at the moment that ICPS, the currently standard inorganic analysis tool, still 'fit for purpose', became affordable. I doubted then whether anyone else would ever again attempt regional analysis of ceramics using AAS, and so it has proved.

I was less pessimistic about the archaeological contribution of my research, although for years I have tended to assume that this could be summed up in one illustration (slide Figure 1: Figure 6.3 from my thesis). This rather opaque figure identifies a zone within west Dorset where three utilitarian ware ceramic traditions overlapped in their supply to domestic sites in the 13th to14th centuries. Each tradition is chemically and visually distinct, apart from some cross over between wares S1 and S4, which seem to have similarly derived clay matrices, but differing inclusions.

It is necessary to provide some background to this figure. Ware C1, a coarse sand tempered type of lower iron content (thus lighter-firing), was made at a few widely-spaced, larger-scale pottery industries located on the urban-fringe of places like Poole (postulated from my research and the volume of pottery discovered locally), Southampton and Salisbury. It was usually also associated with decorated fine ware production and C1 vessels included a variety of jars, bowls, jugs and tripod pitchers. Ware C1 from different producers was not effectively separated using statistics derived from chemical analysis. Nonetheless a large zone of ware C1 dominance of utilitarian products was apparent, this being also fairly coincident with the distribution of related finewares. This zone extended westwards to overlap with the distribution of the other wares studied. In north Dorset it seemed that C1 was present in vessel types not made at more local production sites.

Wares S1 and C2/S4 contain more iron and fire to darker hues. They contain fine quartz sand and in the case of the latter, often flint and/or shell inclusions. Prior to my research only one small rural kiln site was known (Hermitage in northwest Dorset, producing S1), along with another likely source of manufacture postulated in south Somerset. Analysis of pottery fabrics from consumer sites showed that there were probably several production sources, and that these kiln sites could make both ware types, and they probably distributed to relatively small, and often erratically shaped areas.

What this figure tells us is that the zones of occurrence of these differing wares and traditions overlapped in central and west Dorset. What the chemical analyses suggested was that an eastern zone of large-scale production of a recognisable 'product' overlapped with and then gave way to a western zone of smaller-scale production of a more variable, but still very distinct 'product'. Applying a greater depth of archaeological knowledge enabled me to associate these two pottery traditions with, on the one hand a central southern (even south-eastern) tradition and on the other hand a west country tradition. These distinctions extended not just to the type of pottery fabric and range of vessel types, but also to the scale and location of production (larger scale urban fringe versus small-scale and rural) and to the geographic extent, and the key modes, of distribution (wide-scale through major market towns versus geographically irregular local distributions via market villages and through hawking by the potters themselves).

Additionally, and crucially, this distinction did not exist in a vacuum as a clear difference in both topography and rural settlement morphology has been observed for many years between these two regions of southern England. The nucleated villages, densely populated parishes and more easily travelled and less isolating environment of the open chalklands and coastal plains being contrasted with the dispersed rural communities, low level of urbanism and more deeply corrugated, isolating landscape of the western counties. The change point between these two landscapes is coincident with the zone of tension between ceramic traditions shown on this figure.

At the risk of blowing my own trumpet, albeit a rather rusty 1980s one, I still feel that this study exemplifies how the proper application of science to archaeology can yield rewards. It also convinced me that the best level of application for ceramic provenance studies utilising chemical analysis is when dealing with wares and regions, and not in a preoccupation with defining each an every separate kiln site and fabric.

4 The Middle Ages

I would like to move this presentation on almost 20 years, and show you how this experience, and that background in the 'Bradford ethos' has enabled me to effectively return to ceramic provenance analysis, albeit by proxy.

In recent years, when able to find the time to consider medieval ceramic studies, I became regularly frustrated by the lack of regional synthesis in Cambridgeshire and the East of England where I now work. Fortunately I was not alone in seeing the shortcomings of attempting to publish a great volume of medieval pottery from development-funded commercial contracts without a local type series or serious assessment of production sites. Thus I was able to persuade English Heritage to fund, first a study of the medieval Ely pottery industry, due out any time now as East Anglian Archaeology volume 121 (Slide Figure 2, cover of volume) , and secondly to fund a much larger study on medieval ceramics in Cambridgeshire generally, currently underway. In both cases these studies are primarily to define fabrics, production sites and products, offering data on date-range, geographical distribution and vessel form, manufacture and decoration, for all recognisable products present in the Cambridgeshire ceramic assemblage from the seventh to sixteenth centuries. Being a land-locked county many products found in Cambridgeshire derive from adjacent areas and these are investigated in detail only where such work has not been achieved within the home County of the ware type. With some traditions of manufacture spreading across large geographic zones, this work can be challenging and often assumptions about the origin of fabrics have to be rigorously tested.

