9. Pottery production and consumption in Protopalatial North-Central Crete: from pots and patterns to people and process[1]

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Introduction

This workshop continued a series of very useful meetings on Minoan ceramics by period, that have principally involved site-specific presentations of material, with some inter-site comparisons and island-wide observations. Building on these studies, we need to move from details of the pottery assemblages at individual sites to recognising broader patterns, to identify the behavioural processes enacted by people in the past that produced them. This objective was captured by some contributors to the discussions published in the LM IB conference, where participants were enjoined to move beyond discussions of stylistic details, to 'historical interpretation' (Brogan & Hallager 2011: 637, 641). But the way this is often done tends to jump directly from limited material patterns to historical interpretations, largely by-passing detailed considerations of the processes that produced the patterns, as if identifying and explaining these processes are not, in fact, our major challenge.

That challenge concerns what material culture distributions – in this case regionalism in Protopalatial pottery styles – represent (Whitelaw 2018: 223-228; Cadogan 2021; *cf.* Brogan 2011; Rutter 2011; Arvanitakis 2007; Oddo 2019; Langohr 2019). There is a great deal of interest in interpreting such distributions in political terms, to define the territories of palatial polities on Crete (Knappett 1999a; Cadogan 2011; 2021). But the challenge is linking bottom-up, empirical patterns in ceramic variations, to top-down interpretations about social, economic and political structures and interactions (Knappett 2002; Whitelaw 2018), without clear ideas about the processes by which the patterns were produced, and which processes specific patterns represent. It is this conceptual gap that this paper engages with, to identify elements of an interpretive framework and outline some parameters for considering relevant processes.

The root of the interpretive problem is that artefact styles do not necessarily represent cultures, ethnic identities or political groupings (*e.g.* Shennan 1989; Jones 1997). Some distributions may represent such groups (or others) in specific circumstances – passively or actively, unconsciously or intentionally – but we need to tease out what they represent, how and why, and in what contexts and conditions. To do this, we cannot rely on patterns in the pottery alone, but need to contextualise these patterns against others that can more directly and convincingly be interpreted in, for example, social or political terms. This ambiguity is recognised by an expression of caution, as in many of the original presentations at this workshop. But after such an initial disclaimer, the distributions regularly are interpreted as if they were political and pot styles can define Palatial territories, or affiliate a site politically with a specific palatial centre. This is extremely unlikely. Even where strongly centralised polities have erected frontier walls to police their boundaries and control flows of people and things, material exchanges and stylistic

1 I would like to thank the organisers of the workshop for the invitation to participate as a discussant, particularly focusing on the meaning of regionalism in pottery, and their willingness for me to contribute a fairly general chapter to this volume. I would also like to thank participants at the workshop who indicated an interest in the approach explored here, which encouraged me to develop it further for publication. I am also grateful to the editors, and Kostis Christakis, Carl Knappett, Nicoletta Momigliano and Jerry Rutter for their comments on the draft, particularly highlighting points I needed to clarify, and Emmanouela Apostolaki for information on the assemblage from House 2 at Galatas. Dominic Pollard kindly produced the base map for Fig. 9.2; otherwise, all illustrations are by the author. Calculations are presented to variable decimal values, not to imply spurious precision, but to avoid distorting rounding errors.

influences tend to cross these variably permeable borders through various processes (*e.g.* Hedeager 1979; Fulford 1989; Galestin 2010; Bruhn & Hodgson 2022; Gardner 2022).

There is a tremendous temptation to interpret regional pottery styles in this way, not least because pottery is overwhelmingly our most abundant class of artefact. But there is also increasing recognition that material styles cannot be assumed to represent political affiliation. For example, very few analysts now consider the pronounced (but variable) adoption and adaptation of Minoan style ceramics and other material practices in the LB I Southern Aegean, to represent political domination of island communities by one or more Cretan centres (Berg 2007; Abell & Hilditch 2016; Knappett 2018), or interpret the standardisation of Mycenaean fine wares as evidence for political integration across the Mycenaean mainland (Galaty 2016), or the emulation of Mycenaean ceramics at sites in the coastal Aegean, Sicily and Southern Italy as documenting political dominance (Kiriatzi & Andreou 2016; Iacono 2019; Jones *et al.* 2021). As in these examples, resisting a simple political interpretation encourages consideration of multiple other potential processes.

