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NEW LOOKS AT OLD POTS: RESULTS OF RECENT MULTIDISCIPLINARY STUDIES OF GLAZED CERAMICS FROM THE ISLAMIC WORLD

Ceramics constitute one of the foremost of the arts of the Islamic world from the eighth to the eighteenth centuries. In certain cases, the sophistication of execution was equal to any other art of the period, while the technological requirements have traditionally been recognized as extremely innovative. But despite its importance, serious study of the ceramics of the Islamic world have in the past been hampered by a number of serious problems.

Although hypotheses existed regarding the impact of courtly patronage on these wares, in many cases no reliable correlation of the production of the ceramics to the place and period of these courts could be established. Clearly, a reliable way of assigning these materials to places of manufacture was necessary, as was a more reliable chronological ordering of the wares. Theoretically, certain classes of wares should be capable of as finely resolved a chronology as, for example, ancient Greek painted wares, where attribution of a piece to a single decade may be possible, enabling considerable correlation with the contemporary culture.[1] Chronologies have even been constructed for Neolithic pottery which attribute styles to a particular generation,[2] enabling the sort of refinement that makes it possible to interpret ceramics in a socially and culturally meaningful manner. Further, although the technological sophistication of the ceramics has been recognized, few analytical studies had been made to investigate this technology.

In my recent research these problems were approached using three chief methodologies, focusing on wares made in the Islamic world between about 700 and 1250.[3] The objectives of this paper are to outline the methodologies employed and to report on some of the results of the findings and their relevance. Further research on ceramics of the late fourteenth to early sixteenth centuries undertaken in collaboration with others will also be referred to,[4] as will preliminary results of unpublished studies.

PROVENANCE

Whereas it may often be preferable to think of a particular ceramic object in terms first of its typology, followed by its origins and technology, in research it is important that origin come first. This is partly because the origin of the pot is not dependent on date or technology, and so is a useful place to start, and partly because in typological study it is important when developing a sequence that one is indeed studying a true sequence, that is, material made in the same center.

Although preliminary studies utilizing chemical analysis of bodies and lead isotope analysis of glazes have been undertaken, the preferred technique is petrographic analysis. This technique relies on analysis of the mineralogy and texture of the inclusions found within the ceramic body. These variables are dependent on the geology of the region where the pottery was made and on the depositional regime of the raw materials. Ceramic petrography has long been a component of archaeological ceramic studies in many parts of the world, with regular application from the sixties onwards.[5] Effectively the technique has been used intermittently since its development in the last century, but with continuing application since the work of Anna Shepherd in the United States in the forties, in Germany since the fifties, and in the United Kingdom and Soviet Union since the sixties of our century. Research has touched most periods and regions of the New World, prehistoric to classical Europe and the Near East, and medieval Europe.

One of the few areas to have received limited attention in the past is the Islamic world. Apart from my own work[6] published studies of Islamic pottery incorporating petrology have had a distinctively Maghrebi accent, and include that on North African wares[7] and Spain.[8] Due to their lack of exposure to the technique, some Islamicists may regard ceramic petrography as revolutionary, but it must be recognized that it is regarded as standard, and indeed essential, research by many archaeologists. The

aim of most of these studies is largely the same as that in my work. Initially, the objective is to group ceramics together on the basis of their common use of the same raw materials, defined by the same petrographic fabric (petrofabric); and further, to attribute that particular group to a specific site of production. Such studies are especially important when working with trade ceramics, such as Roman amphorae.[9]

One major difference that exists between this study and those undertaken on other types of pottery is that much of the material here consists of the stonepaste type of ceramic body, mostly comprising quartz held together by glass, whereas all other studies have been on clay bodies. For differentiating between groups of stonepaste, it has been necessary to develop new criteria for distinguishing the characteristics of each center based on the petrographic characteristics of the quartz itself.

Results of the provenance study have in some cases allowed the attribution of various wares to precise sites of manufacture, while in other cases it has shown that certain wares were not made at particular centers. For example, all luster-painted wares of Abbasid association are solely of the Basra petrofabric and all of Iranian association are solely of the petrofabric attributed to Kashan, but Syrian pottery commonly called "Raqqa" wares appear attributable to a number of Syrian centers, including Damascus (although not including luster-wares). The determination of long-distance trade or other contacts is also an important aspect of this research. Particularly notable in this regard is the distribution pattern extending from Spain to Thailand and South Africa of Basra wares in the eighth to tenth centuries. Similarly, although there appear to be a number of Syrian production centers of the "Raqqa" styles, the Damascus petrofabric overwhelmingly dominates in wares found in sites beyond Syria, notably including northwest Europe.

TYPOLOGY AND DATING

A hierarchical taxonomic structure was used for the ceramic typology wherever possible. This involved ordering into primary classes by glaze technology (lead-glazed, opaque-glazed, etc.); divided into type by decorative technique (luster-painted, slip-incised, etc.); which was in turn divided into style (e.g., Iranian Group-One Luster-painted). Classification was often designated with reference to the analytical glaze study (see below), but in every case reflected readily visible diagnostic criteria. Although this system worked admirably for the majority of cases, occasionally reality would impinge upon its order. For instance Iranian luster-painted wares may be found on alkali glazes or tin-opacified glazes, or even both on the same vessel, with no chronological or stylistic distinction. A further important characteristic in classification was the ceramic body. In a gross sense, division is ordinarily made between stonepaste and fired-clay bodies, but division is also made with the aid of magnification based on body texture and mineralogy. This would be linked to the petrographic study to ensure that one was indeed studying a sequence of ceramics from a single production site.