The main work being conducted though this project is characterisation of fabric and form. The latter is carried out through normal archaeological processes. The former utilises a combination of macroscopic description, thin section petrology and chemical analysis using ICPS, followed by multivariate statistical treatment of data from many elemental concentrations. Both of these analytic procedures are conducted by myself jointly with Alan Vince, who also conducts the petrological description and initial statistical treatment and analysis of ICPS data sets. ICPS analysis is carried out by Royal Holloway College, London under the supervision of Dr J N Walsh.

4.1 Characterisation of Ely Ware

I will now illustrate aspects of science-based provenance research on the first of these two projects, the characterisation of medieval Ely ware, which, in technique and concept is now also being rolled out for a variety of other research questions regarding other medieval ceramic types and their distributions in Cambridgeshire as part of the larger county-wide research project.

Initial thin section petrological work by Alan Vince provided characterisation of Ely ware from two waster groups and from excavations of a domestic site on Forehill in Ely. Most of these sherds can be grouped into a general petrological description for the ware (Slide, Table 1) that is characterised by a range of sand and gravel inclusions; subangular and rounded quartz sand, rounded stained flint, fresh flint, rounded red opaque grains, rounded chalk, glauconite and other minor inclusions. For the most part the inclusions appear to derive from added sand temper from a locally-sourced fluvio-glacial deposit rather than from the clay itself. The groundmass itself often has a distinctive high organic content that probably indicates use of an unweathered organic clay. Calcareous microfossil evidence and an absence of fine grained quartz or muscovite silt suggests a source in an Upper Jurassic facies which at Ely is most likely to be Kimmeridge clay.

A small group (Forehill fabric C) was deemed to be not an Ely product due to a high glauconite content, but all other visually comparable sherds from the town fitted into the ware description provided. Visually comparable sherds from contemporary production sites at Bourne and Baston in south Lincolnshire were found to be petrologically distinct from Ely ware.

Forty two sherds, which through macroscopic characteristics would be classified as probably Ely ware, were next selected from contemporary consumer sites across the Fenland (slide, Table 2) and subjected to both Thin Section petrology and sampling for ICPS analysis. In most cases these thin sections confirmed the identification as Ely products with no difficulty; this included sherds of so-called Grimston software from Kings Lynn, which David Hall and myself first recognised as in fact almost certainly Ely ware in the late 1990s.

In a few cases, this identification could not be confirmed through petrological characterisation (slide Table 3). Only one of these samples appears to be of Bourne/Baston ware (V817) whereas three are probably from other, unknown sources (V825, V839 and V852). In the main, however, the visual identifications are consistent with the petrological evidence, indicating the transport of Ely wares throughout the fens. Samples from Orton Longueville identified visually and through geographical proximity as being either Ely or Bourne/Baston type were shown in thin section to be probably of Ely origin.

I must emphasise here that the following interpretation of ICPS data analysis is wholly the work of my colleague Alan Vince, reiterated here with limited alteration by myself.

All of the samples were analysed at Royal Holloway College, London. The following major elements were measured as percent oxide weight: Al_2O_3, Fe_2O_3, MgO, CaO, Na_2O, K_2O, TiO_2, P_2O_5, MnO. A range of minor and trace elements were measured as parts per million weight (Ba, Ce, Co, Cr, Cu, Dy, Eu, La, Li, Nd, Ni, Sc, Sm, Sr, V, Y, Yb, Zn and Zr). Zirconium is likely to be only partially dissolved during the sample preparation process and the Zr count is therefore only a minimum.

Lead was also measured, mainly as a guide to possible glaze contamination. (Slide, Figure 3) indicates the lead for each ware and this shows a strong correlation with the usually glazed Late medieval Ely fabric LMEL and also isolated glaze contamination of CLMEL and the Bourne/Baston samples (BOUA) appear to be represented.

In order to estimate the amount of silica present in the sample the total percent oxides count was subtracted from 100% to give a notional SiO_2 value. This will, however, include other unmeasured elements, such as chemically combined water and organic matter. Thus, samples with a high organic content might be expected to have a higher 'SiO_2' value that the equivalent oxidized sample.

Slide, Figure 4 indicates the SiO_2 values for the measured groups. This shows no such difference, indicating that the organic content is low in comparison to that of silica.

The data were then normalised by expressing each element value as a ratio with Aluminium, which is present mainly in clay minerals and feldspars. The Forehill A samples show a wide range in silica content and this is mainly explained by the high calcium content of three of the samples (Slide, Figure 5). With their exception, there is no obvious correlation of calcium content and whether or not they were identified visually as being calcareous. This may, however, be due to the firing out or leaching of calcareous inclusions.