If pottery styles (and technological variants) are not primarily an expression of political affiliation, what are they? Fundamentally, they result from and represent economic and social processes involving the selective (unconscious or strategic) sharing of ideas and understandings, and document the movement of pots, potters, and ideas about how it is appropriate or desirable to make and consume pots. In this sense, while not necessarily informing us about political structure, they can help us understand the nature, intensity, and significance of a potentially wide variety of interactions and the motivations behind them. So, we should be able to use pottery distributions to consider a far wider range of dynamics and processes active at different scales (*cf.* Van de Moortel 2002; Knappett 2012) during the Protopalatial period than over-optimistically delimiting political territories.

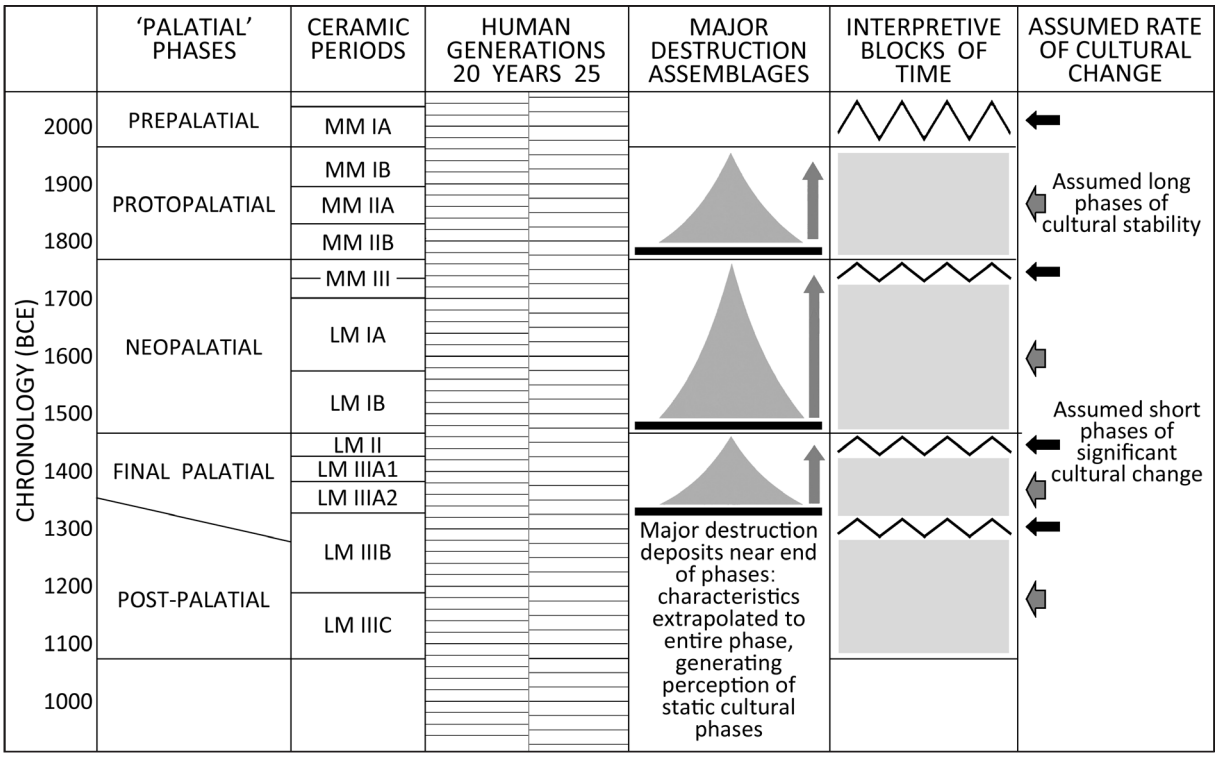

Fig. 9.1 Chronological framework, resolution of ceramic variation, human generations, material samples and interpretive conventions.

