

**The role of craft practice in changing glass working traditions:  
the formation of glass vessels in the Classical and Hellenistic  
Mediterranean world.**

**Volume 1: text**

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## Thesis Abstract

This study combines a theoretical modelling of dexterity with a practical apprenticeship in glass-working in order to examine a group of core-formed glass alabastra from Mediterranean Group I (c.525 to c.400 BCE).

Core-formed vessels were made by forming glass around an internal mould which was scraped out after the vessel had cooled. The core-forming tradition lasted from c.1500 BCE until c.100 BCE. Mediterranean Group I is of interest because of the wide variety of consistency displayed in body shaping, rim and handle making, and decoration. To understand this variety it was necessary to undertake a theoretical and practical investigation of skill.

The theoretical investigation revealed that skill has been conventionally analysed in terms of knowledge. This cognition-based analysis ignores the dimension of moving, specifically of the skilled gesture and the process of becoming dexterous. The practical apprenticeship demonstrated that this process, as a kinaesthetic experience, is value-positive – that is to say, it gives rise to value judgements on artefact feature, gesture in synergy with tools and materials, and craft working behaviour.

This remodelling of skill allows one to form a gestural as opposed to a feature-based artefact typology; and in so doing to identify, not simply distinct communities of practice, but different *types* of communities whose judgements arose out of the experience of becoming dexterous. Redefined in this way skilled making can be repositioned within archaeological theory as a central mode of interaction with the material world, a mode which has the intrinsic potential to generate value and social meaning.

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## **Acknowledgements**

I am extremely grateful to Professor Ian Freestone, who as my doctoral supervisor provided continued support and encouragement throughout my time at Cardiff University. My study combined artefact analysis, practical glass working, and theoretical modelling; Ian not only guided me around a great many organisational pitfalls but also provided me with a great deal of useful professional advice. This particular doctoral journey was neither straightforward nor as short as some, but Ian greeted each new bend in the road with unfailing equanimity.

I am lastingly indebted to Mark Taylor and David Hill, whose depth of knowledge and experience in ancient glass forming is unparalleled. They are almost certainly the only people in the world who have the skills, expertise, resources and generosity required to make the Core-Forming Project happen. Mark, as teacher, responded to an apprentice core-former's clumsiness and ignorance with the dedication and perseverance that only a true craftsman possesses. Both Mark and David freely shared their time, experience, attention, and sustaining baked potatoes from the annealing oven.

Many museum staff took time out from their busy schedules to bring alabastra (in the case of the British Museum, repeatedly) from store and display so that I could photograph and film them. My thanks go to: the staff of the Greek and Roman Department of the British Museum, especially Alex Truscott and Alex Bailey; Dr. Veronique Arveiller-Dulong of the Louvre; Jutta Page of the Toledo Museum of Art; Dr. Joaquín Montorió of the Archaeological Museum at Gerona; Aurora Martín of the Archaeological Museum at Empúries; and Dr. Despina Ignatiadou, who kindly showed me some unpublished core-formed vessels in store at the Archaeological Museum at Thessaloniki

Regarding the theoretical aspects of this study, I am grateful to Professor Tim Ingold of Aberdeen University and Dr Stephanie Koerner of Lancaster University, whose interest in this research led me to gain the invaluable experience of road-testing my theoretical framework in seminars and conferences. Among many in the glass community I would like to thank Bill Gudenrath, Colin and Susan Brain, Professor Jenny Price, Professor Marie-Dominique Nenna, and Martine Newby for their expert and friendly comments, conversations and advice on the topic of ancient glass.

I would like to thank the Arts and Humanities Research Council for funding my PhD, Cardiff University and the Association for the History of Glass for providing contributions towards travel and conferences; and the Rakow Foundation at the Corning Museum of Glass for their indispensable financial contribution to the Core-Forming Project.

Lastly I am grateful to my husband Robert Heath, who over a period of years listened (or equally importantly, out of the kindness of his heart, made a semblance of listening) to my thoughts on ancient glass, academia, and South-West trains. And who on many occasions was left literally holding the baby.

Frances Liardet. 31 January 2011

## **Chapter One. Introduction**

### **A. Thesis Background and Aims**

It is not contentious to suggest that in most ancient societies the activities of making, mending and adapting artefacts constituted a primary mode of interaction both between individuals and with materials. Instrumental in creating identities, generating symbolic representations, constructing memories, and supporting – or breaking down – social structures, skilled making provides an essential dimension to many fields of archaeological research. However, although archaeological artefacts have been pressed into the service of a wide range of theoretical causes over the last 100 years, they have not generally been studied primarily as instances of skilled making, or craft.

It is suggested here that one of the reasons why skill and making are not more widely addressed is that the models we have to study skill are generally cognitive. Skill is thought of in terms of different types of knowledge, which makes it vulnerable to being reified and packaged. This makes it hard to analyse an important dimension to craft, which is movement: movement in interaction with tools and materials, where the experience of becoming dexterous is central. This means that the wealth of information artefacts contain about things which interest us as archaeologists – people performing all kinds of social interactions through a particular kind of movement – remains largely overlooked.

Instead of thinking of skill as knowledge, I will conceptualise skilled crafting as an experiential process of becoming dexterous – that is to say, in learning to make gestures with tools and materials. I will use this conceptualisation to analyse and systematically document my own apprenticeship in the making of core-formed alabaster. I will then apply this theoretically- and practically-generated perspective to a group of



archaeological artefacts – a set of core-formed glass alabastra. This will show how an analysis based on dexterous movement both cuts across and creates new divisions within the conventional core-formed vessel typologies to bring to light communities united in an extremely dynamic and essentially social kinaesthetic event – that of skilled making.

### **B. Artefacts, Skill and Making in Archaeology and Anthropology**

The most literal definition of the term ‘artefact’ is ‘a thing made with skill.’ The study of ‘things made with skill’ in archaeology has encompassed a range of themes, and artefacts have been used by archaeologists for a variety of purposes. During the first half of the twentieth century culture-historians like Gordon Childe (1929) identified assemblages of artefacts with particular, originally ethnically-defined, social groups. ‘We find certain types of remains - pots, implements, ornaments, burial rites and house forms - constantly recurring together. Such a complex of associated traits we shall call a “cultural group” or just a “culture.” We assume that such a complex is the material expression of what today we would call “a people”’ (Gordon Childe 1927, v-vi). By indicating the presence or absence of these social groups, artefacts could be used to document the rise, expansion and fall of various ‘peoples’ of the past. Artefact typologies were obviously vital to this type of investigation as their stylistic traits were cultural markers.

By contrast the New Archaeology identified the goals of archaeology with those of anthropology (e.g. Willey and Phillips 1958, Binford 1962) and used artefacts actually to investigate, as opposed to merely document the presence of, societies of the past. These societies were conceived of as adaptive in the evolutionary sense and artefacts were used as evidence of that adaptation, variations in artefact production being the result of various kind of societal and environmental pressures, culture being the ‘intervening variable’ (Binford 1962, 218), a concept intended to rebut a possible charge of environmental determinism that might otherwise be levelled at this view. ‘The comparative study of cultural systems with variable technologies in a similar environmental range or similar technologies in differing environments is a major methodology of... “cultural ecology” and certainly is a valuable means of increasing our understanding of cultural processes’ (Binford 1962, 218). The artefact in this conceptual framework is now a marker, not of cultural identity, but of cultural adaptation.

Subsequent critiques of the New Archaeology centred on its notion of societies as bounded and sealed homeostatic entities where cultural change was extrinsic and human agency minimal (see Dobres 2000). Post-processual archaeologists advocated instead a subjective and relativist view where interpretation was the mode of enquiry, where a multiplicity of meanings was acknowledged, and where ideological concerns were addressed. A feminist enquiry such as Janet D. Spector's *What This Awl Means* (1980) exemplifies the reflexive intentions of the interpretive turn as well as the role of artefacts in it: the awl of the title, uncovered during excavation, serves as an informant on gender roles and as a metaphor for how, and why, anthropology and archaeology should be 'done.' Artefacts are important to this enquiry as bearers of meaning, epitomised by the approaches taken in Ian Hodder's edited volume *The Meanings of Things* (1989). As Christopher Tilley observes: 'The traditional functionalist approach has been to investigate these parameters in terms of environmental constraints, the maximisation of efficiency and the effects technologies have on culture and society. More recent approaches have suggested that technology and techniques may be far better understood as cultural choices or social productions intimately linked to systems of knowledge and value... This moves us away from thinking of technologies as mechanical actions applied to objects and requires us to think instead about the way actions on the material world are embedded in a broader symbolic, social and political system' (Tilley 2001, 264).

Tilley's formulation of the shift from processual to post-processual thinking shows how even when talking about making – for Tilley speaks of 'techniques and technology' rather than artefacts *per se* – making itself is not explicitly addressed. Making is released from its role as a functional response to environmental constraints only to become one element in a system of ideology and representation. Although skilled making is described in certain instances (e.g. Spector 1980), it is not theorised in such a way that it can be used as a term of analysis. This is not to denigrate these various theoretical frameworks; merely to show that skilled making plays a relatively small part in answering the questions they pose, so that in many cases artefacts can largely fulfil their role in the frameworks without an overt consideration of what skilled making, or even making, is.

This is not to say that the theory and practice of making has received no attention. From Leroi-Gourhan (1943, 1945) and Marcel Mauss (1950) onwards many workers in anthropology have considered making and skill (e.g. Hasslöf 1972, McCarl 1974, Gatewood 1985, Harper 1986, Coy 1989, Singleton 1989, Keller and Keller 1996, Ingold 1993, 2000a, 2006). Critical questions are now being asked of the cognitive interpretation of making (Marchand 2010, Portisch 2010, Makovicky 2010), and the recent consideration of materiality in anthropology has proved another way to think of skilled making – as an interaction with the material world (e.g. Warnier 2001, 2009, Portisch 2009). The sensori-motor aspect of skill is mentioned in these studies but, because its implications are not considered, dexterity is not explicitly discussed or used as a term of analysis. Tim Ingold's studies of skill and making (e.g. 2000a, 2000b, 2006) go further by defining skill as a property not of a single body but of the 'whole system of relations constituted by the presence of the artisan in a richly structured environment' (Ingold 2000b, 64), where the essence of skilled movement is that it is tuned 'to an emergent task whose surrounding conditions are never precisely the same from one moment to the next' (Ingold 2000b, 65).

But in what ways has craft, as skilled making, been considered in more recent studies of artefacts in archaeology? Craft traditions in artefact production have been addressed in a variety of ways over the last two decades. The evolutionary-archaeological explanation of cultural change uses the concept of 'cultural transmission' to interpret patterns in the archaeological record (Shennan 1989a, 1989b, 1999, 2002). Modes of transmission have traditionally been described in terms of direction and bias without reference to skilled making (Shennan 1989a, 1989b, 1999, 2002), but these modes now include imitation, emulation and teaching as this research field now advocates an 'archaeology of pedagogy' (Tehrani and Riede 2008, 322). Cognitive and behavioural archaeology both make use of Leroi-Gourhan's *chaîne opératoire* concept to theorise artefact production with a view to addressing making as knowledge (e.g. Pelegrin 1990, Wynn 1994, Graves 1994), as a system analogous to language (e.g. Apel 2008), and, with significant modifications, as a system subject to performance-related constraints (e.g. Schiffer and Skibo 1987, 1997). The part of knowledge and learning as related to artefacts in archaeology is the subject of considerable discussion; in some instances the

inquiry is into how much of making is unconsciously deployed motor skills and how much conscious and propositional (Pelegrin 1990; Roux, Bril and Dietrich 1995, Roux and David 2005); in others, levels of skill and types of learning practice are discussed (Crown 2001, 2007a, 2007b, Bamforth and Finley 2008, Budden 2010). All of these approaches address artefacts as instances of skilled making rather than adaptive environmental strategies or the construction and communication of social identity. But it seems that even when skilled making is discussed in archaeology, it is in terms of knowledge and not in terms of movement.

### **C. Artefacts, Skill and Making in this Study**

This study intends to analyse artefacts in terms of making, and making in terms of skilled movement. Skilled movement will be examined using two key related concepts: dexterity, and kinaesthesia.

The neuroscientist and kinesiologist Nikolai Bernstein was instrumental in explaining skilled movement not as repeated identical actions played out along the same neurophysiological pathway but as the coordination of the somato-sensory and the musculo-skeletal systems to produce a facility of manoeuvrability where the skilled body constantly retunes movements to a constantly changing environment (Bernstein 1996). This interpretation of dexterity has been noted by Ingold (2000b, 2006). In order to study skilled movement it is necessary to think of it in terms of dexterity, and to think of the learning of skilled movements as the process of becoming dexterous.

The second concept is kinaesthesia; that is, not ‘moving’ but specifically ‘the experience of moving’. This is illustrated in the work of Maxine Sheets-Johnstone who, in emphasising the shortcomings of a purely physiological approach to the body, also shows the drawbacks of a purely cognitive approach to skill. ‘Movement is not behaviour; experience is not physiological activity; and the brain is not a body... what is of moment to living creatures is not physiology but real-life body happenings that resonate tactilely and *kinaesthetically*, which is to say *experientially*...’ (Sheets-Johnstone 2009, 214). The notion of kinaesthesia here dissolves the dichotomy between brain and body; if movement is not exclusively a body, neither is it exclusively a knowing mind; those categories, along with the sub-categories of knowledge debated in

archaeology, are dissolved and subsumed into the experience of moving. It is important to note that the experiential aspect of kinaesthesia means that moving is meaningful. Therefore the learning of skilled movement will be defined as the intrinsically meaningful experience of coming to move dexterously, and it is in these terms that artefacts will be examined; as instances of this experience.

#### **D. Archaeological Database and Research Questions**

The artefacts under discussion here are a large group of core-formed glass alabastra from Mediterranean Group I, a chronological grouping dating from c.525 BCE to c.400 BCE. Core-forming is an archaic method of glass vessel-making which involves forming glass around an internal mould, or core, made of a mixture of clay and organic materials, which is scraped out when the vessel has cooled. Core-forming is a long tradition which began in the 16<sup>th</sup> century BCE and ended in the first century BCE, approximately at the time when the technique of blowing glass emerged. The vessels in the archaeological database are all essentially of the same shape, made by the same basic technique, and displaying strongly similar – though by no means identical – suites of decorative motifs: spiral trails of melted glass wound around the body and tooled into zigzag or festoon shapes. The decorative glass is usually a combination of yellow, white and turquoise; the bodies are dark blue, white, reddish-brown, turquoise, or green. Body shapes follow the alabastron type, being a broadly bottle-shaped body longer than it is wide, between 8 and 14 cm in height with a moderately rounded base, two ring handles below the neck, and a round rim which is either flat or cupped. (See Appendix 1 for images).

The primary reason for compiling a database from this particular category of artefacts was the wide range of consistency in execution displayed by them. Figure 1.1 shows two such widely varying vessels. The vessel on the left, called IB, displays a decorative design and body shape executed to a high level of consistency; the vessel on the right, called IJ, does not. This situation occurs repeatedly throughout this category of artefacts. Furthermore, the design of the IB vessel is found at a wide range of consistency, but the IJ design is always made inconsistently. There are specific reasons, discussed in Chapter Two, why the IJ vessels are neither novice work nor the result of haste. Why should this be? If, as I suggested, the fabric of people's lives was informed

by skilled making, why did the IJ makers come to move so differently from the IB makers, and to such different effect? This question is central to an inquiry into skilled making. To address this instance of inconsistency is to embark on the larger issues of how and why people become – or do not become – dexterous; how the experience of coming to move dexterously can inform our understanding of artefacts; and what meanings and values arise from this experience. This in turn can help us detect shared experiences of skilled making in the archaeological record, and explain why certain makers never came to produce consistent work. The thesis is therefore structured around the following research questions:

- What are the specific problems raised by the archaeological database and by core-formed vessel typologies?
- What is skill in movement and making? How does a person become skilled?
- How can skilled making be conceptualised?
- When a theoretical model of the process of becoming dexterous is applied to a practical craft project, what does this reveal?
- What is the relationship between the process of becoming dexterous and the generation of craft values?
- What is the relationship between the process of becoming dexterous and continuity and change in artefact production?
- How does dexterity develop within a community of makers?
- How can we identify individual archaeological artefact features in terms of dexterity?
- Can we identify communities of makers in the archaeological database? If so, what can we say about their respective craft values?
- How can we explain communities who do inconsistent work?

### **E. Chapter Breakdown**

I will address these questions in the following way. I will first present the archaeological database and raise specific questions about it in terms of skilled making (Chapter Two). I

will then review the approaches to skill itself which have been adopted in a variety of fields including physiology and neuroscience as well as sociology, anthropology and archaeology (Chapter Three). I will draw on this review to construct the framework for analysing skilled making (Chapter Four) which forms the basis for the development and documentation of the practical element of this study – my apprenticeship in making core-formed alabastra. This apprenticeship, referred to in this study as the Core-forming Project, will be presented as a personal, shared, and experiential process of becoming dexterous in the manipulation of tools and materials (Chapter Five). I will document my own and my collaborator's engagement with gesture, tool and material (Chapter Five) which gave rise to certain specific meanings and values (Chapter Six) . I will then apply this enriched skill model to the archaeological database by analysing the artefacts in terms of particular suites of shared gestures which can be organised into a gestural, as opposed to a conventional typology (one based on certain abstracted notions of form and pattern) (Chapter Seven). This gestural typology will be used not simply to identify different communities of practice but different types of communities of practice, each with different value judgements stemming from particular and identifiable instances of shared and meaningful kinaesthesia (Chapter Eight). Chapter Nine will conclude by suggesting how this work can be used in other areas of archaeology.

## **Chapter Two. The archaeological database of core-formed vessels. Context and research problems**

### **A. Introduction**

This chapter addresses the first of the research questions presented in Chapter One:

- What are the specific problems raised by the archaeological database and by core-formed vessel typologies?

The chapter begins by presenting the archaeological database before moving on to the archaeological record of core-formed vessel-making. The vessel typologies are then described, followed by a survey of previous experimental work on core-formed vessel manufacture and archaeological materials analysis. The chapter then elaborates on the problems and research questions raised in Chapter One.

### **B. The Archaeological Database**

This thesis has not only entailed a theoretical study of skill and a practical apprenticeship in core-forming but also the compilation of a database of archaeological artefacts to be studied in the context of the theoretical and practical work. The archaeological database is a group of core-formed vessels from Mediterranean Group I (c.525-c.400 BCE), the first of three chronological categories of Mediterranean core-formed vessels. It comprises all but one of the total number of Mediterranean Group I alabastra held in the following collections: the British Museum (75 vessels), the Louvre (38 of 39 vessels, one being on loan), the Toledo Museum of Art (30 vessels), and the Girona and Empúries sections of the Archaeological Museum of Catalunya (23 vessels). These 166 vessels are listed in tables in Appendix 1 and will be referred to by their catalogue number prefixed by the abbreviation BM, LOU, TMA, or FEU (referring to Feugère 1989, the catalogue for the Catalunya vessels). The database is large enough to constitute what at the moment seems



to be a representative sample of extant, intact vessels of this kind; future excavations may, of course, change the picture.

I compiled this database by taking detailed photographs, as many as thirty pictures per vessel (Appendix 1 and Ch 7, figures). I also filmed the vessels with which was to prove extremely useful for showing features which were hard to understand, like the particular layered, thready appearance of the handle loops and middles (clip 2.1). While filming I also made a verbal commentary to draw attention to aspects which seemed important.

I selected Group I because it is the largest of the three Mediterranean Groups of core-formed vessels (Grose 1989). It is true that Group I does not comprise as many types of vessel as Group II; there are just four: the alabastron, the amphoriskos, the oinochoe, and the aryballos (Appendix 2). But the total numbers mean that there are a great many of each of these types.

The principal problem with the compilation of this database is that out of the four available vessel types in Group I, I selected only the alabastra. This means that the experience that could have been gained from exploring the techniques used to make the shapes of amphoriskoi, oinochoai and aryballoi has not been gathered, so that there is a dimension missing from this study. The disadvantage is freely acknowledged. But the mode of enquiry of this study is apprenticeship in craft work; learning the skills for core-formed vessel-making in order to gather data not simply from the objects made but from the actual process of becoming dexterous. As Chapters Four and Five will illustrate, this involves repeated episodes of making. Had I worked until I attained the same level of skill in producing the other vessel types that I had in producing alabastra, as much as four times the quantity of data might have been generated – an amount which time and resources did not allow. The alternative, to work for a quarter of the available time on producing each vessel type, might have resulted in my reaching such a negligible level of skill that very few conclusions could have been drawn. The alabastron was chosen because, out of the four vessel types, it was the most numerous and the most varied type of vessel in terms of body shape and decorative style. Above all, of course, the alabastron was chosen because of the wide variety of consistency in execution displayed by this vessel type. This central point will be discussed in Section E.

### C. Core-formed vessels: the archaeological record

At the end of the 3<sup>rd</sup> Millennium BCE glass was fashioned as an independent material into glass beads and seals (Barag 1985, Grose 1989). The technique of shaping glass around an internal mould in order to make a vessel is first attested in 16<sup>th</sup> century BCE in the Hurrian kingdom of Mitanni in Northern Mesopotamia (von Saldern 1970, Vandiver 1983), and vessels of this kind dating from the following two centuries have been found at various sites in Western Asia (figure 2.1). The oldest core-formed vessels in Egypt date from the middle of the sixteenth century BCE (Lilyquist and Brill 1992). This early production gave way to a major episode of core-formed vessel-making in 18<sup>th</sup>-dynasty Egypt during the reigns of Amenhotep II (1426-1412 BCE), Thutmose IV (1412-1397 BCE) and Amenhotep III (1397-1353 BCE) (Nicholson 2000) (Figure 2.2). Vessel-making took place at Malkata and Amarna (Nicholson 2000, 2006), the result of royal patronage, on a scale large enough for the development of 12 principal distinct forms of vessel (Grose 1989). The possibility that core-formed vessels were also made in the Levant and Cyprus at the same time is supported by the discovery of forms of vessel which do not conform to Egyptian styles (Harden 1981). All of this early vessel-making was centred around the prestigious palaces of kings and pharaohs (Grose 1989, Harden 1981). The containers themselves were intended for aromatic oils, scented unguents, or valuable incense 'which were thought to possess magical powers and used to anoint the statues of the gods, the participants in religious observances, and the bodies of the dead' (Grose 1989, 51).

Towards the end of the 2<sup>nd</sup> Millennium BCE and the beginning of the first there is a well-attested and problematic absence of glass artefacts in the archaeological record, not only for Egypt but for the Near East as a whole: '.. Few archaeological sites spanning the years from 1200 to 900 BCE yield glass of any sort' (Grose 1989, 57). The concomitant decline in many types of artefact production during this period suggests widespread political and economic change in the region (Stern 1994). And although core-formed vessels are found in Mesopotamia, North West Iran, and Etruria during the *second* quarter of the 1<sup>st</sup> Millennium BCE (Barag 1970), it is only in the 6<sup>th</sup> century BCE

that core-formed vessel-making once again becomes significant (Harden 1981, Grose 1989).

It is at this point that the consumption and the distribution of core-formed vessels also changed. The vessels are found overwhelmingly on the sites of Greek settlements and their forms are derived from the Greek ceramics and metalware of the Archaic, Classical and Hellenistic periods. Throughout this period the find-spots of artefacts suggest a funerary or votive purpose; a great many intact examples come from cemeteries such as Kameiros on Rhodes where they were buried alongside high-quality metalware and ceramics (Harden 1981), and shrines such as those at Delos and Cyrene have yielded a great number of fragments (e.g. Nenna 1999, White 1990). It has been suggested that they were used in homes for cosmetic purposes and then to anoint the dead, 'after which the empty bottles were discarded in the grave' (Grose 1989, 109), but the absence of domestic finds does not support the first claim. As for the second, it is not certain whether they were actually used as containers during this period. All those who have examined these vessels (including this author) report core material adhering in a layer to the interior walls of the vessel (figure 2.3) which, while this does not prevent one anointing the dead, would certainly make applying, say, kohl to the eyelids of the living a rather gritty process. (This material adheres in a thin layer to the vessel walls and is not to be confused with clay and organic materials which may have entered the vessel after burial.)

This 'Mediterranean' period of core-formed vessel-making is currently, but increasingly problematically, divided into three groups. These problems are chronological and geographical. Initially the absence of evidence for production sites meant that the location of workshops has had to be determined on the basis of find-spot distribution alone. On this basis it was inferred that Mediterranean Group I, which covers vessels dating from the late 6<sup>th</sup> century BCE to the early 4<sup>th</sup> century BCE, was made on the island of Rhodes; Group II vessels (dating from the mid-fourth to the late-third century BCE) in Southern Italy or Magna Graecia; and Group III (mid-second to early-first century BCE) on the Syro-Palestinian coast. However the discovery, not of a workshop site but of heat-deformed wasters (vessels which have been discarded unfinished) dating from the Hellenistic period on the island of Rhodes suggests that core-formed vessels from Group II and possibly Group III were also made in this one location (Triantafyllidis 2002). In

addition dating ambiguity and formal considerations means that the division between Groups II and III is no longer clear-cut (Grose 1989). The problem of ‘gaps’ between the Mediterranean Groups evidenced by the dating above, and indeed the question of how the Mediterranean production was established in the first place, are all issues of craft tradition; how it is engendered, how it continues, and how it survives change.

#### **D. Research into the making of core-formed vessels**

Research into core-forming has focused on the analysis of archaeological core material, and the methods used to apply glass to the core. Of the researchers cited below Dudley Giberson has worked most extensively at reproducing Egyptian core-formed vessels. His technical results are summarised below (Giberson 2004) but, more importantly for this study, he has also developed furnaces, trialled different methods of applying crushed glass to the cores and – especially interesting – invited friends and colleagues to work with him. However his enquiries (Giberson 2004) are focused on the technical details and the aspects related to craft and skill are mentioned peripherally.

#### **1. Core composition**

W.F. Petrie (1894, 27) originally referred to core-forming as a ‘sand core’ technique. But analyses of core material from a mid-Bronze Age Egyptian small glass coffin and a Cypriot bottle proved it to be composed of a mass of organic material, seeds and leaves, enveloped by a layer of ferruginous clay which in turn was covered by a calcareous layer (Bimson and Werner 1969). This layer was defined as a slip of lime wash consisting of ground lime and reused core material. The major finding was that the cores contained an organic component which, when the core was heated, burned away to leave a porous and therefore friable core (Bimson and Werner 1969). This would crush as the glass contracted upon annealing, preventing cracking. Bimson and Werner also analysed some later cores, one from Naukratis dated to 500BCE and another probably from the Eastern Mediterranean and dating from between the 8<sup>th</sup> and the 5<sup>th</sup> century BCE, and found that although the clay type was different in each vessel, the first being dark red and the second grey-brown, both these cores had a significant proportion of quartz grains in the mixture. To an extent, then, sandy material was used in these later

core mixtures. John Wosinski and Robert Brill's (1969) analysis of core material from Egyptian, coeval Mesopotamian, and later Mediterranean cores concurs largely with the findings of Bimson and Werner although they note the absence of a calcareous layer in the examples they analysed and speculate that the organic component may have been animal dung. Wosinski and Brill (1969) also note an increase in the size and angularity of quartz grains in the later Mediterranean examples. Experiments performed by Frederic Schuler before this research was published produced cracked vessels because Schuler, unaware of the benefits of the organic component of the core, used pure clay cores which failed to crush under the contracting glass (Schuler 1962). Dominick Labino also made experimental cores prior to the composition research but he kept his core recipe secret to prevent forgery of the vessels; although he succeeded in producing a number of intact vessels, there is nothing known about the cores beyond Labino's statement that they were inorganic (Labino 1966). William Gudenrath, however, used the core composition research to make a successful vessel on a crushable core made of a mixture of clay and horse dung kneaded to the consistency of bread dough and fired before use (Gudenrath 1991, 214 and figure 2.6a). Giberson, whose core-forming experiments focus principally on ancient Egyptian vessels, uses a mixture of clay, sand, sawdust, and dung (Giberson 2004).

## **2. Core covering**

Speculative core covering methods include both cold and hot glass working. Cold methods consist either of dipping the core in a suspension of powdered glass or of rolling the core over a bed of crushed glass. Hot working methods comprise dipping the core in a crucible of melted glass, spirally trailing melted glass onto a briskly rotating core, or softening canes of glass and bending them round a slowly rotating core.

Schuler (1962) experimented with two cold-working and two hot-working techniques. His methods and findings are described as follows. He firstly formed a core out of pure clay on a metal rod, air-dried it for a week and then heated it to 800°C before rolling it over powdered glass (figure 2. 4a) which fused together as it adhered to the core. This vessel, for reasons discussed above (Section D.1), cracked after annealing. Schuler then made a core of plaster of Paris and sand and pre-fired it to 700°C before

dipping it into a suspension of powdered glass and water. Once the desired thickness of glass had been achieved, the covered core was air-dried. Because of the robust and non-friable core, this vessel again cracked. A third experiment entailed dipping the hot clay core into melted glass at a temperature of 1050°C (figure 2. 4b); this produced bubbles in the glass and the same core problem caused the vessel once again to crack upon annealing. Schuler also made detailed speculations about the possible success of trailing hot glass (figure 2. 4c) or softening canes of glass and forming them around the core, but he did not try these methods. (He finally produced an intact vessel by making a two-part mould and using the lost-wax process (figure 2.4d) to produce a vessel the outer surface of which was then fire-polished to smoothness – a method which he referred to as ‘speculative’ (Schuler 1962, 37) because there is no archaeological evidence for two-part moulds. This is why it is not included in the list of core covering techniques above.) Labino (1966) chose hot working; his method was to hold both heated core and glass-trailing rod, which had a right-angled tip, inside the furnace and trail the hot glass spirally onto the core (figure 2.5a). The core was withdrawn periodically and a paddle was used to smooth the glass evenly over it. A bare patch was left to allow gases to escape. The vessels he produced are of the shape and decorative style of Mediterranean Group I Class IA, made in white glass with purple trail decoration (figure 2.5b). William Gudenrath (1991) produced an alabastron in the style of Mediterranean Group I. This vessel was made by dipping the fired core into a crucible of melted glass (figure 2.6b). Dudley Giberson (2004), whose core-forming research focuses on the Egyptian vessels, rolled the core in powdered glass and heated it in a small low-temperature burner modelled on a small volcano-shaped furnace made of clay and traditionally used for bead-making (figure 2.7).

It is extremely hard to tell which methods were used on archaeological core-formed vessels. This is because glass, as it melts, retains negligible traces of how it was applied. When it comes to the glass application methods for core-formed vessels, these traces – if they exist at all – are currently ambiguous since a systematic comparative microscopic analysis of archaeological and experimental glass application methods has yet to be undertaken. Paul Nicholson and Julian Henderson suggest that it was because little was known about furnace technology in Egypt that the idea arose that, while the

later Mediterranean vessels were formed using hot glass, the Egyptian vessels were made at low temperatures using cold glass (Nicholson and Henderson 2000). The idea that cold glass was used has been espoused by Giberson (2004) and Stern (1994) on the assumption that Egyptian workers could not make glass hot enough to flow and therefore adopted a technique of slowly heating, softening and fusing together small pieces of cold glass. However the discovery of a furnace at Amarna, and subsequent experimental firings with a replica, have demonstrated that a furnace of this type, without any additional ventilation beyond wind-generated draught, could achieve a temperature of 1,100°C (Jackson and Nicholson 2000). This is hot enough not simply to work glass but actually to make it from raw materials (Jackson and Nicholson 2000). This implies that core-formed vessel-making, while it could have used cold glass, did not necessarily entail cold working techniques.

If there is no firm evidence for cold working in the Egyptian period, what about the period of the Mediterranean Groups of core-formed vessels? Brigitte Schlick-Nolte has suggested that hot glass has been trailed on to the cores of these vessels (figure 2.8), citing the appearance of the bases of some of the alabastra (figure 2.9) (Schlick-Nolte 1994, 2002). While trailing cannot be discounted, it is questionable whether this particular feature is evidence for it (Chapter Five).

Turning to methods of decoration: Labino (1966) and Gudenrath (1991), when reproducing the later Mediterranean decoration, used gathers of hot glass as opposed to softened canes. Both these attempts successfully replicated the appearance of the Mediterranean vessels, where the decoration has been noted to be generally less even than that of the Egyptian examples (Schlick-Nolte 1994, 38). Certainly at least some of the *rims* of Egyptian vessels are made from softened canes which are bent into position; this can be seen by the examples where the cane is clearly pre-made – spirally-wound in two colours, for example (figure 2.10). This is the decorative technique espoused by Giberson (Giberson 2004). But there is no such conclusive evidence for the decoration on the *bodies* of Egyptian vessels, where the decorative glass could equally have been applied in hot gathers but with greater attention to temperature and speed of application.

How was the hot decorative glass applied? It has been suggested (Stern 1996) that glass workers rolled the rod of the core along their thighs to wind the decorative trail

from a hot cone of glass onto the vessel body. This would also explain how there were comparatively few decorative trails on Group I vessels, in that the workers could only fit about ten turns in before reaching their laps (Stern 1996). This, as Stern points out (Stern 1996, 26-7), includes using a rod as thin as 1cm in diameter. To account for the closer-packed and far more numerous decorative trails of Mediterranean Group II vessels Stern presupposes a yoke in which the rod would be rotated at great speed (Stern 1996). The method of rolling the core-bearing rod along the knees has also been put forward as a way of applying the actual body glass to Mediterranean vessels (Stern and Schlick-Nolte 1994, 39-40).

This brings the discussion to a question at least as important as furnace technology and core mixtures – that of glass composition. While both Labino (1966) and Gudenrath (1991) both used a soda-lime glass of proportions typical of ancient glass of the Roman period, it is only very recently that the composition of glass from Mediterranean Group I vessels, which are dated between c.525 and c.400 BCE, has been analysed (Shortland and Schroeder 2009). As this study will go on to demonstrate, glass produced by Mark Taylor from the analyses by Shortland proved to be comparatively ‘short’ – that is to say, it required regular reheating in order to keep it workable (Ch 4.C.3b, Ch 5.B.2). It is certainly no longer possible to claim that ‘... Mediterranean glass was a *long* glass’ (Schlick-Nolte 1994, 37, citing Pfaender 1980, 26-29), i.e. a glass which is mobile enough to be worked extensively before returning it to the heat. This makes it less likely that Mediterranean core-formed vessel-making involved working the glass extensively away from the heat source, whether by rolling the core-bearing rod along the knees or by another method. As Stern herself suggests when speaking of Egyptian glass production, ‘... it remains desirable to repeat these experiments with ancient glass compositions’ (Stern 1994, 27). The experimental glass working project at the centre of this study involved using glass of an authentic composition. Understanding, and responding to, the behaviour of specific authentic glasses proved to be an indispensable vessel-making skill, one which had a major impact on the development and selection of particular core-forming techniques.



## **E. Typology and Problems**

The review of typological work on core-formed vessels will focus on the Mediterranean groups in general and on Group I in particular, as this is the group to which the archaeological database belongs. It will use examples from, and focus on issues which relate particularly to, Group I. In so doing the problems raised in Chapter One will be presented in detail.

### **1. Type, form and class**

The term ‘type’ in this study denotes the different kinds of core-formed vessel – for example, Group I has four types: alabastron, amphoriskos, oinochoe and aryballos (figure 2.11). Group II has seven, adding the stamnos, the hydricke and the unguentarium. The types for the three chronological Groups are shown in the survey in Appendix 2. This survey was carried out by counting the number of each vessel type for each Group present in eleven museums and catalogued collections. No-one would claim that this was a totally accurate picture of actual vessel type production but the proportions do appear to reflect the widely-attested pattern of ‘Mediterranean Group’ finds (see Fossing 1940, Harden 1981, McClellan 1984, Grose 1989). They show that although Group II has a greater variety of vessel types than Groups I and III, vessel production is at its greatest volume during the Group I period.

The term ‘form’ denotes the particular variety of shapes of each vessel type. (figure 2.12). The form of the alabastron, for example, describes three aspects: its overall body shape including a reference to height (tall and bag-shaped, squat, or tapering, for example); the shape of the rim (wide, flat, cupped); and the characteristics of the handles (high, small, vestigial, et cetera).

The term ‘class’ is a combination of form and design motif. It is an attempt to acknowledge that certain designs appear often with certain forms and to provide a more integrated approach to categorisation. Class will be discussed further below.

### **2. Developments in typology**

Poul Fossing (1940) was the first to distinguish the main chronological groups and types, and also made some distinctions of form. He also identified some of the main

decorative styles, noting particularly whether the alabastra were made with white or with 'dark' (usually blue) glass (figure 2.13).

Donald Harden (1981) developed the typology further by producing a comprehensive classification of forms for all vessel types, isolating six main forms of alabastra in Group I. The primary category in Harden's typology, however, is vessel type, followed by rim shape, a category which separates flat-rimmed from cup-rimmed vessels. The third level of classification is trail pattern, and the fourth the colour of the body glass. Only at this point are the vessels divided by form (figure 2.14). Harden's classification is based on the core-formed vessels in the British Museum. Harden lists groups of vessels which share a quite precisely defined decorative motif; for example: '... a trail in relief round the lip, a continuous spiral, first in straight lines, then in zigzags, on the neck and upper half of body and finally, below this, either a twofold horizontal trail, marvered or in relief, or else two separate marvered horizontal trails of different colours' (Harden 1981, 62). Those examples which do not fit into one of these several moderately precise patterns are placed in a category called 'miscellaneous.' Harden notes the more common patterns and makes informed speculations on the existence of workshops but the classification itself is not structured according to these speculations: the categories are not named 'workshop 1', for example. The 'miscellaneous' vessels are certainly not taken to be the products of small workshops; they are simply scarce in the British Museum collection. Had there been more vessels bearing a particular 'miscellaneous' pattern, they would simply have been taken out of that category and listed together, in the appropriate place in the catalogue for their body glass colour and rim shape, under a precise definition of the pattern.

Murray McClellan (1984) made a survey of core-formed vessels from dated contexts. (Core-formed vessels are dated by association with other widely-found and dateable artefacts, chiefly pottery, metal ware and coins, found in the same grave.) McClellan's primary category of classification is vessel type – that is to say, alabastron, amphoriskos, et cetera – which, confusingly, he terms 'class.' This is followed by a category termed a 'group'; this term should not be confused with the greater chronological category of the Mediterranean Group which is used in all current classifications including that of McClellan (Chapter 3.A.1). The members of McClellan's

'groups' share the following attributes: colour of body glass, rim shape, overall body shape (known as 'type' in this survey and corresponding to, but not equivalent to, Harden's 'form') and decorative motif. Taking as an example category II.A.viii: the designation *II* refers to Harden's Mediterranean Group I (the designation *I* in McClellan's survey denotes earlier Iron Age core-formed vessels) and *A* refers to the first of the vessel 'classes' (i.e. types), the alabastron. The designation *viii* refers to the 'group,' which in this case is described as 'alabastron of dark glass, with inward sloping rim disc and rounded body, decorated with zigzag pattern' (figure 2.15). While some of the McClellan 'groups' contain vessels which have exactly the same colourway and pattern – i.e. Harden would have listed them together – other 'groups' contain a somewhat wider variety of decorative motif, a *broad similarity* of pattern which admits different colourways and indeed body glass colours. This is because the vessels are chosen from dated contexts – the vessels within the groups are listed in order of date. As McClellan points out: 'Harden's divisions, however are admittedly typological and not chronological. It is only when further subdivisions, based in the main on differing decorative schemes, are made that closely dated types emerge...' (McClellan 1984, 28-9).

McClellan's aim in identifying closely dated types is to isolate craft traditions, or 'workshops' – within the data set. Figure 2.16 shows a group of vessels whose similarity makes it easy to believe that they are all made in the same place within a limited period of time. These are referred to by McClellan as group A.II.vii and by Grose as Class IE; McClellan mentions them as a closely-dated and homogeneous group and Grose doubtless had this group in mind when he talked of some classes being 'the output of independent factories that operate in a number of locales for brief periods' (Grose 1989, 111). Figure 2.17 shows a group of vessels whose wider date range is accompanied by gradual morphological change – an example of what Grose referred to as classes which 'may represent successive periods of production, possibly over several generations, at the same manufacturing centre' (Grose 1989, 111). This group is dubbed II.A.iv by McClellan and, along with its larger family of similarly-patterned purple-on-white amphoriskoi, oinochoai and aryballoi, is called Class IA by Grose (figure 2.19, top).

David Grose (1989), bases his description on Harden's forms; he also notes the distinction between flat and cupped rims. But Grose elaborates by splitting Form 3 into

3A and 3B, adding a Form 7, and re-ordering them; Harden's Form 4 becomes Grose's Form I:6. It is Grose who is responsible for prefixing the Form number, for example "4", with the Group number, to make "I:4"; this makes it easier, when studying Groups II and III alongside Group I, to move between, say, Forms I:4 and II:4 without confusion (figure 2.12).

More importantly, it is Grose whose principal innovation it is to divide the groups, not simply into forms, rims, body colours and trail type, but to unite alabastra and other *types* of vessel, the amphoriskoi, oinochoai, aryballoi and so on, into a series of *Classes* (figure 2.20). (This term should not be confused with McClellan's 'class', which refers to what Harden and Grose call a vessel 'type' – that is, an alabastron, amphoriskos, oinochoe et cetera.) The Class of a vessel in Grose's sense refers to its decorative style *combined* with its particular form i.e. the body shape and colour, rim shape, handle style, plus the number, type, colour and arrangement of the decorative trails. For example, Grose's Class IB, a major class of dark blue bodies with a distinctive pattern of yellow and light blue decorative trails, embraces all group I vessel types: alabastra, amphoriskoi, oinochoai, and aryballoi. The same vessel types appear in Class IA (figure 2.19). Other classes, for example IE, comprise only alabastra; therefore decorative style IE is found only on alabastra and not on other vessel types (figure 2.20).

It should be noted that vessel *forms* are not confined to particular classes; this means that certain forms of alabastra can be decorated in more than one way. Both Class IA (purple on white) and Class IB (described above) contain more than one form of alabastra. (Only Form I:2 appears in figure 2.19). It is also true that particular forms are associated with particular classes, and that some forms are never found in particular classes. Grose also abolishes the distinction made in the classifications of Harden and McClellan between dark bodies and white bodies; he notes that the dark-bodied Class IB is far more similar in style to the white-bodied Class IA than it is to many other dark-bodied classes (figure 2.19). Grose also notes that the principal difference between flat and cupped-rimmed vessels is not simply the rim shape but the technique: rims which are flat are applied separately using additional glass, whereas cupped rims are integral, fashioned out of the body of the vessel (e.g. Grose 1989, 137).

Nevertheless, as far as catalogue classification goes, Grose also splits the classes into vessel type, listing all alabastra before amphoriskoi, and so on. He admits the disadvantages of this approach while at the same time acknowledging its rationale:

‘Any strictly morphological approach disperses the output of a single workshop (and therefore period and place) throughout the catalogue according to the forms included... Morphological classification may also obscure the chronological relationships among related forms and allied workshop groups. However, until there is a better understanding of the products of individual workshops, shape still remains the most convenient method of cataloguing Mediterranean core-formed vessels. Such a system allows the reader to find a particular bottle quickly, based on its gross shape, and then to proceed to a discussion of its date, provenance, and proposed workshop group or class in the text’ (Grose 1989, 126)

### **3. Problems with typologies: research questions elaborated**

It is McClellan’s typology which most clearly highlights the problems central to this inquiry. In cases of the highly homogeneous groups mentioned above, those with both narrow and extended dating periods, it seems quite natural firstly to identify them with particular workshops, to assess their duration and, by distribution patterns, to speculate about their possible location. But difficulties appear with McClellan’s groups II.A.vi, viii and xii. These are the ones described above as containing a *broad similarity* of pattern; where, strictly speaking, there appears to be more than one decorative design.

In Group II.A.viii a variety of decorative designs are divided into three subgroups by chronology. It is implied that the first group, the oldest, is dated to 525-500, the second to 500-475, and the third to 475-450 BCE (McClellan 1984, 39-41). Before discussing the decoration it is necessary to examine this chronology. While it holds broadly true for the second subgroup, the first has two marked exceptions, the vessels discussed above, BM 119 and 120, which are dated to 475-450 BCE (Harden 1981, 67-8). The third subgroup, which contains 4 vessels, has only one securely dated to 475-450; another vessel in this subgroup, no. 2 (B.M. cat. no. 114) is actually dated to 500-475 BCE (see Harden 1981 p. 66-7) and a third to c. 500 (no. 35). The remaining vessel has

no secure date. This means that the statement ‘the third group seems to be slightly later than the second group, and may be thought of as the products of a third generation of craftsmen working in the second quarter of the 5<sup>th</sup> century BC’ (McClellan 1984, 40-41) cannot really stand. This brings the discussion to the question of the decorative motif and body shape of the vessels. Even if one were to reorganise group II.A. viii into a more accurate chronology, the difference in their appearances would still be marked, as can be seen with the examples in Figure 2.18 where two vessels are dated 500-475 BCE and two dated 475-50 BCE. The earlier two vessels appear different from the later two, and all of the vessels appear equally different from each other. It is unclear what grounds there are for stating that: ‘... [t]he three groups of type II.A. viii alabastra could have been made in a single or closely-related group of workshops over a period of fifty or more years’ (McClellan 1984, 41).

Some individual vessels in this group can be assigned a Grose class; BM 122 (1894.11-1.213), no. 42 from McClellan’s group II.A.viii, belongs to Grose’s Class IG. (This vessel is not shown in figure 2.18 but in figure 2.21). None of the other vessels in group II.A.viii are sufficiently like BM 122 to qualify as class IG. Of course, there are pairs and threes of vessels within group II.A.viii which could readily form new classes (Grose himself admitted that his classes were only the beginning of a classification and certainly not intended to be comprehensive). Indeed, that would be a viable option. The question is whether there is any validity in putting these new putative classes together as a *group*, in order to claim some kind of *commonality in making*; whether one can in fact say that they ‘... could have been made in a single or closely-related group of workshops over a period of fifty or more years’ (McClellan 1984, 41).

But *why* does one balk at this claim? What exactly is it that makes us doubt that two vessels could have been made by the same person or workshop? The fundamental response is, of course: “They do not look the same.” This almost instinctive observation is the basis for connoisseurship. This is not to say that connoisseurship is crude; the ‘eye’ of the connoisseur is a skill in itself, generated out of years of practice. This skill can describe vessels on a forensic level of detail. But the only type of statement that can be made using this skill is that artefact A is more like artefact B than artefact C. Everything else is based on the assumption that a maker who made artefact A is therefore more likely

to have made another artefact similar to it than one which is different from it. It is on this assumption that artefacts are classed into groups which are then dubbed the products of an individual (if they are almost identical), or workshop (if they are extremely similar). Very often there is a clutch of features shared variously by several artefacts where none possesses all and all possess some of them, but not, unfortunately, the same ones; this situation is characteristic of McClellan's group II.A.viii, and here there is often a reference to a 'closely-related group of workshops' (McClellan 1984, 41), or to 'allied workshop groups' (Grose 1989, 126).

There is another related and equally instinctive assumption: that skilled work has certain recognisable characteristics, the chief of which is consistency – internal consistency, of an artefact itself, and consistency across a range of vessels. This assumption, that one can make value judgements about artefacts on the basis of consistency, actually defines some of Grose's classes. It is one of the criteria of belonging to Class ID that the neck of a vessel be finely-shaped, for example (Grose 1989, 114; figure 2.13), whereas one of the criteria for Class IG is '... hasty or careless craftsmanship [where the] ... decoration is also haphazard...' (Grose 1989, 115; see figures 3.13 and 3.14).

This is the situation which was represented in Chapter One by figure 1.1. Figure 2.22a features a number of vessels like the alabastron on the left of figure 1.1. These are exceptionally consistent vessels from Class IB. Figure 2.22b. shows a number of alabastra of the group exemplified by the vessel on the right of figure 1.1. These I have dubbed 'Class IJ'. I have found no vessels of this design which is any more consistent than those shown. That is to say, none of the IJ vessels have a smooth profile, a symmetrical neck, or even and evenly-spaced decorative trails.

One can put forward various explanations for this. Perhaps the IJ vessels are a novice's version of the IB ones and my typological designation IJ is invalid; perhaps IJ simply belongs at the low-skill end of the range of Class IB? In fact there are gross stylistic distinctions: not only is the method of rim making and neck shaping entirely different on each vessel but the basic decorative motif is also distinct. In Class IB the yellow spiralling trail at the neck and shoulder descends in an unbroken line to join the panel of zigzags; in 'Class IJ' this does not happen, and there is an extra turquoise trail on

the upper section of IJ decoration which is not seen in Class IB. Again, although fairly inconsistent examples of Class IB exist in the archaeological record (figure 2.23) no highly consistent IJ vessels have been found. For this to be the work of beginners, one would have to suppose that they abandoned this decorative motif while simultaneously making a sudden marked improvement which included an entirely different rim application technique which they had not previously practised. Perhaps the IJ makers were working in a hurry, or even purposefully turning out crudely-made vessels as a frivolity or a form of dissent. For either of these to be the case, the IJ makers' consistency would have to be degraded either involuntarily or voluntarily. But why would they be hasty only in that design? And is it possible for a skilled glass worker to purposefully return to lumpy, wobbly work?

The fact that consistency is taken as a sign of skill tells us what is immediately apparent when watching or, even better, doing craft: skill is a measure of the level of control the makers have over their movements. It is surely much easier to make an object differently every time, because this allows the maker a far wider range of desirable outcomes, and therefore acceptable movements, none of which need to be pre-planned or even pre-conceived; this can therefore be achieved with a relatively low level of control over movement. With consistent work, however, the desired outcome, and therefore the series of movements, is widely known, intended, admired, pre-planned, and one and the same, each and every single time. Consistency cannot be achieved without a high level of control over movement. One can then re-cast the issue in terms of movement: the IJ makers 1) moved differently from the IB makers and 2) never got any better at moving. To address this we need to explore skill in movement. We also have to consider that this is a particular kind of movement: making gestures with tools and materials. This brings us to the second and third of the research questions: What is skill in movement and making? How does a person become skilled? This study will now survey the literature on skilled movement and skill in making.



## **F. Conclusion**

- What are the specific problems raised by the archaeological database and by core-formed vessel typologies?

This chapter has addressed the first of the research questions listed in Chapter One by detailing the archaeological record of core-formed vessels, the history of experimental research into core-forming materials and techniques, and the typological context. The long history of core-forming is marked by an increase in the period c.500 – c.400 BCE when a great variety of vessel designs were produced and when there also seemed to be a wide range of consistency of execution. Research into core-formed vessel-making has been conducted in two strands: core material composition, and core-covering techniques. No research has been done into the place of skill in core-forming. Core-formed vessel typology has divided vessels according to body shape and design motif. Attempts at further grouping, by positing that certain very different-looking vessels were made by the same workshop or generations of a workshop, encapsulate the problem, which is that the question of how vessels get to be the same or different, how sameness is carried across generations, and how vessels get to be consistent or inconsistent, is not examined. It was suggested that this problem could be looked at in terms of skilled movement, and in particular skilled movement with tools and materials. This study will now survey the literature in several fields on skilled movement and skill in making.

## **Chapter Three. Approaches to Skill, Movement and Making**

### **A. Introduction**

- What is skill in movement and making? How does a person become skilled?

This chapter will consider this question by surveying approaches to skill from a number of different disciplines. This survey will contextualise the questions and show how I arrived at the definition of skill outlined in the conclusion. The context is important because I will use the definition to analyse and document a craft apprenticeship. In this situation it needs to be clear why skill is defined the way it is and therefore why, during the apprenticeship, I did things and recorded things in a certain way. A robust definition is also important because an apprenticeship moves forward in time and cannot be repeated, and because hot glass work cannot be ‘undone’ and started again; there is one chance only to make sense of it all. Since it is technically and logically impossible to ‘just film everything’, I had to begin with a clear idea of what is vital about becoming skilled, and a framework to help me document the process of becoming skilled. In this way theory informs practice.

### **B. Psychological, phenomenological and physiological approaches to skill**

#### **1. Knowing how and knowing that**

One of the primary distinctions in skill studies in psychology is between procedural and declarative knowledge – that is to say, between the ‘know-how’ or practical knowledge necessary for performing a task, and the ‘knowing *that...*’ – the knowledge which can be articulated in propositions. When riding a bicycle, ‘you obviously cannot adjust the curvature of your bicycle’s path to the ratio of your unbalance over the square of your

speed; and if you could you would fall off the machine' (Polanyi 1958, 50). Learning can be seen as a process of contextualization; a novice moves from context-free declarative knowledge to procedural knowledge which is contextualized - adding in and responding to situational information, thereby developing skill (Dreyfus and Dreyfus 1986).

This particular skill learning model – from the part to the whole – is not designed to be universal: Dreyfus and Dreyfus emphasise that it corresponds specifically to the situation of an adult acquiring skill by instruction. What is important about both Polanyi's exposition and the Dreyfus model is the extent to which declarative knowledge, propositional thinking, is not only not used but actively abandoned in the course of becoming skilled. What does that say about the relationship between these two types of knowledge? It is necessary to consider the phenomenon of 'verbal overshadowing.'

Facial recognition was given by Polanyi as a prime example of tacit knowledge. 'We know a person's face, and can recognise it among a thousand, indeed among a million. Yet we usually cannot tell how we recognise a face we know' (Polanyi 1966, 4). Polanyi goes on to describe the then novel introduction of the police identikit system for helping witnesses identify the perpetrators of crimes. A more recent study confirms that this facility of facial recognition is impaired by verbal description. A report of a study by Schooler and Engstler-Schooler (1990) notes that these authors 'observed that participants who described a difficult to verbalise stimulus – the face of a bank robber – from memory were much worse at later recognising that face than were participants who did not put their memory into words. This effect was termed *verbal overshadowing*, on the basis that verbalisation creates a language-based representation that overshadows difficult-to-verbalise aspects of the perceptual memory' (Flegal and Anderson 2008, 927).

The same effect appears to take place with skilled movement. Intermediate-level golfers, when asked to repeat a putting manoeuvre after giving a detailed verbal description of their previous performance, performed markedly worse during the second putting manoeuvre than during their first (Flegal and Anderson 2008). A comparable group of intermediate golfers, asked to perform an irrelevant verbal activity between putting episodes, maintained their level of performance (Flegal and Anderson 2008). This test was also performed on two groups of novice golfers; here the detailed describers

*improved* their performance while those who did the irrelevant activity, like the intermediate group, performed at the same level as before. So with the unskilled cohort, whose level of autonomy in skilled gesture was low or non-existent, articulating the details of their performance after playing helped them to improve; with the moderately skilled cohort the same verbal review impaired their subsequent performance. ‘Whereas it may seem intuitive that consciously reflecting on one’s skill during execution would cause dual-task interference, it is surprising that simply describing one’s skill after the fact can be so disruptive’ (Flegal and Anderson 2008, 931).

Flegal and Anderson offer two explanations. Firstly, that the result is simply an effect of attention to detail – that is to say, the unskilled group benefited from a verbal iteration of each component of the process, while the more skilled group then paid too much attention to particular components at the expense of others. Secondly, that what is happening is that declarative memory is being formed to the detriment of procedural memory, which implies that these two types of knowledge are not neutrally-disposed as was previously assumed but act in competition with each other (Flegal and Anderson 2008). From the point of view of this study, however, the two interpretations are both equally interesting because that they show the ‘knowledge’ framework being used. The assumption is that because a tacit knower is not focusing on, or indeed is utterly unaware of, the particulars of an activity – whether these be physical laws or a simple scrutiny of individual fingers during piano playing – it is impossible to be specific (Polanyi 1958). According to this idea, to interrupt procedural or tacit learning with an episode of eliciting declarative knowledge is to wrench the learner’s absorption in the whole to a piecemeal focus on a selection of parts which, when named individually, start to lose their context and whose articulation is necessarily incomplete. ‘All the curious properties and implications of... [tacit] knowledge go back to what I have previously described as its logical unspecifiability; that is to the disorganising effect caused by switching our attention to the parts of a whole’ (Polanyi 1958: 63).