Factor analysis was then undertaken of the entire dataset using just the main elements, excluding CaO (for the reasons described above).

A single significant factor was found (explaining 35% of the variance in the data, compared with only 10% for the next factor). A plot of the Factor 1 scores against Silica content (slide, Fig.6) separates the Bourne/Baston wares from the Ely wares and indicates that one Peterborough sample that had been flagged as either an Ely or Bourne/Baston product from visual characteristics and geographic location is indeed likely to be a Bourne or Baston product (BOUA?). One of the unknown samples has a different factor score whilst the other two are similar to the Ely wares, as are the three glauconitic samples from Forehill (marked as MEDLOC). The three highly calcareous Forehill samples have similar Factor 1 scores to the remaining Ely wares and are only separated in Fig.6 by their lower Si02 samples. High factor 1 scores indicate high values for K2O, Fe2O3 and MgO whilst negative Factor 1 scores indicate high TiO2 values. This is illustrated graphically by a plot of TiO2 against K2O values (slide, Fig.7) . This plot not only indicates the clear distinction between the majority of the Bourne/Baston and Ely wares but also reveals that the Forehill A samples fall into two groups, distinguished by their K2O values. All three 'unknown' samples plot peripherally to the medieval Ely group. When the same data are grouped by findspot, the Ramsey samples are distinguished from the remaining Ely wares by their low K2O and high TiO2 values (Slide, Fig.8). This suggests that the Ramsey samples might come from a different source, although clearly closer in composition to the medieval Ely wares than to the Bourne/Baston wares.

Factor analysis of the minor and trace elements was also carried out but appears to reveal differences which are due to calibration variation rather than variations in the actual chemical content. Removal of rare earth elements appeared to resolve this problem and offered some more detail in discrimination between groups that nonetheless did not counter the assertions made through assessment of the minor elements.

4.2 Conclusions and contextualisation of Scientific study

Thin section analysis indicates differences between Bourne/Baston and medieval Ely wares and also suggests that one sample from Peterborough is of Bourne/Baston ware.

Three of the samples from consumer sites are unlikely to be medieval Ely ware but cannot be provenanced.

The chemical analysis confirms this distinction between Bourne/Baston and medieval Ely wares.

Forehill fabric A is chemically distinct from the remaining medieval Ely wares whereas Forehill fabric B has the same composition as the Potters Lane kiln waste and consumer site samples. Forehill fabric C was produced from a glauconitic clay and is unlikely to be an Ely product.

'Grimston Software' from King's Lynn has a similar composition and petrology to medieval Ely ware and is probably an Ely product and there is only slight evidence for differences in composition between the medieval Ely ware samples from different consumer sites, indicating perhaps that the Ramsey samples come from a different source, based on their titanium and potassium contents.

This latter point is of great interest and is now being explored further as, feeding this data back into routine archaeological observation, increasingly, we are able to see minor macroscopic differences in the fabric of Ely-type ware sherds from the Ramsey and Huntingdonshire fen edge when compared with pottery found at Ely itself and other centres further east, something that had proved invisible to us previously. (Slide, Fig 9 map of sites with Ely ware in the fenland). If one were to assume that pottery was not only made at Ely in the southern fenland in the 12th to 15th centuries, then the one other place production might be expected is on the western, Huntingdonshire fen edge under the auspices of Ely Abbey's great local rival at Ramsey. Ramsey Abbey owned almost all of eastern Huntingdonshire and became very wealthy during this period principally through effective fenland waterway management and the setting up of the town and fair at St Ives. It seems wholly appropriate that, if an Ely type ware were made somewhere else, Ramsey Abbey would be the instigator, or controlling landlord.

5 The Road Goes Ever On

So, problem-specific provenance still yields rewards, and I, through a background in the teachings of Arnold and the Bradford ethos, feel able to combine a reasonable understanding of the methods of scientific provenance analysis, with a current involvement in the archaeological investigation and understanding of medieval micro-economics and landscapes in eastern England, to deliver appropriately conceived projects with properly positioned interpretation.

When not running a field unit, the next year will see me direct our Cambridgeshire Medieval Pottery project towards a whole host of specifically-tailored research goals (Slide, Table 4) for which in most cases both thin sections and ICPS analysis are necessary. I think this study will break ground in the detailed application of routine analytical chemistry to a host of interleaved specific research questions, which have been identified though a thorough understanding and critical analysis of problems of the archaeological record in detail. This is not bolt-on technology, but the proper use of applied science. That, if nothing else, is Arnold's legacy to me.