Previous stylistic analysis of this pottery had largely been undertaken by art historians utilizing traditional connoisseurship techniques and focusing on whole vessels. In contrast archaeologists have consistently concentrated on particular sites, where only segments of the entire sequence, or even single finds, could be found. My approach to the typology of the wares was undertaken by applying practices familiar to archaeological ceramicists. This involved an integrated study of archaeological fragments with that of whole vessels of unknown origin. The characteristics of all the examples were broken down into a number of attributes, specifically form and motif assemblage. Form was studied by recording vessel profiles in the usual archaeologist's manner, by accurate measured drawings (for an example, see fig. 1). Although commonly used by archaeologists,[10] or by art historians with archaeological training,[11] the nearest use in standard art-historical ceramic studies may be at best to have a draftsman draw a few misleadingly "representative" pieces. In an ideal situation the drawing should be done by the ceramicist, to ensure accuracy and as an aid to study. Distinctions in forms may be very subtle, yet consistent and meaningful. Effectively, one is examining the motor-habit patterns of the potter. What appears to be a major change in a profile may be due to an insignificant change in motor-habit pattern, while a seemingly subtle change, perhaps even invisible without accurate drawings, may indicate a radical change in motor-habit pattern which easily delineates a division between major groups. Form appears to be a major time-specific variant in these wares, providing the above methodology is used in their study.

Decoration was studied by reducing the overall design to an assemblage of repeated structural motifs rather than studying the overall iconographic significance of the design (an example is provided in fig. 2). A classic example can be found in Iraqi, or Abbasid, luster-painted wares. Here the well known "Sasanian wing

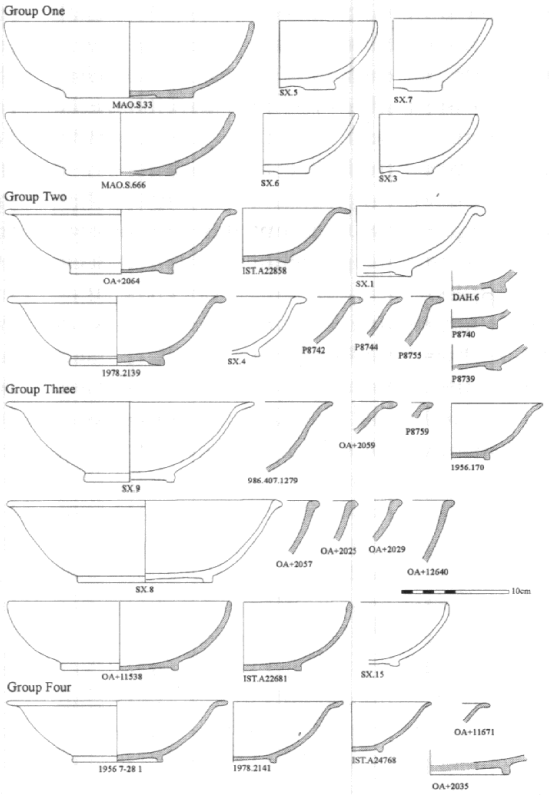

Fig. 1. Form study of Iraqi blue-painted ware. Vessels with shaded profiles are drawn by the author; those with no shading are taken from other publications. Examples include pieces from Susa (MAO. nos., SX. nos. after Kervran 1977), Samarra (OA nos.), Hira (nos.), Istakhr (IST. nos.), Siraf (986. nos.), Dahran (DAH. nos.) and pieces without origin in the Ashmolean Museum (e.g., 1978.2141) and the British Museum (e.g., 1956 7–28 1).

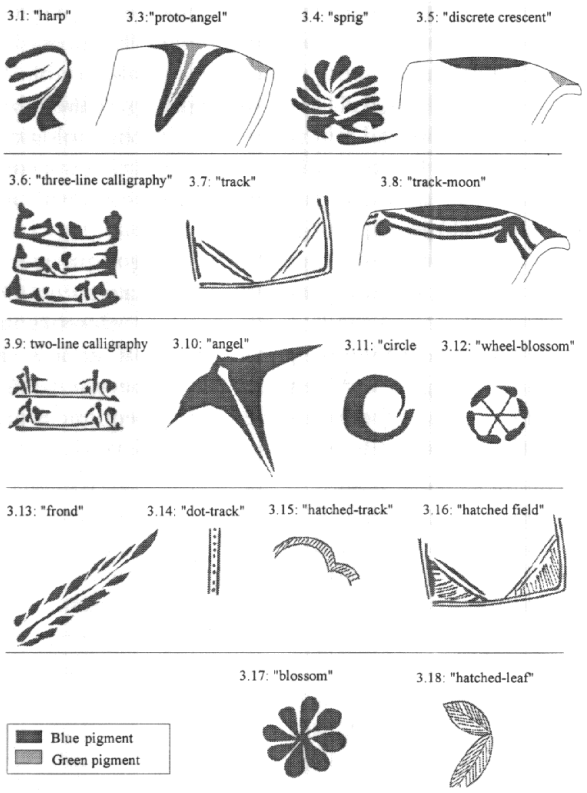

Fig. 2. Motif study of Iraqi blue-painted ware.

motif" would be ignored but for the pattern which filled it. In examination of these motifs, it is essential for the chronological ordering of the ceramics that the execution be precisely the same. Again it is the motor-habit pattern of the individual artisan being examined, and "reminiscent" or otherwise similar designs must be classified as such and discounted.