But is it helpful to talk of the process of becoming skilled in terms of moving from one kind to another kind of knowledge? This raises the more important question: is it valid to talk of skill in terms of knowledge at all?

## 2. Moving through time

‘I have been dreaming of some sort of photographic gun which would catch birds in an attitude, or better even in a succession of attitudes, displaying the successive phases of the movements of their wings.[...]’

E.-J. Marey, *La Nature* n° 291, December 28, 1878, p. 54.

E.-J. Marey’s pioneering work in chronophotography, a method of producing successive images of bodies – both animal and human – in motion, gave the study of skill in physiology a new and decisive turn (Lefebvre 2005). Not only was it possible to study the body in motion but the motion was inextricably contextualised: in Marey’s eyes, purely laboratory-based investigations into skilled bodily movements did not engage the body in the same way as when the movement was performed in the environment in which it was created (Bril and Gouasdoué 2009). Included in that environment are, of course, tools: Marey’s erstwhile student and long-time collaborator Georges Demenÿ also noted the interaction between weight of hammer and speed of hitting strokes (Demenÿ 1924 in Bril and Gouasdoué 2009). Movement can be understood as taking place within a body-task-environment nexus; learning to walk as a child is a matter of using the body, the ground and gravity and is impossible to analyse simply in terms of the body (Brenière and Bril 1988). In this way action can be seen as ‘an emergent property of... the subject, the task and the environment’ (Newell 1986, 417).

The indispensable nature of context in skill is taken further by the Russian physiologist and neuroscientist Nikolai Bernstein. Building on the work of Marey and Demenÿ Bernstein developed a more sophisticated system of cyclogrammometry which was based on a film camera which he built, the kymocyclograph, which measured the positions and velocities of moving body segments to a high degree of precision (Bongaardt 2001). He used this to record two types of movements using a hammer and chisel and was able to show how the adductive movement, which engaged the shoulder in producing the force for the blow, was more accurate, economical of energy, and therefore productive (Bernstein 1926). In his landmark study *On Dexterity and its Development* he went on to develop an innovative heuristic of movement as coordination, demonstrating

how, when repeating movements, the skilled body is *not* actually reiterating the exact same physiological event (Bernstein 1996). The result can be identical – an athlete can execute ten running steps ‘as identical as coins’ (Bernstein 1996, 180), but this is not because the brain sends identical motor impulses to the muscles. His explanation for why this is so follows:

‘Because of a huge redundancy of the degrees of freedom in our effectors, *no motor impulses to the muscles, no matter how accurate they are, are able to assure a correct movement* corresponding to our intentions. The elasticity of muscles, which prevents them from transducing force as carefully and precisely as rigid rods, the enormous mobility of the long joint extremities, and finally, the numerous external forces that confront us from all sides lead to a situation where, in addressing a certain muscle, the brain cannot know in advance what the effects will be on the limb movement.... *There is only one way to make a limb controllable*: From the very onset, the brain must continuously and watchfully *check the movement based on reports of the sensory organs* and harness the movement with corresponding *corrections*. We have also mentioned that all the sensory organs, without exception, carry this additional load, which is called the *proprioceptive functioning* of these organs... Apparently, because the external conditions are so variable that the movement can be controlled only on the basis of sensory corrections, repetition of the same movement will be accompanied by *different motor impulses from the brain to the muscles*’

(Bernstein 1996, 180, emphasis in text).

The crucial implication of this, acknowledged by Bernstein, is that what is learned is not a package of information which is then replicated using an identical neural pathway but a highly responsive facility of *manoeuvrability*. If the muscles *had* ‘received ten absolutely identical motor impulses in a row, there would be... ten ugly steps, *each one different from the others* and with a result quite different from running’ (Bernstein 1996, 180). First attempts at artefact production are characterised by uncontrolled variability as novices struggle to control and limit the many degrees of freedom of their hands, wrists

and arms to produce the right gesture. Skilled movement is the result of a tight control of those degrees of freedom, which is how skilled artefact traits, unlike novice ones, can be repeated. The special meaning of ‘repeated’ is emphasised here by Bernstein: ‘...practice, when properly undertaken, does not consist in repeating the means of solution of a motor problem time after time, but is the process of solving this problem again and again by techniques which we changed and perfected from repetition to repetition. ... Practice is a particular type of *repetition without repetition*’ (Bernstein 1967, 134, emphasis added). David Sudnow, in his account of learning the jazz piano, describes the painful beginning of this process:

‘I found a particular chord, groping to put each finger into a good spot, juggling around the individual fingers a bit to find a nice way to get the hand arranged so that it felt comfortable, and once having a hold on the chord, getting a good grasp, I would let it go, then look back to the keyboard only to find that the grasp had not yet been properly established’

(Sudnow 1978, 9)

Gradually the body ‘takes up’ the gesture: Sudnow found his hand preparing for the chord as he reached for it (Sudnow 1978, 9). This ‘uptake’ of the gesture by the body, or better, the way the body learns to move in this particular way, is what Bernstein means when he talks about ‘autonomy’. Sudnow was not consciously forming his hand into the correct shape: indeed, he was not strictly aware that his hand was forming the shape: he *found* his hand forming the shape. But autonomy is not automatism: because the reach to the chord is never precisely the same in each case, the hand and arm subtly reconfigure their shape and grip. Furthermore the hand and arm equally flexibly, and equally without recourse to Sudnow’s conscious deliberation, move into the shapes for a series of *different* chords.

Bernstein’s *On Dexterity* was written in the 1940s but only published in 1991 (Soviet ideological obstructions impeded his career; see below). This means that contemporary psychological and phenomenological approaches were addressing movement and skill without reference to Bernstein’s work. Did this matter? Maurice

Merleau-Ponty's *Phenomenology of Perception* (first published in Paris in 1945) states that our apprehension of the world is essentially and not accidentally partial, contextualised, and mediated through the body. Skilled movement, then, is not a matter of abstract intellectual calculation, as shown by Merleau-Ponty's example of an organist given the task of playing an unfamiliar organ. The process of preparing to play is a bodily apprehension rather than a mental construction. 'Are we to maintain that the organist analyses the organ, that he conjures up and retains a representation of the stops, pedals and manuals and their relation to each other in space? But during the short rehearsal preceding the concert, he does not act like a person about to draw up a plan. He sits on the seat, works the pedals, pulls out the stops, gets the measure of the instrument with his body, incorporates within himself the relevant directions and dimensions, *settles into the organ as one settles into a house*. He does not learn objective spatial positions for each stop and pedal, nor does he commit them to memory' (Merleau-Ponty 1962, 145). This approach appears to share common ground with Bernstein. The striking image of the body 'settling into' a device, the way that the perception of space is physical, body related, is echoed in Sudnow's account of the changes which took place as he learned to play. 'I was gaining a sense of... [the piano keys'] location by going to them, experiencing a rate of movement and distance required at varying tempos, and developing, thereby, an embodied way of accomplishing distances...' (Sudnow 1978, 12). Practising the scale of F, the F key literally became more prominent in Sudnow's eyes: 'How I had practiced fingering the scale became part of the way it was visually appreciated' (Sudnow 1978, 21). Merleau-Ponty also integrates tools into his conceptual framework. 'The blind man's stick has ceased to be an object for him, and is no longer perceived for itself; its point has become an area of sensitivity, extending the scope and active radius of touch...' (Merleau-Ponty 1962, 143). As this happens the person perceives that 'the world of feelable things' begins 'not at the outer skin of the hand but at the end of the stick' (Merleau-Ponty 1962, 152). Notably this same phenomenon is described by Michael Polanyi: 'our awareness of its [the stick's] impact on our hand is transformed into a sense of its point touching the objects we are exploring' (Polanyi 1966, 12-13). It is interesting to note here that a recent experimental study shows how tool use induces a temporary alteration of the bodily schema – the posited mental 'map'



of the body created by the proprioceptive system. Shortly after using a long mechanical grabber to pick up objects at some distance away, subjects received touches to their elbows and fingertips. These touches they perceived to be further apart than in reality – as if, in effect, their arms had grown longer (Cardinali et al. 2009).

The difference between Merleau-Ponty's approach and Bernstein's is highlighted by the discovery of 'mirror neurons' in the human brain. Mirror neurons support the idea that the perceptual and the motor system are not in fact distinct at all. Hitherto the parts of the brain involved in motor activity were thought to be involved only in the planning and execution of actions, with a separate perceptual system responsible for recognising, categorising and understanding the meaning of objects and actions (Adenzato and Garbarini 2006). But mirror neurons, initially inferred from functional MRI scans but more recently directly detected by using electrodes to record brain activity, fire not only when a person is performing an action but also when a person is observing another person performing the action (Mukamel et al. 2010). This has inspired the comment that 'Bernstein's intuitions anticipated the current neurophysiological *sensori-motor concept*, which holds... that there is no separation between the perception and execution of an action, but that both are inevitably coupled in the bimodal structure of neurons endowed with perceptual as well as motor functions' (Adenzato and Garbarini 2006, 754). Where for Merleau-Ponty movements are bodily positions mediated by perceptions, Bernstein's heuristic of tuning dispenses with this distinction.

This original and primarily kinetic perspective has now been elaborated by Maxine Sheets-Johnstone. According to Sheets-Johnstone we have been at the mercy of a culturally-generated misconception of motion. 'Traditional views of motor behaviour, motor control, motor habits and so on, exemplify a further dimension of the bias in their Cartesian reduction of movement to objects in motion, quantifiable things tied to positions in space and moments in time, and either by nature not kinaesthetically attuned or by manner of study not recognised as being kinaesthetically attuned' (Sheets-Johnstone 2009, 273). Sheets-Johnstone advocates thinking in terms of the primacy of moving: Nature is a 'principle of motion... and kinetic form its natural expression' (Sheets-Johnstone 2009, 216). Kinaesthesia, a person's awareness of bodily movement, is its natural mode of experience and this, of course, has a temporal dimension which has

been ignored at the expense of the spatial (Sheets-Johnstone 2009, 273). Rejecting the notion of a bodily schema precisely because it presents movement as a series of points in space rather than a temporal passage of movement, Sheets-Johnstone suggests that this is why Merleau-Ponty can talk of ‘the knowledge in the hands’ (Merleau-Ponty 1962, 144) but omit to explain how the knowledge got there. How it got there, and stayed there, is the outcome of a person moving their body through time and in so doing, accumulating experience in the manner described by Bernstein (Bernstein 1996, 19). The quotation at the top of this section highlights the way that the early photographic technology of Marey and Demeny, which provided a starting-point for Bernstein’s work, actually epitomises the Cartesian position by representing movement in a succession of stills.

The approach elaborated by Sheets-Johnstone and Bernstein has a great deal to offer this study. A corporeal-kinetic dynamic foregrounds the body in movement, and furthermore a *kinaesthetic* dynamic, one centred not simply on a moving body but a person’s necessarily temporal experience of moving. The temporal dimension is also found in Bernstein’s work where he defines dexterity as ‘an accumulation of life *experiences* in the field of movements and actions’ (Bernstein 1996,19, emphasis added). Kinaesthesia, in the form of accumulating experience, provides an alternative term of analysis for knowledge and in so doing allows the study of skill to develop independently of cognitive models.

In this light one can speculate on what might have happened if Bernstein had published *On Dexterity* in the 1940s. Instead his work was sidelined in favour of Pavlov’s more rigid reflex model which defined movement in terms of stimuli travelling along a fixed neural pathway (Latash 1996, Bongaardt 2001). It was this model which inspired Skinner among others and laid the foundations for behaviourism (Bongaardt 2001). The popularity of behaviourism at the expense of the more nuanced approaches characteristic of the earlier studies of movement and perception described above provides some explanation for why studies of movement, and therefore enquiries into *skilled* movement, remain so uncomfortably divided between the life and the human sciences, leading to a dichotomy between ‘movement without meaning’ – laboratory studies conducted without taking into account the social context of movement – and ‘meaning without movement’ – where the significance of bodily gestures is discussed without addressing their

contextualised physiological and kinetic aspects (Bril and Gouasdoué 2009, 2). This dichotomy has made it easier to interpret skill as knowledge rather than as the experience of moving.

### C. Sociological and Anthropological Approaches to Skill

How does Bril and Gouasdoué's (2009, above) divide between meaning and movement actually manifest itself – if it does at all – in sociological and anthropological discussions of skill? In other words, how is the physical body, its dexterity, and the experience and knowledge accumulated in the process of becoming dexterous, addressed by research in these fields?

#### 1. Techniques, tools and the body

André Leroi-Gourhan's *Gesture and Speech* (1993) (originally *Le Geste et la Parole*, 1964-5) emphasises the relation of the human body to culture. Bipedalism freed up the hand and the face for the development of tool use and language. In this sense 'the body social... forms the prolongation of the anatomical body' (Leroi-Gourhan 1993, 20). Compiling an encyclopaedic ethnology of craft techniques, Leroi-Gourhan created a typology of technical actions; this he used as the basis for a notion of underlying technical dynamics or tendencies (*tendances*) which take varying specific forms, depending on the ethnic group in which they appear (Leroi-Gourhan 1943, 1945). Leroi-Gourhan's approach is problematic in two related aspects. Not only does it adopt a far more essentialist and biologically-based interpretation of ethnicity than is currently accepted, but it also subsumes particular instances of technique under generalist categories. This means that communities of makers are not generating techniques through skilled practice; they are merely modifying a fundamental, underlying and essential *form* of technique.

The actual process of learning skill is approached from the point of view of forming 'operational sequences' or *chaînes opératoires*. The *chaîne opératoire* is explained as follows: 'techniques involve both gestures and tools, sequentially organised by means of a syntax that imparts both fixity and flexibility to the series of operations involved. This operating syntax is suggested by the memory and comes into being as a

product of the brain and the physical environment' (Leroi-Gourhan 1993, 114). Suggesting that 'operational behaviour' – that is to say, the skilled deployment of a *chaîne opératoire* – is a continuum and that any attempt to divide it is arbitrary, Leroi-Gourhan nevertheless divides it into stages – the biological, the mechanical, and the lucid – which correspond to the contemporary psychological divisions of the unconscious, the subconscious and the conscious (Leroi-Gourhan 1993, 230). The most interesting type of behaviour is the mechanical or subconscious, which is described as 'operational sequences acquired through experience and education, recorded both in gestural behaviour and language but taking place in a state of dimmed consciousness which, however, does not amount to automatism because any accidental interruption of the sequence will set off a process of comparison involving language symbols' (Leroi-Gourhan 1993, 230).

Leroi-Gourhan's teacher Marcel Mauss seemed to be closer to a kinaesthetic, or at least a kinetic perspective through his focus on the body, which he described as '... man's first and most natural technical object, and at the same time technical means... Before instrumental techniques there is the ensemble of techniques of the body. [...]. The constant adaptation to a physical, mechanical or chemical aim (e.g. when we drink) is pursued in a series of assembled actions, and assembled for the individual not by himself alone but by all his education, by the whole society to which he belongs, in the place he occupies in it' (Mauss 1979, 104-5). This accounts for the cultural specificity of certain traits: whilst ill in New York, Mauss watched the hospital nurses and wondered when he had seen girls walk that way before – and then realised that it was back in Europe, when watching Hollywood films. Then, he notes, French girls learned to do it too. Just as American walking was desirable for girls, so was the young Marcel rebuked: "“ why do you walk around all the time with your hands flapping open?” Thus there exists an education in walking too' (Mauss 1979: 100). Mauss's exposition of numerous bodily activities, from swimming and eating to dancing and washing, aims to show that they are learned in the same way as tool use is learned (Mauss 1979). When he does consider tools, Mauss is illuminating. Most notably, he noticed that the English soldiers he accompanied during the First World War could not use French spades and had to be supplied with English ones. 'This plainly shows that a manual knack can be learned only

slowly. Every technique properly so called has its own form' (Mauss 1979, 99). Why then does Mauss say a manual knack – or dexterity in a particular gesture – can be learned only slowly? What he is observing, of course, is not a different kind of learning from the process of becoming dexterous but its corollary; if one's body is already dexterous in one suite of tacitly-learned autonomic responses, it is very hard to abandon those responses and create a new set designed for a new and unfamiliar tool.

Of course this is the hallmark of the *habitus* as described by Mauss – the aggregation of tacit practices, skills, tastes and styles inherent in individual bodies and in collective groups which 'go without saying' until brought into contact with difference (Mauss 1979). This element of the troops' *habitus* only became apparent to them in exceptional circumstances – in this case, literally a foreign field. Had they remained in their towns and villages, tackling ditches and garden plots with their own spades, they would never have known that there was a different way of digging. The fact that the practices are termed tacit, however, confines the enquiry firmly to the cognitive domain. The implications of this will be pursued below in Bourdieu's development of the concept of *habitus*.

## 2. The social world

Originally construed as a response to a politically liberal conception of the individual as a rational, autonomous socio-economic entity whose actions are seen in terms of choices, Pierre Bourdieu's *habitus* is a set of 'structured and structuring dispositions' (Bourdieu 1990, 50). These dispositions or habits, ways of doing things, are both formed by past habits and form future habits. The *habitus* works within, and interacts with, the *field*, that is to say the shared consensual norms produced by the plural *habitus* of individuals occupying related social positions (Bourdieu 1990) – broadly, a 'community' as the word is understood in its contemporary sense. The relationship of the two terms *habitus* and *field*, i.e. between an individual's set of dispositions and the community norms, can be understood in terms of an individual's 'feel' for the 'game', where *habitus* is 'feel' and *field* is 'game' (Bourdieu 1990). One plays by the rules, but one can also change the rules. By modelling the activities of individuals as practices which are both created by, and capable of creating, structures, Bourdieu (1990) provides a model where 'individual'

and 'society,' as two aspects of one structuring and structured entity, can no longer be disconnected or opposed.

This highly influential set of ideas has two main implications for sociological and anthropological enquiries into skill and making. The first concerns the all-encompassing nature of *habitus*. All human activity can be discussed and analysed in terms of *habitus*, and all activity takes place in a *field*. This means that not only does the idea dissolve the boundary between 'individual' and 'society', it also removes the pernicious division between 'technical' and 'social'; since all activity is essentially social, 'technical' activity simply becomes just one of many subsets of *habitus* (Sterne 2003). Not only is skill understood as an essentially social practice: the process of becoming skilled is open for analysis as a process of socialisation. To this end Jean Lave and Etienne Wenger have developed two powerful related concepts, those of Situated Learning and Legitimate Peripheral Participation (Lave and Wenger 1991). These terms describe how a person's learning is not an abstracted set of concepts to be imparted but an activity embedded in a community of practice. According to this set of ideas, one's learning increases according to the extent to which one's *habitus* is altered by progress into a new *field* (or acquires a feel for the game). Learning is, not functionally but essentially, a process of increasing participation in that community. The concept of Legitimate Peripheral Participation enables Lave and Wenger to isolate common themes as well as meaningful differences in modes of apprenticeship in several communities of practice including those of Indian tailors, Mexican midwives, American trainee naval quartermasters and American alcoholics in recovery (Lave and Wenger 1991). What is particularly interesting is the way that the learning outcome corresponds to the degree of embeddedness in the community of practice; the trainee butchers, for example, were on a programme which led to employment in supermarkets where many of their skills would never be used, and consequently their learning was not particularly successful (Lave and Wenger 1991). This follows a longer tradition of ethnographic work (e.g. Brewer 1974, McCarl 1974, Lancy 1980, Harper 1987) which offered much-needed counterweights to abstracted and inert accounts of technical activity. Douglas Harper (1986) describes his own study (1987) of a mechanic's son who learns by imitation and whose expertise is given only when the person requiring it 'treats him right' (Harper 1986, 228), showing how the work is

profoundly socially shaped. Robert McCarl's work applies folklore theory to urban welders to show material and oral communication. Dexterity is adduced to show a social phenomenon, the persistence of traditional craft worker's practices in an urban, 'technical' setting: 'Management would be aghast if they knew the extent to which most welders successfully work by 'eye-ballin' it' [i.e. dispensing with measuring], even when craftsmen are working to within a thirty-second or a sixty-fourth of an inch' (McCarl 1974: 246).

Learning is not ignored, but its sociality, and the nature of its sociality, is generally the point of interest. Patricia Greenfield (1984) shows how young Mexican girls do not practice, in the sense of *rehearse*, weaving skills, but rather produce a finished piece from their first day at the loom. Yarns are costly and any finished piece has commercial value, so the progress of these small learners is measured by the proportion of each piece which is actually made by their mothers; competence is marked by the unaided production of an entire piece. This learning method, termed 'scaffolding' (Greenfield 1984), is very much the sort of 'learning as doing' which epitomises situated learning. This can be seen when it is contrasted with another approach known as ICM or Increasingly Complex Microworlds, where a task is segmented and each segment is taught independently, with much repetition, before moving to the next segment, and not necessarily in order; novice skiers, for example, are taught to stop before they are taught to move along (Burton et al. 1984). Likewise, moving is given great attention in an account of the reciprocal and regulated nature of the learning in a Japanese garage where the ritualised pattern of the mechanics' movements as they worked in a coordinated group on a car repair amounted to a choreography (Madono 1998). Also noted is the intense and communal watchful concentration displayed by those who were not moving, because waiting in this context is treated as *timing*: at the right moment, those who were still would then start to move again in the rhythm of teamwork (Madono 1998).

What is clear about this approach is that the theorising of learning as an essentially socialising process results in the equation of all kinds of skilled practice, regardless of the level of dexterity required. On this level of analysis the alcoholic in recovery, although s/he uses no tools and works with no materials, undergoes the same process as the novice tailor or mechanic. Subsuming apprentice potters and trainee

doctors in one conceptual scheme, that of becoming socialised into a community of practice, has its drawbacks. John Singleton's study (1989) epitomises the problem. Among many other aspects of Japanese folkcraft pottery Singleton gives an account of relationships between master, apprentice workshop and village, of five stages of apprenticeship from menial tasks to workshop production, and of learning by covert watching. In addition Singleton describes the great burden of skill learning on the apprentice: 'Once on the wheel, the apprentice is often told that he should make ten thousand small sake drinking cups (*guinomi*) in the exact shape, size, and thickness of the master's model cup. These are practice pieces and will be returned every day to the clay pit for recycling, not to be fired until the apprentice has mastered the form exactly. Even then, the apprentice will be expected to continue practice of the form' (Singleton 1989,19). But what is it *like* to come to turn out ten thousand drinking cups? Getting to be so dexterous constitutes a powerful transformation; the changes that occur within the learner's mindful body must surely be major, crucial, and therefore of prime importance in any socialisation process. But posture, hand movements, the increasing obedience of the clay, and the learner's sharpened feeling and seeing, receive little notice – and when they do, it is interestingly incidental: '...additional forms to be learned require the *internalisation* of the shape, so that they may be produced automatically and without intentional effort' (Singleton 1989, 20, emphasis added). Another pottery study of Japanese pottery apprenticeship makes the following fascinating observations: 'A strange transformation gradually overtook me during the six months I was trying to throw these tiny pots. As I was straining to distinguish almost imperceptible differences in shape and thickness in these forms, in order to produce them perfectly, I began feeling myself shrink to the size of these tiny sake cups. I was feeling very small!' (Haase 1998, 119). Again: 'two things were especially interesting to me. One was the way [the master]...wiped his hands clean of slip and tossed it back in the pot or wiped it into the waste clay container. *This move was like a hand dance.* The other thing was the way he would roll and nod his head as the clay revolved. [*The master's*]... *father also did this, and at some point I found myself doing it, too*' (Haase 1998,119, emphasis added). Bill Haase found his teacher a hard and somewhat capricious taskmaster who repeatedly rejected work which was self-evidently adequate, but his study nowhere acknowledges



that the fascinating perceptual and kinetic transformations he mentions in passing are precisely what the master, through his repeated injunctions to keep practising, is trying to engender. Of course the master enjoins a high degree of social conformity, but surely one of the major reasons for this is that this is how a learner becomes dexterous.

Why is dexterity not discussed more? This brings us to the second major problem of the Bourdieuan *habitus*, and back to the problem of knowledge. It has to do with what one might call the mechanics of the *habitus*. ‘There is a particular mode of understanding, often forgotten in theories of intelligence, which consists of understanding with one’s body. There are a great many things we understand only with our bodies, at a subconscious level without having the words to say them’ (Bourdieu 1988, 160). What this means is that the acquisition of *new* elements of the *habitus* is *not a conscious process*. ‘The process of acquisition [is] a practical *mimesis* (or mimeticism) which implies an overall relation of identification and has nothing in common with an *imitation* that would presuppose a conscious effort to reproduce a gesture, an utterance or an object explicitly constituted as a model... [which operates] below the level of consciousness’ (Bourdieu 1990: 73). Craft learning, then, happens in the same way. The tacit and mimetic nature of bodily learning may not, at first glance, pose problems. The core physical aspects of becoming dexterous as described by Bernstein are not amenable to conscious interference (see section B) and the concept of situated learning discussed above, where learning is framed as doing, allows learning to take place without the participants realising that it is even happening. If one concentrates solely on the ‘social’ aspects of a tool-using craft (e.g. Lancy 1980), then it does not matter. But when one actually addresses not just people using tools but people learning to use tools and materials, as a subject of the study, that the major problem emerges.

Erin O’Connor’s study of glass-blowing training illustrates this. O’Connor puts forward a definition of apprenticeship: ‘This is the defining exercise of apprenticeship: the apprentice fashions her practice by making an implicit technique explicit, improving and re-aligning that technique with its intended purpose, and allowing the revised technique to again recede into unconsciousness, with the effect of shaping the still nascent glass-blowing element of her *habitus*, ‘the system of structured, structuring dispositions’ (Bourdieu, 1990: 50)’ (O’Connor 2007 130-131). But it is noteworthy that

O'Connor maintains that in order for her to learn, an implicit technique had to be made explicit – in which case, the learning is no longer tacit. O'Connor deals with this by rejecting the notion that an explicit post-performance review is an integral part of practice:

‘That an evaluation of the gather, a reading of the glass, would necessarily be retrospective leads me to suggest that reading a skill, like glassblowing, may be the mark of the novice and, while it can improve technique through bringing it into a state of exception, it can never be an operative mechanism of proficiency. When gathering for the goblet, I did not need to evaluate each of its constitutive moments to understand the deftness of the gather. Sense-making happened otherwise than through this retrospective meaning-making’ (O'Connor 2007, 131).

The kind of understanding which was being used was rather

‘bodily intentionality: ‘practical, nonthetic intentionality, which has nothing in common with a *cogitatio* (or a noesis) consciously orientated towards a *cogitatum* (a noema), is rooted in a posture, a way of bearing the body (a *hexis*), a durable way of being of the durably modified body which is engendered and perpetuated, while constantly changing (within limits), in a twofold relationship, structured and structuring, to the environment (Bourdieu, 2000: 143–144)’ (O'Connor 2007, 131).

Is the problem that the propositional, reflective mode has been excluded from practice? It is true that doing so makes learning a process distinct from doing; and the other is that that once a craft worker attains proficiency, therefore, s/he will have no use for this kind of thinking. But the problem is conceptualising skill as knowledge at all. The work of Loïc Wacquant exemplifies this. In Wacquant's *Body and Soul*, the extended account of his apprenticeship in boxing which he undertook at a fight club in an impoverished predominantly African-American neighbourhood of Chicago (Wacquant 2004), he describes the teaching method as follows: ‘If DeeDee [the teacher] can allow himself

such an economy of words and gestures, it is because *the gist of pugilistic knowledge is transmitted outside of his explicit intervention*, through a silent and practical communication, from body to body' (Wacquant 2004, 113). Wacquant also moves on to describe the difficulties of learning: 'The surface simplicity of the boxer's gestures and moves could not be more deceiving: far from being 'natural' and self-evident, the basic punches... are difficult to execute properly and presuppose a thorough "physical rehabilitation", a genuine remoulding of one's kinetic coordination, and even a psychic conversion' (Wacquant 2004, 69). This is a matter of 'making the practical schemata enter into the corporeal schema of the apprentice pugilist' (Wacquant 2004, 104).

It sounds like a struggle. Elsewhere the more pertinent information on how he learned is contained in the actual field notes, separated from the main text in indented paragraphs. Here the feel of wrapping on the hands, of Vaseline spread on the face; the unfamiliar sensation of being in head protection and large gloves, are all described. More importantly, so is the step by step progress towards dexterity *in a series of movements*: jabbing at a pad held up by an 'opponent' he tries using both fists, but cannot get the right 'snapping' speed, so returns to single jabs; then he tries both fists again, then rests after two rounds, then tries short uppercuts (Wacquant 2004, 64-66). It is actually moving which constitutes becoming skilled. In order to learn, he simply has to keep moving; to give his body the experience of repeatedly tuning to the continually altering task. To what more appropriate activity could Bernstein's facility of manoeuvrability be applied than that of learning to box? Wacquant has instead to develop a somewhat laborious mechanism whereby a reified action is somehow transmuted into knowledge: 'a learned action... [becomes] the support, the materials, the tool that makes possible the discovery and thence the assimilation of the next' (Wacquant 2004: 118).

Knowledge is also a primary term of analysis in Charles and Janet Keller's *Tool Use and Cognition* (1996), where a dialectical relationship between knowledge and practice gives rise to the emergent qualities of a particular task – emergent, because 'practices have the potential to transcend and reconfigure the traditions and representations on which they are based' (Keller and Keller 1996, 14). The constellation is the aggregation of resources, both material and mental, brought together by the craft worker in order to accomplish a given task. For example, to make a twisted bracket the

worker must create the twist and bend the rod. The necessary transformations include semi-squaring, quenching, twisting, straightening, and bending. Each of these involves a notion of specific means and ends: each is associated with a particular set of enabling implements. 'From the possibilities offered by the shop and the blacksmith's stock of knowledge, particular elements are selected in what becomes a series of constellations for production of brackets' (Keller and Keller 1996, 96). The active part played by the selection and positioning of tools is not only defining but also changing the work process shows at first hand how deeply interconnected are tool, process and innovation. However, the practices and the representations appear to be conceptually quite separate. It is stated that the representations are 'constructed by smiths themselves and rooted in the founding principles of thinking hot and transforming iron by the skilled application of risky and unspecialised tools' (Keller and Keller 1996, 59). But how do the Kellers' 'principles and schemata' (1996, 13) arise? The answer is surely through experience, and that experience being specifically kinaesthetic, i.e. arising from learning how to move. But although Charles Keller underwent an apprenticeship in craft blacksmithing, the cognitive paradigm ensures that he mentions only necessary transformations to tools and materials, and not the temporal, experiential and bodily transformation which would account for how smiths become skilled.

### **3. The body and the material world**

A number of studies present alternatives to the cognitive paradigm by relating the body to the material world in sensori-motor terms. This interpretation means that skill learning is a taking-in of material elements into the corporeal schema; this taking-in happening through the sensing and moving body. Therefore an airline pilot can be said to have '*incorporated in his sensori-motricity* the 200 tons of the jet liner, the take-off power of the engines and all the equipment of the cabin...' (Warnier 2001, 12) This notion of bodily schema, popular in neuroscience and familiar in the work of Merleau-Ponty, makes it possible to conceive of 'the body' not as 'the anatomophysiological sum total of all the human organs...[but as] a dynamic synthesis of sensori-motricity in a given materiality' (Warnier 2001, 7).

Warnier has also suggested that to bring movement to the fore is desirable to ‘produce an ethnography of bodily techniques in a given material culture’ (Warnier 2001, 9). Warnier’s scheme appears to be a deepening of Mauss’s original notion of body techniques by drawing upon the work of the noted French physical educationist and sociologist of sport Pierre Parlebas. Parlebas’ central idea, the substitution of the notion of *action* – that is to say, a culturally meaningful motor behaviour integrated into the actor’s environment - for the comparatively impoverished notion of *movement*, enabled him to develop motor praxeology as a new physical and social science (Parlebas 1999). As Warnier suggests, it is this science which could then be used to investigate the at once socially-contextualised and meaningful and physically-constituted suites of gestures comprising different crafts. This is accomplished by a variety of methods: for Warnier’s pilot it is by: ‘...[e]ndless drilling of motor algorithms, of verbal and non-verbal communication with the instructors or the co-pilot in the interaction with the machine, repeated de-briefing after the flights, retraining in a flight-simulator before piloting a different type of aircraft... [which build] up *bodily habits fully adjusted to the material culture of civil or military aviation*’ (Warnier 2001, 12, emphasis added). Although this approach appears analytical to the point of destruction, the aim is not to ‘shave’ movements from their contexts but rather to preserve the direct relationship between bodily habits and material culture, or gesture and tool.

These types of approach, then, should give rise to a more dynamic scholarly engagement with the phenomenon of skilled movement in craft activity. Skilled movement can be seen as an element of subjectivation, as an expression of agency, as an interactor with materiality in the form of tools and materials to be worked, as an element in a wider environmental landscape. Does this mean that dexterity, and the process of becoming dexterous, is recognised as a term of analysis? Miryem Naji shows how a group of North African women, through weaving, express their gender, identity and ethical status (Naji 2009). In the process she describes a great number of the postures and body techniques used: ‘When several weavers pass the weft at the back of the carpet whilst the others knot the pile at the front, the latter are attentive to the tempo of the beating which comes from those at the back who weft, whilst the latter have to keep up with the progression of the line of knots’ (Naji 2009, 60). The various types of

movements are listed and illustrated with extremely informative images including those showing the position and relative tension of the threads on the loom. A phenomenological approach means that the sounds and tactile aspects of weaving, including pain, also contribute to subjectivation. But the actual process of interacting increasingly skilfully is not overtly addressed. How did the women come to be attentive to the rhythm? What gestures did they find hard and what easy? What style or level of work is admired, and what disparaged? It is interesting that Naji also notes that young children play around the loom and pull on the loom threads (2009, 53); but they are not only being socialised into the weaving community as Naji states but also learning how hard they can pull, which is the first stage in tuning the body to the tension of the material; and in reaching the point where they can perform the movements rhythmically. 'Good weavers are those who perform a constant maintenance of their ethical self through an aesthetic of the correct gestures, through body techniques characterized by care, precision and attention' (Naji 2009, 68); while this is undoubtedly true, good weavers have reached this point because their selves have been constructed through a personal journey of becoming dexterous. This temporal dimension of becoming, which would have inevitably been introduced by thinking of the weaver's dexterity as accumulated experience, is missing.

Other recent ethnographic studies aim to challenge traditional cognitive approaches adding phenomenological, or at least physical, elements to a cognitive approach: 'Rather than being imposed according to a separate set of mentally held principles, assessments [made by Kazakh carpetmakers during the work process] are based in somatic-sensory interactions with practical tasks, with tools and materials' (Portisch 2010, S72). Portisch (2009) describes how a Kazakh baby first learns about the carpet in terms of a series of received impressions (woolly, rough, itchy, smelling of lambs). But it is only when she describes the first stage in the carpet-making learning process, when the young Kazakh women are fourteen, that Portisch notes that ' [t]hey may sit with an experienced craftswoman and wind up the yarn that has been spun, thus gaining a tactile and motor-kinaesthetic understanding of the quality of the spun yarn' (Portisch 2009, 478). But it surely has to be acknowledged that the young women will have begun this tactile and motor-kinaesthetic learning as children, when they experienced the carpet as something which is not only a series of received sensory

impressions but something to interact with: which can or cannot be chewed, pulled, rolled on, crawled under, or carried. By the time the young women come to learn carpet-making, they already know how the materials behave as things to be worked, not just as textures to be felt; and consequently, how they should be treated. This shows the disadvantages of a purely phenomenological approach which deals in impressions rather than interactions. Rather than simply feeling wool as a tactile sensation the subject is not only interacting with it but also learning ('you may not put that in your mouth') how it should be interacted with. By missing out on dexterous interaction as a continual life state, one can miss out on the ethical aspects.

Another perspective to the cognitive paradigm is put forward by Tim Ingold who suggests that, because of Bernstein's understanding of movement as essentially *corrective*, that skill is a form of attunement (Ingold 2000a, 353; 2006, 74). People work in synergy with tools and materials which is part of a 'field of relations' (Ingold 2000a, 353) with the surrounding environment. Keller appears to be aware of this phenomenon of attunement when he describes a 'flow' situation where the craft worker's attention continually moves back and forth from tool, resources (fire, for example), co-workers, and artefact (Keller 2001). What is being tuned is the skilled, moving, mindful body's relation to all these things. .

#### **D. Archaeological and ethno-archaeological approaches to skill**

Self-evidently archaeology cannot 'see' making, only its results in the record of material culture. The patterning of this material record has been interrogated using a variety of theoretical frameworks to address a range of questions. This section surveys those approaches where artefact production is foregrounded in order to identify what part is played by skill learning, or the process of becoming dexterous, either in forming the research question or in providing the answer.

##### **1. Cultural transmission**

Stephen Shennan states that '... archaeologists' desire to see people in the past as the active knowledgeable agents we naively believe ourselves to be, has meant that they want to see all change as the outcome of the conscious choices of individuals with existentialist

mentalities walking clear-sightedly into the future' (Shennan 2002, 9). Shennan asserts that changes in material culture through time show an evolutionary force at work; more precisely, they are the result of adaptation by selection, through a mechanism analogous to, but not working in exactly the same way as, biological genetic inheritance. This is termed dual inheritance theory. As with genetic inheritance, a trait is passed, but in this case from not a biological but a cultural parent. Shennan, with reference to the activity of fishing, cites the following description of how people learn to fish: 'The body of knowledge [surrounding fishing] is *transmitted* to the next generation as an objective truth during socialization, and then it is *internalised* as a subjective reality' (Shennan 2002: 42, quoting Ruddle 1993, 20). One would then expect, in this context, to learn more about the processes of transmission and internalisation – how do people 'do' transmission and internalisation? Shennan notes different modes of cultural transmission, for example one-to-one teaching, one-to-many, and sole learner in a group of experts, and also uses the idea of directions of transmission – vertical, horizontal, and oblique, for example. This analysis is framed by Boyd and Richerson's (1985) definition of four types of cultural learning; Boyd and Richerson define culture as '... information capable of affecting individuals' phenotypes which they acquire from other conspecifics by teaching or imitation' (Boyd and Richerson 1985, 33, in Shennan 2002, 37). Their four types of learning can be listed as follows: *guided variation*, which involves copying a pattern of behaviour and modifying it by trial and error experimentation; *direct bias*, that is, choosing a behaviour pattern from a range of possible options; *indirect bias*, or choosing the behaviour pattern selected by a successful or prestigious individual; and *frequency-dependent bias*, i.e. choosing the most-commonly selected behaviour pattern. Guided variation, for example, can be described in archaeological terms as follows: 'individuals acquire a pattern of behaviour from their (cultural) parents and then modify it in the light of their own experience – learning through interaction with the environment. It will be this modified form of behaviour which is then passed on to subsequent (cultural) offspring, who will no doubt modify it in turn' (Shennan 1989a, 335). However the shortcomings of the wholesale and unmodified adoption of this framework in archaeological studies have been noted. The work of Mimbres potters in a study by Crown (2007a) would, according to Boyd and Richerson's model, be interpreted



simultaneously as guided variation – because of the level of experimentation by novices – and also as biased transmission – because the teachers were so closely involved in novice work that they drew lines on the pot for the trainee painters to follow (Bamforth and Finlay 2008, 14).

The deeper reason why the activity of transmission has not been considered in any depth takes us back to more fundamental conceptual divides. It should first of all be noted that at work within the idea of ‘transmission’ is another concept: that of the meme. The meme, as conceived by Richard Dawkins, is ‘... [a] unit of particulate inheritance, hypothesised as analogous to the particulate gene, and as naturally selected by virtue of its phenotypic consequences on its own survival and replication in the cultural environment’ (Dawkins 1982, 290). The gene to which Dawkins refers is classically defined as a packet of developmental information, surviving by the process of replication – that is, producing a copy of itself which in turn expresses an individual phenotypic trait. It is to this uniquely-endowed, *self-copying* entity that the meme is analogous; and in order to maintain the analogy a distinction has to be made, as Dawkins does above, between the meme itself and the trait it expresses. It is termed ‘a patterned neurological connection’ by Shennan (Shennan 2002, 39). The ‘bit’ of culture it expresses, say, might be shaping hot glass by rolling it on a slab, or, when adzing a frame for the hull of a boat, leaving the top side rounded so that it can be lashed into place; or laughing only behind your hand. These memes would continue to replicate, and continue to express these behaviours, until they were selected against by changes in the cultural environment that would favour memes for other behaviours, as it might be shaping hot glass with a wad of wet newspaper; adzing the top side of the frame flat; smiling openly. (The novel availability of newspapers, nails, and dentures being possible examples of the cultural changes in question.) In all cases, the emphasis on replication is maintained as the exclusive property of the meme, as it is the gene, and *how* it is copied is not examined beyond the description of the meme as ‘patterned neurological connection.’

The key concepts used in this explanation are either explicitly or implicitly at work in many areas of archaeology where traditions can be described as long and relatively unchanging, for example in nautical archaeology. William Hornell in 1943 doubted that Egyptian sea-going vessels were frame-built because it would result in their form being

too different from the simple shell built river craft: ‘a mutation of this kind would be too revolutionary – too great an advance to be made in a single step’ (Hornell 1943, 30). Later, Mediterranean boat family trees were constructed (Basch 1976) and short-hand use of the term ‘families’ has continued to be used (e.g. Pomey 1996). More recently stylistic and functional changes in Polynesian craft have been ascribed to varying selection pressures:

‘... Using functional and symbolic features for Polynesian canoes, we show that natural selection apparently slows the evolution of functional structures, whereas symbolic designs differentiate more rapidly. This finding indicates that cultural change, like genetic evolution, can follow theoretically derived patterns’

Rogers and Erlich 2007, 1

Two major difficulties stem from ‘... a specific aspect of the theory: the notion that culture is ultimately made of distinguishable units which have a life of their own’ (Bloch 2005, 91). The first problem, therefore, is that a discussion of selection and transmission in culture inevitably entails the assumption that there are discrete ‘bits’ of culture to be selected or transmitted. The second is more serious: that explanations like this work just as well as if artefacts give birth to themselves. It can be objected that it is not the artefact which replicates but the technique or routine (Mokyr 2000), but this simply represents people as the vehicles in which techniques reside. This explains why the question of how techniques are actually transmitted is not overly scrutinised in this framework, since the process of transmission can remain completely unexamined and the framework will still operate.

One of the most robust challenges to the idea of the meme comes from Developmental Systems Theory. According to developmental systems theorists, it is because the Mendelian gene has been slotted into the original Darwinian model of organism plus environment that genetic replication has become over-privileged as the only way in which heritable factors can be passed on. This, they maintain, is why the idea has arisen that all epigenetic factors in the development of an organism, for example gravity, sunlight, fire in the case of eucalyptus seeds, culture – as we have seen – in the

case of humans, are inherited according to parallel ‘channels of information’ analogous to genetic replication (Griffiths and Gray 2001). Griffiths and Gray reject this notion in favour of the idea of a lifestyle being reconstructed by a system of resources. In the development of an organism, cell resources are all inherited along with DNA. Indeed, according to context, ‘the same DNA sequence in a different time and place might convey quite different information’ (Griffiths and Gray 2001: 197) Developmental factors, as long as they reliably reoccur, can and should be counted as part of an entire system which exerts selection. The authors then remark that ‘the very idea of developmental *information* runs some risk of disguising [the existence of the system]’ (Griffiths and Gray 2001: 197). Memes, of course, have no conceptual autonomy beyond the traditional conception of gene and genotype challenged by Griffiths and Gray and others (Oyama 2001, Lewontin 2001), out of which they were generated and on which they have been modelled. If a gene cannot be termed a uniquely-endowed physiological unit of reproduction, a meme, as a uniquely-endowed cultural unit of reproduction, has no authority as an idea. Change cannot come out of the selection of behaviour patterns, because change is no longer seen simply as the result of special types of replicating units.

Shennan is at pains to point out that a genetic system of inheritance based on DNA is ‘only one very specific form of a much more generic process involving the transmission of information between entities’ and also makes clear that other caveats and modifications – social theory, developmental theory as well as problems with the idea of the meme – all play a part in refining the process of cultural transmission (Shennan 2002, 26). But referring to the meme as ‘a useful shorthand’ (Shennan 2002, 48) when talking about a system of cultural inheritance appears to shut off enquiry in the direction of how cultural transmission happens, and why, even where it is stressed how long it takes to learn a skill, (1) it is not acknowledged that this is precisely what makes it so very unlike genetic inheritance, and (2) it is not investigated why exactly it *does* take so long to learn something (Shennan 2002). It is telling that when allusion is made to a survey of ethnographic literature on the learning of craft techniques (Shennan and Steele 1999), although this is a discussion of how skills are passed on, and the topic of the survey is literature on learning, the survey is mentioned specifically and only in order to illustrate the directions of transmission.

In this way a relationship can clearly be seen between the standard view of technology discussed by Pfaffenberger (1992), where repetition is a *mindless* activity, and this specific model of cultural transmission, where learning is separated from doing in a two-stage process. This static internalisation of rules, preceding a type of repetition whose sole purpose, now that it is deprived of its function as a learning activity, is the increasingly efficient ‘running-off’ of near-identical copies, is precisely what Ingold (2000, 2001) rejects, claiming instead that ‘the human being is not a composite entity made up of separable but mutually complementary parts, such as body, mind and culture, but rather a singular locus of creative growth within a continually unfolding field of relationships’ (Ingold 2001: 256).

## **2. Style, *chaîne opératoire* and technical choice**

If one were to look for the active theorisation of the teaching and learning of hand skills, or the use of dexterity as a term of analysis, one might expect to find it within these key related fields of archaeological research where there is the closest focus on artefacts as made objects and on the process of making. It is interesting that this is not necessarily so, for reasons which will emerge from this overview.

The concept of style, as it relates to individual archaeological artefacts, has been defined as ‘formal statement of the ways in which different artefacts are similar to each other’ (Davis 1986, 124). Style in this sense centres on the ‘look’ of the artefact; the dimensions, the relative size of different parts, and the type of decorative motifs. The concept was originally employed by culture historians to chronicle the rise and passing of different cultural groups of whom, it was assumed, certain technological styles were emblematic (Dunnell 1986). Later, the patterns generated in the archaeological record by different styles of artefact were used by the proponents of the New Archaeology to explain social processes, the assumption being that the style of an artefact accurately reflected its ‘social context of manufacture and use’ (Binford 1965, 208). This model used ‘style’ in opposition to ‘function’ and therefore identified as ‘style’ only the variables after the artefact’s function had been determined (Conkey and Hastorf 1990). The residual role granted to style was rejected in the mid-seventies by those (e.g. Wobst 1977) who held that style itself had a function, that of information exchange and the

'establishment and maintenance of social boundaries' (Conkey and Hastorf 1990, 4). Post-processual archaeologists deepened and contextualised the communicative aspect of artefacts (e.g. Hodder 1989) and viewed style as a social production (Shanks and Tilley 1987a). Weissner (1990) suggests that style, as conveyor of information, is a social production created and manipulated by social actors, with a distinct target audience or referent in mind (1990, 108). In looking at how style is learned, DeBoer (1990) finds only partial correlation between learner and teacher in terms of style. But here 'style' is interpreted solely as a type of pattern, not as way of carrying out a procedure. This is why no mention is made of gestures and learning on a gestural level; the focus is on the type of style and on the psychosocial factors – stress, a desire to escape their circumstances – in the lives of the women producers that might have influenced it. Dexterity is not considered because such a consideration is not required in a field of enquiry where artefact variability is used in order 'to date sites, to reconstruct village social organisation, and to measure trade and interaction between communities' (Plog 1990, 61).

The art-historical tradition of connoisseurship directs forensic attention to artefact detail in terms of hand movements with the aim of identifying individual makers within assemblages of archaeological artefacts. Its most prominent champion in the field of classical studies was John Beazley. Beazley's analysis of the traits of execution evident in the painting on Attic vases was primarily to identify individual artists (e.g. Beazley 1922). Although Beazley's work was supported by finely-honed observational skill and consummate draughtsmanship, some of his attributions, for example the works he ascribed to the 'Berlin Painter,' have been questioned (e.g. Kurtz 1983). This painter's career spanned 40 years, according to Beazley, who explained visible changes in the later works as a result of the artist's great age (Eisner 1990). What Beazley was identifying were stylistic tropes; whether they were individual traits or a 'house style' is, on this level of analysis, a moot point. (For an archaeologist enquiring how people worked together over time, the latter interpretation is more interesting.) More recent research into the traits of execution of pottery painting has an aim which goes beyond the individual: to gain an understanding, by identifying how many potters worked at a particular archaeological site, of the size, duration, and local influence of the pottery industry. Here, individual

traits are, and must be, seen as unconsciously acquired and then unchanging; in this way groups of artefacts can be analysed statistically to identify a number of distinct ‘hands’ (e.g. Hill 1977, Hill and Gunn 1977). The approach has given rise to detailed archaeological and ethno-archaeological surveys of pottery painting; Margaret Ann Hardin analyses not only the style but also the order of brush-strokes executed by groups of San José pottery painters. Hardin cautions us against isolating individuals too readily, or expecting to be able to, since ‘painters who are socially close, particularly through ties of co-residence or family membership, tend to share strategies for producing common design elements’ (Hardin 1977, 135). While the question of why this is so is not systematically addressed – Hardin notes only that ‘a highly patterned product of motor activity, like a painting style, results from a highly stylised set of actions’ (Hardin 1977, 135) – she does raise the important problem of tools by noting that a son borrowed his mother’s tools to paint in her style. Another caveat is supplied by Charles Redman (1977) who suggests that an individual’s execution can change over time to the extent that their work could not be recognised as the product of one person. Redman prefers to substitute the term ‘analytic individual’ for ‘individual’, meaning the smallest group identifiable by archaeological analysis (Redman 1977). This is not to say that he rejects the analytical methods developed by those in search of the individual, rather that analytical ‘techniques similar to those suggested for identifying individuals could be used to measure interaction or shared learning experience’ (Redman 1977, 44). Again, this research endeavour, dedicated as it is to identifying the size and structure of specific ancient craft industries and therefore societies, does not, and is not designed to, address the idea of the individual as maker, or of the type of teaching and learning taking place, or of the place of skill in craft development.

Leroi-Gourhan’s concept of the *chaîne opératoire* (Section C.1) is widely used in archaeology in order to take a more expanded view of artefact production than that afforded simply by a consideration of artefact style. This is the operational sequence, or series of steps, that make up the artefact. Jan Apel (2008) separates the technological element, defined as the combination of a gesture, intention and tools, from a technological syntax which consists of an aggregate of technological elements that are arranged in a chronological sequence. Drawing on Leroi-Gourhan’s (1993) comparison of

the structure of technologies with languages, Apel uses the cultural transmission model to suggest that ‘it is likely that the syntax of a complex craft, just like the grammar of a language, will be reproduced vertically from parent to child while certain technological elements to a higher degree will be reproduced horizontally, just as single words or expressions in a language might have’ (Apel 2008, 94-95). Alternatives to the classical *chaîne opératoire* include Peter Bleed’s reconceptualisation of operational sequences as trees (2001) and event trees (2008), and the work of Schiffer and Skibo (1987, 1997) whose behavioural chain analysis adds further dimensions to the *chaîne opératoire*. ‘Major causal factors [of artefact variability] are the artisan’s knowledge and experience, extent of feedback on performance in activities along the artefact’s behavioural chain, situational factors in behavioural chain activities, technological constraints, and social processes of conflict and negotiation’ (Schiffer and Skibo 1997). In both these versions of operational sequence models skill is conceptualised as knowledge.

Also inherent in the concept of the archaeological *chaîne opératoire* is the notion of choice: choice of materials, tools, and gestures. Pierre Lemonnier brings this out in his expansion and embedding of the *chaîne opératoire*, bringing into play not only tools, materials and techniques but the idea that these are the result of socially-informed choices which make ‘a set of cultural representations of reality’ also part of the *chaîne opératoire* (Lemonnier 1986:154). Bill Sillar (2000) also takes an embedded view, illustrating how, if one is really to understand pottery-making, the *chaîne opératoire* needs to be extended to include fuel production, specifically the choice of dung for kiln firings. The ‘technical choice’ idea undeniably offers insights into the tensions between western-originated technology and other societies which may or may not adopt certain aspects of it. Some of these show social groups who reject technologies which make activities safer or easier in favour of those which highlight the dexterity of the user: young Yemenis who prefer to use thin-walled tyres on their four-wheel-drive vehicles (Bedoucha 1993), and the occasional favouring, among reindeer herding communities, of the *suopunki* - the trickier ordinary lasso – over the much easier-to-use *vimpa*, or pole-lasso used to catch calves (Ingold 1993a). But in its general *archaeological* application it is questionable whether the concept of choice has always been judiciously employed. What the practical part of this study will go on to demonstrate (see Chapters Four, Five and Six) is precisely how

tools, materials and gestures do not pre-exist, waiting to be chosen, but really do form, and get formed by, each other (this being the synergy to which Ingold (2006) refers). Sillar and Tite's (2000,6) detailed schematisation of the factors affecting technical choice in pottery production (figure 3.1) shows how flexible, complex and dynamic the process of choice making is.

### 3. Skill as an archaeological topic

Skill has been most commonly discussed in archaeology in the field of lithics. Because of this stone tool making is one of the commonest craft practices engaged in by archaeologists. The theoretical basis is largely cognitive, rooted in enquiries into early tool use, bipedalism and language development. The notion of skill *level* receives attention as part of this larger area of interest, and it is noted that high artisanal skill should not be the only type worthy of interest to archaeologists (Bamforth and Finlay (2008). 'More often than not, we rely on a number of subjective value judgements about the relative merits of particular artefacts and what constitutes a skilful piece. Values such as aesthetics, symmetry, regularity and precision are often cited in this regard' (Bamforth and Finlay 2008, 4). It is interesting that, because the dimension of dexterity is missing from this account, so is the significance of 'symmetry, regularity and precision' as expressions of bodily learning; so it becomes lumped in with aesthetics as a subjective value judgement. However it is justifiable to claim that archaeologists should be interested in areas where there are different levels of technological ability and search for reasons, such as the availability of good quality materials, for why this should be so (Bamforth and Hicks 2008). Analogising from the virtuoso work of the cabinet-maker Krenov, Bamforth and Hicks illustrate the quite distinct circumstances of virtuoso craft workers, with their high degree of remuneration, access to the best materials, comparative absence of time constraints and – often – the luxury to select their own projects (Bamforth and Hicks 2008). All these studies employ the distinction between *connaissances* and *savoir-faire* introduced into archaeology by Jacques Pelegrin (1990); these terms refer respectively to 'knowledge' and 'know-how' or, as they were termed in Section B, 'declarative' and 'procedural' knowledge. Peter Bleed identified the use of corrective knapping techniques in the event tree or work steps sequence of one of the



groups; the other group appeared not to need to perform these corrective gestures, getting their knapping strokes 'right first time' all the time (Bleed 2008, 164). This interesting conclusion is presented in a detailed framework of skill learning which does not include reference to skilled movement or the experiential process of becoming dexterous. Again, the aim is to determine the level of skill of the community of producers. Within this field, skill is cognitive: '... skill is a kind of knowledge. It refers to the developed ability to manipulate the vocabulary of techniques, designs, and customary resources that are available in a particular technology. It is a quality that can be developed, something that some people "know."' (Bleed 2008, 156).