Scale, resolution and processes of change in time and space

For Cretan prehistory, we regularly generalise our ceramic chronologies into broad phases, on the Prepalatial, Protopalatial, Neopalatial, Final Palatial and Postpalatial scheme, embodied in textbook chapters, conference boundaries and diachronic comparisons. The material we use to define characteristics of the Protopalatial and Neopalatial phases largely derives from widespread destruction deposits held to mark the end of each phase. In the absence of abundant earlier deposits, these large quantities of material and the ways of life they document, tend to be projected back as characteristic of the whole phase. This masks changes within multi-generational blocks of time, and encourages us to think of punctuated cultural development on Crete, with long periods of stability, interrupted by short phases of significant change (**Fig. 9.1**).

If we are able to disaggregate these broad phases into the shorter periods we can recognise through pottery stylistic changes, we should be able to reconstruct a more continuous and dynamic history. Presently, we are handicapped by the degree to which such distinctions are principally recognised in fine decorated wares, though the recent documentation of entire assemblages from stratified deposits at a limited number of sites is broadening our ability to recognise temporal distinctions in a wider range of wares (*e.g.* Poursat & Knappett 2005; Van de Moortel 2006; Macdonald & Knappett 2007; Caloi 2013; Baldacci 2017; Doudalis 2022). As more Protopalatial assemblages are studied in detail, it becomes possible to recognise early and late sub-phases at some sites, and increasingly, to recognise more subtle regional variations. Not surprisingly, the closer we look, with larger samples, the more readily we can define shorter periods of time and more localised regional variations. But so far, this can only be done for some periods at a few sites. To expand this, thoroughly documented, site-specific sequences, such as those presented for sites at this workshop, are crucial.

While there are few chronologically fixed points in the Protopalatial period, and still very few radiocarbon dates, divided across the chronological span of the phase as a whole, individual ceramic phases should be on the order of three to four human generations in duration, less at the few sites where early and late distinctions can be recognised within some stylistic sub-phases (**Fig. 9.1**). This degree of resolution is crucial in bringing us closer to the timescale of human decision-making, strategies and motivations, to enable us to engage with human-scale behavioural processes. But no-one has achieved a resolution of less than a human generation in ceramic style studies, pretty much anywhere in prehistoric archaeology globally. In Aegean prehistory, analysts regularly assert that deposits within and between sites are 'contemporary', a misleading precision that conceptually encourages the reconstruction of an unjustifiable event-focused pseudo-prehistory (Whitelaw 2022: 37-38, 59-62). Realistically, for the Protopalatial period, the best we can do – if we can distinguish early or late versions of a pottery style within a ceramic phase – is to consider the deposits as contemporary within one to two human generations. Detailed studies will continue to increase the resolution of our chronological frameworks, but we also have to align our interpretations with the data presently available. Rather than assume a spurious precision, we need to calibrate our questions to the resolution of the patterns we can realistically recognise, and match them to the appropriate scale of human behavioural processes – usually an aggregate of many (and probably diverse) processes, playing out over at least several generations.

The other fundamental reference dimension is spatial, at multiple scales, from the individual activity area, household, neighbourhood, community and region, to inter-regional patterns. We are increasingly recognising that processes did not necessarily occur across the entire island at the same time, or develop in the same way, adding spatial variation to the variable pace of changes through time (*cf.* Rutter 2009). Again, we have to match the spatial patterning we can document, to behavioural processes or aggregates of processes enacted at the appropriate geographical, social and demographic scales.

Everyone working on the Protopalatial and Neopalatial periods in Central Crete will have their own ideas about the pattern of development, expansion and probably eventual integration of polities in Central Crete (**Fig. 9.2**). Over the past two decades, it has become generally accepted that there was not a single trajectory that applied across the entire island, but we are still wrestling with defining local variations, and later Cretan prehistory is still primarily viewed from a palace-centric perspective (Whitelaw 2004; 2018). Our understanding of these regionally

variable processes is very constrained by the small number of sites for which we have extensively investigated, well-documented and thoroughly published exposures and pottery assemblages, particularly for pre-LM I phases. The far more limited quantity of non-ceramic material culture contributes to the undue interpretive weight assigned to variations in pottery.