Once these design elements are identified, their occurrence within a type is tabulated together with vessel form, and is thus subjected to seriation (for example, see table 1). This differs somewhat from the usual application of seriation to ceramic studies as first developed by Flinders Petrie in his study of ancient Egyptian pottery.[12] In his application an assemblage of pottery from a context — in Petrie's case a *mastaba* tomb — are considered as the units, and the individual vessels are considered the attributes of that unit. Petrie worked out his seriation by creating long cards with vessels drawn on them. He laid the cards out, juggling them around until a sequence of individual vessels coming in and then leaving the assemblages could be discerned. Petrie's early work still stands to this day,[13] and his methodology is the basis of archaeological pottery dating by archaeologists around the world.

In my research, this technique is applied by considering the individual pot as the unit and the motifs and form to be the attributes. These attributes correlate in an assemblage of design elements and forms. Such an assemblage will define a group of pottery with the same *style*. At times a style group is distinct from others, with few or no motifs held in common with other assemblages. At other times individual motifs may cross over from one assemblage to another in an interrelated sequence of motif assemblages (i.e., are seriated). In some circumstances the cause of such stylistic divisions may represent distinct, perhaps contemporary, workshops. In the majority of cases each stylistic group within

a type represents a progressive series of developments, which is best explained by chronologically successive groups. This may be seen in the relevant table (table 1) where the assemblage shifts to the right down the table in what is considered to approximate a chronological progression. The form studies also generally show a continuous line of development (e.g., fig. 1), even with an eye to the realities of potting precision.[14]

Having been placed in a relative dating sequence, a tentative absolute dating was supplied by reference to the archaeological evidence and also by reference to objects with datable inscriptions. This, of course, is where the dating enters the realm of the speculative. Although some style groups or even major sequences are well dated by this evidence, other style groups may only be dated by their relationship to the reliably dated groups. Thus dates are suggested by the degree of change or "development" in form and design, which relies on the frail assumption that change is constant through time. Apart from being important for its own sake, the typological study also enabled other findings, particularly with regard to technology, to be put on a chronological basis. Without this temporal perspective assertions regarding technological development are meaningless.

This part of the study has benefited tremendously from the breadth of the inquiry, avoiding a narrow focus on one area. The continuum of relatedness running throughout this material has strengthened the study tremendously by allowing comparisons and correlations be-

Table 1. Incidence of motif and form, Iraqi blue-painted ware

Sample No.	Rim	Base	Petrofabric	Motifs																	
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
SX.6	simple	dimple	–	*	*	*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SX.5	simple	dimple	–	–	*	*	*	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SX.3	simple	dimple	–	–	*	–	*	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1978.2139	–	–	–	–	*	–	*	*	–	–	–	–	–	–	–	–	–	–	–	–	–
OA+2064	serpent	wedge	[Basra]	–	*	*	*	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SX.1	serpent	wedge	–	–	–	–	*	–	*	–	–	–	–	–	–	–	–	–	–	–	–
R-A LVb	–	–	–	–	–	–	*	*	*	–	–	–	–	–	–	–	–	–	–	–	–
P8739	–	wedge	Basra	–	–	–	*	–	–	–	–	–	–	–	–	–	–	–	–	–	–
IST.A22681	simple	ring 1	–	–	–	–	*	*	–	*	–	–	–	–	–	*	–	–	–	–	–
Christie's	–	–	–	–	–	–	–	–	–	–	*	2	–	–	–	–	–	–	–	–	–
OA+2059	recurve 1	–	[Basra]	–	–	–	–	–	–	–	*	–	–	–	–	–	–	–	–	–	–
P8759	recurve 1	–	Basra	–	–	–	–	–	–	–	*	–	–	–	–	–	–	–	–	–	–
OA+2029	tortoise	–	[Basra]	–	–	–	–	–	–	–	*	–	–	–	–	–	–	–	–	–	–
Lane 9a	–	–	–	–	–	–	–	–	–	–	*	1	–	–	–	–	–	–	–	–	–
SX.9	recurve	ring 1	–	–	–	–	–	–	–	–	–	–	*	–	–	–	–	–	–	–	–
1956-170	–	–	–	–	–	–	–	–	–	–	*	–	–	–	*	–	–	–	–	–	–
Koech XII92	–	–	–	–	–	–	–	–	–	–	–	–	*	*	*	–	–	*	*	–	–
SX.15	simple	w-ring	–	–	–	–	–	–	–	*	–	–	*	–	*	–	–	–	–	–	–
Pope 574c	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	*	*	–	–	*	–
OA+2057	tortoise	–	[Basra]	–	–	–	–	–	–	–	–	–	–	–	–	*	–	–	–	–	–
SX.8	tortoise	w- ring	–	–	–	–	–	–	–	–	–	–	–	–	–	*	–	–	–	–	–
1956 7.28, 1	recurve 1	ring 2	[Basra]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	*	*	*	–
MIA 32.32.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	*	–	*	*	–	*
MIA 32.32.3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	*	*	*
1978.2141	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	*	–	*
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18

Table headings: Petrofabric in brackets have not been thin-sectioned, but fit macroscopic description of petrofabric. Motifs: 1 harp; 2 central dot; 3 proto-angel; 4 sprig; 5 discrete-crescent rim; 6 three-line calligraphy; 7 track; 8 track-moon; 9 two or one line calligraphy; 10 angel; 11 circle; 12 wheel-blossom; 13 frond; 14 dot-track; 15 hatched track; 16 hatched field; 17 flower; 18 hatched-leaf. MIA nos from Minneapolis Institute of Arts, published by Grube 1974.

tween one ceramic sequence and that of another center. For example, amongst the luster-painted wares, cessation of production at Basra appears practically simultaneously with commencement of production at Fustat, and the first Syrian and Iranian wares are most closely related to the middle of the period of production in Egypt.