Hélène Wallaert-Pêtre (2001) uses a series of polarisations (cross-cultural versus intra-cultural, theoretical versus practical, and cognitive versus manual elements) to structure an enquiry into the theoretical and practical knowledge possessed by different groups of Cameroonian potters. 'Concerning the use of a specific vocabulary, potters and blacksmiths can name the different vessels, tools, decorative patterns, and all the various elements involved in pottery production, while non-potters (male or female) fail to do so' (Wallaert-Pêtre 2001, 481). Potters, in the community in question, are the wives and daughters of blacksmiths. However out of non-potters not even blacksmiths can estimate the volume of a ball of clay needed to make a pot of a certain size. This, Wallaert-Pêtre suggests, distinguishes abilities developed on the basis of theoretical knowledge from abilities based on repetitive practice and unconscious knowledge (*meta-connaissances*). (This skill was not found even in those women and men who every day measure millet in their hand to cook.) Wallaert-Pêtre further contrasts one group whose social structure is more loose – children spend less time with their mothers, they produce a lot of pottery for a market including models they do not use – with three more tight-knit groups where conformism is more highly valued and pottery production is a social act more highly integrated into family and community relationships. The experimental approach is unusual and the findings are interesting, but a problematic contrast is made between 'open' abilities – the adaptability, willingness to innovate, and flexible learning strategies possessed by the market trading community of potters – and 'closed' abilities – more strict learning templates, high degree of conformity in types, unwillingness to experiment

with different styles – possessed by the community potters. Why this contrast is problematic will be discussed below.

A related approach is developed by Valentine Roux who combines experimentation, ethnography and archaeological theory in studies of the ancient carnelian bead industry of Khambat, India (Roux and Blasco 2000, Roux and David 2005). Physical data on the skilled movements of bead workers are combined with perceptual information and planning in an interactive model (Roux and David 2005). Roux not only analyses the different motor movements and shows how a novice and a competent bead maker hit the bead differently (Roux 2000), but also details the learning process, where techniques for each type of flake removal are taught in turn – once one is achieved, the learner tries the next. As with the Indian tailors' apprentice strategy detailed by Lave and Wenger (1991), techniques are not taught in the order they are used when making a single bead from start to finish, but in the order of the amount of motor control needed to carry them out (Roux and Blasco 2000, Roux and David 2005). But although apprentice and competent worker are compared, and although the apprentice strategy is detailed, there is no documentation on how the individual workers move from the novice group to the competent group. The temporal dimension which dexterity entails is missing. What do the novice and competent craft workers find easy and what difficult? What are the physical accommodations they have to make? What techniques do they pride themselves on, and what are admired by their teachers? If apprenticeship strategies are documented in terms of Legitimate Peripheral Participation, which requires no actual analysis of dexterity in order to work, it is not necessary to focus on dexterity.

This highlights the central difficulty of studies such as these, which are conducted in terms of categories or types of knowledge and activity. Are Wallaert-Pêtre's market trader potters less, or more, 'potters' than the conservative village potters? Is their production less 'social'? What is the validity of the categories of 'open' and 'closed' abilities? In both cases the key issue is the conformity, not in terms of pottery *types*, but in terms of the consistency which arises out of dexterity; this, both groups have in common. The secondary difference, that one group has a suite of learned gestures, as opposed to just one, is what makes them willing to try new forms. It does not denote a qualitative difference in dexterity. Are these elements – different types of knowledge and

activity – really discrete or even distinctly different on a qualitative level? Clearly as objects of declarative knowledge they can be verbalised as different things, but their declarative representations are merely modes of expression (and often unhelpful ones). As any multi-tasker knows, one is not suddenly switching from ‘functional movement’ mode to ‘planning’ mode when one turns from toast buttering to busily boiling egg pan. One may know propositionally that the egg needs four minutes in the pan, and that now it is time to get the egg out of the boiling water, but it is one’s senses and a learned bodily experience of time passing which tells one that the egg is ready. Both these things – egg-timing, toast-buttering – are simply two of many orchestrated strands of one experiential flow of activity called ‘getting breakfast ready’, a skilled engagement with the material world, not through impression but through interaction, where there is a right way and a wrong way to do things.

Understandably, research which is less invested in the ‘knowledge categories’ debate tends to focus more easily on the subject of skill learning and how it can make specific contributions to archaeology. An enquiry into boatbuilding traditions (Hasslöf 1972) presents a list of tradition media which can be summarised as follows: the *object tradition*, including models, patterns, guides and above all, tools, some of which can be extremely old; the *social* or *institutional tradition*: the customs, moral standards, and beliefs which are manifested in the tools, sites, and artefacts of the craft and which have to be ‘felt to be understood’ (Hasslöf 1972, 24); the *oral tradition* – difficult for an inquirer to understand, since craftspeople, when questioned, often omit what seems to them trivial details: ‘... in addition, the information often concerns trade, family or social secrets which should not be revealed to outsiders’ (Hasslöf 1972, 24). Indeed, people often cannot communicate a work process in words. This has great bearing on the last and most important tradition, to which, Hasslöf states, all the others are intimately connected: the *manual tradition*. This is conceived by Hasslöf as the observation and imitation of the hand movements, gestures, and behaviour of the craftsman. Hasslöf’s belief in the centrality of the manual tradition is further underlined by the way people react when questioned about their craft: not only do they *not* describe a procedure in words, but instead: ‘... [a person] usually replies: “I do this” and then he makes a hand movement to show how he sets about it. Now and again he makes use of a few isolated words or a

sentence or two. Often he demonstrates in complete silence. This is the way in which, in olden times, for many apprentice years, the majority of craft traditions were passed on' (Hasslöf 1972, 24). This recalls the uneasy relationship between verbalisation and gesture learning experienced by Flegal and Anderson's golfers (Flegal and Anderson 2008; Section B.1). Hasslöf's scheme is also notable for the way in which craft work relates to technological change through the value judgements of the craft worker: he describes '1. a variety of tradition media 2. varyingly mastered by the transmitter who 3. will consciously or unconsciously pass on only what s/he deems important' (Hasslöf 1972, 24). How a maker comes to deem certain things important, and the related subject of values which have to be 'felt' to be understood, will be explored in Chapter Six.

The actual processes of skill learning are also addressed by Patricia Crown, who argues convincingly for the role of children as makers in some assemblages of pottery of the prehispanic American Southwest (Crown 2001). By comparing these vessels with those made by skilled workers Crown shows how the particular social context of learning can be understood. For example, in the Hohokam pottery traditions children begin learning by performing specialised children's techniques with a low error rate, whereas in the Mimbres tradition children are encouraged to use adult techniques from the beginning, decorating wares made by skilled adults even while they are still scribbling. Crown notes that the first style would be dubbed 'closed' and the second 'open' by Wallaert-Petre (Wallaert-Petre 2001), but does not employ these categories herself to describe these learning strategies.

Crown also uses skill learning to uncover instances of collaboration in pottery making, both by analogising from ethnographic evidence of collaboration and by identifying discrepancies in skill level on different parts of a single archaeological artefact (2007a). Crown explicitly addresses the research tradition, discussed above, of searching for individual makers: 'Interestingly, given the goals of *The Individual in Prehistory*, such collaborative vessels are recognizable in assemblages not because we can recognize individuals in those assemblages, but because we can clearly recognize when we do not have a single individual completing a vessel. It is the discrepancies between the motor skills and quality of one portion of a finished vessel and the motor skills and quality of another that alert us to the fact that tasks were shared by more than

one individual' (Crown 2007a, 681). It is also important to recognise collaborative efforts because: if task segmentation is involved it could mean specialised production; it could tell us about the learning and teaching framework; and it challenges models which study technical choice as if it is the province of a single individual (Crown 2007a). It is clear that Marcia Anne Dobres' (2000) plea for a challenge to the notion of the 'lone worker' in archaeology finds a response in Crown's work, but this is not to say that one artefact cannot, and was not, the work of a single individual. Dobres and Crown are simply rejecting it as a *default* notion.

An important aspect of this line of enquiry is, of course, the relationship of the individual to the group and this will be discussed in detail in Chapters Six and Seven, where a further point of Crown's will also be addressed: the relationship of skill level to frequency of production. Crown observes that before 900CE all pottery in the American Southwest was at the same fairly low level of skill, whereas after this date skill levels spanned all levels from low to high; this, it is suggested, is because pottery became something that some members of the community started to specialise in, doing it more often and for a longer time: '... [W]here potters work infrequently and on small quantities their motor performance in decorating pottery remains throughout their lives at a fairly consistent, low quality level' (Crown 2007a, 685).

Willeke Wendrich (1999) analyses the basketry industry of Middle and Upper Egypt with a view to the cautious application of findings to the archaeological and iconographic evidence of Egyptian baskets. Wendrich's survey of contemporary basket makers and their work is distinguished by a detailed itemisation of types of movement, which can be understood in terms of knitting as follows: recurring (as when one is knitting stitches); occurring (as when one is changing knitting needles round in one's hands to start another row); and transition movements, which are often very quick – for example pulling the rows straight before changing to a new type of stitch. This basic analysis is enriched by documentation of the working position, the worker's awareness of the properties of the raw material as it is apprehended physically, the worker's attention to how the artefact will look to the user (the 'good side' at the top or bottom, depending on the shape and use of the basket), and the time relationship of the three types of movement described above. This gives a detailed representation of the rhythm of the

work and its choreography, that is to say the changing relative positions of worker, tools and materials. Many distinct types of basketry technique are then described in these detailed terms.

Wendrich emphasises that ethno-archaeology is not saying that 'contemporary technique' A produces results similar to 'archaeological artefact' B, but rather seeking to understand the production process and the demands of work within a skilled working society (Wendrich 1999, 425). This is a valuable assertion which informs the research of others including Crown and Budden (see below). But what focus is given to the process of becoming dexterous in Wendrich's work? It is discussed in general terms: 'Old basket makers pass tradition by teaching the younger generation. The transmission of skills, practical knowledge, is done by slowly integrating the pupil in the work' (Wendrich 1999, 391). However, there is no documentation of becoming dexterous at the same micro-analytical level as that devoted to individual makers simply being dexterous, nor is there any allusion to the absence of such documentation. When explaining how video is used, for example, Wendrich (1999, 101-6) does not mention how useful this medium might be in recording changes and progress in a maker's technique as they learn. The questionnaires used for participants include questions on learning and teaching which focus on who taught the maker, who they are teaching or have taught, and the age that these various learning experiences started (Wendrich 1999, 447), but there is no more detail than that in the case studies of individual learners. Of course, in some cases it is not possible to document the process of becoming dexterous: the basket-maker Mohammed from Middle Egypt, for example, is not teaching his sons, whom he wishes to become civil servants so that they can lift the family out of its present level of poverty (Wendrich 1999, 397). In the case of Nabawiyya, however, it is stated that in her Upper Egyptian village basketry is thriving, brings a degree of prosperity, and that 'many young girls are learning how to make them' (Wendrich 1999, 401). The absence of engagement with becoming is all the more striking since this is an area of craft where there is excellent archaeological evidence in the form of actual basketry fragments from excavations at Amarna and Qasr Ibrim which have a great degree of similarity with modern styles from the same two regions: 'The basketry excavated at Qasr Ibrim has many similarities with

the modern Nubian basketry, while the basketry from the workmen's village at Amarna corresponds with the modern Middle Egyptian basketry' (Wendrich 1999, 425).

Lastly, Sandy Budden uses her skill as a potter to develop a methodology for skill analysis which is applied to three Hungarian Bronze Age ceramic assemblages, two from settlement sites and one from a cemetery. Budden firstly uses her knowledge of potting to select technological signatures such as clay preparation, wall thickness, and symmetry of rim, handle and profile (Budden, 2010). She then interprets these signatures which are unique to the production of a particular vessel type; different vessel types, of course, requiring different levels of skill (larger vessels being harder). By comparing culturally contemporary assemblages, then, Budden shows how it is possible to 'track the investment and deployment of skill across and between [them]...' (Budden 2010, 14). Statistical analysis of measurements show that different levels of skill can be seen in 1. different vessel types and 2. in different settlements. Cups are found at a wide range of skill in the cemetery and the settlements; poorly made fine wares predominate in the cemetery, whereas they are well-made in the settlements; and urns are made with a high degree of skill in both cemetery and settlements (Budden 2010).

Budden uses these data to challenge certain traditional interpretations. Firstly, that cemetery wares are made poorly because they are made in a hurry to aid expedient burial of the dead: but poorly-made cups are found in the settlements as well, and well-made urns are found in both locations (Budden 2010). Budden also points out that the bodily nature of learning means one cannot unlearn a skill just because one is hurrying: 'signs of haste are not the same as lack of skill' (Budden, 2010, 13). A second traditional interpretation is that the pots in the cemetery are made as symbolic tokens and are in fact not technologically sound. Once again, the urns defeat that argument. A third traditional explanation concerns skill; that the high investment of skill in *settlement* fine-ware is related to the specialist production of elite items, and this merits more attention because, as Budden says, 'Skill is central to the production of all material culture categories. Material culture categories are, meanwhile, argued to be central to the mediation of social practices. Therefore, the maintenance of skill is to be regarded as a key factor in the maintenance of social discourse' (2010,13). Therefore one can apply a new interpretation to the fact that cups appear at all skill levels: this is because cup making is done as part

of learning, by all potters regardless of expertise (Budden 2010, 13). Especially interesting are the cemetery fine wares. Clearly, potters also learned 'on' these vessels; moreover the visually important aspects of these wares, the rims and handles, for example, are well executed, whereas aspects such as wall thickness, which, if the pot were used, would be important but for consignment in a grave are not, are variable (Budden 2010, 14). This implies that more than one potter collaborated in the execution of these vessels – relatively unskilled people practising making the large walls, and skilled potters finishing the vessel with good-looking rims and handles (Budden 2010, 14). Urns, well-made in both cemeteries and settlement, had to be made only by skilled potters and this is either because, unlike fine wares, they were absolutely central to funerary ritual or because they were brought from the settlements where they had been used as storage vessels (Budden 2010, 14).

#### **E. Conclusion**

Sociological and psychological studies have tended to formulate skill in cognitive terms. However certain physiological and neurological enquiries offer alternative concepts: dexterity as manoeuvrability and accumulated bodily experience (Bernstein 1996), and skilled performance as an essentially kinetic, kinaesthetic and therefore temporal event (Sheets-Johnstone 2009). Yet many sociological and anthropological studies of craft, where dexterity, and the process of becoming dexterous is central, subsume bodily learning so thoroughly into the field of social learning that dexterity is seldom overtly addressed. This is partly due to Bourdieu's powerful concept of *habitus* which, with its emphasis on tacitness, ensures that debates continue to be structured around forms of knowledge. In archaeology artefact making has been pressed into the service of various theoretical enterprises including evolutionary interpretations of artefact variability and the forensic identification of individual makers. As in psychology and anthropology, cognitive models are widely referred to. It is through a theoretical turn towards materiality in anthropology and archaeology that skill has come to be of interest 'in its own right', as it were, as a central mode of individual and group interaction with the material world. This is not to say that skill is not a social process: rather that one major



way that people are social is through engaging with things, and they experience this as a bodily transformation which is becoming dexterous.

In the interests of constructing a model of skilled making the following points can be drawn from the survey.

1) It is through the process of becoming, rather than being, dexterous, that people come to engage with craft. People do not take up a craft already possessed of dexterity. Becoming dexterous in a craft is one part of a larger engagement with the material world which begins at birth and which takes the form of interacting, via movement and sensory feedback, with the environment.

2) This means that it is in a state of becoming dexterous that people *continue* to work in their craft. Bernstein's definition of dexterity is 'an accumulation of life *experiences* in the field of movements and actions' (Bernstein (1996,19) It is not surprising that Bernstein adds: 'For this reason, dexterity frequently increases with age and is preserved until later years more than other psychophysical capacities' (Bernstein 1996, 19). It is noted by others that workers increase in dexterity for a major part of their working lives (Crown 2007b).

3) Because this ongoing process of becoming dexterous takes place in synergy with tools and materials, it is an important locus of craft development and technological change. Gestures not only work, but come into being with tools and materials, which in turn, as they are altered, create new gestures.

These points inform the response to the research question posed at the beginning of the chapter:

- What is skill in movement and making? How does a person become skilled?

It is suggested that:

- Skill in movement is an experiential and transformative process: one of becoming dexterous. This is a process which is not simply kinetic – constituted by movement – but kinaesthetic – constituted by a person's experience of movement. Skilled making can therefore be understood as

the necessarily temporal experience of becoming dexterous in making gestures with tools and materials.

## **Chapter Four. Theoretical Framework and Practical Project Design**

### **A. Introduction**

- How can skilled making be conceptualised?

The purpose of conceptualising skilled making is to develop a theoretical model of becoming dexterous with tools and materials which will be used to design and carry out an apprenticeship in core-forming. The research question above will be addressed in Section B. Section C describes the set-up of the Core-Forming Project and shows how it was developed so that the model could be used. Section D details the experimental facilities i.e. the tools and materials developed during the project, in a schematic way. Section E is an equally schematic rendering of core-forming procedures.

### **B. Becoming dexterous**

#### **1. A model of becoming dexterous with tools and materials**

The purpose of the model is to provide a way of understanding and analysing a kinaesthetic event: the experience of becoming dexterous with tools and materials. The model identifies different aspects of this process.

##### **a. experience (figure 4.1)**

In Chapter Three the activity of preparing breakfast – buttering toast while an egg is boiling – was used as an analogy of craft work in order to show that it is neither propositional nor practical knowledge which is in use. People preparing breakfast are relying on the bodily experience of a cooking time which is created out of many iterations of the movements they make while cooking, over many episodes of cooking. So when this study dispenses with the term ‘knowledge’ and speaks instead of ‘experience’ (figure 4.1), it is not to side-step the issue of knowledge but to show clearly that I am referring to

something else, the bodily experience of the things in question. One can only experience the heaviness of a pair of pincers and its pinching power by repeatedly picking them up and working with them, not simply on amorphous lumps of hot glass, but on the real necks of real vessels. The term ‘experience’ has been chosen also because it lends itself very well to gradations – one can be minimally experienced, and experience grows – and to many different types of sensory interaction. So the following summary definitions are suggested:

- **materials experience:** a growing experience of the behaviour of materials and the ability to accept, reject or refine them.
- **tools experience:** a growing experience of the behaviour of tools and the ability to accept, reject or adapt them.

Moving to the two other terms in figure 4.1: artefact experience and work steps experience. The reason for describing these as experience is to dispense with the terms ‘mental image’ and *chaîne opératoire*, both of which belong to conceptual schemes which do not take account of dexterity or kinaesthesia. Replacing those notions is the idea that these are in fact types of experience generated by doing work – making movements with tools and materials.

- **artefact experience:** the growing experience of artefact features which is generated out of repeated attempts to produce that feature using gestures, tools and materials.
- **work steps experience:** the growing experience of moving from step to step, which creates a familiar pathway through the work.

#### **b. sensory activity (figure 4.2)**

This area of craft work is often presented as sensory feedback – tactile, visual and auditory, but it is interpreted here not as passive perception but as active engagement. The only way to understand the colour of the heated glass, the particular roar of the furnace, the radiant heat of furnace and molten glass is to practise watching, listening and

feeling. It is the type of activity which gives rise to comments such as ‘the tip of that iron is cherry red now’, ‘this cowl throws a lot of heat onto your face’ or ‘the furnace is making that noise again.’ It is suggested that watching, listening and feeling are vital to building craft experience and in becoming dexterous in gestures. So the terms are defined as follows:

- **feeling, listening and watching:** the sensory activities which become part of practising gestures and building experience.

### **c. gesture, tool, material (figure 4.3)**

At the centre of figure 4.3 lie the tool and material which are brought together by the craft gesture. It is useful to recall here that dexterity is not a name for instances of repeated identical movements generated by impulses travelling along fixed neural pathways but rather for movements constituted by a corrective facility of manoeuvrability arising from the tuning of many hundreds of neural pathways working in concert and in response to proprioceptive information (Bernstein 1996). Skilled movement is actually a facility of repeatedly solving a motor problem, each time under slightly different environmental conditions which never repeat themselves (Bernstein 1996, 176). What is important is that this becomes autonomic – performed by the body on any one of several levels of complexity, with the deeper mindfulness that has been termed ‘flow’ by many writers (e.g. van der Leeuw 1989, Noble and Watkins 2003). Because of its essential manoeuvrability, autonomy is anything but automatic; but the same facility is what enables the control over gestures, and the consequent conformity of artefact feature, which is the hallmark of a high level of skill. What this implies is that because the hand is not performing the gesture in isolation as in a mime but is holding a tool – a pair of pincers for example – and manipulating material – hot glass – the pressure and weight of metal and the viscosity of the glass should inform the gesture. The muscles should contract to the precise extent dictated by the relationship between strength of pincers and toughness of the glass at that moment. One can suggest the following ‘bundled’ entity:

- **gesture-tool-material:** the movements and postures carried out by a worker in performing a craft gesture, arising out of kinaesthesia, in concert with tools and materials.

## **2. Theory applied to practice: questions**

This model provides a response to the question: How can skilled making be conceptualised? The purpose in making this model was to analyse an episode of craft learning in kinaesthetic terms. But how would theory work in practice? If we changed tools, would it actually change our gestures in an intelligible way? Would it be possible to discern a change in how we watched, felt and listened while working? We would probably gain experience in tools and materials, but how would we actually respond to this increased experience? Would any of this be capturable in photography or film? Are artefacts and work steps generated out of the body, through repeated making? Or are they actually propositional knowledge after all, interacting with practical knowledge in the manner described by Roux (2005, Ch 3.D.3)? That is to say, can one in fact hold an artefact detail in the mind's eye for a long period without having worked to create it? And would it transpire that setting out a detailed plan of action before work begins is in fact integral to craft practice? Is it valid or helpful to break a process down into these 'bits' in the first place? All these issues will be investigated in Chapter Five, an account of the Core-forming Project, where this model was 'tested' and the relationship of theory to practice evaluated.

## **C. Project design: the Core-Forming Project**

### **1. Apprenticeship**

The aim of the Core-Forming Project was to explore and document the process of becoming dexterous in the context of making core-formed vessels. This meant that we had to design the Project and set it up in such a way that all the aspects of dexterity described above could be given maximum opportunity to emerge and be clearly recorded.

I undertook the apprenticeship with the archaeological glass researchers and craftsmen Mark Taylor and David Hill, Roman Glassmakers of Andover, UK. Besides specialising in making reproduction ancient glass vessels Taylor and Hill have conducted

archaeological research into ancient furnace structure, glass composition and glass working methods, including a study of Egyptian core-formed vessels. They have a high degree of dexterity in making glass of ancient compositions, tool manufacture and adaptation, ancient furnace manufacture and behaviour, clay and daub materials, moulding techniques, and glass working techniques. They acquired this through years of experience – gathered from tools and materials, from archaeological research, and from each other’s professional development – a process regarded as ongoing.

However, no work had been done by Taylor and Hill specifically on Mediterranean Group I vessels. This meant that glass composition, tools, and core material, not to mention glass working methods, were as yet undecided, and that therefore there was not yet a definitive set of gestures and tools for a learner to get to grips with.

My relationship with Taylor and Hill developed as a process of what Lave and Wenger would describe as ‘legitimate peripheral participation’ (Lave and Wenger 1991, see Chapter Two), where an apprentice moves through a transitional state, on the edge of the skilled community, towards inclusion. I was introduced to them by my then future PhD supervisor Ian Freestone when I visited their Roman furnace reconstruction project (see the website [www.romanglassmakers.co.uk](http://www.romanglassmakers.co.uk)). I began observing Mark Taylor and noting his gestures as he blew glass (figure 4.4). I then returned for a second session of the Furnace Project, this time as a PhD student, to film their daily activities over a period of three weeks (figure 4.5). This included being present at significant events, for example the lighting of the furnaces on the first day (figure 4.6). During this second session I helped by stoking the furnaces and recording furnace temperatures, including overnight (figure 4.7), for which service I received lessons in blowing glass (figure 4.8). I was exposed to the absolute rudiments of glass working, discovering what it was like to gather and blow glass of a standardised Roman composition at close range, at a low furnace with an aperture built of daub, resting the iron on wooden boards tied to the thighs (as opposed to the glassblower’s bench which is part of a studio glassblowing set-up). I therefore became familiar with a basic glass working tool set – pincers, tweezers, rods and irons – and with the radiation produced by glass heated to between 750°C and 1000°C. I was also able to observe the different styles of interaction between craft workers when engaged in different types of activity – novice work, familiar tradition, and expert experimentation

(Liardet 2009). In terms of legitimate peripheral participation these lessons served as an induction to the Core-Forming Project. When I visited Taylor and Hill while planning the Core-Forming Project and showcased original vessels on film and in photographs in order to excite their interest (it was entirely up to them whether they engaged in it or not), it was not just as a doctoral researcher but as a former helper and pupil who had watched their work almost continually for a period of weeks. By this time Taylor and Hill had a detailed idea of the research questions and understood how the project should be designed.

Mark Taylor had been involved in two core-forming sessions prior to the Project: one in 2004, an experimental session in producing Egyptian forms of core-formed vessels conducted for Paul Nicholson of Cardiff University; and another in March 2008, an experimental session conducted with Emily Coulson, a glass working student from Sunderland University. These sessions are discussed in this study because they made specific contributions to Mark Taylor's experience of becoming dexterous in core-forming and therefore provide a valuable explanatory context to the Project. For the same reason two vessel handling sessions at the British Museum involving myself and Mark Taylor, one before and one during the Project, will also be described where appropriate.

When the Core-forming Project began it was clearly not a situation of apprentice and master working in a familiar tradition. Instead a novice and an expert whose dexterity was also increasing were faced immediately with new developments: a new material (Pichvnari Cobalt Glass 1, Section D) and a new handle-making technique – the result of observations I made about the vessel handles in the archaeological data base and interpreted by Mark Taylor while examining the British Museum vessels (see Chapter Five). The third new factor was an apprentice in the form of a minimally experienced glass worker. I was following in the steps of an expert who was learning not only about the behaviour of unfamiliar glass and core mixtures but also about my own limited glass working capabilities.

We needed to adopt a learning-teaching style that worked with the conceptualisation of the project and, again, allowed it to be clearly documented. The cumulative but atomised approach dubbed 'increasingly complex micro-worlds' (Burton et al. 1984, Ch 3.C.2) was contrasted in Chapter Three with the holistic learning process,



referred to as ‘scaffolding’, undergone by young Mexican weavers (Greenfield 1984, Ch 3.C.2). For the Core-forming Project we chose an approach somewhere between these two: it was decided that I would learn the techniques in context, as a series of linked processes. This would encourage a growing experience of work steps from the outset. Therefore my aim was to complete an entire vessel from the very first work session. I did not repeatedly cover cores and then move onto learning how to make decorative trails, as would happen with an atomised approach. It also meant that Mark Taylor occasionally intervened, taking the vessel over to help finish a process (figure 4.9). But he did not intervene as a matter of course, in true ‘scaffolding’ style, as the Mexican weaving teachers did, by taking the vessel and working it himself in order to produce an acceptable, saleable artefact. We also stepped outside the process in order to practise the making of handles, the gathering, trailing and casting off of body glass, and the application of trailed rims. In addition some sequences were built up gradually, for example moving in several stages from making an integral rim to applying one unaided at the gathering furnace.

The role of Mark Taylor as maker cannot be underestimated. Although it was obviously indispensable that he should watch me making vessels and correct me (figures 4.10 and 11), it was also vital that I watch him making vessels in order to learn the gestures (figures 4.12, 13 and 14). Each of the vessels he made during the project was subject to the same close observation given to the author’s filmed vessel-making activity and analysed in the same way (see Documenting, below).

It is important to note how different the ‘apprenticeship’ context is from the ‘experiment’ context. An experiment would have placed me merely in the position of researcher. I would have paid Mark Taylor to run the project; I may have started making vessels; faced with the intractable heat, the stiff glass, and the unfamiliar tools I would have swiftly given up vessel making. What would have been the point in continuing? My lowly efforts could not possibly help to answer any research questions. Although I wanted to know about learning, my efforts were ridiculous. It would take me forever to make an acceptable vessel. Far better to style Mark Taylor as the ‘learning maker’ – which indeed he was – and monitor his impressively increasing expertise. I would have asked Mark Taylor how he felt his skills were developing, what challenges the materials

presented, how he adapted the tool set, et cetera. As an apprentice, however, I was not allowed to give up. I was engaged wholly with the experience of being faced with these impossible obstacles – blast of heat, stubborn glass, strange tools – while trying to achieve the vaguest semblance of Mark Taylor’s consistency in execution. Furthermore, I was obliged to continue undergoing this experience. Only then would I realise how unlikely it was, had I not been an apprentice, that I would have been able to understand the relationship of kinaesthesia to the dimension of value in craft learning (see Chapter Six).

The Project was carried out in two phases of 20 working days each. Phase 1, which took place over five weeks in the autumn of 2008, was followed eventually by Phase 2, five weeks in the spring of 2009. The timing and length of these phases were determined primarily by funding, research deadlines, and the work obligations of my collaborators.

## **2. Documenting the Core-forming Project**

The original aim was to record all workshop activities using two video cameras running simultaneously, one in long shot and one in close-up. This was to capture the overall body posture of the worker as well as the detailed hand movements. However the use of two furnaces (Section D below) required us to move back and forth across the workshop (figures 4.15a, b and c). A strategy was developed whereby one camera was elevated and trained on the seated worker from above to capture gestures, while the second could be swung from a long shot of the seated worker’s posture to a medium close-up shot of the same worker when s/he moved to stand and work at the other of the two furnaces (figures 4.16a and b). The video was designed to capture gesture-tool-material as well as work steps experience. Photography was included in order to capture not only the gesture-tool-material synergy but also our increasing experience in tools, materials and artefacts (e.g. figure 4.17).

With the stills and video data I could use the model to construct a written notation of craft gestures as they developed in synergy with tools (figure 4.18). This information could then be united with the particular artefact created by the gestures. Artefact features and a ‘broad-brush’ description of their making would be described in a daily summary,

developed from the field diary and the visual data, to log all workshop activities by day (figure 4.19). These recording media were designed to build up a detailed picture of the process of becoming dexterous which included changes in my gestures in concert with changing tools and materials and my increasing experience of tools, materials, work steps and artefacts (figure 4.20). The resulting analysis of my experience and Mark Taylor's experience of becoming dexterous will be detailed in Chapter Five and discussed in Chapter Six.

#### **D. Experimental facilities (see also Appendix 4)**

##### **1. Furnaces and heating**

###### **a. Support heating**

A gas burner was used for heating irons (figure 4.21) and a separate burner for firing cores at between 800°C and 900°C (figure 4.22). We also used a lehr or annealing oven for the controlled cooling of finished vessels.

###### **b. Gathering furnace**

Glass was kept at around 1050°C in the permanent workshop furnace referred to in this text as the gathering furnace (figure 4.23). This was used for gathering melted glass for the vessel bodies, rims and handles. (Decorative glass was not kept in a molten state but softened at the working furnace prior to use.)

###### **c. Working furnace.**

For the vessel making activity itself there was a further gas burner, with a roughly hemispherical cowl on top, referred to in this text as the working furnace (figure 4.24). The cowl was made of a daub mixture, approximately half clay and half straw by volume, which had been developed during Taylor and Hill's 2005-2006 Furnace Project ([www.romanglassmakers.co.uk](http://www.romanglassmakers.co.uk)). Three designs of cowl were used during the project.

**Cowl 1** (figure 4.25) consisted of a dome with a semicircular aperture in the front which was placed on top of the cylindrical burner. The large aperture made it easy to move the vessel quickly into and out of the heat. However the size meant that a lot of heat was directed horizontally, *at* the worker, which inhibited many procedures. Cowl 1 was in use from Day 1 to Day 8.

**Cowl 2** (figure 4.26) had a smaller reheating aperture at the front and an oblong ‘letterbox’ opening at the side, specifically for decorative procedures. Cowl 2 was used from Day 9 to Day 13 of the project.

**Cowl 3** (figure 4.27) was made of the same daub mixture as previous cowls, and in the shape of a dome with the top half removed. A single rounded oblong aperture, long enough to accommodate the tallest alabastron, was made in the top side. The metal rod bearing the vessel rested in a channel made in the rim of the opening. This Cowl was used from Day 14 to the end of the Project on Day 40.

## **2. Other equipment**

Individual pieces of equipment were adopted and discarded as the project continued. The list below therefore contains a number of items that were not simultaneously in use.

### **a. Glass working hand tools:**

large pincers, small tweezers, long tweezers, metal bar for shaping rim, neck and handles (figures 4.28, 4.29, 4.30, 4.31); small bent metal rod and larger bent metal rod for shaping the neck (figures 4.32, 4.33); serrated steak knife and worn serrated grapefruit knife for applying body glass and tooling decorative trails (figure 4.34.); hand-held flat oblong stone block, metal paddle, both for marvering the glass – that is, smoothing the surface by rolling (figures 4.35, 4.36); cleft bamboo (for holding trail rods); gathering irons, for gathering body glass and applying to the core; thin metal spike for tooling handles (figure 4.37); bead mandrel 1, a relatively heavy mandrel, for applying handles (a mandrel being a long narrow cylindrical metal rod with a handle at one end and a point at the other) (figure 4.38); bead mandrel 2, made from a spike mounted on a length of dowelling, with the purpose of gathering finer handle beads (figure 4.39).

### **b. Further tools:**

yoke (figure 4.40, used with Cowls 1 and 3); yoke at gathering furnace (figure 4.41., for holding core rod while glass is applied); free-standing marver (figure 4.42, flat stone block at knee height supported by bricks, for smoothing work); 2 small buckets of water (for wetting marver stone; wetting tools, dunking used gathering irons); stainless steel rods (figure 4.43, for bearing cores and also for bearing cones of decorative glass); plank of wood for forcing a bead onto a mandrel (figure 4.44); small marver (figure

4.45), stone slab for smoothing cores; scalpel blade for cutting in the necks of cores; wooden thigh board – an oblong block of wood tied to the thigh for supporting the core rod while seated and tooling the vessel (figure 4.46); vice for getting annealed (cooled) vessels off rods (figure 4.47); gloves for placing hot vessels in the lehr or annealing oven.

### **3. Materials**

#### **a. Cores**

Cores for core-formed vessels must be robust enough to work but must also crush as the glass contracts during annealing. Otherwise the vessel will crack. This is why plant matter such as grasses, chaff or dung is mixed with the clay; when the organic material burns out it leaves a clay core riddled with interstices. However vessel cracking over Days 1 – 20 was caused primarily by the incompatibility of one of the decorative glasses (Yellow Glass 1) with the two body glasses (Glasses Pichvnari 1 and 2) and reduced markedly when the compositions were modified. The other major cause of cracking was over-firing the core during prolonged working. Nevertheless we initially interpreted cracking as a core mixture problem and over the first 20 days of the project concentrated on varieties of high-organic mixtures in the search for a core that would be robust enough to hold together under heavy marvering during glass-working. Most of these core mixtures flaked at the neck and we began to increase our use of slips and coverings to prevent this.

A second visit to the British Museum between Phases 1 (Days 1 – 20) and 2 (days 20 – 40) confirmed initial observations of the inner surface of the original vessels: a silty terracotta was probably used either for coating or throughout the core. Efforts were made during Phase 2 to modify the composition of the cores accordingly. Vessel cracking was much reduced due to the better compatibility of a reformulated yellow glass (Yellow Glass 2) and such cracking as there was seemed to be related to long working times. It was also clear by the end of the project that cracking was attributable as much to the limited tolerance of the actual glass for extended heat as to the core mixture used.

**Core 1 (Days 2 – 5, figure 4.48):** 1:3 by volume of hydrated ball clay and horse bran. It held together well, was malleable without being sticky, and seemed to bind to the rod easily. Vessels cracked.

**Core 2 (days 6 – 8, figure 4.49):** 1:5 by volume of hydrated ball clay and horse bran. After drying the cores were rough and lumpy because of greater water loss (due to the higher proportion of organic matter in the mixture). Filing simply caused protruding stalks. Sandpapering did not eliminate the lumps.

**Cores 3,4, 5, 6, and 7 (Days 9, 10):**

These mixtures were made to test the limits of core cohesion. Wheat chaff was used for cores 3, 4 and 7; core mixes 5 and 6 were made with the horse bran used in cores 1 and 2, but at different proportions.

The chaff was sieved into coarse chaff - large fragments of stalks and husks – and fine chaff – small fragments including husks, and dust.

**Core 3:** 1:6 by volume of hydrated ball clay and fine chaff. This held together well.

**Core 4:** 1:6 by volume of hydrated ball clay and coarse chaff. The pieces of organic matter were too large, and this mixture could not be brought to form around the rod.

**Core 5:** 1:6 by volume of hydrated ball clay and horse bran. Although this mixture held to the rod it was very fibrous, dry and tough, and impossible to roll, let alone to marver.

**Core 6:** 1:6 by volume of hydrated ball clay and horse bran as above, with additional water added until it was coherent. This held together better than Core 5, but still could only tolerate light hand rolling as it was quite sticky.

**Core 7:** 1:4 by volume of ball clay and coarse chaff. It did not break up like Core mix 4 because of the lower proportion of organics, and was amenable to marvering.

Cores 3, 6 and 7 (figure 4.50) were chosen for glass working. Two cores of each mix were made and dried out on top of the furnace for two days. Then they were burned out for 1 ½ hours at 800 - 900°C.

All these mixtures survived one day of use although they flaked at the neck. However on the second day of use Core 3 fell off the rod at the beginning of glass working. Core 6 started to turn on the rod while glass working was in progress. It too was abandoned. Core 7 reached completion but had begun to disintegrate. It was clear that once they had lost their initial moisture over a period of a day or so these cores were unsuitable for glass working.

**Core 8:** 1:5 by volume of hydrated clay and unsieved chaff (i.e. containing both coarse and fine fragments). This mixture needed water to bind and still was not coherent enough and dried to leave an uneven shape which could not tolerate filing. Core 8 was not used.

**Core 9a (Days 11, 12):** 1:6 by volume of hydrated ball clay and new chaff, this one containing a far lower proportion of coarse stalks and a higher proportion of husks. It was softer to the touch and more coherent even before mixing with clay. The first cores were made without an inner layer and began to disintegrate during glass working, but not to the extent of Cores 3, 6 and 7.

**Core 9b (Days 13 – 17):** the same mixture as Core 9a but with an inner layer and a variety of outer coatings designed to prevent flaking. Core 9b withstood heavy marvering while glass working but still flaked a little at the neck.

**Core 10 (Days 18-20, 21, figure 4.51.)**

**Core 10a:** dry (powdered) ball clay and horse dung. This new organic material was chosen as the different texture might reduce vessel cracking.

**Core 10b:** as 10a, made with dung squeezed of excess moisture and dried briefly in front of the furnace. Only one third of the amount of powdered clay was needed in order to achieve the same dough-like consistency of the cores made with wet dung. Both sets of cores, high clay and low clay, were dried on the furnace and filed.

#### **Coatings for Cores 10a and 10b:**

i) powdered clay (not fired core material as we had tried with Core 9). A thick layer of powdered clay coating was, like the crushed fired core coating, inimical to being coated with glass. When the clay coating was brushed off leaving only a light dusting, the glass took well.

ii) a clay slip the consistency of thin soup. This was successful when the core had been slipped while still damp. When the slip was applied to a dried core the slip peeled off while glass working, taking the glass layer with it.

**Core 11 (Days 22, 23, figure 4.52):** 40:60 hydrated ball clay and medium (neither coarse nor fine) chaff. This high-clay core was trialled with the new more successfully compatible glasses. Vessel cracking was much reduced and from now on seemed only to happen when the vessel was worked too long. A second batch of Core 11 was coated with a slip of terracotta mixed with fine sand.

**Core 12 (Days 24, 25):** 1:4 hydrated ball clay and medium chaff. This core was coated with a slip of terracotta, molochite and fine sand.

**Core 13 (Days 26, 27):** 1:5 hydrated ball clay and chaff, coated in a slip of terracotta and molochite. One of four vessels cracked. Again, cores took a long time to cover.

**Core 14 (Day 28):** 2:2:5 molochite terracotta, and medium chaff. This core was designed to introduce a silty element into the core body. It was also the first terracotta-based core. Although the non-organic component was quite high the vessels did not crack; the single core used was also covered quickly.

**Core 15 (Days 29 – 40, figure 4.53):** 1 : 3 : 12 molochite, terracotta and medium chaff. This higher-organic core was used until the end of the project.

#### **b. Glasses (see Appendix 3)**

The relevant glass composition analyses were taken from fragments of Mediterranean Group I vessels from the Greek site of site of Pichvnari on the east coast of the Black Sea in contemporary Georgia (Shortland and Schroeder 2009). Mark Taylor developed a recipe from the analyses, which was a soda-lime glass distinguished by levels of calcium and aluminium oxides slightly higher, and sodium levels slightly lower, than those found in a typical Roman colourless glass (table 4.1 below).

##### **i. Body glasses**

Five separate body glasses were used during the project;

**Body Glass 1:** Pichvnari Cobalt 1 (Appendix 3-1).

**Body Glass 2:** an extraneous glass for experimental purposes. A soda lime glass, similar to Roman glass except that lithium oxide and boric oxide replaced a small proportion of the sodium oxide in order to further lower the working temperature of the glass.

**Body Glass 3:** – Pichvnari Cobalt 2. As Pichvnari Cobalt 1 except that the sodium oxide level was raised by approximately 1% while the calcium and aluminium oxide levels were reduced by approximately 1% and 1.2% (Appendix 3-2).

**Body Glass 4:** Pichvnari Cobalt 3 (Appendix 3-3). Like Pichvnari Cobalt 2, with higher sodium and also altered for compatibility with **Yellow Glass 2** (Appendix 3-6).

**Body Glass 5:** Pichvnari Glass 3 but with copper instead of cobalt.



	<b>Pichvnari Cobalt 1</b>	<b>standardised Roman colourless glass</b>
<b>CaO</b>	<b>8%</b>	<b>7%</b>
<b>Na<sub>2</sub>O</b>	<b>16%</b>	<b>17-18%</b>
<b>Al<sub>2</sub>O<sub>3</sub></b>	<b>2.73%</b>	<b>1.5-2%</b>

Table 4.1. Body Glass 1 compared with a standardised Roman colourless glass

Body Glass 1 is compared in the table above to a standardised Roman glass. As with most Roman glass, the sodium probably came from natron and not halophytic plant material (Shortland and Schroeder 2009). The important differences are the elevated levels of calcium and aluminium oxides (up by approximately 1%) and the lower level of sodium oxide (down by 1 to 2%) (Appendix 3-1). The glass was melted at 1150°C for four hours, and then at 1070°C for 18 hours. At this point it was put into cold water and broken up. It was then reheated at 1150°C for a further four hours and then kept overnight at 1070°C before using. This was the preparation procedure for all the body glasses. It ensured a homogenous glass batch with consistent properties.

## ii. Decorative Glasses

Two opaque glasses were used for decoration:

**Turquoise Glass:** Pichvnari Opaque Turquoise (Appendix 3-4).

**Yellow Glasses 1 and 2:** Pichvnari Opaque Yellow 1 and 2 (Appendices 3-5 and 3-6). Yellow Glass 2 was adjusted for compatibility with Body Glass 4 by increasing the content of lead and antimony. Both these glasses, along with Turquoise 1, were adopted from the beginning of Phase 2 of the project.

## iii. Behaviour of the Glasses

We used Body Glass 1 for the first 13 days of the project. Heating this glass thoroughly at a temperature of 800-850°C still only left the glass mobile enough to be worked for a matter of five seconds before it had to be returned to the furnace to be heated again. This made working times longer than expected.

Body Glass 2, used on days 14 and 15, was an extraneous standardised soda-lime glass used experimentally to see if our first third core covering technique performed better. Although more mobile it made little difference to core covering times.

Body Glass 3, the second Pichvnari Cobalt recipe, was used from Day 16 to Day 20. The slight adjustments to the composition made this Glass much more workable than Body Glass 1.

Body Glass 4, the third Pichvnari recipe, was used from Days 21 to 33 and 38 to 40. Before the beginning of Phase 2 it was confirmed that the sodium level in Pichvnari Glass 1 was extremely likely to have been lowered by sodium depletion during the original glass-working stage by as much as 1.0% (Ian Freestone, pers. comm.) and that we had been justified in raising it.

Body Glass 5, the copper glass, was in use from Day 34 to Day 37. Some vessels in Class IB are made not with cobalt but with copper glass. This glass was used to see if any of our techniques produced markedly different features with a more mobile glass.

## **E. Procedures and techniques**

I made eighty-six vessels, just over forty in each phase of the Project. Mark Taylor made twenty, fifteen in Phase 1 (Days 1 – 20) and only five in Phase 2 (when he was not so heavily involved in daily activities.) As mentioned in Chapter Three, the great majority of the vessels were made according to the body shape and decorative style of Class IB (figure 4.54). This was in the interests of getting as much consistency as possible in gestures and consequent vessel features; faced with such challenging, and changing, materials and techniques, I had to maintain continuity in artefact type if I was to acquire any skill at all.

### **1. Vessel-making terminology**

The following hierarchy of terms will be used to discuss the work steps of core-formed vessel making.

- **Procedure:** each of the major stages of core-formed vessel making: 1. Core making; 2. Core covering and body shaping; 3. Decorative trailing (adding

threads of coloured glass); 4. Trail tooling (making the trails into patterns); 5. Neck shaping; 6. Rim making; 7. Handle making.

- **Technique:** the specific way in which the procedure is carried out. Pulling the glass up the core with a blade is one core covering technique; trailing on the body glass from a gathering iron is another technique for the same procedure.
- **Operation:** each of the small steps involved in executing a particular Technique. Gathering, reheating and pulling the glass layer with the knife blade are all operations performed when executing Core Covering Technique 1. The first two of these operations are also performed during Core Covering Technique 2 – trailing the body glass onto the core.
- **Gesture:** each of the physical movements or actions which, in synergy with tools and materials, together make up an operation.

## 2. Vessel description and proposed order of procedures

### a. Class IB vessels

We chose to make vessels according to the Class IB design (figures 2.13 and 2.22, left). This was one of the most interesting Classes, useful for the Project because of its popularity and because of the wide variety of consistency displayed within it. The main body of a Class IB vessel from the neck to a point about two-thirds of the way down the vessel is decorated with approximately 10 to 16 turns of opaque yellow trail (covering the shoulders and middle of the vessel) and between three and eight turns of opaque turquoise trail (covering the middle of the vessel only). The trails between the handles and the point two-thirds down the body are tooled into rows of tight shallow zigzags. These trails are flattened by rolling the vessel on a stone slab. In addition the rim is decorated with a trail (usually yellow, occasionally turquoise) and a further trail (referred to here as the ‘base trail’) wraps between one and three times around the vessel at a point about three quarters of the way down the body, below the central panel of decoration. The base trail is not spirally-wound but overlapping. Sometimes two separate base trails, one yellow, the other turquoise, adorn this part of the vessel. The base trail can be marvered (rolled on a slab) or not – sometimes proud of the vessel only to touch and not to the naked eye.

### **b. Proposed order of procedures**

It was proposed that the alabastron core is covered with glass before being decorated; then the neck shaped, the rim applied, and the handles added. This order was drawn from artefact appraisal: clearly the body glass is applied before the decoration, which runs beneath the handles. Unmelted spiral grooves in the rim, and similar grooves in the handles, show that these were applied late. Handles were probably applied last; they could otherwise be damaged during rim shaping and reheating or, as relatively thin extrusions, over-cool and snap off.

### **3. Procedures**

#### **Procedure 1. Core making (figure 4.55)**

A core is formed out of clay and organic material upon a metal rod (figure 4. 34). The core is dried and then fired. (Section D above). Favourable changes in the consistency of cores were produced by increased skill rather than changes in technique. The cores were dried over the gathering furnace and then fired, initially for 5 minutes and then, when gas bubbles and black inner material showed that they were under-fired, for half an hour at 800°C.

#### **Procedure 2. Core covering and body shaping (figure 4.56)**

The core is covered with body glass and marvered (smoothed).

Core Covering Technique 1 involved tugging a single gather of glass up the core with a knife blade. Technique 2, trailing a single spiral of glass onto the core from a gathering iron, failed to cover the core properly. Technique 3, in use from Day 12 to 20, consisted of trailing three or more thick rings of glass onto the core at shoulder, middle and base and marvering and tugging them with a blade until they joined. Technique 4 involved trailing on three rings and then letting them melt down until they joined and covered the vessel. Excess glass was removed by repeatedly casting off at the base. Technique 5 involved trailing two or more spiral gathers onto the core and initially melting them down (Days 24 to 27) before switching to marvering them (Days 28 to 40).

**Procedure 3. Decorative trailing (figure 4.57)**

Opaque yellow and turquoise glass is melted and applied to the revolving vessel so that the glass winds in thin trails round the body (figure 4.36).

In Class IB the main panel of body trails are then marvered (rolled to smoothness on a stone slab or marver). A further trail, unmarvered, is added to the edge of the rim, and a final trail is wound around the vessel near the base. This base trail is sometimes only lightly marvered. It was established that the vessel was wound clockwise viewed from the top – and that the yellow trail was probably applied before the turquoise. Glass rod trailing was used in Phase 1 (Days 1 – 20) and cone trailing in Phase 2 (Days 20 – 40).

**Procedure 4. Trail tooling (figure 4.58).**

Using upward and downward strokes of a sharp implement, the lower part of the main panel of body trails is pulled into rows of tight and shallow zigzags, which are then marvered (figure 4.37).

**Procedure 5. Neck shaping (figure 4.59)**

The neck and shoulders of the vessel are shaped so that they make a defined and symmetrical profile (figure 4.38). The neck is also shaped at points earlier and later in the sequence of work steps.

**Procedure 6. Rim making (figures 4.60 and 61)**

A gather of body glass is trailed onto the revolving neck of the vessel for one to two turns (figure 4.39) The rim is then flattened and further shaped with a pinching tool before being decorated with a trail.

**Procedure 7. Handle making (figures 4.62 and 63).**

Using a mandrel, a bead of body glass (rarely, opaque decorative glass) is applied to a point beneath the vessel shoulder and drawn upwards (figure 4.40). The bead mandrel is withdrawn, forming the handle loop-hole. The middle and tip of the handle are then shaped.

#### **4. Other activities**

Other activities included preparing core mixtures, making translucent cobalt and copper glass and yellow and turquoise opaque glass (done by Mark Taylor) (figure 4.64); cleaning metal rods and gathering irons; detaching vessels from their rods after annealing and assessing them; making new cowls for the working furnace (Mark Taylor, see below) and recording the Project (this author, with assistance from David Hill and Mark Taylor). Contrary to Mark Taylor's suggestions I did not scrape the core material thoroughly from each vessel as we proceeded. This was due to time constraints. But it was noted that scraping out was a lengthy and essential part of vessel making which would have formed a large part of the daily experience of making for some craft workers.

#### **F. Conclusion**

- How can skilled making be conceptualised?

Skilled making, or the process of becoming dexterous, can be conceptualised in a kinaesthetic model using the following terms of analysis: experience (of materials, tools, artefacts and work steps), sensory activities (of listening, watching and feeling), and a 'bundled' gesture-tool-material complex (figure 4.3). This model was created in order to set up, undertake and document an apprenticeship in core-forming. It was noted that applying theory to practice in this way is not inevitably successful and so the model would actually be 'tested' during the practical project. Working routine, learning-teaching style and recording facilities were designed in a way which would best allow the process of becoming dexterous to develop and be documented. The final section of this chapter presented information on tools, materials, vessel-making terminology and procedures.

## **Chapter Five. The Core-forming Project: the Experience of Becoming Dexterous**

### **A. Introduction**

The first part of this thesis problematised a large group of archaeological artefacts in terms of skill (Chapter Two). This involved an enquiry into skilled making; what skill is, and how people become skilled in craft. A variety of approaches to skill were reviewed and it became apparent that cognition was generally privileged over movement as an analytical framework (Chapter Three). An alternative framework was then proposed, one which used the concept of dexterity, and specifically the experience of becoming dexterous, as a primary term of analysis (Chapters Three and Four). A practical project design, centred on an apprenticeship in the skilled making of core-formed vessels, was then presented (also Chapter Four). Chapter Five will address the next of the research questions outlined in Chapter One:

- When a theoretical model of the process of becoming dexterous is applied to a practical craft project, what do we learn about skilled making?

This chapter will provide an account of how the theoretical model worked with the practical Project. In Section B, which forms the bulk of this chapter, I will describe how our skills – mine, and those of my expert collaborator Mark Taylor – developed within each of the seven main procedures of core-formed vessel making in the Class IB design (see Chapter Four for a description and figures 2.13 and 2.22). I will systematically examine our progress within each procedure in terms of our growing experience of tools, materials, artefact features and work steps; of our developing skills of watching, listening and feeling; and in the generation of our gestures in synergy with tools and materials. These terms were introduced in Chapter Four, along with those terms for describing skilful making which will also be employed here: ‘procedure’, which denotes each of the major stages of making a core-formed vessel; ‘technique’, which is the specific way in which the procedure is carried out; ‘operation’, which is one of the work steps involved in performing a technique; and ‘gesture’ which, bundled with ‘tool’ and ‘material’, is one

of the series of actual physical movements constituting the operation. At this point the model will be evaluated (Section C). Conclusions will be drawn in Section D.

## **B. Becoming Dexterous in The Procedures of Making Core-Formed Alabastra**

Mark Taylor will be referred to as MT.

Vessels by Frances Liardet will be referred to as FL1, FL2 etc., and vessels by Mark Taylor as MT1, etc.

The chronology of vessels produced, core mixes, glasses, furnace cowls and main techniques is set out in Appendix 4.

All vessels made during the Core-forming Project can be seen in Appendix 5 (vessels by Frances Liardet) and Appendix 6 (vessels by Mark Taylor).

As well as figures, Chapter Five refers to a series of video clips which can be found on the accompanying CD.

The verb ‘to marver’ means ‘to roll on a marver (a stone slab)’. It is applied to cores and to glass vessels.

The Project took place in two separate episodes referred to as Phase 1 (Days 1-20) and Phase 2 (Days 21-40). Between the phases Mark Taylor and I re-visited the British Museum.

### **1. Core making**

The procedure of core making consists of moulding a mixture of clay and organic material to a metal rod to form the inner shape of the vessel. The organic material is necessary to produce a crushable core which will not crack the glass as it contracts upon cooling (Ch 4.C.3a). Core making involves experience of the correct proportions of the core materials – the clay and the organic components; of their binding properties to metal, and of their coherence when manipulated by hand or rolled on a slab.

In 2004, during the experimental session conducted for Paul Nicholson MT produced a variety of core shapes including a cylindrical perfume phial (figure 5.1.0). In March 2008, when working with Emily Coulson, MT focused more on the alabastron shape and produced cores by marvering from the side of the body to the base in one



smooth movement. This gesture produces an unbroken curve around the bottom of the vessel. The rolling of the core by pushing the rod back and forth with the flat of the palm is one of many rotating gestures used during the Project and is now an essential part of the glassblower's repertoire.

At the start of the Core-Forming Project in October 2008 MT did not change the basic technique from the one he used in March 2008. It involved hand-shaping and then marvering a mixture of clay and organic material on a metal rod to produce a core with a long neck designed to prevent glass from the neck and rim adhering to the hot metal. If this happened the vessel would stick so firmly to the rod that it could only be removed by breaking it. MT added the scalpel to the core-forming tool set at this point because of a change in materials – the creation of Core Mix 1 (1:3 hydrated ball clay and horse bran: Ch 4.C.3a. and figure 4.28)

The first core making operation was to mix clay and organic material to the required proportions (figure 5.1.1). We used large buckets and measured in equivalent volumes, stirring the mixture of clay and bran vigorously by hand and then kneading it equally vigorously, adding water, to the consistency of bread dough. We then had to judge the amount of core mixture for the inner layer, roll it into a ball in the hand, and stick the ball onto the end of the rod. By working the mixture up the rod by squeezing the palm and fingers around the rod MT was able to form a uniformly thin layer on the rod of about 12cm in length; marvering the inner layer (figure 5.1.2). The more organics in the core mixture, the more delicate and cautious are the squeezing gestures. Making the outer core once again involved judging the amount of core mixture for the outer core, rolling it into a ball in the hand, and sticking the ball onto the end of the inner layer-covered rod (figure 5.1.3). The squeezing gestures for shaping the core body are different for those used in making the inner layer; this time the maker cups the palm and smoothes with the fingers (figure 5.1.4). After measuring the result and adding or taking away material the core can be marvered, or rolled, on the small marver or slab (figures 4.45 and 5.1.5). At this point the maker can measure or simply judge the width of the core at base-trail and at handle height to check if the proportions of the body are correct before marvering from body to base in one unbroken movement to make a smooth curve from sides towards the base. Then it is necessary to hand-shape the base to achieve the correct slightly blunt

profile at the bottom. The neck requires shaping either on the edge of the marver or with a tool (figure 5.1.6 shows MT using a scalpel blade) before drying the core on top of the furnace. On the following day the cores can be fired in the gas burner until all the organic material is burned out – approximately 30 minutes at 800°C (figure 5.1.7).