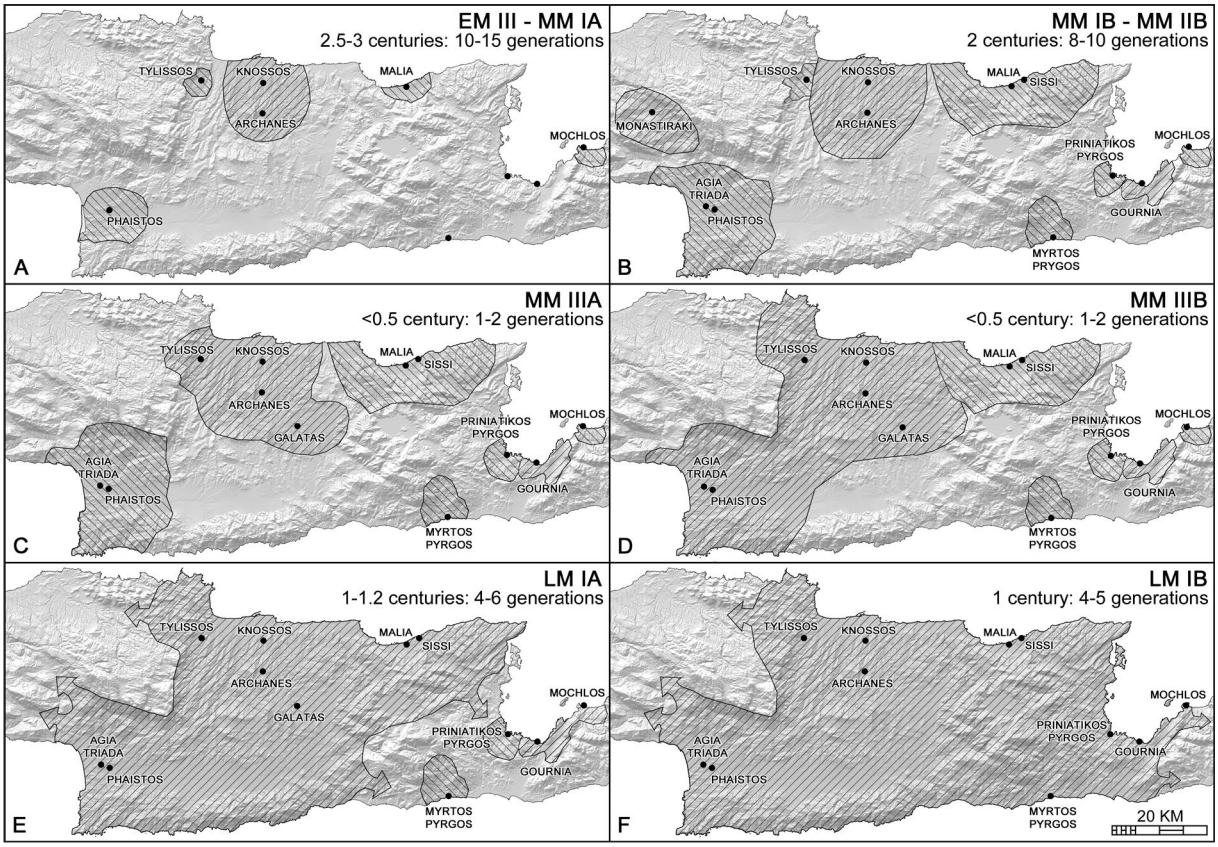

FIG. 9.2 VARIATIONS IN PROCESSES IN SPACE: ONE POSSIBLE RECONSTRUCTION OF THE SPATIAL DEVELOPMENT OF POLITICAL STRUCTURES IN CENTRAL CRETE, MONITORED IN COARSE, MULTI-GENERATIONAL TIME SPANS.