Each stylistic grouping amongst the luster-painted wares appears to be short-lived. In some cases it may be as long as fifty years, but generally a period of twenty to thirty years seems most typical. An important finding regarding the study of motifs has been in the relative degree of innovation one may find on different parts of the vessel surface. In particular the backs of vessels are the most conservative, with effectively the same motif used for entire style groups or even as links between several groups. A slightly less conservative region would tend to be the rim. Decoration here also generally respects a repeated formula, with particular motifs often distinctive to a particular style. The principle area showing the creativity of the painter would tend to be the main face of the vessel — the interior of shallow vessels and the exterior of deep or closed forms.[15] This may not be taken as evidence of division of labor, as brush styles will generally be the same for both the conservative and creative zones. Effectively the painter simply tried to cover the conservative area with a standardized pattern that required little thought.

In many cases distinct stylistic groups are correlated with particular production centers, rather than form sequences at a single site. In these cases objects which share stylistic attributes from one or more centers, or more typically possess the characteristics of one center while being made in another, may be considered to be exhibiting some degree of influence by one center over another, either by copying or the transfer of personnel.

TECHNOLOGY

The third part of the study involved investigation of the technological attributes of the wares by the application of the scanning electron microscope (SEM) with attached analytical facilities, including x-ray spectroscopy. This is currently the principal technique in studies of ceramic technology.[16] In this a small section of the sample, including glaze layer and body, is polished and examined under the SEM. This approach has become the technique of choice in studies of ceramic technology, being far more reliable than other techniques. In this part of the study the various questions regarding the origins of certain technologies have been resolved.

Tin-opacified glazes. One of the earliest new technologies developed by the Islamic potters appears to be the tin-opacified glaze. Glazes rendered opaque by other means had been a common feature of pottery made in Iraq back to Achaemenid times.[17] The earliest Islamic opaque glazes are found in the first stylistic group produced at Basra, having a white opaque glaze and cobalt-blue pigment applied over the glaze (blue-painted ware), and a date of ca. 700–50.[18] In these wares the traditional Iraqi opacifying technique was supplemented by the addition of tin, applied in the form of a "slip" prior to application of the glaze. This traditional potter's approach using material of known effect would suggest that the use of tin was derived from a pre-existing technology, probably glassmaking. In the next stage the tin is applied to the glaze mixture, but in small amounts, hence the tin works in combination with the traditional pre-Islamic opacifying agents. After about 800 the opacified glazes are generally solely reliant on tin as the opacifying agent.

Stonepaste ceramic body. The development of stonepaste was also an important technical contribution of the Islamic potters.[19] It apparently had its origins in ninth-century Iraq, as indicated by two phenomena. The first is found in the body of a fired clay ceramic of a petrofabric tentatively attributed to Baghdad. This "Baghdad" ware, which is the only Iraqi pottery other than Basra to have a tin-opacified glaze, is found in archaeological contexts dating from the late eighth to the mid-ninth century. Along with the range of inclusions typical of the region were found fragments of an alkali-lime-lead glass, in some cases also containing tin. Presumably the glass had been added with the intention of acceleration vitrification of the body. The second phenomenon of pertinence is the application of a quartz-based slip to certain types of lead-glazed wares. This seems very similar in appearance to true stonepaste, but analysis indicates that the slip was applied without added glass fragments, so it does not seem likely that the two techniques were closely related at this stage.

Although the evidence for the movement of the "Baghdad" potters to Fustat is not as strong as that for the Basra potters (see below), to explain the next development in stonepaste it is necessary that either the "Baghdad" potters did move, or that their technology was known to the Basra potters. This next development was the introduction of a proto-stonepaste body at Fus-

tat, comprising quartz and inclusions of relict glass additives in a matrix of highly vitrified clay, during the earliest production of lusterwares at that site (ca. 975–1025). This is a logical development from the "Baghdad" body, as it is still predominantly formed from clay with added glass fragments. But whereas the "Baghdad" body was formed from an ordinary central Iraqi clay, all the components of the proto-stonepaste were prepared separately and brought together specifically. Chemically, the clay does not appear to resemble any of the other Fustat clays, and has no natural inclusions, unless these have been removed by levigation. The quartz is the only inert temper, and is not a natural component of this clay. The class appears to be specifically constituted for its purpose, and is not a byproduct of glaze-making. Hence the Fustat proto-stonepaste body has all the attributes of the standard stonepastes, but in different proportions.