When I began making cores I lacked any materials experience and responded to the lumpiness of the core mixture by applying pressure when rolling the rod on the slab. The harder one presses, however, the less likely it is that one will press evenly on all points of the core circumference. I quickly found that I had a faceted core and one which was not centred on the rod. However pushing hard on the thicker side, as MT advised me to do, only increased the facet problem because I was unable to alter the pressure of my rolling at the right moment. MT cut in the necks of his cores with the scalpel blade (figure 5.1.8) but I cut too deeply, taking off the inner layer and exposing the metal rod. This was because the core material, bound as it was with fibrous stalks of plant material, pulled away unpredictably in large irregular fragments unless one worked extremely delicately. As a bare neck rendered the core unusable (hot glass sticks irretrievably to hot metal) I switched to shaping the necks on the curved edge of the small marver. Figure 5.1.9 shows the resulting sloping necks. The uneven profiles can also be seen, as well as my lack of control over the core size; I was not yet able to judge the right amount of material in my hand. This tussle between inexpert gestures and unfamiliar materials continued as I moved on to hand shaping (figure 5.1.10). and then to pre-forming the core before sticking it on to the rod. By Day 7 I had also tried filing the cores into shape (Figure 5.1.11) – this a response to increasing the organic material in the core, itself a response to vessel cracking – and dispensing with the inner layer because Core Mix 2 seemed to stick better to the rod. When marvering I placed my hand far down on the rod so that maximum pressure was exerted on the neck of the core. I also bore down so heavily that the core came away from the rod and threatened to roll off, leading me to push and squeeze at the core between marvers. I also stood upright at the bench with the cores at elbow height at least 45cm below my eye-line so that I was looking down at my work from a distance (clip 5.1.1). My pre-formed cores rolled off the rod entirely (figures 5.1.12, 5.1.13 and 5.1.14). The dried cores were now slightly less lumpy but still asymmetrical at the neck and shoulder and variable in size (figure 5.1.15). I realised that

the only way to get uniformly sized cores was to repeat the operation until I could feel the right amount of clay in the cupped palm of my hand.

We responded to continued vessel cracking by increasing the amount of organic material in the cores (figure 4.30). Because of this I finally stopped bearing down on the metal rod while rolling, and adopted a more patient dabbing motion when applying the mixture to the rod and particularly when working on the neck. I tried to adopt the gestures MT used in shaping which involved moving the fingers independently in such a way as to allow for, and help to form, a core shape which was thicker at one end than at the other (clip 5.1.2). However I was still neither patient nor dexterous enough to coax a thin coating of core mixture onto the metal rod and so started to omit making an inner layer. However when we switched to Core Covering Technique 2, involving the gesture of heavy and repeated marvering of the vessel (rolling it on a slab) to spread the glass over the core, our current cores (Core 9a) disintegrated and flaked off at the neck. In response MT refined the core-making technique, not only by re-introducing the inner layer but by covering the cores with a variety of slips to prevent flaking. Figure 5.1.18 shows two inner layers made by MT (dried) and four slightly more bulky and uneven examples made by myself.

As the vessels were still cracking we considered that our *core* rolling might be causing the mixture to pack into layers, thereby reducing the core's capacity to crush beneath the contracting glass. Instead we tried light rolling and hand shaping (clip 5.1.3) and MT finished some of the cores with a trowel (figure 5.1.20). We also introduced a new organic material - horse dung. The grass and chopped hay content gave a felted texture to the cores unlike the more 'stalky' bran and chaff (figure 5.1.19). We hoped that these new shaping operations and material would produce a random interlacing pattern of tiny fibres which, when burned away, would make for a crushable core. By this time, as clip 5.1.3 shows, I had changed my core-making posture from standing at a workbench to kneeling on the floor which enabled me to get much closer to the work, necessary to coax small fragments of fibrous clay onto a smooth metal rod.

Despite the presence of a photograph in the workshop showing a 'desirable' vessel (TMA 76, figures 2.12, 2.13, 5.3.0-2 and Appendix One, 1-19), I was still having problems, while I was actually working, remembering what the vessel was like – not

simply what it looked like, but how big it was and how those dimensions would feel in my hand. I concluded that this most important aspect of artefact experience could only be gained by handling the objects *as a maker* and translating their dimensions into the right-sized lumps of clay for cores. This supports Wallaert-Petre's (2001) observation that no-one except potters in the communities she surveyed could estimate the volume of a ball of clay needed for a pot of a certain size (Ch 3.D.3).

Our second visit to the British Museum, which took place between Phases 1 and 2 of the Project, showed me just how bulky and squat my vessels were beside the originals with their narrow and clearly-defined shoulders and necks. We became particularly interested in the shape of a group of vessels which includes those shown in figure 5.1.24: alabastra of about 10cm in height where the sides tapered markedly towards narrow shoulders. The width of these vessels was around 2.5cm at the top of the handles, which were placed relatively low on the shoulder area. Because this series displayed a high level of consistency both internally and across the range we selected one as our new 'desirable' vessel. We also planned to reproduce the sandy-brown colour and the fine gritty feel of core material adhering to the insides of some original vessel fragments (figure 5.1.25) . We thought that a silty clay might be involved at least in the outer coating if not throughout the body of the core. By this stage our materials experience had markedly increased as we became aware of the compatibility problems of Yellow Glass 1 and its role in vessel cracking (Ch 4.C. 3b). We realised that core composition was not the key factor in vessel cracking and this encouraged us to make another materials change: to raise the clay content of the mixture to produce a more robust core which was less prone to flaking. .

My relative lack of dexterity in deploying the scalpel led to a useful addition to the tool set – a nail file. This blade could be used either flat or edge-on as a pressing or a cutting-in tool, and because it was blunter than the scalpel was less liable to slice down to the metal rod when neck shaping. Unlike a scalpel blade, the file's blunt edge could also be used for making slightly curved neck profiles as well as angular ones.

I had to then alter my gestures and become even more sparing when taking a lump of core material, readjusting my perception of the correct size and weight of the core according to what I had seen, weighed and felt of the new 'desirable' alabastra. I also

practised a new fan-like rolling to produce the correct highly-tapered body, but was still using the rounded edge of the core-making marver to shape the neck (figures 5.1.26, 5.1.27 and 5.1.28). MT advised me to use the other, sharp edge of the marver instead and then the flat side of the nail file. This would make the correct angular neck-shoulder profile. At first, when making this new smaller size, my core diameters were too small, with the result that my first vessels in Phase 2 were overly thin (Appendix 5-11, FL 45 to 48: the first vessel, FL 44, was made with a comparatively squat core kept from Phase 1).

We now worked on introducing the core colour and texture attributes we had noticed on some of the fragmented British Museum vessels (figure 5.1.25). MT first coated two cores with a terracotta slip mixed with fine sand but we found this a little to gritty and made a slip of terracotta and molochite (calcined china clay) blended with fine sand which gave a silty feel more like the texture of the British Museum vessel interiors. Eventually we felt it was time to introduce terracotta and molochite into the core body itself (Cores 14 and 15). The more coherent mixture meant that instead of using the flat of the small file to shape the neck as we had done before we were now able to cut away at the neck with the side of the small file blade to get a clean jutting shoulder (clip 5.1.4). The cut reached the inner layer so it was essential for this to be homogenous and coherent and as a precaution we also started to dry the inner layer to leather hardness on the furnace door and briefly moisten it again before moulding on the body material. At this point we were satisfied with the composition and behaviour of our cores.

By the end of the Project I felt that I was dexterous in light pushing, dabbing and swift rolling to make the inner layer; that I was confident in moving from one work step to the next including the interim drying and re-wetting of the inner layer mentioned above; that I could use careful, light hand shaping and light, fan-shaped marvering to produce a smooth-sided symmetrical core (clip 5.1.5). I could also marver smoothly from the side of the body to the base to make an unbroken curve. When it came to neck shaping, I certainly had better control over cutting in with a blade, but I was helped in this by the substitution of a blunt for a sharp blade and for the addition of a robust leather-hard inner layer. This meant that I did not pursue the original 'gesture path' of cutting into a single layer of very fibrous core mixture to the right depth with a cutting blade.

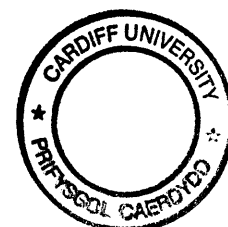
## 2. Core covering and body shaping

Core covering is the procedure of covering the core with glass to make all of the vessel body except the rim and handles.

In 2004 during his experimental session with Paul Nicholson MT used what is referred to in Chapter Four as 'Core Covering Technique 0': trailing body glass in a series of spiral trails onto the core, marvering each one smooth before taking the next gather. (figure 5.2.0). During this 2004 experimental session in the reproduction of Egyptian forms of core-formed MT trailed the body glass onto the core over a simple burner which had an aperture formed of refractory bricks. MT had experience of making an Egyptian alabastron form and the first three operations, and sets of gestures, were familiar to him. However marvering a core, as opposed to a blown vessel, was not an everyday operation.

MT felt that trailing on the body glass was extremely slow. This led him to develop Core Covering Technique 1: gathering glass directly onto the core and pulling it in an even layer up the core with the blade of a knife (figures 5.2.2-4). MT first used Technique 1 during the experimental session he conducted with Emily Coulson, a glass-working student from Sunderland University, in March 2008.

MT was not trying to reconstruct vessels of a particular period and he already had good experience of the materials – a familiar core mixture (Core 0, Ch 4.C.3a); and Glasma, a modern glass widely used in studio glass working. He had less experience of the tools necessary: although gathering iron and marver were familiar the new technique entailed the introduction of two blades – the steak knife and the grapefruit knife (figure 4.14). The major new tool was the daub dome of Cowl 1 with its large horizontally facing aperture (figure 4.5). As for gestures, both marvering and gathering were familiar but the latter gesture needed to be adapted to gather onto the core itself: with the gathering iron held at a high angle in order to achieve a gather of uniform thickness all the way round and a level leading edge perpendicular to the core. The knife blade gestures however arose out of those specific circumstances and developed in synergy with those particular bending blades (figure 5.2.4) and – extremely importantly – with the modern glass. Along with those gestures MT and Emily Coulson developed the skill of watching the glass layer for developing thin patches.



Both MT and Emily found that their cores produced a few gas bubbles in the glass due to unburned organics but they patched them fairly easily and MT resolved to increase the firing time for future core-making. He showed Emily how to cover the core using the grapefruit knife held almost parallel with the core so that the back edge of the blade pushed not down towards the body of the core but along, towards the neck. When MT later held the blade perpendicular to the core so that the edge pointed downward he noted that the glass layer of his vessel was remarkably thin in places and decided that the parallel position was better. Although the aperture of Cowl 1 was very hot the mobile modern glass allowed them to reheat briefly and then lean away to work the glass. Because the glass was colourless they could also judge the thickness of the wall. MT taught Emily to use the far edge of the marver to level off the top of the neck and to shape the shoulder by rolling it at an angle along the near edge of the marver.

Emily was new to core-formed vessel-making and an inexperienced observer both of finished artefacts and forming vessels. The only element already familiar to her was that of gathering; even then, she was accustomed to gathering directly onto an iron and not onto a metal rod bearing a core.

Before the core-formed project started MT, David Hill and myself re-examined some vessel fragments at the British Museum. Like those at the Louvre they were heavily corroded due to surface loss in the burial environment and measured under 2mm (figures 5.2.0-1 and 5.2.0-2). However a less heavily corroded vessel (figure 5.2.0-3) shows walls of between 2mm and 3mm. We judged this to be a good thickness.

The Core-Formed Project began with two major additions to MT's experience of materials: the new material of Pichvnari Cobalt Glass 1 (Chapter 4) and the series of high-organic core mixtures which, as time went on, affected our glass working techniques (see also above, procedure 1, Core Making). An additional significant change was that MT was now teaching a learner whose gesture development was absolutely rudimentary.

My initial gathers were guided by MT because I had no sense of the correct angle for the gathering iron or for how much glass to gather. One of my first attempts was so tentative that MT was obliged to take over and produce a gather of the right size and with a level leading edge – both prerequisites for this technique (clip 5.2.1). From this moment onwards rotation was key. We had to subject the glass to continual, lengthy

reheating between each shaping gesture; as it softened inside the furnace the vessel wall would start to sag towards the lower side unless the vessel was continually rotated on the rod. It took a long time for this continual 'twiddling' gesture to become autonomic for me. Like MT, I would come to perform it both with my right hand when reheating the vessel, and with my left hand when my right hand was heating an iron for applying a rim or softening decorative glass for trailing. It took longer for my left hand to do it than my right.

At all times MT leaned over his work so that his sight line was directly above the vessel (figure 5.2.1) but he still found that the opaque, stiff glass made it hard to judge the thickness of the vessel and that it needed far more reheating than the glass he had used in March 2008. Initially he held the blade parallel with the vessel (figure 5.2.2. and clip 5.2.2), but then switched the blade angle to perpendicular (figure 5.2.3), realising that the flexible blade of the grapefruit knife would not dig into the glass. I alternated between the two knives until Day 5 when I continued with the grapefruit knife for FL 8, 9 and 10. By now I appreciated the flexibility of the grapefruit knife. I began with the blade parallel to the core but, especially when using the grapefruit knife, began to hold it perpendicular to the vessel.

The leading edge of my glass layer was still uneven and I thinned the glass by making too few overly strong pulls with the blade (figure 5.2.4) – five per revolution at the beginning of FL 12 on Day 6. After correction I increased the number of pulls to seven or eight but not to MT's twelve or so. The numbers given here do not mean that these gestures were either counted during execution or adhered to as a rule. They are more the numerical expression of a felt gesture sequence which took place in synergy with the rapidly stiffening authentic glass. I held the knife at a 45° angle and pulled at the side of the vessel instead of keeping the blade level and pulling at the top surface of the vessel, directly in my sight line (clip 5.2.4), to keep an even leading edge. Neither was I leaning properly over my work. My poor posture and tool positioning, combined with initial uneven gathers, made thin patches even more likely (figure 5.2.5).

MT also found the rapidly stiffening glass extremely slow to marver smooth. On Day 5 (MT 6) he introduced a metal paddle to the tool set and applied it to the top half of the vessel while rolling it on the marver. This was an attempt to stabilise the neck area



and smooth the glass before it stiffened. On Day 1 I was so slow that the glass had stiffened by the time I finished my first pass over the marver. The following day MT showed me how to marver from the base to the body (clip 5.2.6) to push glass back up the core (clip 5.2.7). I was making as many as five passes over the marver, possibly the first two of which actually moved the glass.

However even with the stiff Glass 1 it took us only 10-20 minutes to cover a core and shape the body of the vessel. Two or three minutes were spent preparing to gather (that is, heating an iron and making sure the heated core was neither too hot nor too cool), gathering, re-seating ourselves at the glass working furnace, and reheating the vessel. Between 7 and 19 minutes were devoted to covering the core to the neck. Even so, by Day 10 neither of us had solved the main problem of Core Covering Technique 1 – an uneven vessel wall. FL 24, my last vessel made with Technique 1 on Day 10, was still very thin at the base.

On Day 11 MT decided to abandon Technique 1 and instead try trailing body glass in spirally over the core. Technique 2 meant gathering onto an iron; this involved an expansion of tool experience on my part as not only did I have to get the glass onto the iron but I also had to judge the right amount of glass (the correct volume looked different on an iron) and learn how to pre-heat and dispose of an iron. We were also marvering more heavily now; this gesture, which had been used only for smoothing the covered vessel body, now became part of the body *covering* operation as it was used aggressively to spread the glass over the core.

We immediately encountered problems. Diagrams of the spiral trailing of body glass onto a core (figure 5.2.6) show the glass winding around the body in an unwaveringly smooth and even trail all down the core. Schematic representations like this are not meant to be taken literally. But only a very mobile glass would stay workable long enough to produce a trail as long as this, and contiguous turns of the thickness shown in these diagrams would result in extremely thick walls. In 2004 MT had trailed modern glass onto a small core in three or four separate gathers, each one marvered before trailing the next.

Glass 1 stiffened so rapidly that neither I nor MT could achieve a thin trail. The glass crawled off the gathering iron in a thickening mass to make three or four or turns of

a ludicrously thick spiral. We immediately gathered again and laid on another spiral trail before reheating thoroughly at the working furnace. The trails were reluctant to flatten so we used a hand-held stone block, wetted, to marver both sides of the vessel at the same time. While the moisture stopped the stone sticking to the glass, it also cooled and immobilised it. We could not close up the trails by marvering alone, so we pulled the glass over the bare patches with the grapefruit knife, thereby adding a gesture from Technique 1, with its tendency to produce thin patches, to Technique 2. Even when I did use the knife blade I could not spread the trails out so that they joined up completely everywhere. Figure 5.2.7. shows some of my eight vessel attempts, all unsatisfactory, made on Day 11. The unfinished walls are unacceptably thick at over 3mm and often 4mm.

It appeared impossible to cover the core on any reasonable timescale using Glass 1 and we now fully understood the importance of an evenly thick glass layer with an even leading edge. Anything else resulted in over-pulling of some areas of glass and ensuing thin patches. We abandoned Technique 2 at the end of Day 11.

On Day 12 we made narrow cylindrical cores on two metal rods and formed beads in much the same way as wound beads are made on a clay-coated mandrel (clip 5.2.8). We marvered the beads and decorated them with a feathered pattern of spiral trails (figure 5.2.8). We used the grapefruit knife to even up the edges of the beads. We wanted to see if this would help us understand the gestures used in trailing larger gathers of glass onto an alabastron core and marvering them while keeping the margins level. The next stage, Core Covering Technique 3, involved trailing body glass not in a spiral but in three rings. This technique was used in conjunction with Glasses 1, 2 and 3 successively and with Core Mixes 9 and 10. MT's first attempt produced an intact vessel (figure 5.2.9) and we noticed immediately that we could see the thickness of the vessel wall during work as each level ring of glass was flattened by marvering.

I found gathering, trailing and marvering comparatively difficult and initially relied more on my initial gesture of pulling with the grapefruit knife to spread the glass across the core. But I gradually began to adopt the stone block for marvering (figure 5.2.10) to help flatten the thick rings of glass which were starting to produce decidedly sturdy vessel walls of 3mm or more. I was also taking much longer to cover the

core: even the relatively mobile Glass 2 did not produce consistently faster work. FL 33 (an admittedly taller alabastron) took me 50 minutes to cover on Day 16. A well-judged gather and a well-positioned trailed ring of glass were the key gestures for this technique. MT (admittedly using smaller cores) managed times of around 25 minutes for the technique using Glass 3. Towards the end of Phase 1 I was starting to trail the body glass for more than one turn, making a form of close-set spiral. I was also dabbing on supplementary glass in the form of thin spiral trails over the sparsely covered areas between rings. By the end of the first phase of the Core-forming Project my vessel walls were still too thick, over 3mm and sometimes 4mm, but I had no idea how to remedy this except by reverting to the unacceptably uneven knife-based Technique 1. My problems moving from Core Covering Technique 1 to Techniques 2 and 3 will be discussed in Chapter Six.

Phase 2 of the Project brought another materials change; Glass 4, the third version of the Pichvnari Glass. The slightly raised sodium content of this glass (to compensate for sodium depletion while glass working: Chapter 4) made it more mobile than Glasses 1 and 2. This glass was in use for most of Phase 2 and allowed us to try Core Covering Technique 4: trailing on between one and three rings of glass and then, instead of marvering, dipping the core deep in the furnace to melt the glass down the body. Letting the glass find its own level in this way might promote more even and thinner vessel walls. New operations included deep dipping of the vessel in the working furnace and the casting off of surplus glass from the base of the vessel. Deep dipping involved a careful slow plunging gesture which, unless the maker wished to stand throughout, entailed becoming experienced in judging where the vessel was in the furnace so that s/he could withdraw it without scraping it against the side of the furnace or the cowl. Casting off involved using the pincers in a new gesture: gripping the flowing mass of surplus glass at the base of the vessel and drawing it off *over* the hot base in such a way that it melted off. As with casting off a trail, it was important to avoid pulling the cast-off glass *out* from the vessel so that it cooled and stiffened before it separated.

The almost vertical position of the vessel deep in the furnace made the neck glass flow down taking flecks of core material with it, which is what happened to FL 44. I still used the knife to help the melting glass on its way, which left thin patches. My base cast-

offs were not always successful; more than once I had to crizzle (break by sudden cooling with drops of water) an offending thread of stiff glass and knock it off with my pincers because I had not yet become dexterous in base casting off. The technique was even slower than Technique 3, despite the fact that Glass 4 was the most workable authentic glass we had used – more mobile than Glass 3 (Chapter 4). I took 1 hour and 6 minutes to cover the core of FL 45 – admittedly starting with one sizeable gather, but this vessel was made on the new more slender and delicate cores of Phase 2 (figure 5.2.11). A higher number of gathers on FL 47 reduced the time to around half an hour. FL 49 and 50 lost integrity because of flaky, uncoated cores; the neck material started to fall away from the metal rod. I used them to practise Technique 4 with three gathers (figure 5.2.12) and noted how the melting glass formed ‘hills and valleys’ as the rings joined up, the remains of which can be seen on FL 50 (figure 5.2.13). The mark on FL 50 was the result of not marvering the base properly after casting off (figure 5.12.14). FL 44, 46, 47 and 48 were broken to check wall thickness and showed progress although not to the original vessel thickness of around 2mm with an absolute maximum of 3mm.

Eventually we returned to spiral trailing for Technique 5, substituting marvering for melting down after a few more days. The spiral trails were laid on in two separate but sometimes consecutive gathers (that is to say, with no marvering operations between them) and as such this technique could be said to resemble MT’s original Technique 0 were it not for the authentic materials which made so many gestures – the quickness with which we had to lay on the relatively thick trails, the energy we had to devote to marvering – different from those performed with the modern glass of the early technique. Figure 5.2.15 shows MT applying the second of two consecutive gathers for Technique 5 but because this method required speed and dexterity (the first gather would crack if too cool) I nearly always reheated and marvered between gathers. The re-incorporation of these two gestures of spiral trailing and marvering, combined with MT’s increased materials experience evident in the new glass, at last began to produce vessels which not only had acceptably thin and even vessel walls but which also could be covered in under half an hour. By Day 28 we were able to start forming a sequence of work steps out of these gestures, confident that they would produce consistent results.

The majority of our gestures came out of our encounter with a material unfamiliar to both of us – the Pichvnari Glasses. We could not accommodate gestures and tools developed with Glasma – pulling and tugging with two blades – to these ancient glasses and instead we drew heavy rotary movements, paddles, water (for wetting the block) and blocks into the tool-gesture-material synergy. However the blades remained in the tool set and we adopted them not only to help us in core covering but also in other procedures (see below and Chapter Six).

### **3. Decorative trailing**

This procedure involves applying decorative spiral trails of opaque coloured glass to the body of the vessel. Most of these decorative spirals in Class IB appeared to run in an anti-clockwise direction when viewed looking down the vessel from the neck (figure 5.3.10). Many of the more consistent vessels have between 13 and 16 spiral revolutions.

The main difference between our two decorative trailing techniques was related to the form of the material. Technique 1 consisted of trailing with glass *rods*. This means that when MT made the opaque coloured glass he used heavy pincers to draw out cylindrical rods, with a thickness of 2-3mm, from the mass of melted glass. (This was so that they produced a trail of the right width without being pulled out so far that it was hard to hold and control them.) The maker heats the end of the rod, touches it onto the vessel at right angles to the vessel, and then turns the vessel-bearing rod continuously over the heat while letting the glass rod travel down the vessel body. In this way the softening glass winds on in a spiral. Technique 2, in use during Phase 2 of the Project, consisted of trailing with glass *cones*. This involved several operations. First MT cooled the decorative glass after making it and broke it into chips. We then heated the chips near the furnace, stuck each one to a metal rod, and softened it directly over the furnace before shaping it into a cone which we could then heat further, touch to the vessel, and draw out into a decorative spiral trail as described above with glass rods. The reason for this change from rods to cones will be explained below.

MT was dexterous in the gestures and experienced in the tools and materials for rod trailing which he used in 2004 during the experimental session conducted with Paul Nicholson. The upward-facing furnace and the modern glasses made it comparatively

easy for him to adopt a familiar rod trailing posture: holding the arms out from the body at an angle of 45° or so, bent at the elbow, almost level with the shoulder in order to keep the vessel perpendicular to the glass trail rod. Here, watching is directed simultaneously at the melting rod and the heating vessel; rod should be hotter than vessel, which should be comparatively cool. Since it is the vessel which ‘pulls’ the rod onto it, the toffee-like surface of an overheated vessel will be tugged away from the core by the cooler and harder rod. Cowl 1, developed prior to the Core-Forming Project in March 2008 when MT worked with Emily Coulson, caused major changes in posture and increases in tool experience. Emily had to learn to hold the vessel in the right place in the aperture and overcome the heat to judge vessel temperature and glass rod consistency. MT also remarked on the unaccustomed heat of Cowl 1, which led to them adopting a cleft bamboo stick to hold the glass rods. The trail design and colour choice were unrelated to those used during the Core-Forming Project.

I had no experience at all of decorative trailing. Initially I found it so hard to make the gesture of touching-on (attaching the softening rod to the vessel body) that once I made contact, somewhere on the vessel, I then forgot which way I should turn. Consequently out of the 10 vessels made over Day 1 to 5 only FL1, FL9 and FL10 have trails running in the preferred anticlockwise direction. Equally the number of turns was beyond my control. MT instructed me in the posture described above, holding my arms in such a way that the metal rod bearing the vessel and the glass trail rod, sometimes fixed into a cleft bamboo stick, intersected at a 90° angle. I first sat leaning forward but found the heat intolerable and the posture unstable. On Day 2 we tried trailing over the vent on top of Cowl 1 but this did not provide enough heat; MT also taught me how to ‘hang’ the melting trail rod onto the vessel and let it wind on unguided by simply rotating the metal rod, but this could only work at the end of the trail when the trail rod was relatively short (figure 5.3.1). ‘Hanging on’ an entire trail rod would mean either losing half of it as it melted off and dropped into the bottom of the furnace, or dragging it slowly in over the cowl aperture where it tended to move uncontrollably sideways (figure 5.3.2).. MT also used a half-kneeling posture on Day 2 (figure 5.3.3) and on Day 3 fixed a yoke to the left side of Cowl 1 so that I could hold the vessel steady. MT supplied a glove for my right, ‘trailing’ hand, but this only reduced what little dexterity I had. I started to make more

radical efforts to evade the heat, squatting to one side and then standing further away and bending forward and also began to use a new tool, the pincers, to guide the rod onto the body (clip 5.3.1). I also began to adopt an upright kneeling posture (figure 5.3.5 and clip 5.3.2.), just to one side of the opening of Cowl 1, mitigating both the heat problem and that of access.

I rapidly gained materials experience. The window of opportunity for touching on and trailing a well-melted but not yet runny glass rod seemed very narrow. Yellow melted fast and seemingly suddenly; turquoise less so, but still quickly enough to make it hard to get a trail of even thickness. The only way to gain this experience was by close and constant watching; the changing colours of yellow to caramel, and turquoise to slightly lighter turquoise, had to be distinguished against the deep orange glow of the furnace. It was also important to relate the intensity of the glow of the furnace and the heat on the face to the time it took for the rod to melt; a lower furnace meant that the maker waited slightly longer to touch the rod to the vessel. FL 4 to FL 8 show the rapid thinning and thickening of trails, FL 4 and FL 6 the contrast between the over-melted and pulled body trail and the uniform thickness of the base trail which, because it only had to travel twice or three times around the base, I could just 'hang on' (Appendix 5-1 to 5-4). But by Day 6 I had some experience of how the work steps proceeded: I was no longer scrabbling for rods at the last minute but bringing them within reach before starting trailing. This meant that I was able to increase from three (FL1) to five (FL 5, 10), to six (FL 12) trail turns of yellow glass trail. FL 11, 12 and 13 (Day 6) all show the beginnings of consistency in trailing on a rod of yellow glass without pulling it. I began to get used to trailing in the 'right' direction as a matter of course.

MT responded to these gesture and posture problems by making Cowl 2. This cowl had a smaller letterbox-shaped aperture at the front, which cut down the amount of heat escaping, and a side aperture dedicated to trailing. I now no longer had to kneel but instead could remain seated and lean slightly to the right towards the side-facing dedicated trail aperture (figure 5.3.7). There was not much leeway when the vessel was held in front of Cowl 2 and I had to take great care not to touch the sides of the opening. Two apertures proved slightly awkward so MT sawed out the pillar separating them (figure 5.3.8). However because the vessel was *inside* Cowl 2 while we were adding

decorative trails the vessel body was hotter than ever and it was harder to soften the glass rods prior to trailing (clip 5.3.3). This made for an overheated vessel and under-heated rods (clip 5.3.4). The vessel could be re-shaped by marvering, however. I was also able now to make 8 trail turns with one yellow rod.

After ten days or so we noticed a feature that made us start trailing in the other direction. We had originally assumed that the wide, thick appearance of the trail at the neck (figure 5.3.9) marked where the stubby beginning of a rod had been laid on. From this we inferred that we should lay on the trail at the neck as opposed to the bottom of the main body trail zone (about two thirds of the way down the body). As mentioned above, bearing in mind that that we needed to trail anti-clockwise viewed from the top (figure 5.3.10), we laid the trail on 'underhand': that is to say, feeding the trail onto the *underside* of the vessel while turning that underside away from us. But we then observed that that the wide, stubby appearance of the trail at the neck on our vessels was caused by shaping the neck with pincers, which tended to smear the trail rod over the neck, transforming its original shape beyond recognition. As this neck tooling gesture reproduced the appearance of the neck trail on the *archaeological* vessels we could no longer be confident that the neck 'stubs' on the archaeological vessels were the beginnings of glass trail rods. Of course this did not mean that the rods were *not* laid on at the neck. Ideally we would have then checked the shape of the trail extremity at the bottom of the panel for comparison. But unfortunately this trail end was impossible to diagnose; it 'wrapped round' itself in such a way that the extremity of the rod was often impossible to make out. When examining the bottom of the body trail zone we could not tell whether we were looking at a trail beginning hidden beneath a succeeding trail, or a trail end marvered into a preceding trail.

Either way we were happy to find a reason to abandon underhand trailing. We disliked being unable to see the trail as it wound on underneath the vessel body and the rapid melting of yellow glass meant that it was easy to pull the trail off by mistake if it was hidden on the underside of the vessel. We now felt justified in laying the trail at the bottom of the body trail zone and winding up to the neck. Because we had to keep to the same trail direction (anticlockwise viewed from the top) this operation allowed us to switch to our preferred 'overhand' trailing: feeding the trail onto the *top side* of the vessel



while winding that top side away from us. I also started to try to run the turquoise trail accurately between the yellow trails. I made 8 (FL 21) and 9 (FL 24) trail turns, proceeding from base to neck overhand (Appendix 5-4 and 5-5). By this point I understood that I needed to tune my gestures and my watching in order to harmonise furnace heat, rod melting times, rod thicknesses (the diameter varied by as much as 3mm), vessel turning speeds and the rate of sideways 'travel' of my glass rod-bearing hand. Only this would give rise to trail turns of consistent width and spacing

At this point we were applying base trails at different points during the sequence of work steps. The FL 21 base trail was applied the earliest, between trailing and trail tooling; FL 24 and 28 after trail tooling. The base trails on FL 21 and 24 are heat-blurred because they were heated inside Cowl 2 while I painstakingly trailed decorative rods onto the rims of these vessels.

Because the vessels were overheating so much during trail decoration MT developed Cowl 3 and brought it into use on Day 13. This caused a favourable posture change. We could sit in front of it with our arms in the horizontal plane (figure 5.3.11) and place the vessel and the glass rod at right angles (figure 5.3.13). We could touch glass rods onto the vessel more accurately (figure 5.3.12) and achieve better trail spacing. I abandoned the cleft bamboo since I could now hold all but the shortest rods in my fingers, and the shortest rods could be guided with the pincers or left to hang on (figure 5.3.14). I generally used 2 yellow rods for the main body trailing, managing 10 and 13 yellow trails on FL 28 and 31 respectively. The base trail on FL 28 is proud even though I tried to marver it because I applied it a) at Cowl 3 and b) later in the sequence of procedures. The same happened with the base trail of vessel 31, which was applied after the rim was completed.

We introduced glass changes at this time (see Appendix 4). The interim Glass 2 interfered with my improved trailing on FL 29 to 32; the decorative glass rods were so much stiffer than the comparatively mobile body glass that they moved across the vessel surface when being tooled, resulting in wavy rather than pointed zigzags. (Appendix 5-8). Glass 3, the second Pichvnari Glass (Appendix 3b) once again changed the relationship between decorative rod and vessel body. Cowl 3 gave me a clear picture of what I was doing wrong: if the rod was too stiff it would wind on very slowly, thereby overheating

the vessel underside, which would then deform under the pulling action of the stiff rod. As I became accustomed to Glass 3 - stiffer than Glass 2, but much more workable than Glass 1 – I discovered the ideal combination of hot (though not entirely melted) trail and warm (and definitely not over-heated) body. Placing the vessel over to the far side of the aperture gave the rod the maximum time to heat up as it travelled over the heat towards the vessel. I was now able to achieve the harmony mentioned above and watch the trail softening while increasing or decreasing the speed of turning the vessel body accordingly. From Days 16 to 20 I felt that I had begun to move solidly from step to step in trailing, achieving a large number of close- set trails of the right width and spacing (clip 5.3.5).

Decorative trailing was to undergo a major change in Phase 2. This was partly the result of our interim visit to the British Museum. We returned there primarily because of our preoccupations with core shape and size. But during our examination we also made a number of extremely important observations about decorative trailing.

When I compared our vessels to the originals I saw that because of their larger size our vessels sported quite thick decorative trails. If we were to make between 13 and 16 turns of yellow trail on a smaller vessel body and preserve the neat spacing displayed by the most consistent originals we would have to reduce the thickness of our trails while at the same time keeping them smooth and unwavering. MT also noticed that the rim and the base trails of certain vessels in Class IF had clearly *not* been trailed on using rods of coloured glass. Figure 5.3.15. shows two colours on the decorative rim trail. This would have been far more likely the result of workers using another decorative trail technique – *cone* trailing: trailing from a small cone formed of softened chips of glass stuck to a metal rod (see above). Workers who picked up chips of turquoise glass with a rod which already had fragments of yellow glass adhering to it would produce this bicoloured trail as they came to the end of the cone of glass. Figure 5.3.16 shows one of the rare instances of handles made of opaque decorative glass. The turquoise streaks in the yellow handle are evidence of the same trail technique, only this time with a cone of yellow glass formed on a metal rod which had previously been used for turquoise cone trailing. It is hard to see how the use of glass rod trailing, where yellow and turquoise glass were drawn into rods and used entirely separately, could give rise to the same effect unless they were purposefully melted together, in which case it would probably be a more

widespread motif. The different melting speeds of yellow and turquoise glass would make this tricky. I had seen this effect on a Class IB vessel in the Toledo Museum of Art (figure 5.3.17) but had not understood it.

MT also pointed out that some vessels in the Class we were studying, Class IB, had rims where the trail had been wrapped on ‘underhand’ – that is to say, turning the underside away from the body so that the trail runs anti-clockwise. The British Museum vessel BM 97 (1864.10-7.1218) displays this underhand trail wind (figure 5.3.18). What testifies to the ‘underhand’ winding is the unmistakable difference between the ‘blob’ as the glass is touched on and the more wispy ‘pull-off’. These two latter examples conventionally show one colour only, making it more difficult to tell if they were applied as rod trails or cone trails, but the touch-on and pull-off on these rims seemed to MT and David Hill to be at least reminiscent of, if not exclusively diagnostic of, cone trailing. But although was difficult to tell from observation alone whether the trails of Class IB vessels had been applied with rods or softened cones, another factor made this overwhelmingly likely: the development of our new Yellow Glass 2.

Glass *rods* are pulled from a body of molten glass. This entails maintaining the newly-formed glass at a high temperature for as long as it takes to pull the rods. *Cones*, on the other hand, are made from pieces chipped straight off the original ‘cake’ of glass when it is cold. Therefore glass for cones can be removed from the heat immediately after forming. When the cones are later softened for working they do not require nearly the same intensity of heat. It should be observed at this point that the yellow trails on the original vessels are a deep daffodil hue.

However ancient opaque yellow glasses are volatile. They require, and yet are very sensitive to, high temperatures. For this reason they can be difficult to blend and control (Shortland and Schroeder 2009). MT found no problem making rods from the less compatible Yellow Glass 1. But when he prepared the higher-compatibility, and therefore more authentic, Yellow Glass 2 for Phase 2 of the project he found that it started to pale rapidly after forming. Indeed, if it was kept in the heat long enough to be pulled into rods it paled to a vanilla shade (Ch 4.C.3b, figure 5.3.19). We reasoned that if it was comparatively difficult to pull this authentic opaque yellow into rods, this

increased the likelihood of the original vessels being trailed with softened *cones* of glass. These observations made it imperative to try cone trailing during Phase 2.

For Decorative Trailing Technique 2 I therefore needed to use small pieces of coloured glass chipped off a larger 'cake' of glass which MT had withdrawn from the heat at the moment of forming (as opposed to leaving it in the heat and pulling it into rods). I needed to soften these chips in the mouth of the furnace at 600-700°C – much lower than the glass-forming temperature of 1000-1200°C – and marver them into small cones. I had to gain experience in using a great many new tools, some of which MT already had, but some of which he needed to make. I had to get used to scoring a notch in a large lump of glass with a Stanley knife, covering the lump with a towel, putting a cold chisel on the notch and hitting the chisel with a heavy hammer. MT had to find more metal rods to bear the cones and to make two small clay 'toblerones' (triangular prisms) with rounded notches along the apexes to hold these cone-bearing metal rods over the heat (Day 24) (figure 5.3.20a.). MT also covered a metal plate in clay slip so that we could start softening the chips over the furnace. We needed the slip because otherwise the chips would stick to the plate (Day 25; figure 5.3.20b).

Naturally I had to learn a number of entirely new gestures for Technique 2. We started by coating the tip of a heated metal rod in glass (either by a gather of body glass or a rod of decorative glass) (figure 5.3.21). Then we dipped the rod into the heat until the tip was able to pick up small chips of coloured glass (figures 5.3.22. and 5.3.23); as they melted, further chips could be added. We were then able to marver the result into a cone (figure 5.3.24). We then had to position the metal rod on the stands or 'toblerones' near the heat so that the cone did not cool and crack off. Those were the preparatory operations. Shortly before use we would then dip the cone several times into the furnace, marvering between heats, until the cone was well-shaped and softened all the way through. The tip of the cone was then ready to be lightly dabbed onto the body of the vessel which was then rotated so that the trail was drawn off the cone (figure 5.3.25). We then had to gently let the trail melt off the body of the vessel when finished. Again, watching was key: watching the yellow glass change from daffodil yellow to caramel before attaching it to a metal rod; watching the colour change and the changing form of

the cone on the end of the metal rod as it heated in the furnace; and watching the thickness and stiffness of the trail as it came off the cone

As I trailed onto the body of FL44 I was surprised at how easy it seemed; I made 14 turns (Appendix 5-11) trailing 'base to neck overhand' as I had become accustomed to doing. The result was a thin, thready trail but because the cone of glass had been made and then thoroughly heated by MT it was also continuous from base to neck. I applied my rim and base trails 'underhand' as we had decided after examining the British Museum alabastra (see above). It seemed, as MT had suggested it might, appropriate to cast off the rim and the base trails 'forward' over the top of the vessel, with the rod held out of the fire. During the next four days MT continued to help me make the cones, but I was now in charge of reheating them just before and during trailing. Cone heating is accompanied by marvering, the purpose of which is to cool the outer layer of the cone more than the inner. Repeated reheats and marvers will achieve the same temperature all the way through the cone – a prerequisite for a workable cone. I had great difficulty learning to reheat cones; this will be discussed in Chapter Six. On Day 24 MT made a batch of turquoise glass and I then hammered chips off the large lumps of yellow and turquoise glass as necessary throughout the rest of the Core-Forming Project. At this point I began to do all the cone making myself. It generally took me about 30 minutes to prepare two large yellow cones and one smaller turquoise one – enough trail for two vessels. Clip 5.3.6 shows my cone trailing on FL 55 (see Appendix 5-13 for the uneven result). The blue body glass that mixes in with the trail at the neck is a clue to the direction of the trail wind – base to neck – since it shows that the cone was running out and consequently the trail was pulling off the blue body glass I had used to stick the base of the cone to the metal rod.

By Day 27 we had so many reasons to support cone trailing we decided to revisit our trail start-point 'controversy.' My understanding of the archaeological artefacts was increasing along with my experience of ancient materials: before I had assumed over-hastily that a rod trail would begin with a stub and end with a wisp – that is to say, it would be laid on intact and then pulled off at the right moment. But I now realised belatedly that of course a trail rod could also *begin* with a wisp – if a worker laid on the wispy end of a rod which had previously been pulled off another place or vessel, or *end*

with a stub – if the intact extremity of a rod had been allowed to ‘hang on’ without being pulled off or deformed by pincers. Our now disused stocks of old glass rods were testimony to this – many among them now sported wisps at one or *both* ends, having been pulled off a vessel at least once.

I was now able to compare these features to those made by cone trailing. It was immediately obvious that there was no way that a cone trail could *end* with a clearly defined stub, since it was made not from a discrete piece of glass like a glass rod but was stuck at the bottom to a piece of metal – the metal rod on which it had been made. A cone trail could *only* finish, at its neatest, in a short tailing-off thread thinner than the preceding trail and more often in a lengthy wisp. MT’s cone trailed vessels are almost all trailed from base to neck overhand; all the yellow trails finish in a thready wisp at the neck. For MT 18 (Day 27) however, MT decided to do what I was currently experimenting with and trail the other way from neck to base underhand – an operation which he did not like and did not repeat because he could not see the trail where it joined the body of the vessel. Figure 5.3.26 shows the trail thinning out towards the *neck* of MT 19, and towards the *base* of MT 18. In each case, the other end is clearly defined. During Phase 1 we had noticed how the necks of the original vessels bore wide, stubby smeared trail extremities, and when we realised how pincers on the neck could produce this effect we cautioned ourselves against assuming this was the beginning of a trail rod. But we now observed that even when this is thoroughly smeared with the pincers, there is not enough glass for a thin wisp to deform into a thick wide stub of the kind seen on the original vessels. This, as far as I was concerned, strongly supported the idea that the trails – which we now felt to be cone trails – began at the neck after all.

I then speculated that if we saw an overwhelming number of *original* vessels with a) stubs consistently at one end of their yellow trails and wispy threads at the other and, *in addition*, b) stubs at the top and wisps at the bottom, we could infer from that the original workers were cone trailing from neck-to-base underhand. MT cautioned me that we could only make that assumption if we were certain that the workers were trailing with cones. The kind of pattern I was looking for can be seen in figure 5.3.27.

I continued from FL58 to trail neck-to-base underhand, reverting only sporadically (e.g. FL 60, FL 73, FL 74 and FL 79) to the ‘old’ method of base-to-neck

overhand. Even when the cone trail was thin at the starting point it still began with a definite and distinct touch-on which in no way resembled the wispy pull-off of the end point of the trail.

From Day 33 I was in charge of starting the working furnace in the morning and controlling its temperature throughout the day. I needed to ensure that it was hot enough for the decorative trail cone to be thoroughly heated, but not so hot that the vessel body glass started to sag off the core. My problems with furnace temperature are detailed more thoroughly in Chapter Six; MT had few problems with cone trailing (figure 5.3. 28). I struggled to the extent that MT modified Cowl 3 by sawing out a portion with a hacksaw, ostensibly to allow the cone trail more room to heat up (figure 5.3.29), but all this achieved was a flaring of furnace heat up our arms and into our faces. FL 82 to FL 87 (Appendix 5-19, 5-20) show my final attempts to achieve the correct trail thickness, evenness and spacing. As with vessel bodies, it is a matter of dimension: the trails are fairly even and well-spaced but they are still too thick.

#### **4. Decorative trail tooling**

This is the second decorative procedure. In Class IB vessel the decorative trails are shaped into tight shallow zigzags by running a blade-shaped tool or spike up and down the panel of trails covering the main section of the body. There are as many as 16 pairs of zigzags on the more consistent vessels.

We used the blades of the steak knife and the grapefruit knife and a number of different knife handle grips for the down-strokes and up-strokes. We made down-strokes with the blade of the knife in a 'handlebar' grip (figure 5.4.1). To make up-strokes we used several different grips: 1. twisting the hand and pulling with a 'cake-cutting' grip (figure 5.4.2); 2. pulling with an 'oar' grip (figure 5.4.3); and 3. *pushing* with the 'handlebar' grip (figure 5.4.4). I also had to learn to run the blade strictly in line with the vessel in order to avoid slanting tracks; to apply the right amount of pressure – enough to move the trail, but not so much that it gouges into the vessel body; and to rotate the vessel at uniform intervals so that the zigzags are the same size.

During the 2004 experimental session MT conducted with Paul Nicholson he tooled the trails into wide zigzags using the blade of the steak knife (figure 4.14) He used

a 'handlebar' grip for the down-strokes (figure 5.4.4) and a 'cake-cutting' grip for the up-strokes (figure 5.4.5) The handlebar grip worked for down-strokes because the hand was placed near the bottom of the vessel and then pulled away. Pushing the knife blade *up* the vessel in the same 'handlebar' grip brought the hand much nearer the hot glass. Turning the knife for the cake cutting grip involved raising the hand much higher above the vessel and away from the hot glass. The grapefruit knife joined the steak knife in March 2008 when MT and Emily Coulson discovered that the steak knife tended to gouge into the glass when the tip is used to make festoons. (Festoons are a design motif not found in Class IB.) The more flexible and blunter blade of the grapefruit knife ran along the surface of the glass while still moving the trails and MT used the tip of the back of this blade to tool the trails on an Egyptian form of flask into shallow festoons. Neither MT nor Emily were attempting to follow the particular decorative designs of the alabastra of Mediterranean Group I. Their rotating skills and good posture over the work meant that they produced regular patterns.

When it came to making zigzags as opposed to festoons, however, Emily selected the steak knife whose rigid and highly serrated blade seemed to her to gain a better purchase on the glass. When making down-strokes she followed MT and used a handlebar grip and for her up-strokes, again as MT had done in 2004, she turned her wrist to draw the knife up towards the neck of the vessel in a cake-cutting grip.

I felt the same way about the steak knife when I started trail tooling. On Day 1 I used the front of this blade to make down-strokes across the trail lines towards the base of the vessel. For the up-strokes I tried an 'oar' grip but then used a loose cake-cutting grip, trying to keep my hand as far as possible from the hot glass. I tried the grapefruit knife on Day 4 but reverted to the steak knife on the same vessel (FL 7). I also tried to imitate MT and use the handlebar grip for the up-strokes, *pushing* the blade instead of pulling it, but still only reluctantly held my hand over the hot body of the vessel. I succeeded in placing eight zigzags on my vessels on this time and also tried to increase the number of knife strokes per reheat. The blade skidded on the stiffening glass, however, and I almost burned my hand. Fear of bringing my hand too close to the hot glass meant that a some of my up-strokes, where my hand was over the vessel, did not reach up to the beginning of the down-strokes; this resulted in the upper trails of the vessel turning into inverted



festoons instead of zigzags (for example FL 6 in figure 5.4.6) The 'oar' grip for the up-strokes allowed me to raise my hand above the vessel without turning my wrist - unlike the cake cutting grip.

The routine I developed involved placing all the strokes on one direction (figure 5.4.7) before inserting the others between them (figure 5.4.8 clip 5.4.1). shows me beginning with down-strokes before moving to up-strokes. This way I could avoid swiftly changing my grip on the knife. This impeded my efforts to make the zigzags closer together, because then it was hard to see where to insert the second set of strokes. However I wanted, for the sake of time, to make at least two strokes between each reheat, and I lacked the dexterity to turn the knife quickly in my hand and follow a down-stroke with an up-stroke.

On Day 8 I tried the grapefruit knife again. It had seemed to skid on the glass when I had tried it on Day 4 but I was now watching the glass better and making more accurate interpretations of temperature. This meant that I was less inclined to uselessly work at stiff glass. I now viewed the steak knife as overly 'grippy' because it tended to dig in too much when running up the glass and seemed to make the zigzags too tall. I continued with the same routine and grips, finishing the down-strokes with a 'handlebar' grip before shifting the knife to the 'oar' grip and performing the up-strokes, and making three or four strokes between reheats. MT advised me that because I was not leaning over and observing my work properly, I tended not to run the knife exactly along the top of the horizontal vessel (figure 5.4.9). This meant the skidded slipped, risking burns, and made for slanting and not vertical zigzags. By Day 13 (FL 28) I was doing fewer strokes between reheats, only one or two, aiming for as closely-bunched a set of zigzags as possible, and completing 13 as opposed to the 10 I had managed on Day 10 with FL 24. MT on MT12 performed the operation in the same way, making pairs of down-strokes between each reheat and then switching the knife to an 'oar' grip before embarking on the up-strokes.

Now that there were more zigzags it was a problem to see where to put the up-strokes as the space between down-strokes was increasingly narrow (figure 5.4.10). This difficulty may have been compounded on that day by the use of the mobile glass 2, over which the comparatively stiff trail rods stubbornly glided. On Day 17 I began to

following each down-stroke with a up-stroke and making one pair of strokes between each reheat (clip 5.4.2). This painstaking procedure required patience and the ability to switch the knife quickly from down-stroke to upstroke before the glass stiffened. I used a new grip, holding the knife with the hand below it, as if for a salad fork (figure 5.4.11). It paid off in the result, bands of much tighter and more numerous zigzags (Appendix 5-8 and 5-9). I then started to reheat between down-stroke and up-stroke (clip 5.4.3). This still involved regularly switching the grip on the knife, but more slowly. I wanted to make the strokes as close together as possible, not only to fit the required number in, but also because marvering flattened them out and threatened to make them too shallow. However, on FL 38 to FL 42 lengthy working and numerous reheats caused the other yellow-related problem to surface; heat-blurring of the yellow trails (Appendix 5-9). We saw this on a great many of our vessels and conversely on very few in the whole of our archaeological database (Appendix 1). I was now achieving between 12 and 15 pairs of zigzags. I also rolled the vessel on the slab not just after but also during trail tooling in an effort to cool the glass and prevent sagging of the body.

When reheating while tooling the decorative trails I remained seated, merely dipping the vessel into the top of the furnace. In this way the top opening of Cowl 3, by producing these two distinct postures, highlighted the difference between the long thorough reheat necessary after extensive marvering, and the briefer reheat of the worked area of the vessel needed after one or two strokes of the tooling knife.

At the beginning of Phase 2 of the Project, since Glass 4 remained more mobile than Glass 1 and he wanted to eliminate the heat-blurring which was spoiling the decoration on some of the vessels, MT decided to attach a yoke to the working furnace and revert to the 'push-pull' gesture, alternating up- and down-strokes with the same handlebar grip. This time he successfully adopted this gesture without incident and used it with the remaining vessels he produced during Phase 2 - MT 16 (Day 25), MT17 (Day 26), MT 18 and MT19 (Day 27) (figure 5.4.12 and clip 5.4.4).

I was beginning to be more dexterous and confident in tooling but I still followed the work steps I had developed; this laborious sequence meant that I took on average 7 minutes to tool the trails of FL 44 to FL 67 over Days 21 to 32 – twice as long as MT. I remained too inexperienced with hot glass; I did not feel the 'push pull' gesture in my

hand until Day 33 and FL 68 (clip 5.4.5. and Appendix 5-16). Because the vessel remained so near the fire I was able to speed up my trail tooling to between 3 ½ to 4 ½ minutes. On Day 33 I also tried the steak knife with the same gesture on FL 69 but the upper body showed the points of the serrated knife (figure 5.4.13). But the following vessel, FL 70, which was tooled with the grapefruit knife, also shows deep knife strokes in the thick yellow trails (figure 5.4.14). This suggests that the serrations were probably only visible because it was at this stage, before the second and third vessels on Day 33, that I was left in charge of controlling the furnace temperature (see above, procedure 3: Decorative Trailing, Day 33) and set the heat too low. This is supported by the fact that the tooling time for the low-furnace FL 69 is above average for this ‘push-pull’ gesture, at a full 5 minutes. Other vessels made during this time display marked grooves from the knife blade – also symptomatic of low heat. My zigzags seemed slightly shallower but I did not feel that this was a drop in consistency. I continued performing the ‘push pull’ gesture until the end of the Project on Day 40, bringing my knuckles confidently towards the hot glass on the up-stroke.

## **5. Neck shaping**

During the 2004 session MT made a small cylindrical perfume phial of an Egyptian form. The neck of this type of vessel does not extend above the body of the core as it does with the alabastron and MT was able to keep the neck glass smooth and sufficiently thick by marvering. The furnace aperture also helped. For most of the time that it was worked, the vessel was held in a horizontal position over the top of a volcano-type furnace. This meant that no special gestures or tools were used for neck shaping during this session.

During the March 2008 experimental session with Emily Coulson, MT was using Core Covering Technique 1. For this technique he needed to cover the core with a single gather of glass. This meant that it was important to take enough glass to cover the neck in a moderately thick and even layer of glass. Evenness was especially important as MT and Emily Coulson were making integral rims – rims shaped out of the body glass rather than being attached using extra glass. Emily cut in the neck on the front edge of the marver and used the back edge of the marver to level off the top edge of the neck prior to shaping a rim.

We began by establishing some criteria for the necks of Mediterranean Group I Class IB alabastra. A defined neck is one of the main characteristics of Class IB; it is short and straight and lies between the almost completely horizontal line of the flat rim and the near-horizontal line of the jutting shoulder. The vessels that we came to admire by the beginning of Phase 2 (figure 5.5.1) have a particularly angular profile. The neck face is also smoothly circular rather than faceted (figure 5.5.2). It was important to situate the neck of the vessel at the neck of the core – where the top of the core body met the rod. Too low, and a thick shoulderless profile would result, like FL 16 where the neck, such as it is, is formed by trying to squeeze the glass against the shoulders of the core. Too high and the neck of the vessel would indeed be on the neck of the core, but too high above the shoulder (figure 5.5.3). But once a layer of glass covered the core I could not see exactly where the neck of the underlying core lay. To making the neck smooth and the cross-section circular I needed a steady smooth rotation from my left hand, a sensitive holding of the neck in the pincers from my right hand (which varied according to the type of neck-shaping tool used), and the same watching and timing skills important in other procedures and in any situation where the material in question is a stiff and therefore highly heated glass. I found that it was better not to think of the neck tool as pincers at all, since the last thing I needed to do was pinch the neck; this would brake the rolling motion and create flat patches or facets. But I had to try to achieve a smooth circular neck, and our glasses were so stiff that it was almost inevitable that a learner would squeeze the pincer blades too hard in an effort to make any impression on the glass at all. It was only when we found the right tool towards the end of the Project that I was able to take advantage of my increased experience of glass temperature and behaviour and really coordinate my neck gestures.