By the second phase of Egyptian luster pottery production (ca. 1025–75) we see a rapid development to true stonepastes, resulting in essentially the same technology as used for fine Islamic pottery to the present day. At the end of this stage of production (ca. 1075) potters move again to Iran and Syria. In these cases it is not only the technologically demanding luster-painting technology which is introduced into these new areas, but also the stonepaste technology, which also required special expertise. None of these new manufactories will use clay-bodied ceramics; instead in both Iran and Syria luster-ware and all other fine wares are only made of stonepaste.

The ultimate origins of the two Iraqi technologies that led to stonepaste remains a puzzle. Siliceous ceramics certainly existed in pre-Islamic times in Egypt and Mesopotamia, with production of so-called Egyptian faience or Egyptian blue. Normally the ground quartz bodies were initially held together with gum, and the glaze subsequently stabilized the material during firing. The limited and very rare use of added glass fragments and clay in this material, linked with the apparent absence of siliceous vessels for late pre-Islamic periods, would argue that Islamic stonepaste is an independent invention.

There are probably a number of reasons for the development of stonepaste. One of these is raw-material procurement. When the Iraqi potters arrived in Egypt they would have been unfamiliar with local clays and the other raw materials that would need to be added to render the clays suitable to their purposes. Indeed, these resources would most likely have been already vouchsafed by Egyptian potters. About 80 percent of the first group of Egyptian luster pottery was produced on local clays which appear to have been little utilized previously, but these required considerable processing to produce a required standard. Proto-stonepaste would have been a way of making a body of the correct type. During production of Egyptian Group Two the clays seem to deteriorate, becoming coarser and redder. If this was also due to problems with raw materials, then this would explain the switch to stonepaste. The clay used for proto-stonepaste would certainly appear to differ from the standard clays used at Fustat, and so may have been in short supply. Hence true stonepaste could represent a simple move from a high content of costly glass and rare clay, to a high content of cheap abundant quartz sand.

The explanation for the final and complete reliance on stonepaste bodies by the potters that went to Syria and Iran may also be due to raw material procurement. Problems in obtaining the right clays encountered by Iraqi potters coming to Egypt would have been even worse for the Egyptian potters in Iran and Syria. Iraq and Egypt are regions of large, mature rivers with uniform and broad alluviation; Iran and to some extent Syria are high-relief areas with immature and active rivers, depositing less suitable clays. By using stonepaste it would not be necessary first to find suitable clays which were not already spoken for, and then to spend considerable effort developing new processing, forming, and glazing practices suitable to the new clay. Instead, the stonepaste technology would enable production of a dependable ware, using materials not already being used. Quartz will be effectively the same, at least as far as the potter is concerned, wherever it is found. Glass is an industrial product, made to order. The clay needed is of a high quality, but only small amounts are required, and it is possible to transport it some distance. That this predictability of product is important is supported by the fact that the whiteness of the body was not important, as the earliest Iranian luster-wares have a tin-opacified glaze essentially the same as that on the previous Egyptian products.

Underglaze painting. The original development of true underglaze pigment paints, comprising grains of oxide pigment applied to a vessel without a clay or other mounting medium, appears to be another contribution of the Islamic potters. The earliest full use of this technology appears to be in Syria, in the fourth style group of wares, made in Damascus ca. 1125–50. Pigments used include chromium for black, cobalt for blue, copper for turquoise, and iron oxide for red, effectively representing the full range of pigments available. The effect of all these colorants would be known to potters and glassmak-

ers prior to this date, but it remains to be seen how they developed the technology. It is possible that it developed from the polychrome-relief or *laqabi* ware, made in Syria during the production of the first Syrian group, ca. 1075–1100. The carved relief decoration of these wares had a long history in Egypt, and in Syria the relief had the effect of separating the pigments. Unfortunately no polychrome-relief wares were available for analysis of their pigments (although bodies and glazes were sampled), and it remains to be seen in this case whether the pigment was applied under or over the glaze. If under, the underglaze-paint technology would simply be a matter of recognizing that the pigments formed effective designs without separation by the relief once the potters had switched from the soda-lead glaze that the earliest Syrian wares were made with, to an alkaline glaze. This is because the alkaline glaze would be considerably less likely to make the pigments run than the soda-lead glazes of the polychrome-relief wares.

The technology of true underglaze-pigment paints would eventually be transferred to Iran. Here the potters had previously experimented with pigments which had a decorative effect similar to the true underglaze pigments, but in which the pigment was applied in a medium of stonepaste. The most commonly known style amongst the early Iranian wares is the "silhouette" style, but other more obviously linear designs were executed using this black slip-paint technique. This was effectively a continuation of the highly developed colored slip-paint technology of Iran, rather than being a major innovation.

DISCUSSION OF RESULTS

Art versus craft. Collectively these studies divide the glazed wares of the Islamic world into a hierarchy of products. The first-class wares represent the products of very few kilns, perhaps as little as one center at a time in the entire Islamic world, the products of which were then widely distributed. These ceramic centers were commonly in the region of major court centers, but not necessarily in them, probably due to the fundamental requirements of raw materials. In this vein we see the primacy of Basra from ca. 700 to 975, Fustat from 975 to 1075, Kashan from 1100 to 1340, Damascus from 1100 to at least 1600, Samarqand from 1400 to 1430, Nishapur from 1430 to 1520, Tabriz from 1470 to 1550. The high-status wares were executed utilizing advanced and often exploratory technology, in forms and decoration which changed rapidly, with each style group probably not lasting more than twenty-five to thirty years. Designs were not only subject to rapidly changing fashion, but were also original and rendered with considerable artistic aptitude. This combination of technical and creative dynamism may be correlated to that of certain artisans which are the subject of ethnographic studies, who maintained their high social status by innovation.[20] We may picture these medieval Islamic potters in the same context, as artists who used their innovation to maintain their niche in the market. It may also be noted that this technologically dynamic stance befits one of the world's most scientifically progressive regions in the medieval period.