Neck shaping appeared to fall naturally into four discernible stages. As none of the other procedures did, this is probably by chance. I had no sense at the time of ‘moving on’ from one stage to another. Nevertheless, during the first stage (figure 5.5.22) my necks remained largely undefined. MT encouraged me to level off the top edge of the neck by pressing it against the back edge of the marver (clip 5.5.1). I also tried to shape the neck and shoulders by rolling only this area on the marver, but it was ineffectual; it transpired that I had misunderstood what MT had told me and that what I should be doing

was the gesture Emily Coulson had quickly understood: holding the rod at a steep angle and using the right-angled front edge of the marver to cut in a neck line. I managed to do this on Day 5 (clip 5.5.2). MT used the front and then the back edge of the marver for these gestures (clip 5.5.3). MT also advised me to watch the core as I covered it up, in order to remember the position of the neck. Although I concurred with him verbally I did not yet understand the relationship between this artefact feature and the gesture of neck positioning; this meant that I did not practice watching the core neck as I covered it with glass and remembering where it lay. I continued to struggle to cut in necks at all points on the shoulder. I only began to watch for the neck position during Phase 2 of the project, well after Day 20.

As my earlier neck shaping had usually melted out by the time the rim was applied, I shaped it further with the pincers. MT encouraged me to use the tweezers as they were less likely than the pincers to make facets and also produced the shorter neck more typical of Class IB. But I rejected them as they brought my hands very close to the hot glass. As my neck was in the wrong place neck shaping with any tool had little effect beyond thinning the glass. For example I found it hard to cut in the neck on the front edge of the marver because I was choosing a point too low on the core body and so the misplaced gesture had little effect. I also tried to roll the neck in the pincers without squeezing, but failed (clip 5.5.4). This is perfectly possible; figure 5.5.4 shows MT shaping a neck with pincers and figure 5.5.5 is the smooth unfaceted result. It was simply a question of developing the right level of squeeze for the tool concerned. On day 10 I tried the grapefruit knife and the small metal bar on the neck of FL 24 (figures 5.5.6. and 5.5.7). This gave better definition to FL 24 but the flat surfaces of these tools produced facets (figure 5.5.8). I also used the tweezers on FL 29 after applying the rim (clip 5.5.5). FL 29 was made with the extraneous Glass 2 which was mobile at lower temperatures and made it possible for me to use a short-bladed tool. Figure 5.5.9 shows how much shorter the FL 29 tweezered neck is than the pincer neck of FL 24.

The second 'stage' of neck shaping (figure 5.5.23) appeared to begin on or soon after Day 15 and produced short but overly broad necks. On Day 16 MT rolled the neck of MT 13 along the top of the back edge of the marver (figure 5.5.10). This gesture seemed to produce a well-defined neck of the right minimal length. On Days 18, 19 and

20, the last three days of Phase 1 of the project, my neck shaping stabilised into one or two slow and careful passes against the back edge of the marver shortly before the rim was applied (figure 5.5.11. and clip 5.5.6). My improved timing and my refining of this gesture (less speed, increased care) made an impression but I was unaware that I still had not found the actual neck of the core, and that was the reason why my necks were so broad (see fig 5.5. Neck Stage 2). I was also aware that by the end of Phase I we had not found the right neck shaping tool.

On our second visit to the British Museum we discovered that, as with other vessel features, what had been harder to see was the small size and delicacy of the neck. This helped us focus on the selection of the right tool, which we saw needed to be extremely narrow. This challenged and expanded our tool experience immediately. MT filed the teeth of a pair of long tweezers (figure 4.10) and bent two thin rods to form two-bladed tools (figures 4.12, 4.13). Attention was paid to the necks of vessels BM100 to 103; MT noticed deliberate cutting in just under the rim and just on the neck-shoulder angle, which produced a slight pillowing effect in the neck. This confirmed that this neck shape was not a half-formed attempt at a long smooth curve but a deliberate feature.

At the start of Phase 2 I completely neglected the neck. This was because we had just changed our core covering techniques. Core Covering Technique 4 entailed melting the glass down the body, using lengthy and deep reheats with the vessel almost vertical inside the furnace. Beyond using a knife blade occasionally to prevent flaking I had no gestures for maintaining the neck during core covering; my only other neck gesture was running the vessel along the top edge of the back of the marver. Consequently necks of the vessels made from Day 21 and Day 22 were quite thin-walled. I started to remedy this on Day 23 with some new gestures: pulling the glass back up over the neck area with a knife blade and then cooling the neck on the marver to immobilise it before the next reheat. This led to another favourable change and the third 'stage' of neck shaping: better position, but still coarsely shaped necks. The extra attention I now had to pay to the neck during core covering caused me at last to act upon the unheeded advice MT had given me earlier on in the Project: identify the neck position early in the sequence of work steps and start defining it. Figure 5.5.12. shows how on the first vessel of Day 23 I did not do this, and on the second I did; although the neck was too high above the

shoulder it was the first step to the correct profile. Vessels at this stage all display necks formed by careful early attempts to identify and define the neck. However I was still doing most of my *later* neck shaping – the part before and after applying the rim – using the same technique of squeezing with the pincers (figure 5.5.24). Even though I was now squeezing more gently the blades of this tool were too wide, even at the tips, for an accurately reproduced short neck of the vessels in figure 5.5.1. I also tried a narrower tool in the form of the smaller of the two bent rods we had introduced into the tool set. Figure 5.5.13. shows the concave profile produced by the circular cross-section of the rod.

On day 28 however I was at last ready to try the tool MT had selected. He had already used the long tweezers on the neck (figure 5.5.14 and clip 5.5.7. ) and we had both tooled the rims with them. On Day 28 I tentatively tried them after applying the rim of FL 60. Figures 5.5.15. and 5.5.16. show how I discovered a way to press down towards the shoulder as I rolled the neck in the tweezers. This placed the neck nearer the true shoulder of the core and produced a flatter more accurate profile than that of FL 52, where the rounded bent rod has been applied high under the rim.

My adoption of the long tweezers marked the beginning of real progress in my neck shaping. During core covering I was not longer content to use just the knife and the marver; I also actively shaped the neck with the pincers and then the long tweezers., which I tried to use exclusively at the later neck-shaping stage, before and after rim application. The necks were still slightly faceted because I was using a squeeze more appropriate for the more robust pincers. The grip on the tweezers had to be even more gentle and I should have been holding them firmly but lightly in place and rolling the vessel neck between the blades (clip 5.5.8). I seemed at times to be purposefully putting facets on the neck by my regular squeezes with this tool, which I then tried to remedy with a rolling action between their blades (clip 5.5.9), producing a slightly squashed, faceted result (figure 5.5.24, FL 65).

On Day 34 I moved to the fourth and last stage; the shaping of well-positioned, short, narrow, smooth and circular necks (figure 5.5.25). Our switching to copper glass allowed me to make favourable gesture changes. The smooth circular neck of FL 72, contrasted in figure 5.5.17 with FL 65 described just above, shows how I discovered I was able to shape this more mobile glass simply by a new light rolling gesture with the

long tweezers and avoid squeezing altogether. When we returned to cobalt glass I transferred the gesture, taking care to ensure the stiffer glass was well heated. In figures 5.5.18, 5.5.19, and 5.5.20 a neck is being formed by light rolling with pincers, the bent rod, and the long tweezers. Clips 5.5.10 and 5.5.11 show the rolling gesture in use, and figure 5.5.21 the rather tall profile made by the pincers, the slight grooving produced by the bent rod, and the comparatively smooth and narrow neck made by the long tweezers. The resulting necks (figure 5.5.25) show a similar angular profile to the archetype vessels although I did not achieve the cutting-in refinement observed by MT during our visit to the British Museum and mentioned above.

## 6. Rim shaping

In 2004 MT made a rim for the small Egyptian cylindrical phial by trailing on one turn of hot glass. This procedure took place after decoration. Unlike the Mediterranean Group I alabastron, where the rim is placed on the neck so that it covers the top edge, this rim was placed about 0.5cm *below* the top edge of the neck (figure 5.6.0-1). MT then shaped it with the pincers and before adding a decorative trail (figure 5.6.0-2) and then making deep indentations with the edge of the blade of the steak knife to form the rim into petal shapes (5.6.0-3). When he worked in March 2008 with Emily Coulson, however, they made an integral rim out of a prepared cuff of body glass formed at the neck. This involved careful preparatory operations since the cuff has to be level and evenly thick if a symmetrical rim is to be produced. They then shaped the rim with the pincers. As the workers were not trying to reproduce Mediterranean Group I, Class IB alabastra they had no reason to make applied rims.

However it is extremely likely that the rims of Class IB alabastra were applied, that is, formed from a second, separate gather of glass as with the Egyptian phial MT made in 2004. The archaeological database features I recorded in photographs and film were confirmed on our visit to the British Museum prior to Phase 1 of the Core-Forming Project. Lenticular bubbles in the rims of some of the original vessels are one of the signs that the glass has been trailed onto the neck of the vessel with a spiral wind (figure 5.6.1 and figures 4.41 to 4.44). In addition *decorative* trails from high on the neck have sometimes been seen on the upper surface of the rim, near the opening, surrounded and



partly covered by blue rim glass. This feature can only arise when extraneous glass is trailed on *around* the extruded trail (figure 5.6.2).

On Day 1 of the Core-Forming Project I started with an integral rim because it was easier than trailing one onto the vessel. I failed to lean over my work to make sure the rim was level and continued to squeeze the rim long after the glass had stiffened. I left the first two rims undecorated but the following day managed to apply a yellow trail to FL3. I did some elementary pincer work before applying this trail (clip 5.6.1). MT produced round and symmetrical applied rims by holding the pincers level and at a right angle to the vessel (figure 5.6.3) and leaning over his work (figure 5.6.4). On Day 3 I attempted an applied rim. MT began by miming the actions with the correct tools. I remained seated at the glass working furnace while he brought an unloaded gathering iron into position for me to grasp with the pincers, as if I were holding it steady as I rotated the core-bearing rod to wind a thick trail of hot glass onto the neck of my vessel (clip 5.6.2). I then began to take delivery of applied rims, remaining seated and allowing MT to bring me the gather and cast off the trail for me after the right number of turns. I tooled the rim with the pincers, incorrectly using the tips of the blades (to keep my hand away from the hot glass) and failing to hold them level (figure 5.6.5) and leaning away from, rather than over, the work, making it impossible to see if the rim was level (figure 5.6.6). The more experience I had of the work steps the easier it became for me to judge when I was ready for a rim; to turn the rod more quickly for a thinner trail (making for a more even rim) and to decide when to cast off the trail – sometimes rather late, as with FL 12 (clip 5.6.3) where the wide rim is the result of three turns (figure 5.6.7).

I found rim *decoration* hard with Cowl 1. I had to kneel as with body trailing (clip 5.6.4). The rim heated faster than the trail rod, so that the trail rod pulled it out of shape. (clip 5.6.5). (The problem of overheated vessels and underheated decorative glass dogged me throughout the Project.) Often I held the rim out of the perpendicular so that when I hung a rod on to melt of its own accord it looped over the top or the underside of the rim (figures 5.6.8. and 5.6.9). I laid the rods on underhand because it seemed to help the yellow glass soften more quickly; I had to watch carefully for the small window between unworkable stiffness and melting off entirely. MT had no problem using the tweezers to give a finer finish to the rim but as with neck shaping, although I tried them on Day 6 and

again on Day 10 the short blades brought my hand far too close to the hot glass for comfort.

The most uneven rim decoration I did, however, was when I was using Cowl 2. Figure 5.6.10 shows the rims of FL 21 and FL 24 with uneven and overlapping decorative rim trails. This was because I had to hold the vessel far back in the cowl to keep it away from the slightly narrow aperture.. The rim quickly overheated and bent under the comparatively stiff rod (clip 5.6.6. and figure 5.6.11) and I also had to lean (clip 5.6.7).

Returning to rim *application*, I gradually became more tuned to the gestures involved: judging the size of the gather, holding it at the right angle to the vessel, touching on lightly but firmly at the top of the neck, rotating, and casting off cleanly (figures 5.6.12a. – f.). I could not get to grips with casting off the trail. I kept moving the iron away from the vessel while trailing, so that when it was time to cast off, my trail iron was separated from the vessel by a thick thread of cooling glass which was difficult to detach (clip 5.6.8). MT told me I should hold the iron closer to the hot rim, but I could not understand how I was then to separate the two. As for rim shaping, I continued to favour the pincers over the tweezers not only because they seemed safer but also because I could squeeze the rim harder, important when the glass was rapidly stiffening. I continued to pinch and pull the rim into shape, only half-leaning over my work (clip 5.6.9).

Now the horizontal aperture of Cowl 3 allowed us to shape the rim while holding the vessel over the heat. The posture I had to adopt – working to the front instead of leaning down to the side – also made it easier for me to keep the rim perpendicular to the vessel. Shaping the rim over the heat was something we both adopted with Cowl 3 (clip 5.6.10). Because of the good visibility and temperature control it provided Cowl 3 also made it extremely easy to decorate the rim with a yellow glass rod trail (figure 5.6.13) and many of the vessels made during this period testify to this: FL 35, 38, 39 and 40 for example (Appendix 5, 5-8 and 5-9).

On Day 19 I practiced rim application and casting-off. I was still far from making a smooth clean cast off; after each trail I pulled the stiffening trail *away* from the core, where it stiffened into the tough thread described above (clip 5.6.11). I finally understood what MT had been telling me: I should have been wrapping the hot trail smoothly *over*

the hot glass of the applied rim and melting it off, pulling it away as easily as if it were honey as MT did (clip 5.6.12). I had only just realised how the hot glass could help me finish the gesture rather than hinder me.

We then returned to the British Museum. As with other features, our ideas about rim size needed to be revised. It was obvious in photographs of the originals that a well-melted *decorative* trail of about 2mm thickness completely covered the side of the rim. This meant a smaller gather trailed on in one thick revolution or two thin ones, and tooled to not more than 3cm or so in diameter and less than 2mm thickness. We also needed a long, strong, yet fine pair of blades to squeeze the rim. MT thought that the blades he was proposing for neck shaping, the long tweezers with teeth that could be filed off, could also serve for rim shaping. We hoped that the reduced volume of glass in the rim would allow it to heat more quickly, since most of all we needed the rim glass to be mobile for long enough to be finely worked.

At the beginning of Phase 2 I was at last becoming dexterous in gathering and managing sometimes to apply an acceptably small trail. I was also leaning far enough over my work to produce a reasonably level rim which was, satisfyingly, already thinner than those I had made towards the end of Phase 1. So it was dismaying to see these rims pulled irretrievably out of shape by a thick, stiff *decorative* trail. This arose because of our change in decorative trailing: from rods to cones. It seemed that the superior temperature control offered by Cowl 3 – the vessel was above and not in the furnace and the rim could be moved away from the heat at any point – made it even harder to heat the decorative glass cones thoroughly (figures 5.6.14a. and b. and 5.6.15a. and b). These rims have regained some of their shape by being pressed against the marver – a remedial gesture performed by us both from time to time. The more I tried to heat the cone trail after it had been attached to the vessel, the hotter and softer the rim would become. It was only when I overcame this difficulty (how I did this is discussed in Chapter Six) that I began to produce better decorative rim trails.

In spite of their advantages I was slow to adopt the long tweezers for rim shaping. I had got used to the strength of the pincers and I was beginning to use them to better effect, aware by this stage that where pincers did not need to be squeezed to shape a neck, much more pressure could be applied to flatten a rim. My rims were still (undesirably)

robust enough, in my opinion, to call for pincers to flatten them into shape. The small and undistinguished rim of FL 55 made on Day 26 has been shaped with the long tweezers: it is probably the first gather of Phase 2 which is genuinely small enough for these tools. It is marred by a thin and wavering under-heated decorative cone trail (figure 5.6.16). From Day 26 to Day 30 I began to use the long tweezers alternately with the pincers; some of my efforts with the pincers were neat (figure 5.6.17a. and b.) if on the large side. Sometimes I followed the pincers with the long tweezers on the same rim, hoping to refine the appearance with the second tool. Clip 5.5.9., mentioned above (Section 5) shows the rim being worked with pincers over the heat, then out of the heat with pincers and long tweezers. The pincers are held pretty level and the worker is leaning over her work.

The casting off gesture still eluded me: I was still making the usual mistake of pulling the trail away from the rim so that the glass stiffened (clip 5.6.13). But the return to cobalt glass at the end of the Project marked the beginning of a run of flat thin round rims, shaped exclusively with the long tweezers (clip 5.6.14). Most rims made in Phase 2 measured between 30mm and 35mm (figures 5.6.18a – c). Many Phase 1 rims were also that diameter but many others were closer to 40mm or more (figures 5.6.19 and 5.6.7) and all Phase 1 rims were about twice as thick, at 4mm or so, as most of the Phase 2 rims. The final rims are thin enough for the edges to be convincingly covered by the decorative trail (figure 5.5. 25 and Appendix 5-20).

## **7. Handle making**

In both experimental sessions prior to the Core-Forming Project (in 2004 with Paul Nicholson and in March 2008 with Emily Coulson) handles were made by applying a small gather of hot glass to the vessel, cutting it with shears and tooling it with pincers into a loop and a tail. This technique was familiar to Emily Coulson and this session was not focussed specifically on recreating the handles of Mediterranean Group I alabastra.

However during my examination of the archaeological database I had noticed a particular thready, grooved quality to the handles of Mediterranean Group I alabastra of all Classes (figure 5.7.1). MT thought that this could be because the handle was applied as a bead which had been gathered on a mandrel and stretched somehow up the body to

form a loop and tip. This would account for the layered appearance of some of the handle middles. This hypothesis was promising enough for us to try immediately we started the Project.

We needed to perform the following operations for handle making: gathering a bead from the melted body glass at the gathering furnace; stamping the mandrel point into a plank of wood; reheating the bead; touching the bead to the side of the vessel at the point where the tip is to be; dragging or lifting the bead to a point where the loop is to be; withdrawing the mandrel; and tooling the loophole, middle and tip of the handle into shape (clips 5.7.1. and 5.7.2). Because these operations were all new we introduced a number of new tools quickly. We began with bead mandrel 1 (figure 4.18) and swiftly followed it with the plank (figure 4.24), the tweezers (figure 4.9) and the spike (figure 4.17). We also sharpened bead mandrel 1.

This technique was entirely new to MT at the beginning of the Core-forming Project. On Day 1 he gathered a bead and seated himself immediately at the working furnace before touching it to the vessel (clip 5.7.3). He continued to work the bead with the mandrel he had used to apply the bead, pressing down on the middle of the dragged bead. (clip 5.7.4). This closed the loopholes, which MT tried and failed to open with the tip of the steak knife. The tip of the bead was too flat so MT squeezed it with the tweezers. I did not attempt to apply handles to my first vessel, FL 1.

The first handles MT made had closed loopholes. He concluded that the loophole could be widened by forcing the bead further down the mandrel and consequently he placed a short plank of wood near the gathering furnace. Once he had gathered the bead he could immediately stamp the point of the mandrel into the plank and force the bead further onto the tip, thereby widening the loophole (figure 4.24). At this point he discarded the mandrel by the gathering furnace and re-seated himself at the working furnace. He used tweezers not only to shape the tip but also to press down the middle of the handle. He also tried to widen the open loophole with the steak knife again for the first handle and the tweezers for the second (clip 5.7.5).

On Day 2 I began by practising gathering beads and then moved on to practising handle making on FL 2 (Appendix 5-1). Bead gathering gestures were new to me and I had no experience of mandrel heating. I struggled to gather beads of a consistent size and

to remember to reheat them after stamping the mandrel into the plank. Not only was it hard to judge where position the bead, the rapidly stiffening glass meant that I sometimes could not drag the bead far enough up towards the shoulder and some of my early handles were low, fat and short (FL 5 and FL 10 in Appendix 5-1 and 5-2). I then reheated the handle at the working furnace and, following MT, used the tweezers to shape the tip (FL 5). I tried to open the loop hole with the tweezers but failed, so MT suggested the spike.

The 'touch and drag' gesture that we were currently using is illustrated in figure 5.7.2. The rather flat tip produced by dragging the bead up the side of the vessel meant that we had to squeeze it into position. This caused a strange bifurcation of the tip (figure 5.7.3). Instead MT devoted MT 5 to handle experimentation. He began as he had done the previous day, by touching the bead to the vessel wall at the point where the tip was to be. But then he lifted the mandrel up off the vessel wall, pulling the bead into a thick thread, and touched down for a second time at the loop position (clip 5.7.6, figure 5.7.4, Appendix 6-1). The gap between pulled bead and vessel wall is visible on this vessel in the working furnace. This gesture gave more scope for reattaching the bead out of line but made it easier to produce a handle of the right length. He was then able to push the middle down against the vessel wall while leaving the tip alone, an action which created a naturally jutting tip. MT was now satisfied that the technique we were developing was viable and would produce correctly-shaped handles. We dubbed this second technique 'touch and lift'.

When I tried the 'touch and lift' gesture I found that the glass was too stiff for me to move and I had to return to the working furnace to reheat, thereby separating touch-on from lift. (clip 5.7.7). We supposed that this had happened because we had two furnaces. MT speculated that the original makers might have kept a glass pot for gathering handle beads in their working furnaces.

I thought that if I used the spike to open the loop and then to flatten the middle of the handle it was not necessary to try and shape the tip. I felt at this point that the tips were 'good enough' to leave. As with the dimensions and other features of the artefacts, I was relatively inexperienced in looking at them as a maker; in spite of all the photography I had done I had not really looked closely enough at the tips of the original handles to see how mine differed.

We gradually became accustomed to the following sequence: gathering the bead at the gathering furnace, stamping the mandrel into the plank, reheating the bead, touching it onto the vessel and lifting it, touching the stretched bead down again at the loop point, discarding the mandrel, moving to the working furnace, reheating the bead, widening the loop with the spike, and flattening the middle with the spike. MT sharpened the point of the mandrel on day 8 so that from day 9 I managed to gather less glass, with the result that the handles on FL 21, 24, 28 and 31 are all smaller than those made over the first five days. The small size made it easier for me to shape the middles. I continued to use the short tweezers to narrow the middle of the handle when I gathered too large a bead was gathered, and to tweak the handle into the vertical when the loop was out of line with the tip. Figures 5.7.5a. and b. show fairly level handles of the same size, in proportion to the body, with round well-shaped loops and tips. Clip 5.7.8. shows firstly control of the touch and lift gesture on FL 24 and secondly a good posture while tooling the handle and calm assessment of the result. I was now able to pay attention to other aspects of handle making.

It was only now that we began to notice from database photographs that the handles on the first vessel we thought of as 'desirable' (figure 5.7.6) were somewhat different from those on other original vessels. It looked to MT as if they had been pressed with the flat blade of a knife. It was helpful to discuss while working because when speculating about tools we could mime what we imagined to be the appropriate knife-wielding gesture (clip 5.7.9). From this point until the end of Phase 1 at Day 20 we tried intermittently to form handles of this style. On Day 18 I used the fruit knife on the middle of the handles on FL 36 (figure 5.7.7). The results are moderate (figure 5.7.8) and MT on Day 20 managed a better result (figure 5.7.9).

By the end of the first 20 days I was becoming more confident in the handle work steps. But I still had difficulty controlling the amount of glass I gathered on the bead mandrel and I had no real experience of how the mandrel temperature affected bead gathering. The tension between the slightly unusual archetype handles on TMA 76 and the more conventional thin-middled handles found on the majority of Class IB vessels made me change from one shape to the other as I worked and my gestures suffered as a result. Only when we revisited the British Museum was I then struck by the relative

crudeness and chunkiness of my handles when placed beside the originals. MT's vessels were more in proportion but we both realised that sharpening bead mandrel 1 had not altered the tool enough, and something much finer was needed – unsurprisingly, a tool more of the dimensions of the spike we used for handle tooling. We had also been aware since the beginning of the project that some Class IB vessels were made in copper glass rather than cobalt, and decided to make some vessels, and handles, in copper glass to see how differently it behaved.

The sequence of highly consistent vessels, BM 100 to 103 noted above when discussing core making and trailing, also sported slightly unusual, thicker-middle handles. These can be seen compared to an example from the original archaeological database (figure 5.7.10) where the middle is thinner and the tip is more pointed. It seemed that the vessels we liked were always a little unusual when it came to handles. However these handles showed no evidence of having been made with different tools – unlike those on the previous archetype TMA 76 where the middle seemed to have been flattened with something the same shape as a knife blade. However we turned to making handles with slightly thinner middles.

At the beginning of Phase 2 we adopted bead mandrel 2 which was made from a spike inserted into a piece of dowelling. It was longer and lighter than mandrel 1 and the spike was much thinner, which meant that it tended to bounce slightly during the 'lift' stage of bead application. Glass 4 was more mobile than the previous Pichvnari recipes. In addition, I had to gather what seemed to be an impossibly small bead and apply it over a length of less than 2 cm. All these factors contributed towards difficulties with bead gathering.

As mentioned above many of the Class IB handles have pointed tips. We were aware by now that the origin of the shape of handle tips lies not in the later tooling but in the initial bead application gestures. Therefore MT tried touching the bead down and then lifting it *exceptionally high* before touching down for a second time. This results in a raised 'arch' in the thread of glass which, with careful tooling, can be pushed into the shape of the handle tip. Careful touch-down and tooling can also produce a thinner middle. With a stiff cobalt glass it requires speed and strength, but it was perfectly possible as figure 5.7.12. shows. This prompted us to speculate on the thicker handles on



the archetype vessels (figure 5.7.10, mentioned above). It seemed more likely that they were made that way as a matter of choice and not simply because a stiff cobalt glass ruled out pointed tips.

It was at this point that I encountered my first simultaneous change in materials (Glass 4), tools (bead mandrel 2) and gesture (touch and *high* lift). This was very challenging. My handle making became noticeably more inconsistent. Figures 5.7.13a – d show handles of noticeably different sizes with the emphasis on gigantism; a great number of the beads I gathered were unintentionally enormous. The only exceptions are FL 60 and FL 66, where neither handle is overly large. The other exception is FL 56 – where the handles are not mine: I had to abandon the vessel in order to leave the workshop on time and MT had added handles for me. The inconsistency affected only the work I did at the gathering furnace – bead gathering and application. I continued to carry out the shaping operations at the working furnace as consistently as before.

The reasons for the inconsistency can be analysed in terms of gesture, tool and material. The longer mandrel reduced my control of the size of the bead I gathered, and the new glass was less viscous, which meant that I needed to dip the mandrel slightly deeper and rotate slightly longer than I would if I were using the previous more viscous glass. I failed to do this, thereby gathering unacceptably small beads. I then overcompensated, plunging the mandrel into the glass pot and rotating repeatedly until I had an enormous bead. Unwilling to abandon the operation and start again for a third time I touched this bead on and then lifted, applying the amount of pull necessary for a far tougher bead made of the previous stiffer glass. The new mobile bead then stretched rapidly upwards, the top end flung even higher by the long, bouncing mandrel; alarmed, I then plonked the mandrel back onto the vessel as quickly as I could, ‘anywhere it could go’. This resulted in the differently sized, strange-looped, and out-of-line handles in figure 5.7.13.

I then made a concerted effort to become dexterous in this new gesture-tool-material complex by doing what I had done when applying rims: taking time out from the normal run of vessel-making to practice a particular series of operations – in this case, bead gathering, touch-on, lift, and touch-down. I also took care with handle tooling during this practice session and managed to produce a series of handles with well-shaped

tips and round loops (figure 5.7.14a). At 2.0 – 2.5cm they are slightly too big. A comparison with the more melted-on handles of copper glass in figure 5.7.14b. shows how much more mobile the copper glass is; this latter set is, at 1.5cm at most, a little too small.

The following two days showed more consistency in my handle work. On Day 32 I aborted the first gather of FL 66, and for both handles elaborated a sequence of tooling steps, pushing down against the tip, then opening the loop, and then flattening the middle. I followed this with remedial alignment with the short tweezers. The tips of this vessel are quite pointed which suggests a high-ish lift. The next vessel, FL 67, sports one small misshapen handle with a perky tip paired with another giant. After that point, however, there is only one more instance of truly ‘comedy’ handle making – on FL 75 (figure 5.7.15), where I gathered hastily in an attempt to apply two beads consecutively and then work them consecutively after reheating. With a few exceptions the copper glass sequence of FL 71 to 80 show noticeably similar, though slightly small, fairly symmetrical handles (figures 5.7.16a, b and c). I refined my bead application, realising belatedly that too heavy a touch-on left too much glass behind producing a small loop and large tip; too light a touch-on had the opposite effect (figures 5.7.17a. and b.). I also continued elaborating the sequence of steps for handle shaping, using the spike to push against the tip and then to slide, exerting pressure, along the middle. Further refinements included moving the hand further towards the business end of the mandrel and using the spike to pinch in just below the loop; this resulted in a sequence of well-applied and well-shaped handles on the final cobalt glass sequence of vessels, although some of the bead gathers were too small (figures 5.7.18a and b). On the last day of the Project I managed to pause after gathering to let the bead become fully round before touching it onto the vessel. My final handle making sequence, then, included a variety of small but indispensable gestures which became integral and highly-valued operations in this sequence of work steps (clip 5.7.10).

### **C. Summary**

The model presented in Chapter Four posited that the process of becoming dexterous can be discussed in terms of various aspects of the process. Whether this was possible was to

be assessed by applying the model to a practical project. It appears that when a craft apprenticeship is conceptualised, carried out, documented and analysed in these terms it shows that the different aspects of skilled making are highly interrelated and extremely dynamic elements of a kinaesthetic process. Some of our interactions will be presented here with summaries in bold type.

The problem of vessel cracking (which actually turned out to be largely unrelated to core composition) afforded me the experience of working with fibrous, stinky, flaky core mixtures. Initially I was too light in my glass marvering just as I was too heavy in my core marvering. But my glass marvering became heavier and more aggressive as my core marvering became lighter and more tentative. This gesture ‘tuning’ aspect of skilled making is especially highlighted in a craft where not only are different materials subjected to similar gestures but where the properties of materials change during the working process. Glass becomes less mobile the longer it is withdrawn from the heat, so even as we rolled the glass we increased the pressure and vigour. **Our response to one materials problem (glass) was to change another material (core mix), increasing our experience of both: this in turn led us to develop two gestures out of an original single gesture: much lighter rolling (for cores) and much heavier rolling (for glass).**

When we decorated the vessels we were also dealing with materials – in this case, decorative glasses, whose properties changed while they were being worked. Additionally the major *form* change of the decorative glass – from rod to cone – was tantamount to a materials change in itself, so great was the alteration in the behaviour of the glass. A plethora of preparatory operations involved new tools: a Stanley knife, a lump hammer, metal rods, a slipped metal plate, and a clay ‘toblerone.’ All these we ‘drew in’ to the decoration procedure by adopting this new technique, much as by adopting the second core covering technique we ‘drew in’ the block and the paddle for heavy marvering. When decorating different problems with temperature and tempo arose; while rods overheated, cones stiffened. **Our increasing experience of materials (decorative glass) allowed us to bring in a major new set of gestures and tools which we took time to get experience in using .**

When tooling the trails the closeness of my hand to the vessel made it one of the procedures where fear played a part. The experience of the full range of stiffness of the

hot glass could only be increased by using tools on it, and at some point the knife would skid. So I proceeded in cautious increments. **Becoming dexterous increases a maker's experience of materials, but at the same time it is materials experience which allows a maker to become dexterous. This is highlighted in cases where a maker may get injured because it shows very cautious increments of dexterity and experience.**

When making necks my response to our switch to copper glass was to embark on a 'tool-gesture path' (from squeezing with pincers to not squeezing at all with tweezers) that I was then able to use when returning to a previous material – cobalt glass. Additionally our use of long tweezers, appropriate to shape the flatter, smaller rims of later vessels, allowed us to develop not only the swift gentle run of squeezes which became the desired rim-flattening gesture but also the quick and economical turn-and-a-half of the vessel-bearing rod, which was all one needed when applying the rim glass from a trail iron at the gathering furnace (figures 5.6.12a-f, clip 5.6.8). Any more than one and a half turns and the rim would be too wide, or too thick, or possibly both, to benefit from squeezing by the delicate pincers. **A tool (the tweezers) can be used in such a way that the worker makes changes to another gesture entirely (applying a rim) using another set of tools entirely (vessel-bearing rod and trail iron).**

With handle making the gesture-tool-material interaction was also immediately apparent as was the relationship between this and our experience of an artefact feature. I belatedly took up MT's suggestion that I should place a photograph of vessel TMA 76, a desirable Class IB vessel, within my eye-line when seated at the glass working furnace so that I could refer to it during the course of work. I had rejected the idea at first: I had been so focused on the most basic aspects of work and safety that I did not imagine I would be able to take the time to look at the picture, let alone act on it in any meaningful way. As mentioned above, the picture was of limited use. Even with it in front of me It was as if until I understood handles, the alabastron effectively had no handles. I could not understand their shape until I had become dexterous enough to achieve a semblance of a handle. I could then identify this feature with the concomitant feature of the vessel I was trying to reproduce. At this point the handles in my mind's eye began to stabilise and solidify – and consequently differentiate themselves from other kinds of differently-shaped handle in the archaeological database. As our handle-making grew more

consistent, so did our understanding of the handles and the complexity of our work-steps. Considering work steps in this way highlights the essentially kinetic and real-time nature of craft work: as people move through space, wielding tools and materials, so do they move through time. There is an internal sense to the organisation of steps, which lead one from the other in a way that has been described as ‘narrative’ and ‘processional’ (Ingold 2000b, 65 and 2006, 67). All memory of often very carefully explained processes can desert a novice, either momentarily or, in the case of a hot-worked craft like glass, to the point where the artefact has to be handed over to the teacher or abandoned. When on Day 3 I attempted an assisted applied rim it was after a careful mimed rehearsal with an unloaded gathering iron. Even so, when MT returned with a hot gather of glass I still had to ask repeatedly ‘How shall I hold it?’, as if the situation were completely unrehearsed.

**Work steps sequences, and artefact features, need to be experienced through making. The experience of both work steps sequences and artefact features is kinaesthetic, just as the steps themselves are generated out of kinaesthesia.**

The holistic nature of the process was shown by the way a *lack* of dexterity affected not just the hand, tool and material but the totality of the working environment. Initially I could not even make out what MT was saying above the roar of the furnace. When I did hear the words, it was hard to make sense of them because I was hot and frightened as well as ignorant. On Day 1 I was so unconscious of the tools I was using that although I was using the grapefruit knife I took the steak knife from MT after he had demonstrated a stroke and continued working with it, unaware that I had changed tools. As the days passed, however, I noticed a calmness and clarity in the surrounding environment. The sense of danger, haste and pressure abated. The tools settled into position around me and I could reach them without taking my eyes from the vessel in the furnace. Then I became aware of an increasing meaning to my gestures. The decorative glass rod was stiff *so* I paused for it to soften; *because* the body glass was a deep orange I waited and reheated it more thoroughly before working it. But even when I attained a measure of stability the process was easily disrupted, as many of the changes described above demonstrate. In my experience the disruption took the form of a return to the initial incoherence caused by the lack of ‘meshing’ of the various aspects of becoming dexterous. The simultaneous tool, material and technique alterations which took place

after 20 days of handle making not only made me feel as clumsy as I had during the first days of the Project; I was also made aware of how little I experience I had of spikes, runny glasses, and even of handle shapes. The substitution of glass cones for glass rods in decoration (a glass cone replacing a glass rod is tantamount to a materials change) also shows how wide-reaching this disruption can be: not only did I find decorative trailing harder, it also hampered my rim making and shaping – a different procedure. **The experiential process of becoming dexterous is holistic and therefore fragile. Disruption in one aspect affects many other aspects.**

#### **D. Conclusion**

- How does a theoretical model of skilled making help one to experience and document the process of becoming dexterous in core-formed vessel making?

In response to this research question a kinaesthetic model of skill development, one which conceptualises the learning of skill in terms as the experience of becoming dexterous, was applied to an episode of learning skilled making. All Project activities were undertaken and described as instances of this experiential process and documented in the terms of analysis presented in the model. It was shown that this type of analysis foregrounds the synergy between movement, tools and materials and shows how this synergy both increases and depends on experience of tools, materials, artefacts and work steps. The indispensable role of watching, feeling and listening in the larger interaction between gesture and experience was also noted. The way that the makers' responses in one aspect led to multiple changes in other aspects showed that the process of becoming dexterous is both dynamic and holistic.

## **Chapter Six. Dexterity and Value: the Implications of a Kinaesthetic Analysis of Skilled Making.**

### **A. Introduction**

Chapter Five analysed an episode of craft learning in terms of a specific kind of kinaesthetic event; the experience of becoming dexterous with tools and materials. It was suggested that the various aspects of this experiential process were deeply interconnected and to understand it entailed taking a holistic view which contextualised skilled making within a wider material context. This chapter explores the implications of the analysis presented in the last chapter by addressing the next three research questions:

- What is the relationship between the process of becoming dexterous and the generation of craft values?
- What is the relationship between the process of becoming dexterous and continuity and change in artefact production?
- How does dexterity develop within a community of makers?

This involves bringing out some further dimensions to skilled making implicit in the analysis: the dimension of value, that of communality, and the nature of continuity and change in artefact production. Section B describes how the early phases of becoming dexterous generated a system of values. Section C suggests how the highly dynamic and contingent nature of skilled making can be reconciled with a strong impulse towards conformity in artefact production. Section D develops the concept of the ‘working group’ and the ‘spiral of dexterity’, an explanation for how artefact features develop within communities of makers.

### **B. Dexterous Movement: a Value-Positive Experience**

Skilful movement and artefact consistency, it was suggested in Chapter Five, arise out of the interaction of different aspects of the process of becoming dexterous. But this is not to reify, abstract, or ascribe agency to these different aspects. MT’s development of Cowl 1

did not of itself drag the cleft bamboo into the workshop and onto the upturned box beside the working furnace where we kept our tools. Neither did the bamboo appear simply because MT had made an observation about the cowl: ‘this cowl is throwing a great deal of heat out horizontally.’ The bamboo actually appeared because MT formed the following judgement: ‘... which is bad, because it is hitting our hands and faces: so we need something long, to hold the decorative glass rod.’ MT could equally have made a value judgement which caused things to be left as they were: for example ‘the cowl is hot... but we will see if we can alter our posture or get used to it’. In this way, whether it leads to change or stability, a judgement helps in the formation of a sequence of work steps. Some judgements can in principle be formed extrinsically, without any connection to the working process. Any reasonably knowledgeable person could say: ‘that bottle is too big: you need to make smaller cores’; an expert connoisseur with no hands-on experience could also add: ‘and the neck is coarsely shaped: you need to find a set of pincers with narrower blades.’ What distinguishes the maker’s judgements from those of the viewer (however well-informed) is that the maker’s judgements arise out of the process of becoming dexterous. This chapter suggests that this process is inherently value-positive, and proposes to describe exactly how value is generated.

### **1. How materials should be treated**

The change in decorative trailing technique from using glass rods to using cones meant that I had to become familiar with a great number of new preparatory steps. Heating small chips of glass on a slip-covered metal plate over the furnace; sticking one onto a metal rod which I had already tipped with a melted and wound-up glass rod; holding the chip at first high and then lower over the furnace so it did not crack off from sudden heating; carefully sticking another chip to the one already attached and repeating the process; then carefully marvering the result into a small and symmetrical cone: all these operations could not be hurried and required active, patient watching and repeated small careful movements (figures 5.3.21 – 24). I then heated the cone and started the decorative trail. But each time as the cone stretched out it stiffened and needed to be either pulled off or melted off before being marvered back into shape, reheated, and touched back onto the vessel. I tried to overcome this by pushing the stiffening thread



down into the furnace to soften, which prompted MT to suggest widening the aperture of Cowl 3, but although the heat came out vertically as opposed to horizontally as with Cowl 1 we were reluctant to expose ourselves to more heat without good reason and I concluded that I should first try and increase my skill rather than immediately modify the cowl aperture.

After eleven days of cone trailing – Days 21 to 31 – I was becoming dexterous in the operations needed to prepare a glass decorative cone. But however well I performed them, my trails pulled out in stiff stalks when MT's trails flowed in regular spirals onto the vessel as if they were made of toffee. Although I did not realise it at the time, my small materials experience had led me to form a value judgement about how decorative glass should be treated. This arose partly because I had first started decorative trailing using glass *rods*. As far as I was concerned at the beginning of Phase 2 the procedure of decorative trailing was characterised principally by the rapid melting of opaque yellow glass. Yellow glass *rods* seemed to take no more than ten or twenty seconds to soften enough to be wound on to the vessel. One could control the speed of melting by winding on at varying speeds, none of them over-fast – briskly for a thin rod which rapidly turned a deep caramel shade and threatened to melt off, and slightly more deliberately to allow a thick rod to brown as it moved across the aperture towards the vessel, thereby preventing breakage of the glass rod or deformation of the vessel. Zero preparation – MT had made the rods for me – a quick pre-heat of the end of the rod and then deliberate, even leisurely, winding: these were the operations for decorative trailing as I understood and performed them and all my gestures, my sense of the tempo of the work, i.e. when to pause and when to move swiftly, were tuned to these operations. Because I had attributed ease of heating to yellow glass itself, and not to yellow glass *rods*, I did not understand that cone trailing was all about heating. The actual winding part, if one had heated sufficiently, was far quicker than when trailing with rods. The entire mass of glass was thoroughly softened and demanded the most rapid application before it cooled.

The situation was further exacerbated by my lack of experience in tools. During Phase 2 MT assigned to me the task of lighting the working furnace. Gas flow to the burner at the base of the working furnace was controlled by a gas tap and a regulating wheel. The rate of flow could be judged by turning the wheel to its full extent and then

some distance back again. Turning the gas too high resulted in a howl from reverberation – similar to water hammer in a pipe. But when I assumed this responsibility (on Day 33) I had not developed any skill in listening and found the more desultory tone of a cool furnace almost indistinguishable from the higher-pitched, busier roar of the hot furnace. Fearful of making the burner vibrate – the one sound I could distinguish from the others – I tended to set the temperature too low for successful cone heating. Although the prime indicator of my furnace temperature was, of course, the mobility of the glass as I worked it, I did not immediately turn up the heat. My experience from Phase 1 was that successful trailing depended on a good relationship between trail glass and vessel body temperature. Too hot a vessel and the trail glass would pull and deform the vessel wall.

These low temperatures should have prompted me to dip the cone ever deeper into the furnace and marver ever more repeatedly – but this did not occur. Because I did not understand how low the furnace was I did not realise what had happened. My initial response was to disengage from the situation. So I heated and marvered less, if anything, out of impatience to complete the procedure. The introduction of Glass 5 on Day 34 only prolonged the problem. Glass 5 was a copper glass - Pichvnari Glass 3 but with copper instead of cobalt. (We knew from the database of original vessels that a sizeable minority of Class IB vessels were made with copper blue glass and decided to try it.) Copper glass being more mobile than cobalt, it required a lower temperature for covering the core than did Glass 4 and so my cautious furnace settings were even less noticeable during core covering. I tried making long thick cones but they were not stable: on FL 71 the cone fell apart and trailed onto the vessel in a thick lump. I reverted to squat pointed cones for FL 72 and produced the same, if slightly less marked, lumpy trail. The relatively even trails on FL 73 have been applied overhand from base to neck, which is why they are narrower at the shoulder. Had they been applied from neck to base underhand and with more attention to spacing they would have been judged more highly. Inadvertently I had produced the ideal cone for trailing at lower temperatures - small and thin. The result was ten continuous turns of yellow trail. By dint of thorough reheating, which I did not notice – I thought simply he was ‘taking rather a long time’ – MT had achieved even trails on four vessels by this point. I continued to blame my tools; feeling that a larger aperture would give the trail more room to heat up as it travelled from the cone to the vessel body

I finally asked MT to take a piece out of the aperture of Cowl 3 (see figure 5.3.29). but the main difference was that trailing was now hotter work, which only interfered with my rudimentary furnace temperature observation skills.

In this instance I did not revise my judgement of my own accord. The situation was resolved by an extraneous factor. On Day 36 the furnace was affected by the formation of an unknown substance on the surface of the glass which created a light, slightly iridescent layer over vessel body and cone which made it difficult to touch the cone onto the body. This meant that on FL76 it took me *six minutes*, and repeated attempts, before I even managed to make the cone stick to the body glass, during which time I gave the cone *seven* marvers (rollings) and reheats. The result: eight and then, after a reheat, three more turns of markedly more even, well-spaced yellow trail *of the right thickness* (see Appendix 8-17).

It was only on Day 39, when I reverted to cobalt glass, that lengthy core covering prompted me finally to increase the furnace heat. I did not turn it down for trailing and found that my – now much more thoroughly-heated – cones suddenly more manageable. I produced admittedly thick but even, and evenly-spaced, trails of the same consistency as FL 68 made on the morning of Day 33, my first day in charge of the furnace. Although I have no record of this, the difference in trail consistency between FL 68 (Day 33 a.m., Appendix 5-16) and FL 69 (Day 33 p.m., Appendix 5-17, which I thought were so bad that I trailed all over the body for practice) prompts me to speculate that although MT showed me how to start the furnace on the morning of Day 33, it was not until after the midday break that I first turned up the furnace completely unsupervised. A judgement – one might almost say a prejudice – about decorative trailing, stemming from a lack of experience with yellow glass and with furnace heating sounds, created this situation which was resolved not through an increase in tools experience (I never really became sensitive to furnace behaviour) or a revised judgement about heating cones but through an extraneous event (the iridescent layer on the surface of FL 76) and a return to a more familiar glass.

## 2. The worth of a task

In every case where experience led me to revise my judgement, it resulted in a new awareness of the worth of a task. It was worth heating the cones properly; thorough heating, I realised, was the right way to treat a cone. A judgement about core making, when revised, produced another such instance of the awareness of worth. My initial problem with core making was not simply that I was unable to make symmetrical and uniformly sized cores. Rather it was that 1) I could not see what was going wrong and 2) I wanted to move on to glass working. I did not realise at the time that these two problems were connected. Having decided that core making was a tiresome and baffling preliminary chore I developed no skill in watching MT and did not notice the slow pace and the care with which MT worked. This was why, when making the inner layer to the core, I found it hard to get any mixture to adhere to the rod at all. It is noticeable how on Day 5, when making cores, at no point did I bend to scrutinise the work or to view it from a horizontal angle (clip 5.1.1). Core forming was literally 'far down' in my estimation. Even when cores rolled off the rod, and it was obvious even to me that an inner layer was probably needed, I continued to shirk this step until absolutely compelled, by the catastrophic performance of my cores under glass working conditions, to do it. By Day 7 I did at least realise that the only way to get uniformly sized cores was to repeat the gesture until the right amount of clay in the cupped palm of the hand felt 'natural'. This was very slow in coming because of my impatience to start glass working and my reluctance to develop a sequence of work steps for core-making. I was also still under the mistaken impression that marvering 'hard', i.e. applying pressure, was the right way to consistency.

On day 14, however, I finally paused long enough to watch what MT was doing. The key gesture for making an inner layer was a gentle squeezing action which worked the mixture *upwards* from the bottom of the rod to form a thin but coherent inner layer. I had been starting at the *top* of the area to be covered and squeezing the material down to the end of the rod with open-fingered, clutching grabs. I also observed the lightness of touch needed, especially in his response to loose fragments of mixture. Whereas I, faced with disintegration of the inner layer, tore the entire layer off and started again, MT gently dabbed the fragment back into place. It was at this point that I noticed the high

level of attention he was giving the work. I realised that it was because he thought that the work deserved this attention. If I were to do this well I needed to revise not only my core-making gestures but my understanding that every little detail of the work merited painstaking attention. In fact it was this missing understanding of *worth* which had impeded my becoming dexterous in these gestures.

On day 17 I eagerly practised using a lighter touch for some more lightly-made cores and also improved the cut-in at the neck. On that day MT and myself were engaged in a variety of careful hand-shaping and marvering operations at a high level of attention (clip 5.1.2. and clip 5.1.3). Although it is not necessary to kneel on the floor, I found that it was easy to bend forward and look closely at my work. The clips show that my hand gestures are not as varied or as agile as his and consequently not as effective, but I was still working intently and carefully. I achieved a more symmetrical core shape as a result (figure 5.1.23). It is instructive to compare clip 5.1.1 with clip 5.1.3 and with clip 5.1.5, not just to see that I did attain a level of dexterity but also to get a sense of the steadily increasing attention and effort I devoted to it. A feeling of worth was indispensable to my becoming dexterous; at the same time, however, dexterity appeared to generate this feeling. This will be discussed further below.

### **3. A sense of rightness**

Chapter Three mentioned the role of sensory corrections, rather than particular bodily movements, in skill learning (Bernstein 1996). The corrective nature of skilled movement is why bodily learning does not consist of one single action activated by a single neural pathway but rather a facility of repeatedly solving a motor problem each time under slightly different environmental conditions which never repeat themselves (Bernstein 1996, 176). Bernstein lists several stages of skill acquisition, from engaging with the skill on a particular level of consciousness and specialism, through identification and distribution of the vital corrective movements through repetition, to the relegation of these corrections to background levels of autonomy – an autonomy which, because it is a facility of corrective manoeuvrability and not a mechanistic reiteration, can be extremely creative and agile in problem-solving (Bernstein 1996, 189). As the vital correction is activated, the gesture is performed correctly; Bernstein then mentions that sometimes

this seems to happen suddenly, which accounts for anecdotal reports of ‘getting the knack’ for a task or ‘getting one’s hand in’.

My first task on the first day was to learn to cover the core with glass and I was introduced to Core Covering Technique 1 (Ch 4.D.3 and Ch 5.B.1). My initial pulls with the knife blade were unfamiliar, difficult to repeat, and occupied all my conscious attention. Then, as my hand and arm muscles became used to the feel of the blade in a certain position and the toughness of the stiffening glass as I pulled it, my body tuned to the gestures and they became autonomic. This left my attention free to concentrate on checking the core for flaking and for thin patches and even to think about future procedures like decorative trailing. However, the most important thing about this ‘bit’ of dexterity, the gesture of tugging, was the almost automatic attachment of value to it. The moment that it physically felt ‘right’, that is to say, comfortable and easy, able to be reliably reproduced without concentration, it also became ‘right’ as in ‘the correct way to cover the core.’ *The second, ethical kind of ‘right’ appeared to be contingent on and inseparable from the first, physical, kind.* So if the source of rightness is bodily autonomy, or dexterity, the nature of rightness is a physically-generated sense of correctness. Explanations for the retention within a craft community of techniques which appear inefficient, time-consuming or wasteful of resources often centre on the social – that they confer status on the producer, emphasis identity, reinforce kinship links – or the economic – that they provide labour, produce useful by-products, or have a high market value by conferring status on the consumer. However it is suggested here that the primary impetus for the retention of a technique is simply this sense of physical-ethical rightness which stems from the dexterous gesture. ‘Rightness’ does not relate to efficiency, thrift, speed, or the converse of these things. It is entirely related to a person or a group of people, arising as it does out of a specific body or group of bodies. It certainly does not mean that because an enquirer finds that it ‘feels right’ that ‘that was the way they did it.’ Rightness of this kind can certainly ‘impede progress’, if ‘progress’ is what one is concerned with (which is why craft communities are often characterised as ‘inherently conservative’).

Core Covering Technique 1 was fast but produced thin patches in the glass which made it fundamentally unacceptable. Nowhere in the original vessel fragments did we see

such fluctuations in wall thickness. Not only did MT have sufficient materials experience to see that the behaviour of the glass was becoming an intractable issue, he also possessed a repertoire of alternative skills which might eliminate thin patches. For him it was a question of finding gestures already present in his repertoire and modifying them for Glass 1 (choosing to trail three rings of glass instead of a spiral.) But for MT to actually start trailing he had first to revise his existing value judgement about it. He had prior experience of trailing body glass in spirals onto a core from his 2004 experimental session – a technique which took, as it seemed to him then, an inordinately long time. But the shortcomings of Technique 1 raised the spiral trailing of body glass from ‘done before, acceptable, but slow and not as interesting as Technique 1’ to ‘produces even walls, could be speeded up, and definitely worth trying’.

The fact that this change only took place after ten days was due precisely to the kind of ‘rightness’ discussed above. It should be pointed out that Technique 1 had already been started by MT and Emily Coulson during their two-day experimental session in March 2008, using modern glass. This comparatively mobile material afforded them a great deal of practice in the technique. As they repeated the various operations, these operations began to form a sequence of core-covering work steps. When on one occasion Emily was prompted by MT to abandon the pincers she was using to shape the neck and roll the vessel shoulder against the near edge of the marver instead, she apologised saying ‘I forgot’, because there was already a set sequence she was engaging with. Emily’s behaviour showed how quickly – over two working days – the sense of rightness was building up around the execution of this technique. It encouraged the workers to minimise the problems of the new technique; the tendency towards thin patches was viewed as a teething problem solvable through tool and gesture refinement, which accounts for the attention MT paid at this stage to the angle of the knife blade.

Naturally as a novice glass worker I also accepted Core Covering Technique 1, thinking that it needed only minor tuning ( as in the selection of tools and the angle of the blade) to be acceptable. I treated the disappointing results in the same way that I treated my marvering skills: I was still baffled by the limited effect my marvering had on the body shape and neck and shoulder profile of my vessels; I could see the principle of marvering from the base to the body and vice versa, but did not manage to move the glass

around the core by this operation. But I assumed this was due to my lack of dexterity in marvering. In the same way I attributed my thin patches to clumsy knife work. I was fully engaged in learning the necessary gestures, saying on Day 9 'I've got used to this knife' (the grapefruit knife) and fully expecting to be able to win the battle against thin patches over the following weeks. Like Emily Coulson I rejoiced in the growing sense of physical and ethical 'rightness' as I practised a gesture which, along with those for the remaining procedures for core-formed vessel making, constituted my entire glass working experience. My experience of tools and materials, unlike MT's, was inadequate to counter the 'pull' towards rightness that the repetition of a craft gesture engenders.

Technique 2, trailing body glass onto the core in a spiral, proved impossible with Glass 1, so we moved to Technique 3, trailing body glass onto the core in three or more separate rings (see Chapters Four and Five). Technique 1 had entailed taking a core, heating it, and then gathering glass straight onto the base of the core before tugging it up the sides. Technique 3, on the other hand, involved the following operations: selecting a gathering iron; taking it to the gathering furnace; propping it in the yoke to heat with the furnace door closed on it; watching until the tip was cherry red; making sure my core was heated; taking my core to the gathering furnace; taking the gathering iron in my right hand and propping the metal rod of the core in the yoke; cooling the gathering iron if necessary; trailing the gather onto the core; casting off; putting the used iron in the bucket; closing the gathering furnace door; and returning to the working furnace. That was before any core covering had actually been done. When we switched to this technique I was at a loss. My routine had been destroyed and I was exposed to learning skills that I had no experience of and which my teacher was expert at. I was challenged by the preparatory steps listed above but demoralised by the hugely increased amount of time it took me, even with Glass 2, to actually cover a core. I experienced again all the stiffness and tentative motion of my first few days on the project. My body glass trailing technique, which was very new (I had trailed the rims onto half a dozen vessels unassisted) was unequal to three, four or five gathers per vessel and I found myself laboriously trailing on thick masses of rapidly stiffening glass which left a much more uneven leading edge than I had become accustomed to with Technique 1. As described in Chapter Five, casting off the gather was especially hard to master.



These difficulties gave rise to a hostility which I struggled to quell. The technique represented a negation of all I had learned about core covering. Just as the physical and ethical rightnesses were indissolubly linked in learning the gestures of Technique 1, so they were involved in reacting to the change. Our teaching and learning relationship had been constructed around Technique 1 and the fact that MT had checked my work and adjusted my gestures to an agreed norm only reinforced the approving judgement I felt was being attached by him to this technique. I eventually learned the gestures for trailing body glass onto a core but it was not simply out of stubbornness that I continued to use knife strokes I learned from Technique 1; it was, of course, because it also *felt right* to do it. I was encouraged in this idea by the fact that when we were making beads we both gathered and trailed glass onto a rod and then shaped the edges with a knife blade. (The ‘stickiness’ of tools, the way they cling on when new procedures are adopted, will be discussed more fully in Section D.)