The second-quality wares were made in a greater number of centers; possibly every urban center would have maintained a workshop making them. Technologically and creatively the products were conservative and unoriginal, befitting the craftsman status of the potters. Again this may be correlated with ethnographic studies, where innovation is a very slow process, aimed solely at increasing efficiency.[21] In most cases these potters were content with copying the products of the high-status kiln sites, using cheaper and less demanding technology. The market for these wares would have been restricted and effectively localized.

The roving potter. The movement of potters from place to place has traditionally been used as a model to explain the spatial and chronological disposition of production centers. My results would strongly support such a model. Basra can be considered the Islamic world's foremost production center of high-status wares between 700 and 975. However in about 975 this production ends, and production commences in Fustat. This has traditionally been one of the most obvious cases of the roving potter, particularly due to the technically demanding and possibly secret technique of luster-painting. New technical evidence would now include the similar movement of the proto-stonepaste technology and a quartz-slip technology for incised-slip wares. The strength of technical evidence such as this is that it would have definitely required direct transfer either of personnel or of expertise. It is not considered feasible that the second group of potters (in this case in Fustat) would have been able to develop new techniques without the preliminary technological developments shown in the products of the first group (in Iraq). Although the transfer of expertise is within the realm of possibility, perhaps in the form of a technical treatise, it must be recognized that potters are well known to be very secretive about their arts. Techni-

cal treatises, notably that of Abu'l-Qasim, are known, but they are always written for an audience that is not likely to steal one's ideas for profit: Abu'l-Qasim knew that the Ilkhan Ghazan was not going set up shop and compete with his relatives in Kashan.

This technical evidence can be combined with the form and motif analyses of the typological study. If possible, this aspect is even more indicative of the transfer of personnel. Copies of Basra products occurred throughout the Islamic world, but in every case the superficial resemblance in shape is betrayed by the continuing tradition of local forming techniques. Here the potter is constrained by personal motor-habit patterns and regional tradition, and no treatise can tell him how to form a vessel like a Basra potter. Of course some copies may be very close, but it must be recognized that the potter was trying to delude the contemporary buyer, not the trained eye and callipers of the modern analytical ceramicist. Hence the direct continuation of Basra practice at Fustat must show direct transfer of personnel. This may be combined with the typological study to show that Fustat most certainly does represent a continuation of Basra practice. Copies of Basra products occurred throughout the Islamic world, but in every case the superficial resemblance in shape is betrayed by the continuing tradition of local forming techniques. This is not so with Fustat, which shows direct continuity.

The movement of potters is similarly used to explain the movement of lusterware potters to Syria and Egypt. In the traditional model the potters rush out of Fustat after the burning of the potters' quarter in 1171 quickly to produce a variety of distinct styles, mostly unrelated to Egyptian prototypes, prior to the first dated piece of 1179. The seriation of the Egyptian wares indicates that the technology, forms, and decorative styles most closely related to early Syrian and Iranian styles would have been current about 1075. This date marks the division between Egyptian luster-painted style groups two and three, which is not secured by firm dating, but is evidenced by luster pottery from Pisa which is derived from this period,[22] and also by the Crusader-period destruction levels of a number of sites. The Pisan pottery in question is probably Spanish, which would suggest that some potters left for the east and west at about this date, while those that remained in Egypt radically changed technology, abandoning stonepaste bodies and tin-opacified glazes. Hence, although it is possible that this occurred a decade or so either side of 1075, it is tempting to suggest that the sudden radical change and diaspora of potters was in part due to the famine lasting from 1065 to 1072 which was so terrible that people were reduced to eating dogs, cats, and even each other.

Again the technical demands of luster have traditionally been posited as requiring an actual movement of individuals from Egypt to Syria and Iran. This must now be coupled with the technical demands of stonepaste, which would also have been beyond the abilities of the average conservative potter. The earliest Syrian luster-painted wares, widely known as the "Tell Minis" style, are directly related to certain Fustat products of ca. 1075, and so a simple direct movement is probably valid. This center, still not satisfactorily identified, appears to have been shortlived, and probably ceased by 1100, to be followed by centers in Damascus, Raqqa, and other not yet identified locations. The earliest Iranian pieces are not precise parallels with the closest Egyptian wares, and so a gap in production probably occurred, suggesting a date of about 1100 for the beginning of Iranian production. Kashan is by far the first and foremost Iranian center. Apart from proving Watson's hypothesis that it is the sole producer of luster-painted ware, analysis has shown that it was the predominant center for other wares, even relatively coarse monochrome wares, evidenced by sites such as Ghubeyra and Gurgan. This pattern would effectively be maintained through the Mongol conquest, although certain centers, such as Rayy, Gurgan, and Raqqa, did cease production and a few still unknown centers commenced production in Iran under the Ilkhans.

Apart from the chinoiserie ceramics of Damascus, there seems to be no evidence of production of high-status wares in the later fourteenth century. Instead in regional centers wares that are desultory echoes of the "Sultanabad" and "panel" styles of earlier in the century are produced. This would change with the new order established by Timur. A number of these minor regional centers appear to have ended production at this time, to be replaced by a single center: Samarqand. Potters from Damascus were taken to Timur's capital after 1402, and there commenced a new line of production. As the potters were constrained to produce at Samarqand, it was necessary to use the local raw materials despite problems that existed with them. The Damascus potters were accustomed to using an unusually pure sand for their quartz source. In Samarqand these potters continued to use sand, at variance from typical Iranian practice, but the sand was very impure and unpredictable, with numerous non-quartz inclusions. Hence after a few decades, the Samarqand potters left for more suitable centers, in a diaspora of artisans. In a number of centers, foremost among them Nishapur and Mashhad, new pro-

duction developed. The first products of these new centers were obviously derived from Samarqand practice, but distinct new styles soon evolved. After about 1460 production also commenced at Tabriz, at first continuing practices of the Khurasan potters, but again soon to develop a distinctive style. Although I have done little work on Ottoman pottery, amongst the wares which have petrofabrics commonly found in the well-known "Iznik" wares is a piece in the Ashmolean which combines motifs from late-fifteenth-century Nishapur and Tabriz together with the first expressions of the Iznik style.[23] It remains to be seen how the later Safavid pottery fits into this picture, but preliminary study again reveals considerable technological innovation in a very restricted number of centers.

In each of these new centers the original practices of the potter are rapidly modified to develop a new style distinctive to the center. This fits our model of the potters as innovators, developing new styles to establish a reputation amongst their patrons and their niche in the market.

CONCLUSIONS

From these studies it is clear that pottery production in the Islamic world was dynamic throughout most of its history. Perhaps more than with any other art of the Islamic world, technical innovation was an important component of the status of the trade, and this technology deserves to be placed amongst the great advances in science in the region at this time. It should also be considered to have prominent stature as an art amongst the arts of the period. Quite often forms or decoration found both in ceramics and in some other medium are suggested as having originated in that other medium, rather than in the ceramic. As innovation can be proved for ceramics on the technical side, it may be more logical to consider that the decoration is equally innovative. Technical innovation cannot be proved for the other arts, and in the majority of cases it is clear that the technology progressed little or not at all from pre-Islamic techniques. This question of derivation is certainly problematic with regard to vessel form, often ascribed to metal prototypes. Ceramic is arguably the most plastic of the media, and most shapes are completely natural for it. This includes faceted forms, which can easily be produced by molding,[24] but particularly puzzling is the attribution to metalwork origins of forms that would be most comfortable when thrown in clay on a wheel.[25] Clearly some reassessment of the status of ceramics amongst the art of the Islamic world as considered by modern art historians is justified.

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NOTES

1. J.J. Pollitt, *Art and Experience in Classical Greece* (Cambridge: Cambridge University Press, 1977).
2. Karen D. Vitelli, *Franchthi Neolithic Pottery*, vol. 1 *Classification and Ceramic Phases 1 and 2* (Bloomington and Indianapolis: Indiana University Press, 1993).
3. R.B. Mason, "Islamic Glazed Pottery 700–1250," D.Phil. diss., 1994, University of Oxford, Some travel for this research was supported by a grant from the British School in Iraq.
4. L.B. Golombek, R.B. Mason, and G.A. Bailey, *Tamerlane's Tableware: New Approach to the Chinoiserie Ceramics of Fifteenth- and Sixteenth-Century Iran* (Princeton: Princeton University Press, and Toronto: Royal Ontario Museum, in press). Research on this material was supported by a grant from the Social Sciences and Humanities Research Council of Canada.
5. A useful history with numerous examples of previous studies is provided in D.F. Williams, "Petrology of Ceramics," in *The Petrology of Archaeological Artefacts*, ed. D.R.C. Kempe and A.P. Harvey (Oxford: Oxford University Press, 1983), pp. 301–29.
6. Relevant major publications include R.B. Mason, "Petrography of Islamic Ceramics," in *Recent Developments in Ceramic Petrology*, ed. A. Middleton and I. Freestone, British Museum Occasional Papers no. 81 (London, 1991), pp. 185–210. R.B. Mason and L.B. Golombek, "Differentiating Early Chinese-influenced Blue and White Ceramics of Egypt, Syria and Iran," in *Archaeometry '90: Proceedings of the 27th International Archaeometry Symposium, April 1990, Heidelberg*, ed. E. Pernicke and G.A. Wagner (Basel: Birkhäuser Verlag, 1990, pp. 165–74). R.B. Mason and E.J. Keall, "Provenance of the Local Ceramic Industry and the Characterization of Imports: Petrography of Pottery from Medieval Yemen," *Antiquity* 62 (1988): 452–63. R.B. Mason and E.J. Keall, "Petrography of Islamic Pottery from Fustat," *Journal of the American Research Center in Egypt* 27 (1990): 165–84. R.B. Mason and E.J. Keall, "The Abbasid Glazed Wares of Siraf and the Basra Connection: Petrographic Analysis," *Iran* 29 (1991): 51–66.
7. J.A. Riley, "The Petrological Investigation of Roman and Islamic Ceramics from Cyrenaica," *Libyan Studies* 10 (1979): 35–46; "Islamic Wares from Ajdabiyah," *Libyan Studies* 13 (1982): 85–104. D.F. Williams, "Petrological Examination of Islamic Pottery from Carthage," in *Islamic Carthage*, ed. G. Vitelli (Carthage, 1981). T. Mannoni, "Present-day Knowledge of Mediterranean Pottery after Ten Years of Thin-Sectioning at the University of Genoa," in *Current Research in Ceramics: Thin-Section Studies*, ed. I. Freestone, C. Johns and T. Potter, British Museum Occasional Paper 32 (London, 1982), pp. 89–92.
8. T. Mannoni, "Mediterranean Pottery." A. Vince, "Medieval and Post-Medieval Spanish Pottery from the City of London," in *Current Research in Ceramics: Thin-Section Studies*, ed. I. Freestone, C. Johns and T. Potter, British Museum Occasional Paper 32 (London, 1982), pp. 135–44. H. Blake, M. Hughes, T. Mannoni and F. Porcella, "The Earliest Valencian Lustre-ware? The Provenance of Pottery from Pula in Sardinia," in *Everyday*