As with core making, the lack of a sense of worth was what impeded the emergence of rightness. If a worker does not think a procedure is worth doing, s/he will find it more difficult to become dexterous in it. This really happened with Core Covering Technique 3, which took such an unconscionably long time that it led to a shift in materials – the creation of Pichvnari Cobalt 2 (Glass 3) and Pichvnari Cobalt 3 (Glass 4) (Ch 4.D.3, Appendix 3) – and gave way itself to Core Covering Techniques 4 and 5. As noted in Chapter Five it was on Day 27 of the project that I was finally satisfied that a technique had the potential to cover the core acceptably. Just as value judgements of a technique’s desirability – the speed and ease of Core Covering Technique 1 - caused us, in spite of its eventual inadequacy, to learn to perform it with dexterity and generate rightness, so did our judgements of a technique’s *undesirability* – the laboriousness and slowness of Techniques 3 and 4, and their tendency towards *thick* walls – prevent dexterity, along with its consequent sense of rightness, really taking hold.

The most important consequence to be noted here is that once a person becomes dexterous in a gesture it is extremely hard for them then to produce inconsistent work using that gesture. Firstly, the gesture is now an instance of bodily autonomy (Bernstein 1996) and one cannot simply decide to ‘strip it out’; it is a suite of continually retuning responses. Secondly, the tool and material experience which a maker builds up through

the process of becoming dexterous means that tools and materials will be suitable and well-prepared; this further militates against inconsistency. Thirdly, the sense of rightness concomitant with autonomy gives rise to a conviction that this is how the feature should look and should be made. These three points are important archaeologically since they support the vital corollary to the statement ‘these inconsistent makers could not have made this consistent work’, which runs as follows: these consistent makers were very unlikely indeed to have been able to make this inconsistent work.

### **C. The Role of Value-Positive Dexterity in Continuity and Change**

Section B concentrated on the various dimensions of value which are intrinsic to the generation of dexterous movements and indispensable to understanding how skills are developed. The aim of this section is to resolve, by reviewing aspects of our skill development in the light of this discussion of value, the apparent paradox of skilled making: that skilled making appears to promote great continuity while at the same time seeming to have enormous potential for change.

#### **1. Continuity: attaining stability**

There appeared to be a point in our work when we were satisfied with the features of an artefact and we no longer tried to alter gestures, tools or materials. Continued change in the procedure responsible for those features was then no longer thought necessary.

We felt satisfied with our core covering by Day 27 or 28, when I substituted marvering for melting down in Technique 5 (Ch 5.B.5). A sense of ease permeated the work; the individual operations seemed to slow in tempo, knit together smoothly, and become more expansive physically (rather as the roads widen and the traffic mysteriously calms down as a novice driver gains experience.). The same happened with neck shaping at around the same time. The stabilising procedures presented themselves as areas of clarity or smoothness surrounded by other areas still chaotic and uncharted. I adopted the notion of ‘islands of stability’ to describe this, acknowledging the relief upon arrival at one of these islands which came from the fact that I no longer had to consciously address this procedure as a problem; my body was now solving it. (Bernstein (1996) defined

dexterous movement as the repeated solving of motor problems.) Some procedures had a rougher passage to stability than others, especially those which became fragmented, separated in time by intervening operations belonging to other procedures. Neck shaping is a good example of this, involving possibly a record number of tools and gestures (Ch 5.B.5); the back and front edges of the marver, the pincers, short and long tweezers, two different bent rods, a metal bar, and the blade of the grapefruit knife, which were used variously for rolling, squeezing, pressing and pinching. We shaped the neck during core covering and then again later before and during rim shaping, these two episodes separated by the decoration procedures of trailing and trail tooling. When a core covering procedure was abandoned this initial episode of neck shaping went with it, to be replaced in the case of Core Covering Technique 5 with nothing at all. This variety of tools and gestures, and this sometime neglect of the procedure, stemmed from a problem discussed in Chapter Five: a lack of understanding of the correct position for cutting in the neck. Until the importance of locating this position was perceived the procedure would continue to produce unsatisfactory artefact features and remain unrewarding.

The same understanding applied to the application of the base trail – the decorative trail placed below the main panel of body trailing at a point about three-quarters of the way down the body – which also ‘jumped about’ between other procedures for most of the Core-Forming Project. Many base trails are unmarvered and remain proud of the vessel, which means that they must have been applied not only after the body trails had been marvered but also well towards the end of vessel making – or they would have melted into the body. My base trails were applied immediately after body trailing, after adding a decorative trail to the rim, and even after handle application, and this was chiefly because I did not understand that they were conceived at least originally, if not throughout the history of the procedure, as a way of using up a trail cone. Cones do not last; if they cool, they crack. If they do not crack they are hard to recoup for future use by chipping them off the metal rod. Iron scale invariably adheres to the underside of the small half-finished cone, and that has to be removed by further chipping to separate out the clean glass. The usual result is a large number of tiny chips, each with its cap of unusable iron scale. Far better to use up the cone while it is hot. One large cone might suffice for the decorative trailing of body and rim: more commonly two

smaller cones may have been used. Two cones are more likely because 1) it is easier to thoroughly heat a smaller cone than a larger one and 2) larger cones can pull off the metal rod in an uncontrolled mass if they have not been thoroughly marvered after forming; and 3) the decorative rim trail on the original vessels is generally fat with a round-ish cross-section, a sign of the well-controlled start of a cone rather than the more wispy and capricious tail-off which one would expect if the cone had already been used for body trailing. It is base trails which are wispy and capricious: they range from one to as many as three turns and they are 'wrapped' almost casually over each other. For these reasons I chose finally to lay on the base trail after the rim trail and before making the handles, because I felt that in this way I would be doing the same as the original makers: using up my cone.

It was my progress in decorative trailing, however, which showed most clearly how artefact continuity might arise. Decorative trailing continued to be a problem for me, demanding a series of compensatory gestures and manoeuvres – pushing the cone trail down into the furnace, marvering the cone into a variety of shapes, making cones of different sizes, and so on. This procedure attracted a great deal of advice from MT and practice from myself but by the end of the Project it was still a mystery to me how MT managed, with what seemed like minimal marvering and reheating, to produce a smooth unbroken narrow yellow trail of sixteen or so revolutions when the same actions (or what I *thought* were the same actions) when performed by me produced a thick lumpen trail which appeared after five revolutions to turn to stone. But because he had succeeded and was convinced that I would as well, there seemed to him to be little justification for us to further modify tools and materials. Not only had MT harmonised gesture, tool and material to produce the desirable feature in question; the gesture had also become, in Bernstein's sense, autonomic for him. This meant that MT had the same sense of physical and ethical rightness that I had felt when using the doomed knife-based core covering technique. The difference being, of course, that where my inadequate experience of body glass behaviour had led me to think my uneven walls could one day be 'okay' if I tried hard enough, I was now sufficiently experienced in artefacts (trail appearance) and materials (yellow glass) to agree that the decorative trails MT was producing were 'right'. I would suggest here that this is one of the primary factors in introducing stability into

work steps and consequent artefact continuity: the skilled person in a group (whether s/he is formally designated 'teacher' or not is irrelevant) is convinced, on this kinaesthetic level, that this is how the task should be done, and others, whose experience of tools, materials and artefacts is sufficient to allow agreement, try to follow by tuning their bodies dexterously.

Whether or not the artefact feature is 'right' is, of course, a matter of consensus. This important communal dimension to dexterity will be addressed in section D.

## **2. Change: the contingent nature of skilled making**

By the end of the Project we had the makings of a sequence of work steps. This can only arise out of episodes of dexterous movement. It cannot be constructed by an unskilled person; more importantly, neither can it be determined in advance by a person skilled in associated areas but new to this particular craft. The unskilled person cannot build a sequence of work steps because s/he clearly lacks the experience. The peripherally skilled person cannot determine it in advance because each procedure depends on the interaction between as yet untried tools, gestures and materials. The interrelated nature of aspects of coming to move dexterously with these tools and materials is what gives rise to unforeseen change, and the construction of a sequence of work steps happens *through* these unforeseen changes. What will now be addressed is the highly contingent (i.e. produced out of specific pre-existing factors) and dynamic (in itself productive of change) nature of skilled making.

It is possible to draw upon the descriptions of individual procedures in Chapter Five to show how development within a procedure is often characterised by a repeated interplay between the same small group of elements. One example of this is the relationship between core mixture, core covering gestures and tools, and glass. Our response to vessel cracking – a glass problem – was to produce core mixtures with an increasingly high organic content. If we increased glass mobility we could reduce core covering times. If core covering times went down, so could the organic content of core mixtures. As we moved one element 'moves' along its own particular value scale – of friability for core mixtures, mobility for glass, duration for core covering techniques – we then had the opportunity to move the other elements. We realised that this

core/glass/technique(duration) nexus could have several areas of viability. A friable core mixture might still crush after lengthy firing during working with a ‘stiff’ glass; with a mobile glass we might overcome the challenge of a rather rigid core mixture because we had shorter working times.

Chapter Five also illustrated another interaction, between furnace aperture and the procedure of decorative trailing. Our choice of cowl shape formed, or deformed, our trail techniques; in turn our choice of techniques made demands on cowl shape. As noted above, it was our value judgement about the large horizontally-facing aperture of Cowl 1 which led us to adopt a succession of remedial tools and postures into the developing sequence of work steps. We were able to make two further modifications to the furnace aperture: Cowl 2, rejected after trial because it overheated the vessel and made decorative rim trailing very difficult, and then Cowl 3 which remained in use until the end of the Project, its success shown by our posture – upright and seated, with arms comfortably at right angles, and by the lack of remedial tools – the cleft bamboo, yoke and glove (figures 5.3.11, 12, 13). All that remained were the pincers, used now only to guide the shortest lengths of decorative glass rod into position. However if we had been unable to change Cowl 1 a range of gestures and additional tools (a kneeling mat for one) could have followed the glove, yoke and bamboo into our tool set to physically and mentally reinforce this posture. It was noticeable that within days of using Cowl 1 kneeling had become an accepted part of my routine and that by the end of the first week I was moving onto my knees as preparation for, and not in reaction to, the heat exposure caused by decorative trailing. This would have been another possible and different area of stability. These examples show that although each individual sequence of work steps unfolds in a narrative (Ingold 2000b), with its particular internal integrity and organic relationship with the work that gives rise to it, there are alternative narratives that could be developed.

The contingent nature of skilled making is further highlighted by the way a maker can bring a tool into the sequence of work steps for use in one particular procedure and then deploy it in another procedure entirely, and therefore for an operation or set of operations for which it was *not originally selected*. The pincers were originally used by MT in 2004 for rim and neck shaping; in March 2008 and then during the first half of the Core-Forming Project we also used them to guide short decorative trail rods onto the

body of the vessel. The knives were originally conceived as implements for meat cutting and grapefruit segmenting. Their simple inclusion in our glass working tool set marks them out as highly dynamic elements. We continued to take these blades from one procedure to the next; when selecting tools for decorative trail *tooling*, that is to say the shaping of the spiral trails into a zigzag pattern (Ch 5.B.4), these knives, which I had become acquainted with as core coverers, were at hand. So it seemed as if the blades of the fruit knife and the steak knife, used in the initial procedure of core covering, went on to shape a key decorating procedure – trail tooling – as well. But this example underlines the importance of contextualisation. During his Egyptian core-forming session with Paul Nicholson in 2004, when he covered the core not with a blade but by trailing body glass from an iron, MT was already using the steak knife for decorative trail tooling. The relationship was therefore the other way round. The choice of tool for the procedure of decorative trail tooling in fact pre-dated and helped to develop Core Covering Technique 1. And in fact the original steak knife was not ideal for core covering, which is why the grapefruit knife became involved. The narrower more flexible blade of this second knife seemed not to dig into the glass layer as much as the steak knife when it was used to cover the core. It was not long before, for both of us, the grapefruit knife had ‘followed’ the steak knife from core covering to trail tooling and indeed replaced the first knife entirely. And it was the grapefruit knife which continued to be used in succeeding core covering techniques in any instance requiring the remedial tugging of glass over bare patches of core. By Day 30 this blade was in regular use on the neck, keeping it covered with glass which would otherwise slump towards the base during the ‘melting down’ operation of Core Covering Technique 5 (Ch 5.B.2). In this way whole procedures can be contingent upon a tool selection made for a different purpose in another procedure. If there had been no trail tooling involved in the making of Egyptian core-formed vessels, if their design had either been plain, or featuring straight spiral trails, or even just the kind of deep festoon produced with a spike or hook, there may have been no blades, and very probably not these blades, in MT’s core-forming tool set at all. This in turn may have led us to develop different gestures for core covering. I might have become more dexterous at spreading the glass over the core by marvering. We would have also had a dedicated trail tooling implement which might not have been a knife at all, but a mandrel

or similar spike (probably not a hook, which would not make the tight shallow zigzags required.) If we had then been offered a knife, we might have viewed it with misgivings. Who on earth would do core-forming with a grapefruit knife?

As the grapefruit knife ‘followed’ the steak knife, so did the long tweezers ‘follow’ the pincers from one procedure to another. The long tweezers were introduced in Phase 2 to shape the short but still clearly defined neck which we had now realised the pincer blades were too wide to produce. Where MT used them on neck and then on rim, for me the tools made a reverse journey from rim to neck and then, finally, to the much earlier stage of neck shaping which took place during core-covering near the beginning of the sequence of work steps. I had stuck to my familiar knife blade for this early neck shaping; I had it in my hand anyway, for helping the melting glass over the core (see the above discussion of blades). When the long tweezers *did* make their appearance at this earlier neck-shaping stage, they were first preceded by, and then used alongside, the pincers. Over the final days of the Project the pincers were only used to correct work.

Location is also a factor in contingency. Charles Keller notes how shop organisation, that is to say how the work space is set out, can have a major influence on forming work steps and consequently on the finished artefact (Keller and Keller 1996, Chapter Three). This was particularly the case with our handle making.

Figure 6.1 shows how our particular workshop layout, and the way the tools were arranged in it, had set in chain a series of steps which had led very quickly to a separation of bead application from handle shaping, not only in location but also, and contingent upon that spatial separation, in the choice of tools and the development of gestures. (The relative positions of our furnaces are presented schematically in figures 4.15 and 4.16). On Day 1 MT moved from the gathering to the working furnace with the hot freshly-gathered bead still on the mandrel. He was able to seat himself at the working furnace, briefly reheat the bead, and touch it onto the vessel. At this point, seated and ready to shape the handle, he still had the mandrel in his hand. To shape the middle of the handle with the mandrel was an easy gesture to adopt.

However this gesture closed the handle loopholes so on Day 2 MT introduced a plank to force the bead onto the mandrel. It was placed, as it had to be, by the large gathering furnace. After using the plank the bead was colder and needed immediate



reheating. Therefore touching-on, the initial application of the bead to the vessel wall at the ‘tip’ point, was done at the gathering furnace. But we perceived handle shaping, like all other tooling, to be something done at the working furnace. The mandrel now was no longer carrying a bead, and since it had only been used once to shape the middle of the handle it was easy for MT to discard it before moving away and re-seating oneself at the working furnace. Now the separation between tools for applying the bead – mandrel – and tools for shaping the bead – tweezers – was complete.

On Day 3 we introduced the spike for widening the loopholes because the steak knife and tweezers seemed to be the wrong shape for this task. It is instructive to note that the alteration sequence ends on Day 4 with the selection of a spike for widening the loophole and shaping the middle of the handle; this spike strongly resembled, in diameter and length, the bead mandrel we eventually devised (Chapter Four and figures 4. 37, 4.38 and 4.39). This resemblance supports the idea that gathering, touch-on and shaping were done originally by the same tool.

This instance of tool selection on Day 1 generated a chain of alterations which might well not have happened had the mandrel been thinner. The role of location cannot be ignored – it was our decision to have two furnaces and to position the working furnace (the gathering furnace was immovable) as we did which contributed so efficiently to the near-decoupling of the handle application tool-set and gestures from that used for handle shaping. However the overarching factor was not our judgements about suitable tools or where to put the working furnace, but rather our value judgement about what was suitable to be done at each location.

This highlights the way that makers’ gestures arise out of the tools in their hands. Craftspeople who retain only the minimum of favoured tools are often described as ‘conservative’ or ‘parsimonious’, as if they are applying values generated elsewhere in social life to tool use. But this minimum tool use actually arises out of the gesture-tool synergy. It is much easier to work smoothly and in tempo if one is not constantly changing tools. Releasing the grip and selecting another tool, especially in hot, time-sensitive crafts like metal- and glass-working, can disrupt the flow of work. When MT introduced the tweezers to shape the tip of the handle on Day 2 he retained them in his hand to flatten the middle and then to try widening the loop (figure 6.1). Because the

tweezers were unsuccessful at this latter operation MT introduced the spike. Again, once the spike had been used to widen the loophole it was not discarded in favour of the tweezers but retained in the hand to shape the middle. Retention in the hand accounts for this particular instance – though not all instances – of tools ‘following’ one another through the sequence of work steps.

### **3. Resolving continuity and change: spirals of dexterity**

The many variables at play within the most simple of operations – the different yoke options, blades, grips and stroke patterns involved in making a trail into a zigzag, for example – each have the potential to lead to a new set of gestures, operations, and possibly entire techniques. It has been emphasised above how a change in work steps has hinged upon a single tool or gesture and how, given different circumstances, a different sequence could have arisen within the sequence of work steps. So what of the physical and ethical transformation termed ‘rightness’ and described in the previous section as *also* intrinsic to craft activity? Is it switched on and off – on when we are happy with a technique, and off when we reject said technique? But how do we reject the technique if at the heart of it are gestures that feel right in every sense? It seems paradoxical that at the heart of a very dynamic process of interaction between skill elements, which offers such potential for change, lies a skilled gesture whose physical and ethical dimensions appear to drive the maker powerfully towards conformity. Indeed many hold this to be the essential mode of craft activity; skilfully producing, out of a continually altering material and mental reality, a series of artefacts which are all either the same or very similar indeed (see Singleton 1989, Ch 3.C.2).

This tension makes it easy to conceptualise technological activity as a duality, one which is recursive in that one part – the dynamic interaction of skill elements – both creates the other – dexterity – and is modified by it (due to its inherent conformism). In this way a model of technological practice can be fitted comfortably into more wide-ranging but similarly dualist and recursive models (e.g. Giddens 1984) as a subset, or particular kind, of social practice. However this model relies on a notion of dexterity as unremittingly conformist. It is important not to forget that the ethical dimension of dexterity stems from a physical facility of manoeuvrability. We should recall Bernstein’s

(1996) observation that the brain cannot control the motion of the long bones and strong muscles of the limbs in space without continual feedback from the proprioceptive system which tells it where the body parts are in space (Ch3.B.2). This feedback system causes continual corrections to the original motor impulse. So the movement is in fact a series of corrected movements. This means that dexterity is a name not for instances of repeated identical movements generated by impulses travelling along fixed neural pathways but rather constituted by a corrective facility of manoeuvrability engaged in by the tuning of many hundreds of neural pathways working in consort and in response to proprioceptive information (Bernstein 1996). As such skill is a problem-solving facility, tuned to engage with a continual series of admittedly similar but *non*-identical and therefore unforeseen situations. So the ethical aspect of a physical instance of embodiment of this nature is similarly adaptive, corrected, responsive and tuned.

Therefore, rather than locking into a single neural pathway, the body is learning a suite of responses; this essential potential for continual change allows the body to get out of one suite of responses and eventually into another. What goes along with that, of course, is the ethical dimension – the idea of what is correct. The most interesting thing about the switch from the first, core- and knife-based, technique of core covering to the second, spiral trailing, technique was the way in which MT and I eventually altered their judgement of the merits of the first technique. While using the first technique we had every confidence in it and viewed its shortcomings as teething troubles which would vanish the moment we found the correct angle of the blade; after we had dispensed with the first technique and were engaged in spiral trailing it was – eventually – a matter of complete agreement that the first technique was inherently flawed and would never have worked; indeed, all its gestures, from gathering onto the core to using a knife to spread the layer, were held to be inimical to the successful manipulation of hot glass. This alteration of values took longer for me than for MT because – of course – it took me longer than it did MT to become dexterous in the second technique. But eventually I worked utterly securely in the rightness and correctness of the spiral trailing core covering technique, producing evenly thin walls on vessel after vessel without a thought of returning to the old method (even if I did include a bit more knife work than MT). In this way the values attached to work ‘close up’ behind the craft worker, in the wake of

change, as the physical transformation of dexterity, along with its consequent ethical transformation ('no – *this* is the correct way to do it'), takes place.

What this means is that dexterity, in its physical and in its ethical manoeuvrability, has the potential for change of itself. It need not be dragged into change by a conflicting idea; it can also produce change by becoming *more* itself, or 'even righter.' It is in this context that my observation that the decorative trails on one particular vessel were good but 'too wide and too widely spaced' should be understood. It was remarkable that, although I had just succeeded in producing smooth and unbroken trails for the first time, my attention was immediately attracted to another area of perceived deficiency. This was a new criticism which, although true of many previous vessels, had not been made before because more serious and basic flaws were still in evidence: grossly uneven trails made of thick masses of under-heated cone, trails which crossed over, trails which ran out after two or three turns. But now it was time to move on from dexterity and experience in preparation to the same in execution: shaping the cone tip to produce a narrow trail, letting the cone-bearing rod travel down the length of the vessel body at smaller increments. The next step was to look again at the desirable vessel; the step after that, to make the cone tip yet thinner, the travel of the rod yet more precise and gradual. MT and I then 'raised our game' again and started aiming for sixteen trails (a popular number in the original data set) and then sixteen trails where (as on the vessel on the left of figure 1.1) the width of the space was about the same as the width of the trail. It did not happen, but MT and I considered introducing a different and narrower rod for bearing the cones; and after the apprenticeship ended I still pondered on better ways – starting with smaller pounded fragments of decorative glass, for example – to produce uniformly heated and malleable cones.

In many instances MT and I used dexterous gesture, material handling, and tool development in what might be termed a 'spiral of dexterity'. Another example was in our development of handle-making work steps. The simplicity of figure 6.3 hides a multitude of additional gestures which had to be practised: the depth, precise angle and speed of turn of the mandrel in the glass pot to gather a bead of the requisite daintiness; the reheating after stabbing the mandrel in the plank to make sure that the bead was not only hot but round; the two or three modifications of gesture from drag, to lift, to *high* lift, to

attain handle tips of the right delicacy; and the unfinished search for the right gesture to smooth the handle middle to a jaunty curve. Gradual change, in this context, is really better understood as artefacts and work processes becoming 'even better', in a shared spiral of dexterity. More sudden change, such as the abandonment of tugging the glass up the core for trailing the glass round the core, may be felt as ruptures, as problematic in terms of value as they were in terms of movement for those, like myself, on whom they were 'foisted'. What is equally interesting, however, is the way in which values are reorganised upon, or immediately after, satisfactory changes in work steps, be it the discarding of a single gesture or the abandonment of an entire technique. When we developed a core covering technique that worked, the values surrounding our first core covering technique were altered, not because we had found a different way to cover the core but because we felt we had found a better way to do it.

It is perhaps worth putting the 'same/different' polarity aside and instead thinking of continuity and change like this, as episodes on a value-positive continuum of 'goodness/betterness'. It may be true that at the point of attaining 'rightness', as MT did with the decorative trails, tools and materials may then be treated in such a way that they promote continuity: tools are repaired or replaced as near as possible to previous specifications, materials are selected prepared and refined to the same end. But this is not easy or automatic. Producing consistency is a dynamic, agile process, one fraught with challenges from materials (a badly blended batch of glass, or coarse stalky chaff), tools (a blade wearing so thin that the point, used for making decorative zigzags, breaks off) and difficulties with gestures (an injury such as a burn, or, in the longer term, a need to sit down because of arthritic feet or knees). Likewise autonomy in gesture and flow in work steps do not mean that one dispenses with quick-witted or complex manipulations. Dabbing on a handle-bead is a high-focus, multi-gesture episode where deep attention and tempo are paramount as well as glass colour and quality of furnace roar. Whether we were making the 'same' thing or a 'different' thing, the enterprise was still essentially a question of a series of dynamic resolutions: of bringing everything necessary for the task to bear on the task, in the right order, at the right moment.

#### **D. The Dimension of Communaliry: Working Groups**

This leads us to the workshop, the production of artefacts, and the role of consensus in the values of skilled making. M. A. Dobres has noted how in studies of ancient technology the assumption has been that work processes are undertaken by, and therefore should be considered by us in the context of, the lone worker (Dobres 2000) (figure 6.2). Dobres points out that there are no grounds for this assumption and that the further one departs from the context-free, ‘experimentalised’ notion of ancient technology, the easier it is to consider a default position of communaliry. The analysis of craft tradition as a process of becoming dexterous involves as a matter of course the idea of watching gestures as well as performing them. We may consider that from the moment of entering a craft tradition to the moment of abandoning it in old age, many workers would have been operating almost continuously in some kind of group. Abandoning the default ‘lone worker’ paradigm enables one to consider a group of core-formed vessel-makers sharing tools and materials not as an exceptional situation but as entirely unexceptionable.

Shared tools and materials, in combination with a consensus about what the artefact should look like, quickly give rise to a sharing of gestures as well. It is suggested here that we talk of a ‘working group.’ This term is used in preference to ‘workshop’ because it more closely defines the relationship between maker and artefact. A workshop is a place where there is a consensus over the broad outlines of vessel types, body shape, or suite of body shapes, and decorative motif, or set of motifs which are being produced; it may contain one or more working groups. The working group, on the other hand, is defined in terms of people who are continually gaining experience in sequences of work steps, who have become, or are becoming, dexterous in the particular gestures, tools and materials – a process which helps and is helped by their experience of tools and materials. Although the consistency of the artefacts produced may be high, the worker is no more locked into a mechanistic, repetitious routine than members of an orchestra are ‘locked into’ playing a symphony. Working groups are about proximity between individuals who have become accustomed to each other’s movements, working tempos, and habits – the preferred placement of decorative cones on the edge of the furnace, for example. This means that continuity in artefact traditions can often best be understood as an expression of shared values.

In sociological terms working groups are, of course, communities of practice (Lave and Wenger 1991). But sociological discussions are not obliged to consider the dimension most important to archaeologists, that of time. What is relevant here is not simply legitimate peripheral participation but the consequences of this participation; how it manifests itself in time. It is apparent that if one talks of a community into which new people are moving, through legitimate peripheral participation, there must necessarily be a difference in the amount of time the members have spent in the community. This in turn means that the community is, essentially and not exceptionally, composed of members of varying levels of skill. The most basic driver of legitimate peripheral participation is, of course, death – the departure of the old and experienced and highly dexterous. Newcomers would therefore be brought into the group and form their skills in the context of the working group values. The idea of turnover is essential to the working group, and this is one way in which change can take place - not because newcomers are socially different and bring different ideas from ‘outside’ the craft context, but because they are simply new people, with their own bodies and experiences, who will also become engaged in the ‘repetition without repetition’ (Bernstein 1967, 134) which is learning craft gestures. The most important thing about people who develop a spiral of dexterity is that they are not clones but almost certainly have varying levels of skill and experience. It is in this way that different values can emerge, stemming from and influencing change in the interaction of tools, materials and gesture. It is productive to consider people becoming skilled in making through this highly contextualised and specific process, among members of working groups where the values of the more experienced and dexterous are absorbed by others and then changed through time.

The trail and handle features produced by MT and myself, when considered as the product of a working group engaged in a spiral of dexterity, can be thought of as our signature traits – signature traits, of course, differing from the uncontrolled variability of unskilled work because they can be reproduced. One can look at signature traits shared by a group of artefacts as an expression of value shared by a working group, and as such a way of understanding a working group. This is archaeologically more meaningful than the forensic analysis of individual ‘hands’ which, as discussed in Chapter Three, constitutes another perspective on artefact analysis.

## **E. Conclusion**

- What is the relationship between the process of becoming dexterous and the generation of craft values?
- What is the relationship between the process of becoming dexterous and continuity and change in artefact production?
- How does dexterity develop within a community of makers?

This chapter suggested that value judgements are an intrinsic part of the process of becoming dexterous and a sense of rightness arises directly out of the experience of learning skilful making. Change and continuity both stem from this sense of rightness which is nevertheless essentially manoeuvrable. Because of this change and continuity might be better interpreted not as a polarity of 'same/different' but as a relation of 'good/better/ even better'. From this one can form a definition of communities of practice when applied specifically to skilled making: those people who, by sharing in the experience of coming to move dexterously, also share tools, materials and values. The term 'working group' was suggested for this community. It is in these situations that spirals of dexterity can arise, as instances of refinement and improvement, as can more radical change where, after a period of ostensible disruption, values as well as gestures cohere once more around new tools and materials.



## **Chapter Seven. A Gestural Typology for Core-Formed Alabastra**

### **A. Introduction: the Selected Sets of Vessels**

The research question which is the subject of this chapter is:

- How can we identify individual archaeological artefact features in terms of dexterity?

It is worth contextualising it by following it with the two remaining questions from the original list which will be addressed in Chapter Eight:

- Can we identify communities of makers in the archaeological record, and if we can, what is our purpose in doing so?
- How can we identify and explain communities who do inconsistent work?

This is because the first question is asked in order to answer the two following. This study suggests that the close relationship of gestures to values, and the dimension of communality to the development of skilled craft, means that archaeological artefact features can be understood as the sign of a value-positive interaction between people and materials. The practical work of the Core-Forming Project enables us to be very specific about these value-positive interactions, such was the range of features executed and gestures explored. The experiential process of becoming dexterous in producing certain artefact features also gave rise to an understanding of the important dimensions of skilled making: value, communality and a particular perspective on continuity and change. In the same way the artefact features examined in Chapter Seven will give rise to an understanding of value and communality as it is expressed in the archaeological record – the investigation of working groups discussed in Chapter Eight. Therefore Chapter Seven will set out a methodology for the gestural analysis of vessels in the archaeological database, and begin by introducing the concept of the gestural typology.

It was suggested in Chapter Two that the way that core-formed vessel typologies were organised privileged certain features over others so that the vessels could be grouped for ease of reference. All the typologies described in Chapter Two use the appearance of the features, interpreted in the most broad sense – body colour, decorative motif – as criteria. Other typologies appeared to group certain vessels together on uncertain grounds (for example, McClellan Group II.A.viii). Problems were acknowledged with this approach; David Grose suggested that the typologies made spurious divisions among the products of a single workshop (Grose 1989). The research questions centred upon certain particularly interesting vessels and groups: a highly-consistent vessel from Class IB was contrasted with a seemingly inconsistent vessel dubbed Class IJ by this author (figure 1.1, 2.22a and b) which also features in McClellan's problematic Group II.A.viii subSet 3 (figure 2.11a). It was noted that while many vessels appear at varying levels of consistency in the Class IB design, no highly-consistent vessels were found with the Class IJ design. In addition, other vessels were isolated in this problematic group viii on the grounds of their decorative motif and for no other reason (figure 2.11b). By examining vessels in terms of gesture, however, it might be possible both to see divisions within categories and to identify groups which cross categories.

With this aim in mind three sets of vessels were taken from the archaeological database (Appendix 1). They conform to conventional typological divisions. The selected sets can be seen along with their details as whole vessels in Appendix 7 and in a series of partial close-ups in the figures for Chapter Seven.

**Set 1 ■ BM 97, BM 99, BM 100, BM 101, BM 102, BM 103, BM 105, BM 107, LOU 13, FEU 9,35, FEU 9,36, FEU 9,43, FEU 9,44, TMA 73, TMA 75, TMA 76**

This is a large set comprising a range of examples of Grose's Class IB (Grose 1989), which is the same as McClellan's Group II.A.xi (McClellan 1984). This Class is large and contains many examples of a wide range of consistency, which is why it was chosen as a focus for the Core-forming Project and why examples are taken from it in this chapter.

**Set 2 ▲ FEU 9,46, FEU 9, 47, FEU 9, 48, FEU 9,49, FEU 9,50, FEU 9,51**

This is the group of vessels which has not been assigned a Class by Grose. Examples from this set are placed in McClellan's group II. A. viii subSet 3. This is the group which has not been described by Grose and has been dubbed by this author Class IJ, whose design motif has not been found by this author to exist on any vessel executed at a high level of consistency (Ch 1, Ch 2.E.3).

**Set 3 ● BM 114, BM 115, LOU 11**

This design motif, grouped as 'miscellaneous' by Harden (1981) and as Group II.A.viii subSet 2 by McClellan (McClellan 1984), which is denoted 'decoration confined in the main to the middle of the body' (figure 2.11b). Grose (1989) does not refer to this design motif. This is the vessel set which has been problematically isolated within a larger group for no reason beyond decorative motif (Ch 2.E.3, figure 2.18).

**B. Gestural Typology for the Selected Sets**

As in Chapter Five the study will treat each procedure in turn. The gestural typology for each procedure will be shown in the form of a table, a discussion and a summary of key points. Each vessel will therefore be placed in the table according to the kind of gesture used to execute the particular artefact feature. The sets will all be analysed together. In this way it can clearly be seen if the gestural typology creates new boundaries within or across the conventionally-based set divisions.

**1. Core making.**

Archaeological vessel images: Appendix 7 and figures for Chapter Seven, 7.1, and 7.2

Core-formed Project vessel-making images and clips: references in table.

<b>Gesture</b>	<b>Resulting feature</b>	<b>Vessels bearing feature</b>
<b>Core mixing</b>		
sourcing of core materials – clays and organic components – and mixing them in the proportions which will produce a	Well-integrated core mixture.	all vessels*

robust yet crushable core. (Figure 5.1.1, clip 5.1.5 beginning)		
<b>Initial hand shaping</b>		
pushing, firm squeezing and firm cupping (applying the core mixture to the rod)	roughly shaped core	all vessels*
light cupping and squeezing with palm and spread fingers (shaping the core) (Figure 5.1.4, clip 5.1.5)	asymmetrical core with undulating sides (5.1.10)	all vessels*
<b>Shaping using a slab</b>		
parallel rolling, for the inner layer (figure 5.1.2, clip 5.1.5)	straight-sided inner layer (figure 5.1.18)	■● Probably all vessels in Sets 1 and 3
parallel rolling, for a cylindrical core (figure 5.1.12)	straight-sided cylindrical core (figure 5.1.12, Appendix 5-9, FL 38-41)	■.Set 1 FEU 9,35, FEU 9,36 FEU 9,43, TMA 75
Slightly fan-shaped rolling (clip 5.1.2, 5.1.3)	moderately tapered core (figure 5.1.23)	■ Set 1 BM 97 BM 99 BM 105 BM 107 FEU 9,44 TMA 73 TMA 76
Markedly fan-shaped rolling (clip 5.1.4)	highly tapered core	■ Set 1 BM 100, BM 101, BM 102, BM 103, LOU 13. ● All vessels in Set 3
Brief rolling of actual base area	Base blunted and	■● Probably all

	possibly uneven (figure 5.1.28, far right)	vessels in Sets 1 and 3
Thorough rolling of base by raising and lowering the core-bearing rod far out of the horizontal (clip 5.1.2)	core with smooth and rounded base (figure 5.1.28, far left)	▲ All vessels in Set 2
<b>Neck shaping</b>		
shaping the neck with a rounded implement (edge of the slab, tool with a round cross-section) (clips 5.1.2, 5.1.3)	curved neck profile (figures 5.1.26-28)	■ Set 1 BM 105, FEU 9,35 FEU 9,44
cutting in the neck with a blade-shaped implement (figure 5.1.6, clips 5.1.4, 5.1.5)	angled and symmetrical neck profile (figure 5.1.8, clip 5.1.4)	■ BM 100, BM 101, BM 102, BM 103, LOU 13. ● All vessels in Set 3
shaping the neck with fingertip squeezing (clip 5.1.3)	asymmetrical neck profile (figure 5.1.15, 2 <sup>nd</sup> left)	▲ All vessels in Set 2

**Table 7.1 Gestural typology for core-making**

\* these gestures leave no visible evidence on the vessel walls and are inferred (see text, below)

### Discussion

The most highly tapered cores belong to the Set 1 vessels BM 100, 101, 102, and 103, LOU 13, and the Set 3 vessels BM 114 and 115. The cores of these latter vessels are highly tapered, a feature produced by markedly fan-shaped rolling. The more marked the fan, the more strain is put on the core material; the makers developed a coherent core mixture and very probably applied, by *parallel* rolling, an inner layer to the metal rod for a more robust finished article. Unlike the other rolling gestures, the extreme fan-shaped roll turns the original hand-shaped core into an elongated cone, the top part of which has to be cut away in order to recreate a neck. This accounts in part for the angular jutting neck of these highly tapered vessels: not only was it desired, but cutting-in was necessary

to produce any kind of neck at all. Fan-shaped rolling is what gave rise to the low maximum diameter of these vessel bodies. The makers also applied pressure to the fan-shaped rolling gesture; this produces the rather sharp angle at the widest point of the vessel. They could have softened this angle by rolling gently over this point; they could also have raised the maximum diameter by rolling the core from the vertical to the horizontal position as described above. This would also have produced not only a higher maximum diameter but also a more smoothly rounded base, a feature completely lacking in this set, where the bases are flattish and blunt. (The facets and other irregularities of the bases will be discussed in the section on gestures for core covering below).

Parallel rolling produces a cylindrical vessel. This would seem the easiest and most basic style. But unless one is trying to get an *exact degree* of taper, it is no harder than rolling a tapering vessel. The Set 1 vessels FEU 9,36, FEU 9,43 and TMA 75 are all parallel-rolled but there is only slight difference between them and the Set 1 vessels BM 97, BM 99, BM 105, BM 107, FEU 9,35 and FEU 9,44. These latter vessels have a slight degree of taper and are also slightly rounded-off at the shoulder and base. Typical of this shape are the vessels BM 97 and BM 99 whose maximum diameter lies higher than that of the highly tapered ones described above and whose bases are slightly more smoothly curved, as if more time was spent rolling from body to base and back again. Similar gestures can be used to produce larger vessels. It is only necessary to take a slightly larger amount of core mixture and roll it in a slightly more fan-shaped gesture to obtain the shapes of the Set 1 vessels TMA 73, TMA 76 and the Set 3 vessel LOU 11.

It is noticeable that the base profiles of all the vessels in Set 1 and Set 3 are still slightly lumpy. A smooth base comes from raising the metal rod until the core is leaning slightly out of the vertical and rolling the base back and forth over the slab. The maker can also then lower the rod, without stopping the rolling motion, until the core is returned to the horizontal position. This produces a smooth curve from base to body. By altering the pressure as one brings the rod downwards, that is by rolling harder on the base than on the body, one can raise the widest point of the vessel. It is noticeable that the bases of all the *Set 2* vessels are the smoothest and most rounded of all the database. It is also apparent that the shoulders are more sloping than those in Set 1, which means that the same rounding gesture was used on the top as well as the bottom of the core. Rounding

the shoulders entails pushing the core-bearing rod quite far down below the horizontal. Therefore this gesture, much more deliberate and essential to the shape than the brief rounding off of the shoulder and base angles performed by the makers of Set 1 and Set 3 vessels, is much easier to perform if the slab used for rolling is not on the floor.

However, the Set 2 vessels are those with the most undulating sides of all the selected database. The Project work demonstrated that the *light* cupping and squeezing gestures, with palm and spread fingers, serve to produce a coherent but somewhat asymmetrical core whose sides are undulating and whose base is uneven. Given the evenness of the vessel bases, should one infer that the makers of Set 2 vessels had such a small slab to work on that they could not lay the vessel down and had to shape the sides purely by hand? This suggestion may come, after the discussion at the end of this chapter, to seem less unlikely than it first appears. It is also true that the necks of some of the Set 2 vessels appear so asymmetrical that they could have been shaped solely by fingertip squeezing. But for the time being it is worth noting that other gestures, those used in core covering (procedure 2) and those used in decorative trail tooling (procedure 4), play their part in this unevenness of vessel profiles.

A further difference in the necks of some Set 1 vessels, those with angled jutting necks and those with rounded necks, is once again not wholly attributable to core making. but it would have been as hard for the makers of BM 105, FEU 9,35 and FEU 9,44 to make a smooth neck over a sharp cut-in as it would have been for the makers of BM 100-103, 114 and 115 and LOU 11 and 13 to cut sharply in over a rounded core neck. The other necks in Set 1 lie between these two extremes and the contours can be ascribed mostly to the gestures used in Procedure 5, neck shaping (Ch5.B.5).

### Key points

The basic rolling gestures are: parallel; very slightly tapered and short vessels, slightly more tapered and taller vessels, and tall extremely tapered vessels. All of these include brief rounding-off gestures by slightly raising and lowering the core-bearing rod while rolling, in order to smooth the shoulder and the curve of the base. Set 1 vessels were made using all these gestures. Set 2 makers, however, rounded off the shoulder and base angles by moving the core-bearing rod further out of the horizontal position as they

rolled - upwards to shape the base, and downwards to shape the shoulder. This created a sloping shoulder and a rounded base.

## 2. Core covering and body shaping

Archaeological vessel images: Appendix 7 and figures for Chapter Seven, 7.1, and 7.2

Project vessel making images and clips: references in table below

<b>Gesture</b>	<b>Resulting feature</b>	<b>Vessel bearing feature</b>
<b>Core covering</b>		
Gathering onto the core prior to covering using a blade (Core covering technique 1) (clip 5.2.1)	No evidence	
Core covering using only a blade (core covering technique 1) (figures 5.2.1-4, clips 5.2.2-5))	thin patches in vessel wall	Not seen
Closing gaps in glass cover with a blade, remedial (figure 5.2.5)	thin patch in vessel wall	Not seen
Applying body glass in discrete and not contiguous masses (figure 5.1.12)	Bumps in profile due to uneven vessel wall (figure 5.2.13)	▲ Possible: all vessels in Set 2
Applying body glass in contiguous masses (figure 5.2.15)	Even covering to core	■ ● Probable: all vessels in Sets 1 and 3
<b>Body shaping</b>		
Light and brief rolling without a block	Undulating sides (MT 8, Appendix 6-2)	▲ Probable: all vessels in Set 2
Thorough rolling, possibly using a block (figure 5.2.10)	Generally smooth sides (FL 83-87, Appendix 5-20)	■ ● Possible: all vessels in Sets 1 and 3



Casting off surplus glass from the base after trail tooling	Swirls in scoring lines from trail tooling (see gestures for Procedure 4, below)	■ Set 1 FEU 9,35 FEU 9,43 FEU 9,44 TMA 73
Rolling base to body in one unbroken movement (clip 5.2.6)	Smooth sides and base (MT2, MT3, MT10, Appendix 6-1, 6-2)	none
Rolling base	Rounded base (FL 73, Appendix 5-17)	▲ all vessels in Set 2
Brief base shaping – brief rolling	uneven base (among many examples: FL 21, Appendix 5-4, FL 69, 71, 72, Appendix 5-17)	■ ● Possible: all vessels in Sets 1 and 3
<b>Annealing (controlled cooling)</b>		
Vessel annealed lying on side	<u>Can produce:</u> Long facet on side	None
Vessel annealed standing on base	<u>Can produce:</u> Facet on base	■ Set 1 <u>visible on</u> BM 97 BM 99 BM 102

Table 7.2 Gestural typology for core covering

### Discussion

The Core-forming Project established that although the reheated glass left little trace of how it had been applied, the technique of trailing hot glass onto the core produced vessel walls which resembled those in the data set in terms of thickness and regularity (Ch 4. D and Ch 5. B.2). Although it is possible with a very mobile glass to produce even walls from an uneven trail, the stiffness of the cobalt glasses made from the Pichvnari composition meant it was not amenable to being moved extensively over and around the surface of the core (Ch 5.B.2). The more even the initial gather and trail of body glass,

the more likely the maker is to achieve smooth walls of an even and appropriate thickness. On some vessels in the selected database there is a dip in the body profile between the side and the base, just above the base trail. This could be the result of uneven core covering as it is for Project FL 50 (figure 5. 2. 13) but the fact that the dip occurs in this position on several vessels suggest that it stems from gestures used while applying and tooling the decorative trails – Procedures 3 and 4 (see sections below). During trail tooling the vessel walls above the point of the dip are thickened by the application of decorative trail glass; then, in addition, the mass of body glass is pulled by the upstrokes and down-strokes of tooling towards the middle of the vessel. This can leave the section of wall just below the decorated panel comparatively thin.

#### **Shaping the sides:**

Once the core is covered, the vessel sides can then be smoothed. As with core making, rolling on a slab produces smooth sides. The markedly tapered Set 1 vessels BM 100, BM 101, BM 102, BM 103, LOU 13 and the Set 3 vessels BM 114, BM 115, LOU 11 have the smooth walls which are evidence of rolling of the glass-covered core on a slab. The smoothness in the case of these vessels is also a result of the extremely straight sides of these cores; when covered in glass, a straight profile is easier to roll to smoothness than a gently curved side. The smooth walls of the more curved vessels of Set 1 are therefore evidence of especially thorough and careful rolling. In addition the maker can press a wetted stone or wooden block to the upper side of the vessel as it is rolled on the slab, thereby smoothing both sides simultaneously. This double rolling gesture is especially useful with stiff glass as, although it cools the glass more quickly, it does succeed in moving the glass before it is cooled.

Set 2 vessels, however, are exceptionally lumpy at the sides. The noticeable dips just above the curve to the base, mentioned above, are matched by raised bumps at shoulder height and elsewhere on the bodies. As noted in the previous section on core making these bumps are due in part to the gestures used in Procedures 3 and 4 - decorative trailing and trail tooling; the question of why they were not smoothed down will be addressed in the gestural typology for Procedure 4 below.

#### **Shaping the base (figures 7.2, bases)**

In contrast to their carefully shaped sides (and the attention paid to other Procedures – see below) the bases of the vessels in some of the vessels in Set 1 and all of those in Set 3 are noticeably lumpy. The bases of BM 97 and BM 99 are curved around the sides and flat on the very bottom; as with core making, the curve is evidence of careful rolling from body to base. The careful rolling in this base area suggests that the blunt bottom is the result not of the arbitrary pressing of the vessel base on the marver but of the vessel being stood upright in the annealing oven after work has finished.

The rest of the Set 1 vessels, regardless of taper, share this characteristic of blunted and sometimes even lumpy bases. Set 1 vessels BM 100, 101, 102, 103, 105 and 107 and LOU 13, as well as all the Set 3 vessels BM 115, BM 115, and LOU 11 are characterised by markedly flat bottoms. Initially the result of blunt-based cores, the shape has been accentuated by pressure on the bottom of the upright vessel onto the slab. But the fact that the bases of these vessels are not composed entirely of facets like those on the Project FL 28, and that rolling is therefore involved in base shaping, supports the idea that the blunt bases are only the partial result of working and arise mainly during annealing. It is therefore possible that people made the cores with blunt bases because they knew that the vessels were going to be stood in the annealing oven, so that it was pointless to carefully shape a curved base. Vessel LOU 13 shows an exceptionally bumpy base to which very little attention has been paid. One can also suggest that, given the care invested in the execution of the rest of the vessel, that the makers were either responding to the dimensions of their annealing oven (which may be an overly formal term for what might be no more than a cavity abutting the furnace proper) or not in charge of how it was filled. Others of the Set 1 vessels show that surplus glass has been cast off at the base. The evidence for this comes from the scoring lines made by decorative trail tooling. Some makers made tooling strokes which passed through the panel of decorative trail and down onto the base of the vessel. Corrosion has made these lines more noticeable. The marked swirl at the ends of the scoring lines shows how the mass of glass has been moved and pulled over the base. It is impossible to identify every case of base casting-off but swirling scoring marks can be seen on vessels FEU 9,35, FEU 9, 43 and TMA 73.

By contrast, the bases of Set 2 vessels are comparatively smooth. The maximum diameter is higher than Set 1 BM 100, 101, 102, 103, and LOU 13 and the Set 3 vessels BM 115, 115, LOU 11; this adds to the appearance of a deep, rounded bases of Set 2. The only vessel with a noticeable flat patch on the base is FEU 9, 50 (figure FEU 9, 50 base); this patch strongly resembles those on vessels BM 97 and LOU 13, and is also likely to result from the annealing oven. There are no swirling scoring-marks of the kind mentioned above but base casting-off cannot be discounted. It is safe to assume that rolling plays a large part in the shaping of these bases but, once again, one cannot over-emphasise the importance of the original shape of the core to the resulting body profile.

#### Key points:

Sets 1 and 3 have generally smooth sides, Set 2 has uneven sides; the converse is true of the bases. It has already been noted that the nature of glass work makes it impossible to determine exactly what techniques were used to cover the core. But rather than contrasting core covering techniques *per se* it is better to consider annealing and decorative work (discussed below) as factors in shaping the body profile.

### 3. Decorative trailing

Archaeological vessel images: Appendix 7 and figures for Chapter Seven, 7.3, 7.4b and 7.6

Project vessel making images and clips: references in table below

Gesture	Resulting feature	Vessel bearing feature
<b>Preparing the cones of decorative trail glass (figures: 7.3)</b>		
Reheating and rolling cones repeatedly prior to use (figures 5.3.23,24)	Smooth unbroken straight trail of a constant width, with few 'blobs' or breaks, which (in Set 1) thins gradually as it descends or (in Set 3) joins smoothly end to end. (MT 16, 17, 18, 20,	<ul style="list-style-type: none"> <li>■ all Set 1 except TMA 75</li> <li>● all Set 3</li> </ul>

	Appendix 6-4)	
Heating cones but not rolling or reheating repeatedly prior to use > cone trail goes on slowly (clip 5.3.6)	Trail of fluctuating width or thinning out, sometimes with breaks (FL55, Appendix 5-13, FL 70, Appendix 5-17 FL75, Appendix 5-18)	▲ Set 2 and ■ TMA 75
Taking care to separate cone-bearing metal rods used for yellow glass from those used for turquoise glass	Trails of unadulterated yellow or turquoise glass (all Project vessels except FL 77, Appendix 5-18)	▲● all Sets 2 and 3 ■ Set 1 BM 97, BM 100 BM 101, BM 102 BM 103, LOU 13 TMA 73, TMA 76 FEU 9,44
Forming cones of turquoise and yellow glass indiscriminately on all cone-bearing metal rods	Yellow trails with streaks of turquoise, and vice versa  (FL 77, Appendix 5-18)	■ Set 1 BM 105, BM 107 TMA 75, FEU 9,36 FEU 9,43 Possibly: FEU 9,35 .
<b>Applying the cone (figures: 7.3)</b>		
Touching on very high on the neck (yellow spiral trail: does not apply to ● Set 3)	Neck yellow neck trail often visible on underside, and sometimes on top, of rim FL42, figure 5.6.2b)	▲ All Set 2 ■ Set 1

		BM 97, BM 100 BM 101, BM 102 BM 103, BM 107 LOU 13, TMA 73 TMA 76, FEU 9,44
Touching on at the shoulder so that the neck is bare	FL 69, FL77	■ Set 1 BM 105, FEU 9,35 FEU 9,36, FEU 9,43 TMA 75
<b>Trailing the cone (main section) (figures: 7.3)</b>		
Holding the vessel-bearing rod and the cone-bearing rod at right angles to one another	almost level spiral turns	■ All vessels in Set 1 except TMA 75
Holding the vessel-bearing rod and the cone-bearing rod to make an obtuse angle	noticeably descending spiral turns (FL 45, Appendix 5-1, FL 12, 13, Appendix 5-3 (trails formed with rods)	Set1 ■ TMA 75
Rotating the vessel-bearing rod at a constant and appropriately high speed	trail of moderately consistent width with a few or no breaks, small blobs or wavers FL 87 Appendix 5-20	■ all vessels in Set 1 except TMA 75
Rotating the vessel-bearing rod at varying speeds (clip 5.3.6)		Set 1 ■ TMA 75  ▲ All vessels in Set 2

Moving the cone-bearing rod steadily down the vessel	Markedly evenly spaced straight trails (FL83, Appendix 5-20, MT 20, Appendix 6-4)	■ Set 1 BM 97, BM 99 BM 100, BM 101 BM 102, BM 103 BM 107, FEU 9,36 FEU 9,43
Moving the cone-bearing rod down the vessel at varying speeds	Trails tending to cram together or space out (FL81, Appendix 5-19)	■ Set 1 TMA 73, TMA 76
<b>Applying the base trail or the single straight trail (for ● Set 3) (figures: 7.4b)</b>		
Finishing the base trail or other single trails by casting off directly over the trail	Slight lump or change of direction in trail, or visible but neat trail ends (FL 73, Appendix 5-17)	■ Set 1 BM 97, BM 99 BM 100, BM 101 BM 102, BM 103 LOU 13 ● All vessels in Set 3
Wrapping the base trail in two or more overlapping turns and casting off the trail by 'melting' rather than pulling	Wrapped trail tails off into a wisp parallel with trails (FL 84, Appendix 5-20)	■ Set 1 BM 105, BM 107 FEU 9,35, FEU 9,36 FEU 9,43, FEU 9,44 TMA 73, TMA 75 TMA 76
Finishing the base trail or other single trails by pulling the cone away sharply	Trail tails off in a curling wisp above or below the trail (FL 71, Appendix 5-20)	▲ All vessels in Set 2
<b>Applying the decorative rim trail (figures: 7.6)</b>		
Holding the cone-bearing rod at a	Decorative rim trail laid	■ Set 1

right angle to the rim and touching the cone squarely over the edge of the rim	evenly along the edge of the rim (MT 20, Appendix 6-4, FL 86, Appendix 5-20)	all vessels <u>except</u> : BM 101, BM 103 BM 105, FEU 9,43 ▲ Set 2 FEU 9,49, FEU 9,50 FEU 9,51
Holding the cone-bearing rod at an obtuse angle to the rim, touching the cone tentatively onto a point to one side of the true edge of the rim, then pulling the cone trail away from the rim (figure 5.6.14a)	Decorative rim trail laid unevenly above and below the edge of the rim (figure 5.6.10; FL 70, Appendix 5-17, FL22, Appendix 5-5, rods not cones)	■ Set 1 BM 105 ▲ Set 2 FEU 9,46, FEU 9,47 FEU 9,48
Holding the cone-bearing rod at a right angle to the rim and touching the cone to the <i>very top</i> of the edge of the rim	Decorative rim trail lying consistently around the top of the rim edge (MT 7, Appendix 6-2)	■ Set 1 BM 101, BM 103 BM 9,43 ● all vessels in Set 3
Casting off by pulling away abruptly	Final wisp of decorative rim trail adhering to top or underside of rim	■ Set 1 BM 102, BM 105

**Table 7.3 Gestural Typology for Procedure 3: Decorative Trailing**

### Discussion

Decorative trailing will be analysed in terms of consistency before addressing motif and materials.

The cone preparation and application gestures listed in the table above which produce smooth and unbroken trails of a consistent width were generally practised by the makers of Set 1 and Set 3. Tools experience for cone trailing, as the Project work showed (Ch 5.B.3 and Chapter 6.B.1), includes an intimate understanding of furnace temperature.

#### 1. Consistency



a. high consistency:

Consistent thick trails separated by uniformly wide spaces were produced by the makers of BM 97, BM 99, BM 100, BM 102, BM 103, LOU 13, FEU 9,36, and FEU 9,43.

These trailers repeatedly dipped the cones in the furnace and rolled them before use so that they were uniformly heated all the way through; they also shaped the tips of the cones to produce trails whose thickness was consistent, not only over the vessel in hand but also over preceding and succeeding vessels. As they rotated the vessel-bearing rod they moved the cone-bearing rod steadily down the vessel to produce a consistently wide space between the trails.

If the cone is not thoroughly heated the trail will start to increase or decrease in thickness; makers can compensate for this to an extent by reducing or increasing the speed at which they move the cone-bearing rod down the vessel, but inevitably the alteration will produce wavers and small nodes of the kind seen at the beginning of the trail on LOU 13, the least consistent of this group when it comes to the straight trail panel on the body. Similar wavers and nodes can be seen on the Project FL 85 and FL 86 (Appendix 5-20). All but two of these vessels have uniformly thick rim trails which are consistently placed on the edge of the rim, and base trails consisting of two separate bands, one yellow and one turquoise, where the ends are carefully laid on to meet rather than to wrap round another half or full turn. The two exceptions are FEU 9,36, and FEU 9,43, where the decorative rim trail travels slightly uncertainly round the exceptionally thick rims and where the base trail is not two separate bands but a single trail of two turns which overlaps so that the ends are joined in the style of the vessels in group c. below.

b. consistent thick trails, separated by varyingly wide spaces:

These were produced by the makers of TMA 73 and TMA 76. These trailers prepared their cones as thoroughly as those above. But they paid less attention to the speed of rotation of the vessel and to the steady sideways travel of the cone-bearing rod. This is especially apparent with TMA 73 where consistent, thick straight trails are crammed onto the vessel so that two of the turns overlap. The decorative rim and base trails of these vessels, however, are as consistently executed as those in the majority of group a. above.

c. fewer straight trails of changing thickness and spacing:

These were produced by the makers of BM 105, FEU 9,35 and FEU 9,44. All of these begin as thick trails but thin rapidly and are soon subsumed into the tooled panel of zigzags. Here the straight trail section serves as a preliminary for the tooled panel below; but this was not simply because these vessels were shorter and there was less room for it. The similarly-sized vessels FEU 9,36 and 9,43 (see a. above) both have long panels of highly consistent trails at the expense of the tooled panel of zigzags; an opposing decorative idea. The decorative rim trails on BM 105, FEU 9,35 and 9,44 are well-placed though the BM 105 maker let the trail slip below the edge of one part of the rim. All these three vessels have base trails of two turns of yellow trail formed of one unbroken thread which, as with the vessels FEU 9,36 and 9,43, overlaps so that the ends meet.

d. thin and consistent trails with varying spacing:

These were produced by the maker of BM 107. This trailer began with a well-melted cone with a very thin pointed tip. The thinner the trail, the harder it is to judge where to lay it on and the faster one needs to rotate the vessel, but this is just a matter of becoming dexterous in that sequence of gestures. The alabastra of Mediterranean Groups I, II and III abound in vessels bearing panels of *evenly* spaced, very thin trails. It is simply that this maker, more accustomed to forming the thicker cone tips used in this decorative motif, inadvertently rolled a thinner than usual cone. Extremely thin trails, arising from my lack of control over cone forming, can be seen on the Project FL 73 (Appendix 5-17). Vessel BM 107 has a section of rim missing but the decorative rim trail which remains appears uniformly thick. The base trail is in the style of group c. above.

e. trails of inconsistent thickness with inconsistent spacing:

These were produced by the makers of TMA 75 and all the vessels of Set 2 (FEU 9,46, FEU 9, 47, FEU 9, 48, FEU 9,50, and FEU 9,51). The decorative trailing of this set of vessels is characterised by unevenness; not only is the stiffer turquoise glass thick and lumpy but the ostensibly more mobile and malleable yellow glass is also laid on in large blobs which are especially noticeable in the neck area. Many of these vessels bear an exceptionally thick band of turquoise trail at the mid-handle point and at the base, and it is these thick masses of opaque glass which play such a large part in the uneven body profiles mentioned above (see sections in this chapter on gestural typologies for Procedures 1 and 2). All of these features testify to one gesture, or more precisely one

*omitted* set of gestures: the repeated heating and shaping of the cone of decorative trail glass (Ch 5.B.3 and Ch 6.B.1). It is clear that the makers of these vessels have not heated their cones sufficiently to produce an unbroken trail of even thickness. It can be noted that the larger the cone, the more difficult it is to heat thoroughly; it is possible that the makers were using cones which, for them, were unusually large and that not even the most experienced maker in this working group had really become dexterous in the gesture sequence for producing large cones.

It is not only the gestures involved in cone heating but those involved in the actual execution of trails which distinguish this group. The Set 2 base trails waver and cross over each other and the beginnings and ends often do not meet. The Set 2 makers are not casting off the trail so that it melts into the line of decoration, nor are they winding round twice and overlapping to join the ends; instead they are pulling the cone away from the vessel, leaving a wisp to fall haphazardly out of line and onto the vessel body.

A similar lack of control over the trail can be seen with the decorative rim trail. Yellow glass melts notoriously fast and it is interesting how many of the more consistent rim trails in Set 1 are made of the stiffer and possibly, in this situation, more controllable turquoise glass (BM 100 to 103, LOU 13, and BM 114, 115 and LOU 11). But it is possible to lay a uniformly thick and unbroken yellow trail consistently on the edge of a vessel rim as can be seen with the Set 1 vessels BM 97, TMA 73 and TMA 76. With Set 2, some decorative trails follow the edge of the rim (FEU 9,46) but in other cases the maker has allowed the trail to waver from above to below the edge of the rim (FEU 9,47) or to thin abruptly so that it almost disappears from the rim (FEU 9,48).

## 2. Motif

The selected database consists of vessels bearing the following decorative motifs:

a. Set 1 contains vessels bearing Grose's Class IB design (Ch 2.A.2 and Ch 4.D.2). The key points are a panel of straight yellow spiral trails which at mid-body are joined by several turns of turquoise trail. The mid-body section is tooled into zigzags. Within this, however, are certain distinct ideas about the IB pattern. One concerns the simple matter of where to begin the yellow straight trail. Set 1 contains work by makers who touch the yellow cone onto a point very high on the neck – sometimes so high that

the top end of the trail appears as a sweeping circular band on the top side and inner edge of the rim, marking the boundary between neck cuff and applied rim trail (BM 97 and BM 102). This feature is partly due to the rim levelling gestures which involve pulling the top section of the neck out into the rim and was reproduced inadvertently on the Project (figure 5.6.2). High-neck trailers made the vessels BM 97, 99, 100-103, LOU 13, BM 107, FEU 9,44, TMA 73 and TMA 76. But there are also other makers who touch the yellow cone onto the top of the shoulder: they made BM 105, FEU 9,35, FEU 9,36 and FEU 9,43.

The second distinct idea about the IB pattern concerns the placing of the turquoise trail. Many vessels have several turns of turquoise trail which are integrated with the yellow trails; that is to say they range over a large section of the zigzag panel and if they do not strictly alternate with the yellow trails (they are not so numerous) are interspersed with them in a moderately regular ratio of say one turquoise turn to two or three yellow turns of trail. BM 97, 99, 100-103, BM 105, LOU 13, FEU 9,44, TMA 73 and TMA 76 are all decorated this way. Other vessels have a scant two turns of turquoise trail which are placed in a low spiral at the *bottom* of the zigzag panel, below several rows of yellow zigzags. Vessels BM 107, FEU 9,36, FEU 9,43 and TMA 75 all fall into this group; FEU 9,36 has the most turns of turquoise trail but again these lie at the bottom of the zigzag panel and two of the turns lie completely outside the zone of yellow trails.

b. Set 2 contains vessels of a design which, at the most basic level of description, seems to share features of both Set 1 and Set 3. The makers of all the Set 2 vessels laid on a spiral of straight yellow trails, like Set 1; but then added a single turquoise trail – again, at the most basic level – reminiscent of the single turquoise trail of Set 3 vessels. Like Set 3, they also feature a central band of zigzags where the turquoise is integrated with the yellow (indeed so well that it virtually predominates in the design). But this central band is only *nominally* separated from the tooled zigzag panel. The word ‘nominally’ is used because of an interesting feature of execution: an extremely thin trail which does in fact extend down from the straight trails to the zigzag section. This thin trail is made by pulling the trail cone away from the vessel and laying the resulting thinned wisp on again at the point of the next panel of decoration. This dispenses with casting off the trail, reforming the tip of the cone on the slab, and laying it on again. Does this mean that the

idea behind the design was of a kind with the Class IB design of Set 1? Not really. There is a great difference between the solid yellow trail made by the Set 1 makers and the thin connecting wisps of Set 2 which can almost be said to be not 'real' trails; if they break it does not really matter, since they are not accorded the same level of importance as the rest of the decoration and are simply a convenient way of getting from one panel to the next.

c. Set 3 vessels feature a central panel of decoration bordered by single trails. These makers made sure their three or four bands of turquoise were well integrated with the yellow zigzags and therefore shared the same decorative idea as the makers of the Set 1 vessels BM 97, 99, 100-103, BM 105, LOU 13, FEU 9,44, TMA 73 and TMA 76.

### 3. Materials

Corrosion has played a part in obscuring the colours but it seems that the person who trailed one of the Set 3 vessels, FEU 9,35, used, from neck to base, an entirely bichrome cone. To cover the body in this way seems purposeful and it is rare. What is more common is to find that the rods on which makers formed, say, yellow cones had first been used for trailing in turquoise, and vice versa (Ch 5.B.3). The evidence is streaks of yellow or turquoise appearing in a trail made predominantly of the other colour. Apart from FEU 9,35, where bichrome trailing appears to be used deliberately all over the body (like FL 77, Appendix 5-18), the adulterated trails are found almost exclusively on the rim trail and in one instance on the base trail as well. Vessels bearing these localised bichrome trails are the Set 1 vessels BM 107 (base as well), FEU 9,36, FEU 9,43, and TMA 75. They are not found on any of the other vessels in Set 1 where the colours are completely unadulterated at rim and base. This supports the idea that the makers of these other vessels either made sure that they rigorously separated yellow-bearing from turquoise-bearing rods or that they discarded the last portion of the cone in case the trail became adulterated. It also extends the idea we formed about the base trail to the rim trail – that at these points, which probably followed one another, the makers were often nearing the end of their decorative glass cones. Another opportunity to increase the bumpiness of the profile arises here; decorative trailing automatically adds a further mass

of glass to the middle section of the vessel body. How this unevenness can be exacerbated will be shown in the next section.

#### 4. Decorative trail tooling

Archaeological vessel images: Appendix 7 and figures for Chapter Seven, 7.4

Project vessel making images and clips: references in table below

<b>Gesture</b>	<b>Resulting feature</b>	<b>Vessel bearing feature</b>
Setting tooling strokes closely together (figure 5.4.10)	Numerous tightly-spaced zigzags (FL38., Appendix 5-9)	■ Set 1 BM 107 ▲ Set 2 FEU 9,36, FEU 9,43
Setting tooling strokes wider apart	Fewer and wider zigzags (FL22)	▲ Set 2 FEU 9,46, 47, 48, 49, 50 and 51
Setting the down-strokes at unequal distances between upstrokes	'leaning' zigzags, with one side shorter and more inclined than the other (FL30, Appendix 5-7)	■ Set 1 TMA 75 TMA 76
Exerting great pressure on tooling stroke	Deep tooling furrows (FL 65, 5-15)	■ Set 1 BM 100 BM 101 BM 102 BM 103, LOU 13, LOU 11
Using a spike held near the vertical, or holding a blade-shaped tool downward so that the tip moves across the vessel body	Deep zigzags with a point at the apex	▲ all of Set 2 FEU 9,46 FEU 9,47 FEU 9,48 FEU 9,49 FEU 9,50 FEU 9, 51
Holding a blade-shaped	Shallow zigzags without a	■ Set 1

tool towards the horizontal so that the side of the blade moves across the vessel body	point at the apex	BM 107, FEU 9,36, FEU 9,43 LOU 13
Holding the blade more vertically near the base of the vessel than near the top	Increase in depth of zigzags from the top to the bottom of the tooled panel	■ Set 1 Slight: BM 100 BM 101 BM 102 BM 103  More marked: BM 97 BM 99, BM 105 FEU 9,35, FEU 9,44
Down-stroke starts lower than the beginning of the up-stroke	Top rows of tooled panel are festoons rather than zigzags	■ Set 1 Slight: FEU 9,44
Up-stroke stops lower than the beginning of the down-stroke	Top rows of tooled panel inverted festoons rather than zigzags (FL 6, figure 5.4.6, FL 10, Appendix 5-2)	■ Set 1 Marked: FEU 9,35
Continuing the stroke below the tooled panel	Tool lines scored in vessel wall	● Set 3 BM 114 ■ Set 1 FEU 9,35, FEU 9,43 FEU 9,44, TMA 73
Omitting a down-stroke or up-stroke	Single column of (misshapen) festoons, or	■ Set 1 BM 97 BM 99, BM 100

	inverted festoons, between two columns of zigzags	BM 101, BM 103 BM 105, BM 114 FEU 9,35, FEU 9,43 ▲ Set 2 FEU 9,46. FEU 9,47 FEU 9,48, FEU 9,51
Letting the blade slide into the groove of a previous stroke (glass insufficiently heated)	Column of zigzags narrows and disappears, replaced by (misshapen) festoons or inverted festoons	■ Set 1 TMA 73
Thorough rolling of the vessel on a slab after trailing	Marvered zigzags and smooth sides	■ all vessels in Set 1 ● all vessels in Set 3
Brief or no rolling of the vessel on a slab after trailing	Lumpy decorative glass and vessel sides	▲ all vessels in Set 2

Table 7.4 Gestural typology for Procedure 4: decorative trail tooling

### Discussion

The makers of the selected database tooled the trails into zigzags by sweeping up and down over the central panel of trails with an implement shaped like a blade or a sturdy spike. Increasing the pressure on the tool has a certain influence on the shape of the zigzags, but what chiefly alters the depth of the zigzags is the angle of the tool. A level blade produces shallow, less acute-angled zigzags; a raised blade or a spike, where the pointed *tip* of the tool runs over the glass, produces deeper, that is to say more acute-angled zigzags which often feature a small point at the apex. In order to minimise the chance of fingers touching hot glass on the up-stroke the maker can switch the grip from a 'handlebar' to an 'oar' grip and deploy the end point of the blade (Ch 5.B.4). When zigzags become more acute as they run down the body it is because the maker, holding



the blade in a handlebar grip on the down-stroke, has raised the blade or spike from the horizontal to the vertical as it travels down the vessel. The up-stroke does not balance out the effect because the blade tip is generally far more lightly applied at the end of the up-stroke than it is at the down-stroke. This is because the maker is simultaneously bringing the blade towards the top section of straight trails, which s/he does not want to tool, and bringing his/her working hand towards the hot glass. Indeed, up-strokes are often shorter than down-strokes, petering out before they reach the level of the top of the down-stroke; this gesture produced inverted festoons in the first turn of tooled trails – inverted festoons being the product of decoration with down-strokes only (e.g. FL 12, Appendix 5-3). The deepening appears more marked on the highly tapered than on the more cylindrical bodies (compare FL 52, Appendix 5-12 and FL 66, Appendix 5-16) – possibly because a tapering body profile, when the vessel-bearing rod is held horizontally, rises more sharply than the profile of a more evenly-proportioned vessel, meaning that the tool is driven further into the vessel wall as it travels.

Zigzags which are not only uniform in depth but also noticeably shallow can be produced by placing the blade levelly against the side of the vessel so that it is in contact with as large a part of the tooled panel as possible. Then the gesture is, instead of a long swoop with the tip, the short, vigorous, back-and-forth push-pull, employing the length of the blade, described in Chapter Five. Mark Taylor adopted this gesture for the MT 16, 17, 18, 19 and 20 (Appendix 6-4) and the transition from switching the grip to the single ‘push-pull’ gesture can be seen by comparing FL 52, 58, 56 (switched grip) with FL 66 – made on Day 33, the point when I finally adopted the ‘push-pull’ gesture. The zigzags on this latter vessel and on succeeding Project vessels are uniformly shallow (Appendix 5-16 to 5-20).

The tooling on the Set 1 vessels BM 97, BM 99, BM 105, and FEU 9,44 starts slightly higher on one side than the other; this feature clearly brings to life makers who, while they steadily rotate the horizontal vessel, do not pause to twist the rod through 180 degrees and check the underside as work progresses. The effect is most marked in BM 105. Twisting the rod back and forth to check the spacing of tooling strokes makes it easier to achieve an equal number of alternating up- and down-strokes. (This checking gesture, and its omission, also play a part in handle making (see below).) Missed strokes

can be found on many vessels in Set 1, most vessels in Set 2, and BM 114 in Set 3. A similar appearance can be given by letting the tool slide into the groove of a previous stroke; here the affected column of zigzags gradually disappears and is replaced by festoons as with the Set 1 vessel TMA 73.

Tooling furrows are also widespread through Sets 1 and 2 and one or two furrows also appear on the vessels in Set 3; they testify firstly to a lack of repeated reheating and re-rolling of the vessel after tooling, and also to the speed of the work over the ensuing procedures of shaping the neck and attaching the rim and handles; the furrows are neither consciously rolled out, nor do they melt out in the course of work. There is a possibility that in heavily furrowed vessels that great heating of the body glass means that the trail glass – which is thinner and on the surface – stiffens faster than the body glass. Greater pressure is then needed to push the trails into zigzags – pressure which deforms the comparatively mobile body glass. Noticeable tooling furrows can be seen on LOU 13.

Deepening zigzags testify to the changing angle of the travelling blade or spike on all the vessels in Sets 1 and 2. The comparatively shallow zigzags on LOU 13 again, like the tooling furrow mentioned above and the wavering straight trails described in the previous section, support the idea that this vessel was worked in a very hot fire. Project experience revealed that when the overheated body glass started to move, the zigzags, however sharply they had originally been tooled, displayed a great tendency to ‘fall out’ again. The zigzags do not deepen as sharply in Set 3, which, because of its single short panel of decoration, requires a shorter tooling stroke. BM 115 has only three or four turns of spiral trail in its central panel. However the vast majority of zigzags in Sets 1, 2 and 3 share the distinctive point at the apex which is the result of a tool – whether it be blade or spike – held nearly upright. The Set 3 vessels, plus BM 107 from Set 1, show the least change in depth in zigzags; then FEU 9,36 and FEU 9,43 join the tapering vessels BM 100-103 and LOU 13 with a slight increase. This slight increase seems to be the result of a ‘natural’ end to the gesture as the blade or spike is brought off the vessel rather than a purposeful deepening. Finally there is a more marked increase in zigzag depth in the rest of Set 1, brought about by a deeper more swooping upturn of the blade or spike on the part of the makers, and it is this latter group of makers who seem purposefully to have aimed at a wide range of zigzag depth.

The deep and swimmy appearance of the Set 2 zigzags make those in the other sets look tight and shallow by comparison. But are they more inconsistent? It is true that they are much more widely-spaced, and that it is easier to produce fewer tooling strokes than many. But they are also proportionally deeper and feature noticeable points at the apex. The increased depth also alters the width of the trail, which narrows at the apex of the zigzag to produce the undulating appearance sometimes referred to, especially in the context of bead decoration, as ‘feathering’. On a great many of the vessels they are also of a similar size. All this results from an understood tooling gesture where the tip of the tool has penetrated the vessel wall to the same extent and for the same distance for each stroke. It is also true that the makers of this set missed the odd up- or down-stroke, but this they have in common with the makers of the other sets. Vessel FEU 9,48 shows zigzags which at one point deepen as they go *up*, and not *down*, the vessel; the fact that the straight trails above the deepest zigzags have been deformed by the tooling stroke confirms the relationship between tool penetration and depth of zigzag; these particular up-strokes were so vigorously made that they drove onwards right into the upper section of decoration. It is noteworthy that the makers of Set 2 are more dexterous at tooling gestures than they are at those essential to the laying-on of decorative trails; and equally noteworthy that the gestures of reheating and rolling which follow the tooling in Sets 1 and 3 appear to be absent from the Set 2 routine. This means that the mass of additional glass laid on with decorative trailing is joined by further *body* glass drawn into the central panel by the dragging spike or blade, To mitigate this effect it is necessary to smooth the tooled panel, and indeed the whole side of the vessel, by reheating and rolling on a slab. This the Set 2 makers did not do. The general lumpiness of the body profile in Set 2, then, although core-making and core-covering gestures may be involved, can be attributed to the lack of rolling after trail tooling.

Key points:

Set 2 makers distinguish themselves here in a variety of gestures both performed and omitted, the most important of which are deep tooling strokes, probably with a spike, and a lack of rolling after tooling. Other gestures – omitting to check progress in order to fit in equal up and down-strokes – are common to the makers of all Sets. Set 3 makers made

the most equal and unvarying zigzags while Set 1 appears to be divided between makers who brought the blade moderately upwards at the end of the stroke and those who brought it more noticeably and purposefully towards the vertical.

## 5. Neck shaping

Figures: Appendix 7 and figures for Chapter Seven, 7.5

Project vessel making images and clips: references in table below

<b>Gesture</b>	<b>Resulting feature</b>	<b>Vessel bearing feature</b>
Pulling glass back up over the neck during Procedure 2 (Core Covering)	Vessel wall thick and robust at neck	All vessels
Neglecting to pull glass back up over the core during Procedure 2 (Core Covering)	Vessel wall thin and fragile at neck, leading to cracking	No vessels
Cutting in neck below neck of core	Very thin vessel wall below neck, leading to cracking	No vessels
Cutting in neck some way above neck of core	Tall, stalk-like neck with sloping shoulders (figure 5.5.3 FL 51)	No vessels
Cutting in neck on sharply-defined and narrow neck of core	Narrow and short neck with well-defined angle to shoulder (figure 5.5.25, FL 83, 84, 87, Appendix 5-20)	<p>■ Set 1</p> <p>BM 97</p> <p>BM 99, BM 100</p> <p>BM 101, BM 102</p> <p>BM 103, LOU 13</p> <p>● Set 3</p> <p>BM 114</p> <p>BM 115, LOU 11</p>
Cutting in neck on wide neck of core	Wide neck (FL 15, Appendix 5-3, FL 42, 43, Appendix 5-10)	<p>▲</p> <p>All of Set 2</p>

Shaping the neck with pincers <i>before</i> the rim is applied: not shaping, or only briefly shaping, the neck <i>after</i> the rim is applied.	Varyingly sharp and indistinct angles through 360° (figure 5.5.23)	■ Set 1 FEU 9,36 FEU 9.43, TMA 73 TMA 75, TMA 76
Thoroughly shaping the neck with fine pincers <i>before and after</i> the rim is applied (figure 5.5.14, clip 5.5.5)	Sharp angle to top and bottom of neck profile through 360° (figure 5.5.25, FL 83, 84, 87, Appendix 5-20)	■ Set 1 BM 97, BM 99 BM 100, BM 101 BM 102, BM 103, LOU 13 ● all of Set 3
Thoroughly shaping neck with a tool with a round cross-section after rim is applied	Neck joins rim and shoulder not with an angle but with a smooth curve consistent through 360° (FL77, Appendix 5-18)	■ Set 1 BM 105 FEU 9,35 BM 9, 44
Cutting in with tool with a small round cross-section under rim and at shoulder angle for additional definition	‘pillowing’ of neck: a slight bulge between the two cut-ins (MT 7, Appendix 6-2)	■ Set 1 BM 102, BM 103
Squeezing neck with flat blades (pincers or tweezers) (clip 5.5.8)	Facets on neck (figure 5.5.22)	None

Table 7.5 Gestural typology for Procedure 5: neck shaping

### Discussion

Neck shaping gestures are performed late in the sequence of procedures but they depend on two previous stages of neck making: one at during core-making (Ch 5.B.1, Ch 7.B.1) this chapter) and the other during core covering (Ch 5.B.2, Ch 7.B.2). The integrity of the necks in all these vessels shows that neck-covering gestures were performed while the core was being covered with glass and the body shaped. These gestures are especially important when the body glass is applied from the neck to the base and when the core is

pointing downwards; the frequently reheated and therefore relatively mobile glass moves swiftly down the body leaving the thinnest of layers at the neck. This is not to say that all makers understood and performed neck covering perfectly. It is rather that if the maker omits this gesture the vessel is very likely to break at the neck either during work, while it is being removed from the vessel-bearing metal rod after work, during annealing, or during handling and packing. It is very unlikely that it will survive to the point of exchange. The absence of workshop sites, and therefore of wasters, in the archaeological record means that unlike, for example, cone heating, we have no record of makers neglecting or misunderstanding neck shaping during core covering.

The same applies to the gestures involved in cutting in the neck *below* the neck of the core. During the Project I made this mistake (see Chapter Five, Section B. 5 and figure 5.5.3). Cutting in the neck too low causes the glass to thin beneath the pincers, which gives rise to the breaking hazards described above and consequently to an absence of such vessels in the database. (If my vessels did not crack at the neck, it was because they had walls which, at 4 – 5mm, were so thick that my pincer work did not thin the glass to a critical point.) The wide-necked vessels of Set 2 had necks set in the *right* position on sturdy, *wide-necked* cores.

Cutting in the neck too high, on the other hand, does not thin the glass and merely produces a rather stalky neck and sloping shoulders where the glass is unsupported by the shoulders of the core (figure 5.5.3). This mistake could survive into the database but is not represented by any vessel in the sets discussed here.

The selected sets show how tool and gesture choice for the neck depended for width on the shape of the neck of the *core*. Sets 1 and 3 have narrow necks, set over the narrow neck of the core. The vessels of Set 2 on the other hand, have wide necks. The height of these necks does not depend on the neck of the core, however, and it is noteworthy that all the narrow necks are short and all the wide necks taller. Why is this? In the case of the narrow-necked Sets 1 and 3 it is likely that the makers valued smoothness, because of its indication of consistency, rather than narrowness *per se*. In order to achieve smoothness the maker needs to get the correct light purchase on the well-heated neck as it is rolled. Pincers are at their most controllable when they are approximately half-closed; in this position the maker's hand is relaxed and able to fine-

tune the pincer blades to the rolling neck. To shape a narrow neck large pincers would have to be squeezed almost closed; in this position the muscles of the hand are contracting hard, reducing the ability to fine-tune the gesture. It is then easy to create a flat patch or facet by squeezing the blades too tightly onto the neck and braking the rolling motion. Therefore small fine pincers would be favoured on narrow necks. The initial cut-in by the narrow blades of small fine pincers necessarily creates a short neck; this could be lengthened by moving the pincer blades along and cutting in again, above the first cut-in. But this would very likely result in grooves on the neck which would reduce the smooth appearance created by a single cut-in. Such grooves appear on vessel BM 115 – they are actually the result of shaping the underside of the rim rather than trying to lengthen the neck, but the principle is the same: some kind of blade-shaped tool has been plied on the neck at a point above the original neck cut-in, and the traces remain. Some makers, those who produced BM 97, BM 99, BM 100, BM 101, BM 102, BM 103, LOU 13, and TMA 76 in Set 1 and all the Set 3 vessels BM 114, BM 115 and LOU 11, re-shaped the neck after the rim had been applied until the profile was sharply defined and symmetrical from all angles. Other makers – those who produced FEU 9,36, FEU 9.43, TMA 73, TMA 75 and TMA 76 – did not perform this step, so that the neck profiles, although they appear sharp from certain angles, prove to be less so from other views. A second refinement to neck shaping, in the form of emphasising the angle of the rim and the shoulder, can be seen on the Set 1 vessels BM 102 and BM 103, where a tool has been run against the very top and the very bottom of the neck. This has left no groove; the only sign of this tool is a slight ‘pillowing’ to the neck profile where it bulges slightly below and above these two points. The curve of the two small dips shows that, once again in the interests of smoothness, a tool with a small and round cross-section, possibly in the form of a spike, has been favoured over a blade.

Within Set 1 there are also instances of preferring a rounded rather than a jutting neck profile. These makers also made longer necks before shaping them with a tool with a round cross-section. This tool is much thicker and heavier than the spike which provided the ‘pillowing’ detail mentioned above; when laid against the hot glass of a steadily rotating neck its weight and smoothness creates a smooth curve. The bent rods used on the Project were selected to reproduce this style of neck (see figures 4.12 and

4.13). FL 77 (Appendix 5-18) shows a curved neck profile made with these tools. The Set 1 vessels BM 105, FEU 9,35, and BM 9, 44 all have necks with this profile.

A small, delicate pair of pincers will of course have difficulty in accommodating a wide neck. The maker would necessarily be working with the pincers almost or completely wide open. This creates similar difficulties to working with the pincer blades almost closed; there is less play in the pincers and possibly insufficient room to widen if the neck demands it. If the blades are too small facets can be created without squeezing at all, simply by forcing the narrow blades over the wide neck. The wide and slightly upwardly-flaring necks of Set 2 vessels, then, are the evidence of not only different gestures but also different tools from those deployed in the making of Sets 1 and 3. The least flaring neck, that of vessel FEU 9, 47 is also the smoothest; this smooth, wide and relatively tall neck is most easily produced by making a single cut-in with a large pair of wide-bladed pincers. In Set 2, because the rim is integral and not applied, the gestures for neck shaping and rim shaping are very closely allied and can actually performed in conjunction with each other as an alternating sequence. In many cases (FEU 9,46, 9,50, 9, 51) it is probable, judging by their position under the rim, that dents and dips on the neck are left by pincers engaged in pulling out the rim (see Procedure 6, below). Again, a tool with a round cross-section may have been used to form the shoulder angle but this angle could equally have been formed by rolling it against the edge of a slab. Whether by tool or slab, this very slight jut has been created more by simply squeezing thickly-laid glass away from this area than by following the angled profile of a well-defined core neck. Is this tall style of neck inevitable with an integral rim? The Project MT2 and MT3, both with integral rims, do have necks which are on the tall side, but the rim is of a completely different shape. Furthermore action shots show that Mark Taylor was not *forced* to make a thick neck simply because he was forming a rim out of the neck glass; if the necks on these two vessels are higher than those on later vessels, where the rim has been applied, it is because the pincers used to shape the neck are so large that tooling even with the very ends of the blades creates a fairly high neck.

#### Key points



Set 2 is distinguished from Sets 1 and 3 by a neck-shaping gesture sequence, rooted in core making and core covering procedures, which makes for a tall thick and sometimes flaring neck. Sets 1 and 3 on the other hand display – with the exception of certain vessels with rounded-profile necks – short, narrow necks with varying degrees of definition. This definition is supplied by further tooling after rim application in some of the vessels; those where these final shaping gestures are briefly performed or omitted have a profile which is not sharp from all angles.

## 6. Rim making

Figures: Appendix 7 and figures for Chapter Seven, 7.6

Core-formed Project vessel-making images and clips: references in table.

\*BM 99 has no rim

Gesture	Resulting feature	Vessel bearing feature
<b>Applied rim (made by trailing a separate gather of body glass onto the neck)</b>		
Achieving an adequate and appropriately-shaped gather of glass which will produce an even, hot trail	Potential for a symmetrical rim of even thickness (FL 83-87, Appendix 5-20, all MT with rims, Appendix 6)	■● Sets 1 and 3 (not applicable to ▲Set 2)
Laying the gather onto the top of the side of the neck (figure 5.6.12c)	Rim placed securely on neck	■● Sets 1 and 3 (not applicable to ▲Set 2)
Laying the gather on the top <i>edge</i> of the neck	Gaps between neck and rim; cracking likely	None of the selected vessels
Laying the gather at a point on the neck which is lower than desired	Heavily tooled and asymmetrical neck, widening towards the top	None of the selected vessels
Rotating at a constant speed so	Rim of uniform thickness	All vessels except

that the trail is hot and of uniform width (clip 5.6.12)	(FL 83-87, Appendix 5-20, all MT with rims, Appendix 6)	■ Set 1 BM 105, TMA 75
Rotating at uneven speed so that the trail thickens (clip 5.6.13)	Rim of varying thickness	■ Set 1 BM 105, TMA 75
Casting off neatly by melting the trail off along the rim edge (clip 5.6.12)	No rim glass on neck (FL 84-87, Appendix 5-20, all MT with rims, Appendix 6)	■● Set 1 and Set 3: all vessels except ■ Set 1 TMA 76
Casting off by pulling the trail iron abruptly away, leaving a wisp of glass to fall onto the neck (Clip 5.6.13)	Small wisp of translucent body glass on neck (FL 83)	■ Set 1 TMA 76
Squeezing rim lightly with pincers and/or thoroughly reheating rim (clip 5.5.9)	Rim bare of radial pinch marks  (FL 84-87, Appendix 5-20, all MT with rims, Appendix 6)	■ Set 1 BM 102, BM 103 FEU 9,35, FEU 9,36 FEU 9,43, FEU 9,44
Squeezing rim firmly with pincers while rotating vessel	Radial or tangential pinch marks (FL 83, figure 5.6.18b)	■ Set 1 BM 100, BM 101 BM 105, BM 107 TMA 73 TMA 75, TMA 76 ● all Set 3: BM 114 BM 115, LOU 11
Increasing the upward sweep of the rim by gently pressing on the		■ Set 1 BM 101, BM 103

outer edge of the underside with a flat blade-shaped tool		FEU 9,43 ● Set 3 BM 114 BM 115, LOU 11
Holding the pincers at right angles to the vessel while tooling	Moderately level rim (FL 84-87, Appendix 5-20, all MT with rims, Appendix 6)	■ ● Sets 1 and 3 All vessels except: ■ Set 1 TMA 75
Holding the pincers at acute or obtuse angles to the vessel while tooling	Noticeably sloping rim (FL78, Appendix 5-19)	■ Set 1 TMA 75
<b>Integral rim (made by forming the rim out of the body glass at the neck)</b>		
Preparing neck cuff during Procedure 2, core covering.	Essential for vessels with integral rims	All of Set 2 ▲ FEU 9,46
Squeezing pincers at top of neck cuff of glass (clip 5.6.1)	Narrow, lip-like rim	FEU 9,47 FEU 9,48 FEU 9,49 FEU 9,50,FEU 9,51
Making strong outward pulls at various points on the rim with pincers	'Fried egg' rim – not circular and with wavy edges	▲ Set 2 FEU 9,46 FEU 9,47 FEU 9,49 ■ Set 1 TMA 75

**Table 7.6a. Gestural typology for Procedure 6: rim making**

Table 7.1.6b shows that Set 1 has the widest spread of rim diameters at 12mm between the narrowest and the widest rim (shown by the unbroken circle in the table). The two smaller groups, Set 2 and Set 3, have spreads of 5mm (dotted circle) and 4mm (dashed circle) respectively. While all but one of the Set 2 rim diameters lie 3mm outside the range of Set 1, only one of the Set 3 rim diameters lies outside Set 1, and that by 2mm.

2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9
▲ FEU 9,46	▲ FEU 9,47	● LOU 11		■ BM 101	■ LOU 13	● BM 114	■ BM 100	■ BM 102	■ BM 105	■ TMA 75	■ BM 97		■ FEU 9,35			■ FEU 9,44
▲ FEU 9,49	▲ FEU 9,48				● BM 115	■ TMA 73	■ BM 103						■ FEU 9,35			
▲ FEU 9,50					■ TMA 76	■ FEU 9,36	■ BM 107									
▲ FEU 9,51					■ FEU 9,43											

Table 7.6b. Selected database: rim diameters (in cm). Unbroken line = range of ■ Set 1. Dotted line – range of ▲ Set 2. Dashed line = range of ● Set 3

### Discussion

The major difference between the sets is marked by the gestures central to the procedure of rim making. Is the rim fashioned out of the body glass (integral), or is it created by adding further hot glass (applied)? The first technique requires no extra tools, nor any major change in posture. As noted above (Ch 5.B.6) the preparation for an integral rim begins at the point of the first gather for core covering and continues as the core is covered; it is essential to create sufficient volume of glass and then to reserve it as a cuff at the neck so that it can, when the time comes, be fashioned into a rim. While the makings of the procedure are there from early on, it is still left until late in the vessel-making sequence because frequent reheats would, if the rim was made straight after core covering, result in the rim either melting back into the neck or, if it were wide, drooping

and sticking to the neck or shoulder. Here the Sets divide quite neatly, Set 2 containing the integral rims and Sets 1 and 3 containing those that were applied.

Looking at the integral rims of Set 2 first: there is little variation in the gestures used at the level of individual vessels. In every case (and this shows how it is misleading simply to compare rim diameters) most of the width of the rim diameter is taken up by the wide neck. There is not a deep cup-like rim whose inner surface slopes sharply down to the mouth of the neck; the actual rim section is in fact a thick protrusion, triangular in cross-section with a flattish top surface a few millimetres wide. The side views show how there is in fact hardly any lip to squeeze between pincers while rotating in the style of the applied rim. Instead the makers, probably using the same tools as those employed to shape the neck briefly pulled the rim into shape. This accounts for the almost lobed or 'fried egg' appearance the rims take on as sections are made wider by gripping the glass tightly and pulling outwards. It is almost impossible to create an evenly wide rim by using the points of the pincers in this pulling gesture, and the results are especially noticeable on the rims of FEU 9,46, 9,47, and 9,49 .

Moving to the applied rims of Sets 1 and 3: all the makers achieved the required gather, touch-on and rotating gestures; the only rims of varying thickness are those on BM 105 and TMA 75. Likewise the trail of body glass was almost always cast off without leaving a wisp on the neck, the exception being TMA 76. Both rim diameter and thickness need to be considered when estimating the size of the original gather. Although the rims are significantly larger it is likely that the gather for the Set 1 vessels FEU 9,35 and FEU 9,44 was of the same volume as the gathers for the much less wide rims on FEU 9,36 and 9,43. It can be seen that by extra careful squeezing the former pair of rims has been made much thinner whereas the latter pair are so thick that the body of the rim protrudes above and below the decorative trail. The marks of the pincers can be seen on slightly over half of the vessels in Set 1; the glass was stiffer on these vessels, either through slight underheating or composition. Rims made from stiff glass can also be bare of such marks – in this selected database they are BM 102 (although there may be one possible mark) and the well-heated BM 103.

In addition to the regular squeezing with pincers while rotating the vessel the makers of BM 101 and BM 103 in Set 1 and all the Set 3 vessels BM 114, BM 115 and

LOU 11 applied the decorative rim trail to the top of the edge of the rim and then smoothed the trail with the pincers, pushing the rim up slightly. BM 101 particularly shows how the rim edge has been lifted by this gesture. A return to the rim underside at this point in the vessel-making sequence, especially when holding the pincers, also offered the opportunity for additional neck shaping.

### Key points

One of the most categorical divisions in the database arises through the analysis of rim making gestures – that between Set 2 and Sets 1 and 3. This division is one of technique but there is also a marked difference in consistency of rim shaping gestures. The makers of Set 2 not only formed the rim from the neck glass, but also produced rims of a varying level of consistency by employing a particular pulling gesture with the points of the pincers. The makers of Sets 1 and 3 on the other hand had a well understood gestural routine of gathering, trailing, casting off and squeezing which included right-angled positioning of the vessel and tool, both for trailing on the rim glass and for the shaping with pincers. Here, whole-body gesture, or posture, is involved, since in order to produce a level rim the makers must lean over their work so that their line of sight is directly above it. They either seldom or never used the pulling gesture familiar to Set 2 makers.

## 7. Handle making

Figures: Appendix 7 and figures for Chapter Seven, 7.7)

Core-formed Project vessel-making images and clips: references in table.

<b>Gesture</b>	<b>Resulting feature</b>	<b>Original vessel</b>
<b>Gathering the bead</b>		
Gathering a symmetrical bead at a point near, but not on, the tip of the mandrel	Thick loop, made of one or two turns of gathered trail, with an open loophole	■▲● Sets 1, 2 and 3: all selected vessels
<b>Attaching the bead to the vessel: 1. touching on to form the tip</b>		
rotating the gathered bead on	Loop of moderately uniform	■

the mandrel in the heat, to let it become round (if necessary) (clip 5.7.1)	thickness (FL 84-87, Appendix 5-20)	all Set 1 except BM 97 BM 99 TMA 76 ▲ all Set 2 ● all Set 3
Holding the gathered bead on the mandrel in the heat without rotating the mandrel so that the bead droops on the mandrel and becomes asymmetrical	A loop with thinner outer and/or upper side (figure 5.7.11e)	■ Set 1 BM 97 BM 99, TMA 76
Omitting to reheat the bead	Inevitably, an unusually short and thick handle (figure 5.7.3)	■ Set 1 FEU 9,44
Touching the bead lightly but firmly onto the vessel	An evenly proportioned loop and tip (FL 84-87, Appendix 5-20, MT 19, Appendix 6-4)	■ All Set 1 except TMA 76 FEU9,44 ● Set 3 BM 114, BM 115 ▲ Set 2 FEU 9.47, FEU 9, 48 FEU 9.49, FEU 9.50
Touching the bead very heavily onto the vessel	An unusually large tip and small loop (figure 5.7.17a)	■ Set 1 TMA,76 ● Set 3 LOU 11
Touching the bead very lightly	An unusually small tip and large	■ Set 1

onto the vessel	loop (figure 5.7.17b)	FEU 9,44 ▲ Set 2 FEU 9,46 FEU 9,51
<b>Attaching the bead to the vessel: 2. forming the middle section of the handle</b>		
Dragging the bead along the vessel to the handle loop position (clip 5.7.3)	The potential for a bulky middle section (FL 11, Appendix 5-3)	■ Set 1 BM 97 BM 99, BM 100 BM 101, BM 102 BM 103, LOU 13 TMA 73, TMA 76 ● all vessels in Set 3: BM 114 BM 115, LOU 11
	a distinctly layered middle section (figure 5.7.14a)	■ Set 1 BM 100 BM 102, BM 103 ● Set 3 BM 114, BM 115
	a double-lobed tip (figure 5.7.3)	Set 1: BM 100



Lifting the bead off the vessel again before touching down once more at the handle loop position (clip 5.7.1, 5.7.6)	A middle section of low bulk and projecting tips (MT 16-20, Appendix 6-4)	<p>■ Set 1 BM 105, BM 107 FEU 9,35, FEU 9.36 FEU 9,43, FEU 9,44</p> <p>▲ all Set 2</p>
<b>Attaching the bead to the vessel: 3. forming the loop</b>		
Pressing bead down at handle loop position so that mandrel does not push against the vessel wall (pressure varies with mobility of glass)	Loophole set towards the middle of loop (MT12, Appendix 6-3)	<p>■ Set 1 BM 107, FEU 9,35 FEU 9,36, FEU 9,43 FEU 9,44, TMA 75</p> <p>▲ Set 2 FEU 9,46 FEU 9,48, FEU 9,49</p>
Pressing bead down at handle loop position so that mandrel pushes against the vessel wall (pressure varies with mobility of glass)	Loophole set towards the vessel wall; inner side of hole flattens into a 'trough' (FL 13, Appendix 5-3)	<p>■ Set 1 BM 97, BM 99 BM 100, BM 101 BM 102, BM 103 LOU 13, BM 105</p> <p>▲ Set 2 FEU 9,45 FEU 9,50 FEU 9,51</p> <p>● all in Set 3</p>
Omitting to cool the mandrel	Hot glass from the loophole	■ Set 1

between the first and second handle bead gather	clings to the mandrel as it is withdrawn and is left attached as a tag to the loophole	BM 105 (inner side) FEU 9,36 (outer side) TMA 73 (inner side) TMA 75 (outer side) ▲ Set 2 FEU 9,47 (outer side)
<b>Shaping the loop, middle section and tip</b>		
Pushing the mandrel or similar spike shaped tool up under the loop, over the middle section, and down against tip	Middle section curves outwards as glass cools and becomes less mobile	■▲● all vessels
Pushing down moderately over the middle section of a dragged handle	Tips projecting slightly	■ Set 1 BM 100 BM 101, BM 102 BM 103, LOU 13
Pushing down intensely over the middle section of a dragged handle	Tips projecting markedly (MT3, MT3, Appendix 6-1, clip 5.7.4)	■ Set 1 BM 97 BM 99
Pushing the mandrel under the loop and leaving the rest of the middle section of a dragged handle almost completely untooled	Handle middles slope sharply outwards (MT 15, figure 5.7.9)	■ Set 1 TMA 73 TMA 76
Pushing the mandrel under the loop and moving down to the tip		■ Set 1 BM 9,36 BM 9,43
Letting the middle section get too cool before shaping	Middle section has an uneven profile (figure 7.7.11b)	■ Set 1 FEU 9,36 TMA 75

Extensive reheating of the handle during tooling	Closing of insufficiently large loop-holes	None of the selected vessels
	melting-in of layered middle and double-lobed tip	■ Set 1 BM 101 LOU 13

**Table 7.7 Gestural typology for Procedure 7: handle making**

### Discussion

As described in Chapters Four and Five handle making for Mediterranean Group I alabastra involves deforming a gathered bead, using the wall of the vessel as a secondary tool, into a loop, middle and tip. Group I handles are fully functioning, with loops and loopholes sufficiently robust and open to suspend the vessel with fine cord or wire if desired. The handles in the selected sets are all made from the body glass with the exception of BM 105, where the handles are made from the same yellow glass used for decorative trailing. These body glasses are of different colours, from dark cobalt glass (e.g. BM 100), lighter cobalt glass (e.g. TMA 73), greenish-blue copper glass (e.g. FEU 9,36), greenish glass (e.g. BM 107), and the aforementioned opaque yellow (lead-containing) glass (BM 105). While the operations are common to the makers of all these vessels the gestures involved develop differently in response to the material – the specific mobility of the glass due to the amount of heating.

The maker touches on the bead and then lifts or drags the bead up the vessel wall to the loop position (Ch 5.B.7). The stiffer the glass, the more reluctant it is to lift. Dragging means that the bead loses material at a consistent rate as it is pulled up the vessel wall, leaving not only a thick tip but a thick middle. If the middle of the handle is as wide as the loop in the face-on view and yet flatter, it means that before it was flattened down it was *narrower* than the loop; this is extremely unlikely to happen when dragging the bead, where so much of the bulk is left in the middle that if it were heavily flattened it would be wider, in the face-on view, than the loop. Dragging is used on the

Set 1 vessels BM 100 to 103, LOU 13 and on TMA 73 and 76, as well as all the Set 3 vessels BM 114, 115 and LOU 11. This glass shows the double layer, and in one case the double-lobed tip (BM 100) which was produced with Project vessels by dragging the bead (see table). All these vessels have a lot of glass in the middle, which has not been overly flattened (in the case of TMA 73 and TMA 76, hardly at all). The makers of BM 97 and BM 99 also dragged the handle bead and then pressed the stiff glass firmly down in the middle producing a middle which is wide in the face-on view. Each of these vessels has one loop where the outer section is markedly thinner than the rest; this is a result of the mandrel dragging through the hot glass of the bead. It is likely that this is the second handle, and the mandrel is already hot from gathering and tooling the first. In all these vessels the thickness of the tip, handle middle and the robust loop shows that care was taken to gather a large bead; indeed a large bead may have retained more heat than a smaller one and been easier to move.

The makers of the other vessels in Set 1 and all those in Set 2 did not drag but lifted the bead and touched it down again at the loop position. This can be seen in the combination of high tip and comparatively thin middle achieved by pulling the bead away from the vessel. The height of the lift and the mobility of the glass both determine the volume of glass in the middle of the handle. Although the middles of the cobalt glass handles FEU 9,35 and FEU 9,44 are thicker than those of the high-iron-glass handles of BM 107 the lifting gesture for the cobalt handles was probably as high as that for the BM 107 handle; the 'pull' of the lift being carefully matched to the 'pull' of the glass in question.

The maker then presses the bead, whether dragged or lifted, against the vessel wall. Once again, stiffness of glass and pressure of gesture work together. A heavy press, even with stiff glass, flattens the inner section of loop into the vessel wall, making the loophole flush with or depressed into the vessel wall and often producing a trough of flattened loophole glass on the vessel wall at one or both sides of the loophole. This is especially apparent in BM 97 and BM 99, where the stiff glass has been thoroughly heated; the makers have also moved the mandrel around in the loophole to make it bigger before withdrawing the mandrel. This heavy press can also be seen in the less intensely heated loops of BM 100, BM 102, BM 103, and LOU 13; in BM 100 one loophole is

pushed into the vessel wall. Similar pressure was used with the loops of the TMA 73 and possible TMA 76, where the body glass was also so hot that the loop melted into the vessel wall. All the vessels of Set 3, where large stiff beads were also dragged into position, also show a determined push into the side of the vessel before the mandrel was withdrawn.

A lighter push with the same stiff glass produced the more centrally-placed loopholes of FEU 9,44; it would probably have been a similar level of pressure which pushed the loopholes of FEU 9,36, made with a mobile glass, against the vessel wall. The centrally-placed loopholes of FEU 9,35 and FEU 9,43, made in the mobile copper and brown glasses, were the result of an even lighter push. The maker of the handles of BM 105, made of the lead-containing mobile opaque yellow glass, left an inner margin to one loophole by applying only very light pressure; however the other loophole has been squashed against the wall of the vessel. This, and the tag of glass which is pulled away on the inner side of this other loophole, suggests that the mandrel was already heated and that this is the second handle; and this in turn suggests that this bead may have been applied with no more pressure than the first, and it was simply that the glass was hotter.

Set 2 shows a variation in this pressing gesture, with some vessels bearing handles with central loopholes and others with loopholes abutting the vessel wall. The teardrop-shaped loophole seen on FEU 9,48 shows a large loophole partially depressed by flattening the middle section; many of the loopholes are large in this set and this suggests a larger mandrel and more vigorous ‘wiggling’ of the mandrel as it is withdrawn from the loophole.

It is extremely likely that the middle sections and the tips of the handles were shaped with the same tool used to gather the bead. Once the bead for the handle is gathered and applied it is hard to reheat without closing the loophole. The entire handle-making gesture sequence can be – and with a stiff glass, *has* to be – completed in under five seconds; if the maker keeps the mandrel in the hand and uses it both for the application and for the tooling gestures, this is far easier to accomplish than if one is discarding and picking up tools. Many handles have a smooth curved profile but where there are indentations below the loop and above the tip, marking the beginning and the end of the passage of the tool, they have a round cross-section (BM 97, BM 99, BM 100,

FEU 9,44, FEU 9,46, FEU 9,47, LOU 11). As the glass of the middle section cools, it becomes harder to depress; as the maker runs the tool from under the loop towards the tip, the middle section becomes progressively less flattened, resulting in a handle which naturally curves outward from the loop towards the tip (9,35, FEU 9,36, FEU 9,44). An extreme example can be seen in the jutting handles of TMA 73 and TMA 76, which appear, apart from a push below the loop, to have only the lightest pressure applied to the rest of the middle section.

### Key points

Within Set 1 certain of the handle beads appear to have been dragged up the vessel wall as do all the vessels in Set 3. The thinner middles of the other handles are more likely to be the result of lifting the bead. When making the loophole some makers of Set 1 vessels seem to have pushed the bead firmly against the vessel whereas others have touched down more lightly. As with the pressure applied to shape the middle of the vessel, the position of the loophole probably relates to the stiffness of the glass: the more mobile the bead, the lighter the touch-down seems to be.

## **C. Conclusion**

- How can we identify individual archaeological artefact features in terms of dexterity?

This can be done by developing a gestural typology for the operations in each procedure of core-formed vessel making. This gestural typology comes out of a theory-framed practical project of apprenticeship where gestures were contextualised not only within tools and materials but also within sensory activities and types of experience. These typologies have set out in detail the dexterous gestures (coupled with tools and materials) which makers used to form the principal features of the artefacts. The other equally important aspects, the sensory activities and the types of experience, are discussed in the following chapter.

Classifying vessels in this way has identified differences between groups of vessels within one of the sets and similarities across two of the sets. Not all Set 1 vessels,

in spite of their all belonging to Class IB, share a gestural typology. Set 3 vessels seem to share many parts of the gestural typology with a certain group within Set 1. Set 2 alone remains both homogeneous and unrelated to the other vessels.

It should also be noted that these typologies have been presented discretely. They explore the range of gestures for one particular procedure as it relates to every vessel of the three sets before moving on to do the same for the next procedure. The next chapter will take a more integrated approach and use these data to explore groups of artefacts as episodes of skilled making and to relate them to the idea of working groups.

## Chapter Eight. Working Groups in the Archaeological Database

### A. Introduction

The selections from the database were originally presented as three sets which were chosen according to a conventional typology. Chapter Seven analysed these sets in terms of their *gestural* typology, that is in terms of the gestures which the makers used to produce the vessels. It was noted that not all members of one set shared a gestural typology; that other gestures were shared by more than one set; and that a third set remained isolated. This chapter draws on this analysis in order to identify those vessels which share a gestural typology as the product of particular working groups.

One should mount a final challenge to this idea. Can we really be sure that vessels grouped by gestural typologies really *are* the products of particular working groups? And if so, what can we then say about the vessels and the makers, beyond: ‘these vessels were made by those people’? This leads us to one of the last two research questions presented at the beginning of this study:

- Can we identify communities of makers in the archaeological database? If so, what can we say about their respective craft values?

We can address the first part of the question by recalling from Chapter Six how linked and interdependent are the individual gestures in a sequence of work steps; how time-dependent, forward-moving and irrevocable they are. Drawing on Luria’s notion of a kinetic melody (Luria 1973, see Ch 3) this makes it equivalent, in terms of movement, to a melody whose phrases and tempo were shared, understood and valued. If one also recalls how the dexterous gesture is essentially an instance of bodily autonomy, the likelihood of makers, while in the flow of episodes of making, suddenly performing a new hand movement or picking up a new tool is further decreased. ‘Sharing a gestural typology’ means sharing not only the great majority of the gestures performed to create the vessel, but sharing in the kinaesthetic and communal experience of becoming dexterous in those gestures. This further reinforces the feeling of ‘rightness’, concomitant



on autonomy, which was described in Chapter Six. Collective values, arising out of a collective experience of autonomy, have the potential to produce a consensus on signature traits. Underpinning the values are the gestures which have been taken on by the body in an autonomic way. Chapter Six also suggested that although this autonomy is basically manoeuvrable it is usually only in particular circumstances and in particular ways that gestures, and artefact features, can be altered by a maker: when the current notion of what is 'good' is superseded by one which is 'better'. It is therefore suggested that it is very unlikely indeed that makers would embark on a series of arbitrary and value-free gestural variations, and extremely likely that a certain gestural typology can be identified with a particular working group.

## **B. Working Groups**

Figures 8.1, 8.2, 8.3 and 8.4 illustrate how vessels grouped according to a *gestural* typology relate to the original 'set' designation which was based on the conventional typological categories. It can immediately be seen from figure 8.4 that the development of a gestural typology appears to have done a number of different things. It has brought together vessels from two different sets (sets 1 and 3); it has abolished a set (Set 3); it has created groups within a set (Set 1); and it has reinforced a set by including every vessel within it in one gestural typology without including any vessel outside it (Set 2). This chapter will now examine these individual groups, beginning by isolating, from a group of ostensibly similar vessels, one which does not actually share their gestural typology.

### **1. Working group A : BM 105, FEU 9, 35 and FEU 9,44, compared with a vessel which does not share their gestural typology: BM 107 (all from Set 1)**

**(Figures 8.5a and 8.5b)**

Working group A (BM 105, FEU 9,35 and FEU 9,44) is here contrasted with a vessel (BM 107) which only superficially shared some of the characteristics of the group A vessels.

BM 105, FEU 9,35 and FEU 9,44 have a distinctive tall neck profile with rounded angles at top and bottom – under the rim and above the shoulder. The makers of these

vessels used a pair of pincers with wide blades and then smoothed the neck angles with a tool which had a round or semi-circular cross-section. This second tool could have been a bent rod (figure 4.32, 4.33), possibly a fairly large mandrel used for bead gathering, or possibly the same wide-bladed pair of pincers if their blades were rounded on the outer sides. This last tool would be very convenient to use as the makers could have alternately cut in and smoothed the neck by turning the blades and running the curved outer side against the top and bottom of the neck. The notion that people used wide bladed pincers to cut in the neck is supported by the fact that the rims of these vessels are noticeably flat, thin and wide, as if they had squeezed a normal sized rim trail (i.e. a trail of body glass to form the rim, not a decorative trail) exceptionally thoroughly by an unusually robust pair of pincers. BM 107 appears to have a similar rounded neck profile but figure 8.5b shows how this is actually a neck which has been inconsistently shaped with an angular tool similar to, although probably broader than, that which was used on the consistently-shaped angular neck, that of BM 102.

FEU 9,44 has such a mass of yellow glass on the neck that it looks as if it poured off an overheated cone trail which the maker was intending to place, like those of BM 105, FEU 9,35 and FEU 9,44, on the shoulder. The makers of BM 105 and FEU 9, 44 had the same idea about integrating turquoise into the tooled panel. They did not check that the tops of their tooling strokes were level all the way round the vessel. The bichrome trail of FEU 9, 35 is a deliberate effect. Unlike the accidental streaking of the rims in Working Group C, it takes careful shaping to make a bichrome cone from which trails of turquoise and yellow can both be pulled off equally all the way down the body. Although this is not the Class IB design the same skilled gestures are employed in making it; the zigzags deepen and the tooling strokes are not level, the up-strokes being shorter than the down-strokes.