and Exotic Pottery from Europe c. 650–1900, ed. D. Gaimster and M. Redknap (Oxford: Oxbow, 1992), pp. 202–24.

9. D.P.S. Peacock and D.F. Williams, *Amphorae and the Roman Economy: An Introductory Guide* (London: Longman, 1986).
10. E.g., M. Kervran, "Les niveaux islamiques du secteur oriental du tepe de l'Apadana," *Cahiers de la Délégation archéologie française en Iran* 4 (1974): 21–42.
11. E.g., J. Carswell, "Sin in Syria," *Iran* 17 (1979): 15–24.
12. F. Petrie, *Prehistoric Egypt* (London, 1920), pp. 3–6.
13. M.S. Drower, *Flinders Petrie: A Life in Archaeology* (London: Gollancz, 1985), p. 252.
14. Cf. D. Miller, *Artefacts as Categories: A Study of Ceramic Variability in Central India* (Cambridge: Cambridge University Press, 1985), fig. 9.
15. Apart from my studies, see G.A. Bailey, "The Dynamics of Chinoiserie in Timurid and Early Safavid Ceramics," in Lisa Golombek and Marie Subtelny, eds., *Timurid Art and Culture.* Studies in Islamic Art and Architecture 6 (Leiden: E.J. Brill, 1992).
16. M.S. Tite, "The Impact of Electron Microscopy on Ceramic Studies," *Proceedings of the British Academy* 77 (1992): 111–31.
17. This included crystallization of calcium silicates and magnesium-calcium silicates, coupled with inclusion of quartz grains and production of fine gas bubbles. For a fuller account of this part of the study, see R.B. Mason and M.S. Tite, "Early Opaque Glazes and the Beginnings of Tin-Opacification," *Archaeometry* (in press).
18. This date is uncomfortably early for some, who cite the lack of the blue-painted type at Harun al-Rashid's palace at Raqqa. Although I recognize that the association of this style with coins of the same date at Susa is inadequately proven, the Sasanian derivation of the form and the association of the succeeding group with sites predating 800 (Hira, Nippur) strongly support this date. Most of this eighth-century pottery appears to have had a restricted distribution anyway, constrained to southern Iraq, Susa, and the trade route to the Far East. Besides which, this cavil relies on the archaeologically unsound principal that if you did not find something, it was not there.
19. These findings are provided in more detail in R.B. Mason and M.S. Tite, "The Beginnings of Islamic Stonepaste Technology," *Archaeometry* 36 (1994): 77–91.
20. In particular, see G.C. Homans, *Social Behaviour: Its Elementary Forms* (New York: Harcourt Brace and World, 1961); H.R. Silver, "Calculating Risks: The Socioeconomic Foundations of Aesthetic Innovation in an Ashanti Carving Community," *Ethnology* 20 (1981): 101–14.
21. D.E. Arnold, *Ceramic Theory and Cultural Process* (Cambridge: Cambridge University Press, 1985), pp. 202–28.
22. G. Berti and L. Tongiorgi, *I Bacini ceramici medievali delle chiese de Pisa*, Quaderni de Cultura Materiale 3 (Rome: "L'Erma" di Bretschneider, 1981).
23. This piece, in the Ashmolean Museum, is published in J.W. Allan, *Islamic Ceramics* (Oxford: Ashmolean Museum and Christie's, 1991), pp. 52–53. The rim and reverse motif of this piece are typical of Nishapur, the floral design of the center is typical of Tabriz, and the precise execution of the foliage is typical of the *Baba Nakkash* style defined by N. Atasoy and J. Raby in *Iznik: The Pottery of Ottoman Turkey* (London: Alexandria Press, 1989): pp. 76–82. The petrofrabric of this piece is identical to Iznik style wares from Istanbul.
24. E.g., J.W. Allan, "The Survival of Precious and Base Metal Objects from the Medieval Islamic World," *Oxford Studies in Islamic Art* 3 (1986): 57–70; figs. 10 and 11 (in these particular examples it would seem to this observer that the ceramic betrays considerably more technical and artistic skill than the metalwork); Oliver Watson, "Pottery and Metal Shapes in Persia in the 12th and 13th Centuries," *Oxford Studies in Islamic Art* 3 (1986): 205–12; figs 5 and 5a.
25. E.g., Allan, "Survival of Precious and Base Metal Objects," figs. 8–9; Julian Raby, "Looking for Silver in Clay: A New Perspective on Samanid Ceramics," *Oxford Studies in Islamic Art* 3 (1986): 179–203, figs. 17–20.