Although the Class IB pattern is being followed by BM 107, it does not express the same trailing values as the other three vessels: the zigzags are both shorter and more uniform in height, the result of a blade which has been held as level as possible, and it has a single low turquoise trail at the bottom of the zigzag panel, unintegrated into the main design.

The ostensibly similar handles also show different tools at work. Figure 8.5c shows that a rounded tool, possible the same one as that used on the necks, has shaped the handle middles of BM 105, FEU 9,35 and FEU 9,44; this can be seen on the soft curve just below the loop which could not have been produced by an angular edge. Conversely the accretion on the glass of the BM 107 handle highlights the impression made below the loop by an angular tool.

## **2. Working group B: TMA 73, TMA 76 from Set 1 (figure 8.6)**

Working group B is represented by the vessels TMA 73 and TMA 76. These have handles where the makers have given the middles a very unusual jutting angle. They formed large, slightly tapering cores by rolling in a gentle fan shape after cupping and squeezing core mixture onto the vessel-bearing rod. Like other groups (this will be discussed below and in the next section) they took care to smooth the sides of the vessel and to create a defined neck and shoulder either by squeezing or by cutting away core material; but they treated the base fairly perfunctorily in comparison, the angle between base and side merely blunted by raising the rod and rolling, the bottom slightly flattened. (Again, the flat bottom will be discussed below). They then covered the bodies evenly with glass, the swirling score-lines (the result of trail tooling strokes) on TMA 73 showing how that maker later cast off surplus glass at the base to maintain an even vessel wall. They heated generous cones of opaque yellow decorative glass thoroughly – this would have been going on while the core was being covered in glass – and as a result produced a great many thick trails of even width. However the trails betray no value attached to proportionate trail spacing: the makers did not let the cone-bearing rod travel steadily along the vessel to produce an even space between each trail of some chosen proportion to the trail width (say, half, or three-quarters). As a result the yellow trails on both vessels are very close together and one trail on TMA 73 overlaps another. The thickness of the turquoise trail at the bottom of the panel could mean either that this was the beginning of a thick cone or that it was the end of the trail wound round two or three times so that the trails melted together. However the wispieness of the turquoise trail at the top suggests that they touched the turquoise trail on at the bottom of the panel. But this group was careful to integrate the turquoise into the yellow pattern. They tooled the trails

with a blade-like tool held fairly level to produce zigzags which deepened only slightly towards the base of the vessel; on each vessel the maker dug too deep on one stroke, pushing up a tall peaked zigzag. The scoring strokes were long and covered the base of the vessel for the down-stroke and for the up-stroke; this means that the up-stroke was begun at a point much lower than the zigzag panel far in advance of the trails. It is possible that the makers then added the base trail which was wrapped round for two or three turns; they made attempts to join the ends of the trails together.

These makers re-shaped the necks after applying the rim. Thorough squeezing with strong pincers produced flat rims; these makers also took care to position themselves so their eye-line was perpendicular to the work and in this way produced rims which were level as well as flat. In this position they were able to nearly touch on and cast off the decorative trails for the rim. The yellow rim trail of TMA 73 contains a streak of turquoise. This shows firstly that the maker was reaching the end of the cone and secondly that cone-bearing rods were not separated by colour. The rim trail of TMA 76 is solid yellow; this means either that the cone had not run down to the end or that this yellow cone was attached to a rod which had previously been used for another yellow cone.

The makers took care to attach the first handle at the point where the zigzag decoration was at its most uneven so that the unusually deep stroke was positioned at the side of the vessel. To make the signature 'jut' of the handle profile the maker might have used the bead mandrel, pushing it under the loop and then running it *slowly*, so that the glass progressively stiffened under the mandrel, towards the tip. The dip under the loop of one handle on TMA 76 however is noticeably right-angled as if it were made by the side of a blade itself placed at an angle; the straight jut of the handle middle would then have been produced by the flat of the blade. Although the dips under the loops of the other handles are slightly more rounded they still could have been made with the edge of a blade, one which was pushed slightly less hard against slightly stiffer glass. The handle middles have flat surfaces; contrasted with the thready surface of the actual loops it is easy to see that they have been smoothed by some sort of tool.

There is no major difference in work steps between these two vessels; the only alteration is the selection of turquoise instead of yellow for the base trail of TMA 73. This

is likely to have happened because finishing the decorative rim trail used up all of the previous cone and a new one had to be started.

### **3. Working Group C: BM 100, BM 101, BM 102, 103, LOU 13 in Set 1**

**BM 114, BM 115, and LOU 11. All of Set 3.**

**BM 97, BM 99 in Set 1. (Figures 8.7 and 8.8)**

For reasons which will become clear the last two vessels, BM 97 and BM 99, will be discussed separately below. The first part of this section deals with the first eight vessels listed above.

It is likely that Working Group C began making their cores by gently squeezing core material onto a metal rod and then using parallel rolling to create an inner layer. They may have let this layer become leather-hard, which would cause it to be both robust and, when wetted, moderately adhesive and able to take the outer layer of core material. This would have been applied by cupping, squeezing, hand shaping and then rolling in a markedly tight fan-shape so that the core-bearing metal rod was swung around a still point somewhere not far above the neck of the core. Next they took a blade-shaped tool and cut a neck into the elongated cone created by the fan-shaped roll, carefully removing core material above the neck cut-in but leaving the inner layer as the sleeve of the core. They may have also shaped this neck with the fingers. Necessary at this point, and at many points further on, was attention to posture; in order to make a symmetrical core body and neck cut-in the makers had to hold their eye-line perpendicular to the core body. It should be noted that whether or not core makers and glass makers constituted the same working group they shared the values of symmetry and the corresponding posture (or bodily gesture) of the perpendicular eye-line.

Rolling in this manner produced a low and sharply-angled maximum diameter. The makers carefully smoothed off this angle until it was merely a steep curve. An angle with a point to it would invite crumbling as the core dried as well as a thin patch in the vessel wall. But they did not roll the core from base to body to push the maximum diameter further up the body and create a deeper and more rounded base.

There is no firm evidence for how makers applied the body glass to the core (Ch 5.B.1). But it was likely that the body glass was applied in a way which did not leave

large bare patches on the core which then had to be filled in with more body glass. Glass of the stiffness of the Pichvnari Cobalt glasses was not amenable to being pulled and stretched across the core and irregular application led to thin patches as well as overly thick areas of the vessel wall (Ch 5 B.2). The favoured techniques of the Core-formed Project were the different varieties of spiral trailing which resulted in the glass being laid on in contiguous masses which were nowhere particularly thick, which could be spread evenly, and which when spread joined up easily with the neighbouring mass. Spiral trailing, if it were used, would also have involved rotary motion, not rolling on a slab this time but rotating the vessel 'in the air' by twisting the core-bearing rod round and round. It important to stop the vessel overheating on one side which would have led to the vessel walls becoming uneven and the glass sagging off the base. Therefore once the glass was applied it is highly probable that Working Group C, when they reheated the vessel in the furnace, used the same rotating gesture with the hand which held the vessel-bearing rod. This distinctive hand gesture is common to all glass working operations where the vessel is held on a rod and where symmetry needs to be preserved. They would have alternated this gesture with the rolling gesture over a slab in the same fan-shaped motion which had created the original core. Alternate rotating in the heat and rolling on the slab would have covered the core and produced vessel walls which were extremely smooth and straight.

As with core *making*, what they did not do was pay any particular attention to the base. Perhaps because they knew the vessels would be crowded in the annealing oven (Ch 7.B.2) they did not spend time creating a smooth base with a symmetrical curve to it. What they *did* do, however, was pay regular attention to the neck: making sure that body glass was initially applied to the neck and then, during the repeated reheats and rolls that constitute core-covering, bringing hot glass back over the neck area either by means of rolling or by pulling it judiciously with a blade. It was also probable at this stage that they started to roll the neck while tooling it with pincers; this would at once shape the area and cool it so that it remained relatively stable while other areas of the core were still being covered. In addition it enabled the makers to cut in the neck over the neck of the core in order to produce a well-defined neck-shoulder angle (Ch 5.B.5, Ch 7.B.5).

While the body glass was being rolled it is likely that the makers were already preheating cones of decorative trail glass and sticking them to metal rods. This activity

could have been started either before vessel making began, as soon as the furnace was hot enough, or by some members of the working group as vessel making proceeded. They took care to keep the metal rods which bore yellow cones distinct from those which bore turquoise cones so that no streaks of foreign colour would appear in the trails as they reached the end of the cone. It is also possible that the cone softening step – repeated dipping deep in the furnace and then, when the cone started to run, rolling it on a slab to cool the outer layer – was also done by another worker so that the trail could be applied as soon as the vessel had been rolled to smoothness after core covering. The cone needed to be symmetrical and with a fine but substantial tip; this entailed lifting the rod at an angle and keeping the pressure even while rolling. It is very easy to alter the pressure while rolling and produce a cone with a lopsided tip. If the maker does not lift the rod at all the result is a parallel-rolled, almost cylindrical cone with a very thick tip which is too long and which, when touched to the vessel, will pull off almost in its entirety to make an evenly wide but far too thick and short trail.

Once the yellow cone was ready the makers touched it to the vessel at a point very high on the neck, holding in or over the furnace. Just as with reheating, the makers rotated the vessel-bearing rod briskly but evenly. At the same time they moved the cone bearing rod, keeping it at right angles to the vessel, down the body so that it travelled steadily enough to produce a consistently wide space between the trails. The makers also made sure that while the cone was hot the vessel glass was not overheated and therefore stable enough to pull the trail away from the cone as the vessel rotated. The trail could then be cast off neatly by melting it off so that the wisp from the cone was laid onto, and melted into, the previous trail. The gestures were repeated for the turquoise cone, this time placing it low on the body and winding on between three or four turns.

Trail tooling preceded the base trails, which overlie the lines scored in the vessel wall by trail tooling and visible on some vessels (Ch 7.B.4). The makers used a level tool to produce tight shallow zigzags which were closely spaced. While paying attention to the spacing intervals they tended not to turn the vessel through 180 degrees to check their progress and calculate the number of strokes needed to fill the remaining space. This sometimes resulted in two up-strokes or two down-strokes next to each other at the point

where tooling began and ended. It is possible that they rolled the trails smooth after or even during tooling.

It is likely that the makers then laid on the base trail. Here they took extra care to keep the trail at right angles to the vessel so that the end of the trail was laid as neatly as possible onto the beginning. In some instances (e.g. BM 102, BM 114) they produced base trails the position of whose ends can only be inferred from a slight thickening of the trail. Laying the end of the trail over the beginning was a highly important gesture to this group and lies behind the alternative pattern of BM 114, BM 115, and LOU 11 which features five such neatly-finished single trails. In both patterns the makers' choice of two separate colours for the base trails, which obliged them to produce two single trails and not two or three overlapping turns of the same colour, showed how highly they valued not only this gesture but their ability to execute it repeatedly. Possibly because they used single trails elsewhere in the pattern these makers formalised the base trail; for them it had nothing to do with using up a cone and merited the same attention as other areas of decoration. One can also recall the unremittingly forward direction of the core-forming work steps: if core-formers made a mistake, they could not take the trail off and try again.

Once these workers had applied the base trails they rolled them smooth, possibly individually, possibly as a pair when finished (again treating them the same way as other decoration). They had not finished with their cones, however; although some remnants of used cones might be left out of the heat to cool and snap off the rod, they had to keep at least one turquoise cone in the heat, ready to decorate the rim after it had been applied.

Once again posture was important; the makers leaned over their work so that their eye-line was perpendicular to the vessel. The neck was well-heated and then swiftly rolled between the blades of a pair of narrow pincers without squeezing; squeezing would brake the rolling motion and produce a facet or flat spot on the neck. The pincers therefore had sufficient play to minimise this danger (Ch 7.B.5). This produced a neck which was smooth and symmetrical.

Once the neck was defined the makers applied the rim by taking a finely-judged gather of body glass and trailing it onto the neck. The trailing gestures for decorative glass – vessel rod and trail iron at right angles, perpendicular eye-line, brisk turning of the vessel-bearing rod, and neatly casting off the trail by melting it off over the hot glass –



were re-shaped by the different material (translucent body glass instead of opaque decorative glass) and tools (longer trail iron instead of cone-bearing metal rod) to produce a level and symmetrical trail. The small delicate rim required at the most two turns of glass trail. The makers then tooled the rim by heating it thoroughly and swiftly squeezing it, probably with the same pincers as those used for the neck, while rotating it briskly and steadily beneath a perpendicular eye-line. Sometimes, as with BM 102, the exceptionally high placement of the yellow decorative trail on the neck meant that it protruded onto the top surface of the rim, marking the boundary between the edge of the neck and the added rim trail. The amount of reheating depended on the amount of pincer work necessary to get a level, circular and uniformly thin rim. Extensive reheating melted in the grooves made by the trailed glass.

The turquoise cone which had been kept heated was now dipped into the furnace and rolled on the slab, a sequence repeated until the makers judged that the cone was thoroughly softened. Then they touched the tip of the cone to the edge of the rim of the vessel and swiftly wound on the trail in an underhand direction, again melting off the wisp of cone carefully.

The makers shaped the neck again in order to redefine it after the application of the hot glass trail of the rim and after the reheating necessary to tool the rim. They could have done this neck shaping in conjunction with the rim shaping, alternately holding the pincers to the rolling neck and then using them to squeeze the rim. This supports the idea that the same tool was used for neck and rim. Sometimes they applied the decorative rim trail to the top of the edge of the rim and smoothed the pincers around the underside of the rim. They did this regardless of which decorative motif they were using; it can be seen on BM 101 and BM 103 as well as on BM 114, BM 115 and LOU 11.

Finally, Working Group C used a mandrel to gather a bead of body glass. The gather was fairly substantial in comparison to that made by some other working groups. This may have been in part due to the stiffness of the glass, due to the robustness of the mandrel, or most likely because they required a large gather to produce their desired shape, which were handles with thick middles and jutting tips. They touched the hefty bead firmly onto the vessel and dragged it up the vessel wall before pressing fairly hard *into* the vessel wall and withdrawing the mandrel. The same tool was probably used to

run over the middle section of the handle, depressing it into a straight line or very level curve. Sometimes they did not take care to attach the second handle at the same level as the first (BM 101).

Did these makers also produce the vessels BM 97 and BM 99? Two issues arise. One difference between the highly tapered group and the pair of vessels BM 97 and 99 is the colour used for certain trails: yellow for the decorative trail on the rim of BM 97 and yellow for both base trails of BM 99. (The rim is not extant on BM 99.) Here we can consider the implication of differences in decorative motif. In a conventional feature typology decorative motifs are primary dividers of vessels into groups. What place do they hold in a gestural typology? It has been suggested here that Working Group C produced two decorative motifs by using the same gestures. Gestures show that people learned together. The fact that a rim trail is yellow, if it was put on the same way, can then be interpreted as a minor difference when every other feature of these vessels seems to be the product of the same gestural ‘melody’ – the straight sides and yet blunted base, the well-prepared and consistently thick and well-spaced trails, the moderately deepening zigzags, the clearly defined neck and shoulders (of BM 97), the way that the yellow trail appears, as it does on BM 102, on the top surface of the rim of BM 97, and the relatively thick middles of the handles.

This of course raises the issue of the place of core *making* in the sequence of work steps. In a large workshop, because the activity of mixing and shaping clay and organic materials is so inimical to glass working – core material sticks irretrievably to hot glass – it is highly probable that core making was confined to one place in the workshop. This raises the possibility of a single group of core makers who supplied all the glass working groups and who might have produced ‘runs’ of cores which, in this case, differed only in the degree of ‘fan’ in the rolling gesture. Everything else – attention to neck and base, neck cut-in – would have been the same.

If the makers of all the vessels mentioned above were supplied by a common core-making group this would bring their gestural melodies, as purely glass working groups, much closer together. Naturally the makers of the highly tapering vessels would use fan-shaped rolling to cover the core with glass, but only because there was no other way to roll a core which had been previously shaped, by someone else, with a high

degree of taper. The same necessary correspondence between the core-making and the *core-covering* rolling motion would hold for the less tapered vessels BM 97 and BM 99. This supports the idea that the workshop was large enough for core makers to form a separate group who supplied several glass working groups with cores in a non-specific manner – that is to say, without dedicating a particular shape to a particular working group. It is this type of workshop set-up which would give rise to the typological concept of Forms discussed in Chapter Two within the core-formed vessel typology: the idea that within and across Classes (decorative motifs and rim and handle styles) there exist several distinct shapes of, in this case, alabastron. It is known that different Forms prevail at different times (Grose 1989, McClellan 1984) but the dating of not only BM 97 and BM 99 but also the highly tapered vessel BM 101 to 475-50 BCE – indeed the latter two vessels were found in the same grave (Appendix 7, vessel information) – demonstrates that the two Forms discussed here were probably contemporary.

However one should also consider core-making, with regard to these vessels, simply as a separate activity rather than a separate group of people. Although core making is inimical to glass working, it is also temporally distinct from it. Workers do not need to time their core-making to the glass working; all that matters is that there are enough fired cores ready for glass working. Therefore core making could be done when the furnace was low, either while it was heating up before, or while it was cooling down, after glass working. (The great number of visible bubbles in the glass of many vessels testifies to a practice of letting the furnace temperature go up and down in this way.) Core making itself does not require separate episodes of heating; the cores can be dried on the warm surface of a non-working furnace and fired as the furnace is being brought to glass working temperature. What this means is that it can be done by the same group of people who work with glass without interfering with their glass working. Perhaps this interpretation once again moves the makers of BM 97 and BM 99 slightly more apart from the makers of the other, highly tapered vessels. But is it possible to contend that the makers who produced these two vessels did not share the same gestural values as did the makers of the highly tapering vessels? They attached importance to dexterity in rotating with rods, over slabs or on an axis in the air; keeping vessel rod and trail rod at right angles; incorporating turquoise thoroughly into the yellow trail in the zigzag panel; and

experience in postures required to view at right angles to the work. They also understood and felt the need to alternate rolling with repetitive dipping in the furnace – of cones, to soften decorative glass, and of entire vessel bodies, to heat body glass in order to roll it to smoothness over the core. Key gestures and postures – rolling and rotation, perpendicular viewing and working, and the dip of the cone followed by the roll on the slab – would have become governing principles for the makers of both the tapering vessels and the two wider and squatter vessels BM 97 and BM 99, underpinning so many procedures: core covering, decorative trailing, and neck- and rim-shaping. It is hard to support the idea that BM 97 and BM 99 were made by a different working group.

#### **4. Working Group D: FEU 9, 36, FEU 9, 43, TMA 75. Within Set 1 (figure 8.9)**

The two vessels FEU 9, 36 and FEU 9, 43 will be discussed first. The third vessel, TMA 75, will be dealt with separately below as there is a strong likelihood that it is the work of a maker at an earlier stage of becoming dexterous.

##### **FEU 9, 36, FEU 9, 43**

The makers of these vessels used parallel rolling to make their cores, resulting in a broadly cylindrical shape with very mildly rounded shoulder and base angles. They applied light pressure to smooth the shoulder without changing the shape, but pushed slightly harder while raising the rod slightly out of the horizontal, causing the lowest quarter of the vessel to slope slightly inward to the point where the profile ‘turns the corner’ to the base. Again these makers did not attempt to round out the base in any way, preferring to leave a blunted end with a flattish area on the bottom. Similar gestures and values were involved in core covering; these makers made sure to smooth the glass layer on the sides of the vessel and maintain the neck definition but did not extend the same care to the base. Different coloured body glasses were available to these makers – a light greenish blue and a rich brown – but they made use of the same decorative trail colours which were seen as the norm for this pattern.

They also understood and engaged in the gestures prized by Working Group C: repeated dipping in the furnace and rolling of the decorative glass cone which resulted in thorough heating; trailing with cone-bearing and vessel-bearing rods at right angles; and making sure the cone-bearing rod travelled steadily along the body as the vessel was

briskly but equally steadily turned. All this produced a long yellow trail on vessels FEU 9, 36 and FEU 9, 43 as consistent in width and spacing as those produced by Working Group C.

However, their interpretation of the pattern was distinctive. This is revealed in the placement of both the yellow and the turquoise trails. The makers touched on the yellow trail well down on the shoulder, leaving the evidence of a well-made thick cone with a stubby tip. They made no attempt to wrap or hide the beginning of the trail. A desire to hide the beginning of the trail may lie behind the positioning of the Working Group C yellow trails, which were touched on so high on the neck that in some instances they appear on the top surface of the rim. The greater impression of symmetry this confers is made clear by the contrast between this and these Working Group D shoulders, where one side is bare body glass yet the other bears a large stripe of yellow. This second more obvious trail placement also draws attention to how the decoration is done, something which Working Group C may have been more interested in concealing.

Working group D also applied the turquoise trail largely at the bottom of, outside, and only thinly within the panel. The exceptionally thick turquoise trail at the bottom, coupled with the markedly thin, wispy trail *within* the zigzag panel could imply that they touched the turquoise trail on at the bottom end of the vessel and wound upwards towards the top. They may have had less turquoise to use; they may have heated it less thoroughly (it takes longer to soften turquoise than it does yellow opaque glass). In any eventuality a small turquoise cone touched heavily on to a vessel at a point near the base is not going to travel very far up the vessel. Furthermore if they used turquoise first, and only then applied the yellow trail from the shoulder downwards, this would only increase the likelihood of a slightly 'disconnected' appearance to the colour bands of the decoration. It seems that these makers did not set great store by integrating their decorative colours into one pattern, in contrast not only to Working Group C but also to the majority of the group designated 'Class IB' by Grose, from which Set 1 is drawn and where turquoise and yellow mingle over most of the central zigzag panel. The comparatively unintegrated turquoise is also seen on BM 107, the vessel only superficially similar to those in Working Group A (see above). The winding on BM 107 is not the same as that of Working Group D, however; the maker of BM 107 wrapped the

trail over itself for 1 ½ turns before casting off, and made no attempt to place turquoise trails within the zone of yellow tooled trails at all.

The gesture for tooling the trails into zigzags was consistent but economical. The makers held the tool in one position as they drew it across the trails and down the vessel, moving it round the vessel in comparatively small intervals. These two gestures were very close to those used to make the similarly-sized and -spaced tight shallow zigzags seen on the vessels made by Working Group C.

The necks of the group D vessels are narrow, like those made by Working Group C, and even shorter. The rims are small and even but somewhat thick, rising above and dipping below the decorative trail; this shows that the makers took a gather of body glass and applied a short but quite thick trail of glass for the rim, one which was possibly only one-and-a-half turns long. The dimensions of neck and rim imply that both were shaped with the same type of tool; a pair of not very large, nor very wide, pincers which were not plied in the same exhaustive manner as those used by Working Group C makers. While Working Group D makers made similar gestures for neck shaping just before the rim was applied, they did not re-shape the neck as assiduously afterwards; the result is that the necks do not share the clean-cut angularity of Working Group C and as the vessel is rotated through 90 degrees the neck profile can change from angular to unevenly curved. The smallness of the pincers can also account for the bulging profile of the rims; the smaller blades could have made it harder to get a good purchase on the rim and squeeze it thoroughly to flatness (widening it, of course, in the process).

The decorative rim trails reveal another feature of the Working Group D trailing values. All three trails have streaks of the alternative decorative colour; streaks of turquoise can be seen in the yellow rim trails of FEU 9, 36 and FEU 9, 43 and the turquoise trail of TMA 75 contains a great deal of yellow. This shows that rods used for yellow cones were not rigorously separated from those used for turquoise ones, and that therefore yellow cones were often formed on rods which had previously borne turquoise glass and vice versa (Ch 5.B.3). The result is that, as the trail winds onto the vessel, streaks of the previous colour were pulled off the rod into the trail and thence onto the vessel. The fact that it is the rim trails only of FEU 9,36 and FEU 9, 43 shows that these trails were put on using the last portion of the cone which, as it trailed off, pulled streaks

of the previously-used turquoise glass off the top of the cone-bearing metal rod. Bichrome trails (except in the case of FEU 9, 35 (see above, Working Group A)) are almost always accidental and of course do not show on all vessels which may nevertheless have been made with undifferentiated cone-bearing metal rods.

This also calls into question the nature of the base trails of vessels FEU 9, 36 and FEU 9, 43. Neither of these show any streaks of alternative colour. On the face of it there is no reason why they should; if they were applied before the rim trail the cone might not have run down to the turquoise 'stub' yet. But if one considers an example of a base trail which *does* contain streaks, the yellow base trail of BM 107, a vessel in the selected data set featured above in figure 8.5, one notices something else about the base trails in Working Group D. While the BM 107 base trail narrows to a wisp in the conventional manner of cone trails the Working Group D base trails seem to be exceptionally stringy, that is to say uniformly thin, and possess unusually thin and yet defined ends, almost as if they were pulled rods of yellow glass which have been 'hung on' and wound onto the body (Ch 5.B.3). Project work showed that it is hard to make proper rods out of the Pichvnari Opaque Yellow Glass 2 (Ch 5.B.3). But long wisps of cone trail, made by pulling the cone abruptly away from the vessel on finishing the trail, could have been cracked off, the wispy ends heated, folded and rolled to smoothness, and the resulting rod-like squib of glass then attached to the vessel and wound on without being held at the other end. This would also account for the way the base trail overlaps on both these vessels; as it hangs, the melting rod crosses over the previous trail turn. This would mean that the base trail decorative glass could either have been drawn off the middle of the cone and kept back, or drawn off another cone entirely. Whether or not this particular interpretation is well-founded it reminds us how some features may arise originally from the variety of small preparatory gestures introduced into the work steps for trailing primarily to make the most of the available glass.

The makers finally applied the handles. The handles do not share the thick middles of those made by Working Group C. The group D makers probably lifted the bead after touching it to the vessel, instead of dragging it in group C style. Both FEU 9, 36 and FEU 9, 43 have thick loops; this suggests a light touch-on so that most of the bead came away as it was lifted and was then set down again to form the loop. Again, the

touch-down was light; the loophole was not pressed hard against the vessel wall. The maker of FEU 9, 43 overly flattened the tip of one of the handles. This handle middle is also short, which invites the suggestion that the maker, performing his usual stroke to depress the handle middle, rolled the mandrel down too far and blunted the tip as well. Uncertain rolling with the mandrel, in the form of altering pressure and reducing speed, also features in one handle middle of FEU 9, 36 where bumps can clearly be seen. The other handle of the same vessel, probably the second to be applied, has a tag protruding from the loop, the result of glass clinging to an overheated mandrel. Perhaps this mandrel was not always dunked in water between bead gathers. Both these handles have tips which are thin in profile and protrude at right angles to the vessel, made by running the mandrel down the middle and pressing it against the tip.

**Working Group D, learner: TMA 75 (figure 8.9)**

In vessel TMA 75 the same gestures and values shared by Working Group D can be seen at a less consistent level. The cylindrical body has a more lumpy base, the trail glass is under-heated but the maker nevertheless struggles to cover the upper portion of the body with yellow trails which are designed to be as thick as those on FEU 9, 36 and FEU 9, 43. The result is fluctuating and intermittent and an extra wisp of yellow-streaked turquoise was added to the top of the shoulder. The maker had similar trouble with the turquoise body trail, which is also positioned low on the body as in the other two vessels of Working Group D. The trails are also tooled uncertainly, with the trademark shallow tight zigzags pulled up on one side by a number of much deeper and longer strokes. It is possible that the maker overheated the vessel on this side. The rim and neck are fairly consistent and the neck seems to be carefully shaped; this maker had understood the value of the perpendicular eye-line and held the pincers well. But the rim trail is not only bichrome but bubbled. The turquoise base trail appears more conventional than that of the two other examples. The handles are not symmetrical. Like FEU 9,36, one has a tag of glass at the loophole, betraying a mandrel which has not been cooled between gathers. This handle has a middle and a thin perpendicular tip shaped, like FEU 9, 36, by running the mandrel down the middle and pressing hard against the tip. The other handle is more like the blunted example on FEU 9, 43; the maker started to run the mandrel down but the



glass was too cool; the mandrel could not push into the middle, slipped a little, and blunted the tip.

It is clear that this vessel, although not as consistently made as the two vessels described above, shares with them a common set of gestures and values. For this reason it can be described as the work of a learner in Working Group D. This learner understood parallel rolling but when moving from body to base s/he lacked the control in lifting the vessel-bearing rod to do more than minimal rolling over the base of the vessel. The learner also had absorbed the importance of posture and the perpendicular eye-line (the well-shaped neck and level rim). What s/he did not understand so well was temperature – of the decorative trail cones, of the vessel wall while tooling, of the mandrel when gathering beads for handles, and of the applied bead as it was tooled into a handle. The Project work showed how a novice maker can become consistent in some gestures while others continue to elude the learning body, producing the effect of ‘islands of stability’ in the sequence of work steps. This vessel may be an example of this situation. Additionally the temperature issue shows how many steps of a procedure need to be done at specific speeds and are furthermore linked to other speed-dependent steps – gathering and then applying the handle bead, for example.

##### **5. Working Group E: FEU 9, 46, FEU 9, 47, FEU 9, 48, FEU 9, 49, FEU 9, 50, FEU 9, 51. All of Set 2. (Figures 8.10, 8.11)**

The first impression given by the more uneven profiles of these vessels is that these makers attached only minimal importance to, and possessed minimal experience in, rolling. But the bases are smoother and more carefully shaped than those made by the members of working groups C and D. A closer look reveals firstly that the rolling is of a different kind: applying a firm pressure while raising and lowering the vessel out of the vertical to produce much more deeply-rounded bases than the Working Group C and D vessels. These makers had a different idea about overall body shape. The unevenness may be in part due to core covering but the most obvious cause is decoration; some of the thick trails stand proud of the body (FEU 9, 51) and in other cases the additional glass added by trailing has made for a raised area on the vessel wall. Even if these makers rolled the vessels after core covering, they only rolled enough to flatten most of the

decorative trails; they did not work to redistribute the glass mass so that it was more evenly spread over the sides of the vessel. They did, however, take care to include enough glass at the neck to form an integral rim. It is possible that they went ahead and formed the rim at this stage, before decoration, but the experience of Mark Taylor and Emily Coulson during their initial core-formed vessel-making trials (Ch 5.B.6) suggests that if the rim is made this early it simply melts back into the neck during the ensuing procedures.

The same lack of repeated reheating and rolling applied to the decorative trailing. The thickness of the Working Group E trails indicates that the makers did not do as the other groups did and thoroughly heat their cones of decorative glass so that the inside was as hot as the outside. Instead of streaming smoothly and consistently from the tip of the decorative cone, the trails slid off as large thick, relatively uncontrollable portions of the cone.

They then increased the unevenness by tooling the trails into large tall widely-spaced zigzags. This version of the zigzag panel involved driving the blade or spike relatively deeply into the vessel wall; consequently a larger mass of glass was pushed along in front of the tool and the overall result was to add to the amount of body glass in the decorative panel. These tooling strokes left deep furrows in the vessel wall but the makers did not repeatedly dip the vessel in the furnace and roll it on a slab until the vessel wall was even again.

Group E makers then pulled a rim out of the body glass at the neck. The somewhat wavy edges of most of these rims testify to large-scale tugs with a robust pair of pincers. These pincers would have been an ideal tool to define the thick but clearly delimited neck, which has been cut in at the shoulder and just below the rim. The asymmetry of these rims reveal a generally low level of interest on the part of the makers in producing a rim which is circular in face view and level in side view and they make it very unlikely that these makers adopted postures designed to maintain an eye-line perpendicular to their work.

Working group E made handles which were largely unexceptionable. This significant point will be discussed in the next and final section of the chapter.

### **Working Group Summary**

What first became clear through the discrete gestural typologies seems to be confirmed by this consideration of the vessels in terms of shared episodes of making undertaken by working groups. Set 3, regardless of its different design, was made by those people who made the highly tapering vessels in Set 1 – Working Group C. In addition, the work of two other Working Groups, A and B, can be identified in Set 1. These groups show what happens when simple conceptual interpretations of decorative motif are re-analysed as gesture-tool-material complexes: the different patterns present in Working Group C are made by the same gestures and express the same values. Although the ‘Class IB’ decorative motif is shared by Working Groups A, B, C and D, they clearly manifest different value judgements, and therefore different gestures, about how yellow straight trails should be disposed, how level the tops of tooling strokes should be, and how turquoise should be laid on. Set 2, on the other hand is the product of a single working group, E, who made no other vessels featured in the selected sets and who, although the vessels have inconsistent features, made handles of a *higher* degree of consistency.

This section has analysed the selected database in terms of the gestural typology and shown firstly how several working groups can be identified within a particular set and secondly how a single ‘working group’ designation can cut *across* the sets, that is, include vessels from more than one set. The next section examines the relationship between the working groups and suggests that different *types* of working group can be identified.

### **B. Different Working Groups: Accounting for Inconsistency**

The working groups outlined in the previous section are not all equally different from one another. In Chapter Six the notion of a working group was clarified by comparing it with the idea of a workshop: one workshop, it was said, could comprise several working groups. Working Groups A, B, C and D share a concern for the perpendicular eye-line: this produces a level rim, trails which do not slope, et cetera. They also share the value of rotation: thorough rolling on a slab for smoothness, even rotation of the vessel-bearing rod for decorative trailing. These groups also agree that the rim should be applied and

that the correct profile for the shoulder, neck and rim is angular and the neck is short. These values arise in a spiral of dexterity of tools (stone slabs, narrow-bladed pincers, a trail iron, metal rods) which are movable. A furnace is rather less movable: the principal requirement here is an aperture wide enough to hold the vessel in the heat source while trailing – the other necessity, along with a thoroughly-heated cone of decorative glass, for even trailing. But even this, if it cannot be transported, can be reproduced. What makes it more likely that these working groups shared a location is the feature which does not ‘fit’ – the somewhat lumpy and sometimes even faceted base. Careful rolling could so easily mitigate the appearance of these vessels but it was not carried out; one suggestion is that it was because they were placed in the annealing oven in an upright position, propped on their bases. The fact that all these vessels share this characteristic suggests that it was something over which no members of any working group had any power. It is so easy to make a smooth base that it is likely that the makers were responding to conditions of equipment which in this case they could not change. If, as it seems, none of these three working groups found any way of avoiding bumpy faceted bases when regarding all other procedures they seem so actively enrolled in a spiral of dexterity, then it would suggest that they were, as a group, subject to the same less than ideal annealing conditions. If there were nucleated workshops each with its their own furnace, onto which, or next to which (with a separate fire) one could build an annealing chamber, one might expect to see more evidence of positive base shaping solutions and fewer uneven flat bottoms.

Thinking about furnaces and tools in this way is also productive when considering Working Group E. This group, which produced all of the vessels in Set 2, seems not to share any of the values of working groups A, B, C and D. The perpendicular eye-line and the consequent adherence to symmetry are not part of the values of this group. But considering the differences which are more closely related to tools it is immediately apparent that the bases of the vessels made by Working Group E are not only rounded and deep but smooth. Clearly these vessels were not stacked on their bases when annealing. However it is the more problematic tool-related differences which are of concern here. The principle difficulties relate to cone heating, heating while trailing, and, to an extent, rolling after trailing. It seems extremely unlikely that these makers could not understand, given the substantial materials experience needed to cover a vessel with body

glass, that decorative glass needs thorough heating both before and during the trailing procedure. The same whole body reheating is required to roll the trails, either after trailing or after tooling them into zigzags, so that they are flush with the body. In many instances this does not seem to have happened. Since tool sets develop in synergy with gesture it can be suggested that an inconvenient furnace aperture might have impeded reheating during core-covering and thereby also contributed to the overall unevenness of the body glass itself. But why did Working Group E not procure suitable slabs or modify their furnace aperture? This brings us to the final research question which was presented in Chapter One and which was provoked by these same vessels, one of which, FEU 9,51, is pictured in figure 1.1 to the right of a vessel from Working Group C, BM 102:

- How can we explain communities who do inconsistent work?

In Chapter Two several responses were suggested for this question, once again focusing on the Working Group E vessels (which were referred to as Class IJ in Chapter Two). They might have been the result of novice work, haste, or purposeful crudeness. Taking the first option, novice work: the gestural interpretation shows how unified are the features of vessels from working groups A, B, C and D by certain gestures and postures centred on rotation and angle. It also shows how incoherent are the gestures and postures behind the Working Group E vessels. Almost all of the inconsistent vessels in Set 1 are inconsistent in only one or two areas – an asymmetrical rim, for example, or a single thick and uneven trail. Very few vessels of Class IB design are as inconsistent across body profile, body decoration, neck and rim symmetry, rim circularity and decoration as these Working Group E vessels. It should be noted here that the time it took for this author to produce a vessel of the level of consistency shown by FL 86 (figure 8.12) was forty days – worked over four or five days a week, in two blocks of four to five weeks, separated by six months. After forty days of work, if I was not as good as the most consistent, I was as good or better than the least consistent. The ‘novice’ hypothesis, already weakened by the design-related anomaly (that the design chosen by Working Group E is alone in containing no highly consistent examples), can be discarded.

The 'haste' hypothesis again relates to the distinctive design; highly consistent glass work requires time, chiefly for the extensive reheating of body and decorative glass which is needed in order to roll the body and decorative trails to smoothness. It is possible that the unevenness of Working Group E vessels are the result of haste. But if in haste, why be hasty only in this design motif? Why add so much decoration? Why not make a smaller vessel which takes less time to cover? Ethnographic evidence of craft work done strictly to time suggests that makers reserve distinct, simple designs for the 'commercial,' fast-turnover section of their output, reserving their complex designs for their more deliberately-made fine wares (Hardin 1977). The reason makers do this, of course, is because of the concomitant values of dexterity: there is an ethos behind consistency which makes it the correct way to make things and which shapes the behaviour of the craft worker and the output of the working group.

The third hypothesis, purposeful crudeness, is weakened firstly by the ethical dimension of dexterity mentioned above and secondly by the physical dimension: that once skill is learned at the level of bodily autonomy it is very difficult to unlearn. The skilled maker has learned, on the level of bodily autonomy, how to control the multiple degrees of freedom of the arm and hand which, until they are reduced, produce the inconsistency characteristic of novice work and it is hard, if not impossible, to access and then destroy this bodily learning (Bernstein 1996, Ch 3 and Ch 6). What really militates against the idea of purposeful crudeness, however, is the level of skill shown in one particular feature of the Working Group E vessels: the handles. It was noted above that the handles seem to be more consistent than any other vessel feature in this group. As well as weakening this particular hypothesis, the handles offer an alternative explanation for the level of skill shown by these makers. Handles are a classic test of consistency: they oblige the maker to create two very similar artefacts one after the other with no opportunity to discard failed attempts once the bead has been touched onto the vessel. The set of tools for handles is one commonly used for bead-making. We have seen that the less consistent features – the lumpy body profile and insufficiently-melted trails – point to an absence of rolling and the possibility of a non-ideal furnace aperture. Bead-making furnace apertures are clearly allowed to be smaller than those ideally sized for making core-formed vessels measuring eight to ten centimetres. If the working group

involved in 'E' vessels were primarily producers of beads and only occasionally made larger core-formed vessels this would make their production not 'short-lived' but something entirely different, an *episodic* and therefore secondary production. Essential to the spiral of dexterity is the potential for modification of all tools and materials – furnace apertures, core mixture, mandrels, slabs for rolling, and so on. The assiduous, all-encompassing and continual repetition of gestures which characterised the author's apprenticeship was accompanied by precisely this absolutely unfettered process of tool and material development. Tools which remain unmodified because they are dedicated to other work do not promote dexterity in gestures, especially those gestures which are already neglected through episodic practice. Makers whose fragile gestural learning is continually impeded by a tool set which is 'stuck' (because shaped for another activity), recalcitrant materials, and intermittent work periods, will not attain the sense of 'rightness' that stems from dexterity. This situation is far more likely to produce the kind of artefact features seen in the 'E' group than in the groups A, B, C and D. The Set 1 design is found on numerous vessels at varying levels of consistency, showing a range of skill. Working groups A, B, C and D illustrate the difference between a workshop – production area, either concentrated or nucleated – producing vessels of a certain design or number of designs, and a working group – a body of makers who, in the case of this vessel and its few companions, had elaborated a detailed sequence of work steps out of the kind of 'spiral of dexterity' described in Chapter Six. It is probable that while there were many working groups producing vessels of the Set 1 design there could have been only one working group producing vessels of the Set 2 design – and that 'working group' in the case of the Set 2 design was co-extensive with the designations 'Class' and 'workshop.' It is also possible that this Working Group E made beads most of the time; and that although they made vessels as well, they did not do it often enough to experience in the processes of becoming dexterous explored in this study.

### C. Conclusion

- Can we identify communities of makers in the archaeological database? If so, what can we say about their respective craft values?

- How can we explain communities who do inconsistent work?

This chapter drew on the implications of dexterity outlined in Chapter Six and on the systematic elaboration of a gestural typology in Chapter Seven in order to argue for the validity of an idea: that it is possible to identify vessels sharing a gestural typology with a specific group of makers. The chapter then went on to isolate five working groups from the sets of vessels presented in Chapter Seven and to show the importance of thinking in terms of tool, material and gesture rather than simple divisions on the basis of pattern or an extrinsically-imposed notion of Form. In the case of group E, who produced inconsistent work, it was possible to suggest what type of working group they were – in this case, makers who engaged only episodically in core-formed vessel making and who may otherwise have been involved in bead-making. Contrasting skilled making in Working Groups C and E highlights the indispensability of an interplay between tools, materials and gestures which allows tools and materials to be modified along with gesture. It also emphasises the way that value judgements inform every aspect of skilled making, as they both engender and are engendered by dexterous gestures.



## **Chapter Nine. Conclusion**

### **A. Thesis Summary**

At the beginning of this study I posed a question concerning two sets of artefacts (figure 1.1) I asked why one set was never executed consistently. This question was the starting point for an exploration of skill and making which gave rise to the idea that skill in making is a kinaesthetic process, specifically the experience of becoming dexterous in the performance of gestures in interaction with tools and materials. It can be conceptualised using the following terms of analysis: experience (of materials, tools, artefacts and work steps), sensory activities (of listening, watching and feeling), and gesture-tool-material.

An apprenticeship in core-formed vessel making enhanced the original conceptualisation of skill by showing how intensely interactive were the different aspects of the process of becoming dexterous, and in turn how extremely dynamic the process was. The apprenticeship's focus on the experiential nature of skilled making revealed that the process was necessarily and intrinsically value-positive and meaningful. Craft values, stemming from an autonomy which is nevertheless manoeuvrable, can account for situations of continuity and of change where 'good-better' can be a more useful interpretation than 'same-different.'

These allied conditions of value and autonomy, by ensuring that change happens only in certain specific conditions, greatly reduce the likelihood of a maker embarking on a series of arbitrary gestural alterations. This means that by developing a gestural typology for core-forming one can also identify communities of practice, or working groups, in the archaeological record. It also proved possible to identify different types of community with different craft values and suggest reasons for these differences.

### **B. Originality and Applications**

#### **1. Originality**

This thesis combines theory, craft work and artefact analysis. I identified a problematic approach to artefact making and developed an alternative conceptual framework in response to it. I linked theory and practice by applying this alternative framework to a

practical project which was designed not as an experiment in materials and tools but as an apprenticeship. This constitutes an original approach to ancient pyrotechnology. Out of the theoretical and practical work I was able to develop two concepts which related directly to archaeological artefacts, that of the gestural typology and the working group. With the help of photography and film I compiled a large database of archaeological artefacts and demonstrated how the gestural typology can be used to obtain new information from artefacts about communities of skilled makers – information relevant to several areas of archaeological research.

## **2. Applications**

### **a. technological change**

The theorising of skilled making undertaken by this study can contribute to discussions of technological change. As suggested in Chapter Six, continuity and change can be seen in terms not of producing the same artefact or producing a different artefact, but rather as producing the best possible work and then having a new idea about what is the best possible work. The way that new ideas supersede previous ideas about the best work stems from the fact that dexterity is at once value-positive and essentially a matter of manoeuvrability. Rather than looking first for extrinsic pressures to explain technological change, then, it is fruitful to consider what, in the interplay of tools, materials, gestures and postures, and experience about tools and materials from which the artefacts in question arise, could have led to a new idea about the best work. An example can be found in the field of ancient Mediterranean boatbuilding. An ostensibly radical change in hull construction, the transition from shell-built to frame-built hulls, has been interpreted as ‘driven’ by a factor extrinsic to boatbuilding: a demand for robust and roomy holds for Atlantic trade. But a closer analysis of the extant hulls in terms of tools, gestures and work steps results in an alternative view; that the transition from shell to frame building was long; that the beginning predated long-distance trade by many centuries, and that it came about through a slow and subtle alteration in the sequence of hull planking and framing. This alternative view can only arise from a focus on gestures, tools and work steps and a clearly-understood notion of the role of shared values in craft. It also highlights the essentially dynamic nature of craft activity; that technological change is not

pushed by extrinsic factors but can arise from the actions of dexterous makers. Another example of ostensibly radical change is the emergence of the technique of blowing glass in the Near East during the first century BCE. The development of gestural typologies for the archaic, pre-blowing glass techniques (which include core-forming) could help to identify gestures or work steps which constitute the 'seeds of change' for inflation.

#### **b. typology studies**

Can a conventional typological approach, based solely on the appearance of artefact features, do the same job as the dexterity perspective? This is the same as saying: 'Does it matter that the makers valued these features? Why can we not simply *look* at them?' The first objection to this is that a purely connoisseur approach, by virtue of the fact that the connoisseur is not a maker, has no way of establishing which gestures produced which features. If one knows that all it takes to give a flat rim a slight lift is applying the decorative trail to the top instead of the middle of the rim edge and then smoothing it, then one is less likely to classify this as an entirely different style from a purely flat rim. The same goes for alabastron Forms. They are listed as I:1 to I:6 for Mediterranean Group I. To say that there are six forms obscures the fact that the borders between forms are fuzzy; that there are many I:2 forms which, while being tapered so that they are narrower at the shoulder than at the base, are markedly different in many other aspects including curvature of the sides and roundness of the base. It may be true that a certain vessel has a form I:1 body shape but it is too short to be I:1, because the typological definition of I:1 is 'tall' as well as 'bag-shaped', but this takes us away from the genuine archaeological issue, which is that working groups, shaping clay with their hands, are generating by work and eye the sort of consensus in value that arises from everyone making the same gestures: that this was the proper shape. In the case of this vessel, someone took a small lump and not a big one, perhaps because it was the last bit of that batch of core mixture left. While another group might have rejected the lump because the resulting vessel would be much shorter than the others, nobody rejected it because it was 'too small for a Form I:1'. If one concludes from the short fat exceptional Form I:1 that is 'a rare example of Form I:1a', this statement has no meaning outside the typology and, in terms of working groups, is frankly misleading. Furthermore, the purely feature-based

approach can provide no evidence for the corollary of the position ‘those bad makers could not have made this good work’: that ‘these good makers were very unlikely indeed to have made that inconsistent work’. It has no theory to account for craft values, for how or why some people may have taught others a craft, and neither does it have anything to say about change or innovation. Interestingly a typology expert’s connoisseur-level skill, accrued through years of looking and handling, is the result of the same process of attunement which informs dexterous movement.

### **c. cultural transmission**

Cultural transmission studies have traditionally described the passing-on of cultural information in terms of guided variation, direct bias, indirect bias, and frequency-dependent bias. This approach has been said to take little account of the place of skill in transmission (Bamforth and Finlay 2008, 13). However an ‘archaeology of pedagogy’ (Tehrani and Riede, 316) is now being advocated within cultural transmission studies. This involves developing tools for identifying where teaching has taken place in the production of archaeological artefacts (e.g. Tehrani and Riede 2008).

This approach is designed to identify, as well as instances of imitation and emulation, cases where actual teaching has been involved in cultural transmission. Based on an ethnographic survey of Iranian textile production, Tehrani and Riede conclude that the main diagnostic for the occurrence of teaching is the high degree of conformity in artefact production over time. Tehrani and Riede emphasise that it is not linguistic modes of instruction they mean by teaching, but rather contexts ‘in which an experienced individual modifies their behaviour with the specific aim of facilitating learning in a novice’ (Tehrani and Reade 2008, 319). This definition of teaching will strike many as being so wide as to be indistinguishable from the kind of activity described in this thesis as the normal operation of a working group where showing is a normal part of an expert’s work just as helping the expert is a normal part of a beginner’s. As such, the point of disagreement is over whether teaching is really a *modification* of some kind of original or ‘pure’ mode of behaviour. However, the role of a more formalised separation between doing and teaching emerges in a case study of Scandinavian Neolithic flint daggers where Jean Apel suggests that there are so many complex work steps that production

‘demand[s] an institutionalised apprenticeship system that could guarantee that [they]... could be reproduced for at least 24 generations’ (Apel 2008, 91). Here the problem is more apparent. Apprenticeship is needed to explain complexity, and teaching to explain conformity, precisely because skilled making is theorised in terms of knowledge. If skill is knowledge, then it is knowledge which has to be passed on; knowing it and passing it on become two distinct things; and the more complex and skilled the production process, the more complex and skilled, and distinct, the passing of it must be. If the dimension of dexterity is missing the inquirer remains unaware of the intrinsic potential for conformity, refinement and complexity provided by the working group itself, a social entity whose turnover is staggered and continual, where the dexterous manipulation of tools and materials is not only prized but the *raison-d’être* of that group, and where consensus on artefact features is just one element among many which ‘feel right’. The dexterity perspective suggests that caution be exercised when looking for teaching in the archaeological record; that the concept of teaching be thoroughly addressed; and that it is not necessarily valid to attribute long and complex craft traditions to formal apprenticeship.

#### **d. experimental archaeology**

The kinaesthetic approach to skilled making can enhance experimental materials studies. One can take the making of cores as an example. Making two cores gives minimal information about core composition. Making two hundred cores brings a different quality of insight because, by turning out that number, one cannot help but become dexterous in making them. This includes experiencing the properties of the various materials, beginning to control gestures, and forming a sequence of work steps. The *chaîne opératoire* framework, while it affords clarity and detail, lacks the conceptual link between gestures and values and as a result presents work steps either as extrinsic constraints or as unfettered technological choices. The dexterity perspective, on the other hand, genuinely integrates sociality and materials in one conceptual scheme. It offers experimental archaeologists a set of theoretical and practical tools for 1. setting about the process of becoming dexterous; 2. recording this learning process; and 3. making inferences about the role of dexterous manipulation in the sourcing, refinement and

manipulation of original materials. Experimental archaeologists, due to their extensive materials training, are well-placed to evaluate different suites of gestures in conjunction with compositional evidence. This makes it possible for them to generate extremely thorough gestural typologies which can make a robust case for the existence of a particular working group, and a *type* of working group – information of great interest to non-experimental archaeologists.

#### **e. lifeways**

A central aim of this study has been to reframe making as a kinaesthetic and collective event, important for itself and worthy of archaeological investigation in its own right. I have suggested that this is because skill in manipulating materials and tools was a central and vital activity in ancient communities. There are many things which one will never know about these makers' lifeways, but one of the most important aspects of it was their collective absorption in the making of – for example – straight, thick and evenly-spaced yellow trails. If we regard this as peripheral or somehow unconnected to 'sociality' we reveal more about ourselves, as people for whom the dexterous creation of artefacts is no longer part of daily life, than we do about the makers. A skills perspective might contribute to areas of archaeology which are traditionally viewed as less overtly 'craft'-oriented, for example the spread of agriculture. One could analyse in terms of skill the concept of a 'package' of lifestyle elements as presented in the following statement: 'On the North European plain and in Scandinavia... it seems that hunter-gatherers were highly selective as to which elements of the Neolithic "package" they adopted from the Bandkeramik farmers to the south' (Budja 2004, S113). What are the skills needed for the 'package' and how do they interrelate? How do the skills possessed by the hunter-gatherers relate to those of the Bandkeramik farmers? Archaeobotanical and zooarchaeological evidence would be extremely helpful in this regard.

### **C. Shortcomings and Further Work**

#### **1. Shortcomings**

The major shortcoming of this study is the fact that, out of the four vessel types, only the alabastron was studied and made (see Chapter Two). This means that none of the gestures

involved in making the other types were explored and consequently the gestural typology outlined is exclusively for alabastra. A more complex project would involve making all four vessel types to show the relationship between gestural typologies; the variety of dipping, dabbing and pushing gestures needed to make handles for amphoriskoi and aryballoi, for example. However this does not detract from the theoretical points or their applications.

## **2. Further work: the Bowl Project**

There is scope for applying the theoretical framework of this thesis to other archaeological communities of makers involved in different materials and technologies, as shown by the example of ancient Mediterranean hull construction above. Hydraulic cement, concrete and ceramic building materials are all other possible areas of investigation.

However my immediate area of interest is a proposed large project involving other archaic glass working techniques – those involved in the production of mould-formed open vessels. (Core-formed vessels are mould-formed *closed* vessels.) Open vessels are primarily dishes and bowls. Mark Taylor and David Hill provide an exemplary resource for this project as experienced makers of this type of artefact. Their work on mould-formed bowl-making is both meticulously recorded and ongoing, and part of the project would involve using archived records and artefacts to document Taylor and Hill's past experience of becoming dexterous in mould making and casting. Unlike the Core-formed Project, where Mark Taylor was developing tools and gestures in response to new materials, my collaboration on future open mould-formed bowl-making would be framed as the entry of a novice into a more established working group. Gestures, tools and materials could all be investigated, as well as the potential for change engendered not by a dexterous maker but by a maker with little or no dexterity working with makers already in a spiral of dexterity. Again, no dexterity studies have been carried out in this area. The main archaic glass techniques are core-forming, open moulding as described here, and bead-making. This proposed open-moulded Bowl Project would therefore make a major contribution to theoretical and practical development of the greater typology of

archaic glass working gestures during the five hundred years prior to the emergence of the technique of forming glass vessels by inflation.

#### **D. Concluding remarks**

Skilled making can be analysed as a series of elements whose interaction is subtle, socialised, and intrinsically dynamic. Values arise in a communal context and change can be produced in a special way through a spiral of dexterity. An experiential rather than an experimental process, one where change, difficulties and mistakes are precisely recorded, is the primary mode in which this interaction can be captured and observed. It is productive to consider craft knowledge being spread and passed on in this highly contextualised and specific way, among members of working groups where the values of the more experienced and dexterous are absorbed by others and then changed through time by a process which is capable of generating both continuity and change.

This study is intended as an original contribution to archaeological research into the relationship between artefacts, or ‘things made with skill’, and makers. Because the makers lie unreachably in the past, and because the artefacts do not show the signs of every skilled gesture used to make them, the understanding of this relationship is necessarily partial. Archaeological research into making has tended to analyse making in terms of knowledge; this means that the types of ‘knowledge necessary to make things’ or ‘knowledge generated by making things’, broadly polarised between the practical and the theoretical, have tended to become the focus rather than the making itself. This is perhaps because the archaeological discussion of making happened to arise out of a broader enquiry into the cognitive development of early humans which included language alongside tool use. This may have made it easier to consider making as something studied primarily in order to look at *other* things – not only cognitive development but also social structure and social complexity, the latter including the phenomenon of craft specialisation.

It is notable that making can also be bypassed when the focus lies exclusively on its sociality: when learning to make is seen as one out of many forms of social integration and that things are made solely in order to produce new, or elicit existing, social relations. Of course making is a social activity which entails and creates relationships with people



and things. But dexterity, specifically as a dynamic interaction between movement and material and as a kinaesthetic experience, is an important generator of social relations. This means that making has an intrinsic potential for social change. Furthermore, as learning to move dexterously is a major social experience which transforms individuals, groups, and things, the framework outlined in this study may contribute to understanding aspects of social life other than making artefacts.

Frances Liardet. 28 January 2011.

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