Our chronological resolution, presently, only allows us to track what was almost certainly the result of temporally continuous and spatially variable social, economic and political processes, in time slices that are rarely less than a century long (**Fig. 9.2**). While we rush to interpret these sketchy outlines in political terms, as history richly documents, political transformations, such as the expansion or contraction of polities, proceed through a wide range of processes, peaceful and antagonistic, that may respond to broader transformations, but are enacted locally through context-specific decisions and actions, that can take place on the scale of individual years, depending on the full range of processes from broad ecological and economic transformations, to the personal whims of powerful or charismatic leaders. Political changes can be ephemeral, but if stable for a considerable, often multi-generational timescale, can result in significant changes in economic interactions and the movement of materials, people and ideas that may be detected with the resolution of our archaeological evidence. If stable for long enough, these changes may also result in shifts in regional economic and demographic structure involving transformations in settlement location and character. But with only low resolution chronological frameworks, we are most likely to detect the aggregate outcome of multiple processes, if they amplify each other, for example, the continuous, multi-generational outward expansion of a pattern of behaviour from a point of origin. Stops and starts, expansions, contractions or redirections of such processes, will serve to blur any resulting material patterns, or even make them impossible to recognise.

The combination of low resolution and fuzzy chronologies, multiple interacting, short-term, dynamic and reversible processes, and very few archaeological sample points with abundant artefactual samples, means it is extremely difficult to define or track changes on a temporal or spatial scale that we can attribute to specific behaviours or events. We need to adapt our questions to what we can realistically monitor through the presently available archaeological record. At the same time, we need to develop expectations about the processes we want to investigate and their likely archaeological signatures, to ensure we are collecting relevant evidence to enable us to develop our understandings in greater detail. Through doing so, we will gradually build-up sufficient detailed and comparable evidence to enable us to engage with these questions increasingly effectively. We also need continually to push the limits of the possible, so we open up the possibilities for future, more detailed analyses. Exploring processes and models for understanding regionalism in pottery styles, and expectations for the potential material traces of such processes, is the principal aim of this chapter, even if the presently available evidence, as reviewed and presented in other chapters in this volume, does not yet allow a detailed regional synthesis.

Cultural dynamism in Protopalatial Central Crete

Considering the broader context of the Protopalatial period, whatever cultural transformations we are interested in, including the Late Prepalatial phase, this period of two to three centuries was incredibly dynamic. In recent publications I have explored some implications of one of the principal processes involved, the urbanisation of major centres in Central Crete (Whitelaw 2012; 2017; 2018; 2019). While recognising that these reconstructions are open to alternative interpretations (Militello 2012; Todaro 2019; 2020; Longo *et al.* 2020), I want to explore ways in which these changes are likely to have affected pottery production and consumption, and innovation and the development of regional pottery styles in Protopalatial Central Crete. These suggest new ways to consider ceramic regionalism and the processes involved. In turn, these can point to the sorts of ceramic data we will need to document, to be able to identify, analyse and interpret these processes.

The three major urban centres at Knossos, Malia and Phaistos expanded very rapidly, beginning in the Late Prepalatial phase (Whitelaw 2012). Recent work is clarifying that process at Knossos (Whitelaw 2018; Whitelaw *et al.* 2019; Legarra Herrero 2019), Malia (Devolder & Caloi 2019) and Phaistos (Militello 2012; Todaro 2012; 2019; 2020; Longo *et al.* 2020). However these expansions are interpreted, such high rates of growth will have attracted population from within, and probably beyond, the local regions around each centre, particularly necessary because dense pre-modern urban communities were rife with high density-related disease, and in consequence, suffered high mortality rates. This meant they acted as population sinks, continually needing to pull-in populations to maintain themselves, let alone significantly expand, as these emerging palatial centres did.

The only area of Crete where we presently can assess this is the Western Mesara, where we can directly compare the evidence for the expansion of aggregate site area at Phaistos, and that for the rural sites in the nearby surveyed areas (Whitelaw 2012; Hope Simpson *et al.* 1995; Watrous *et al.* 2004). That the urban centre expanded more rapidly will, at least in part, reflect the greater economic opportunities in the more differentiated urban environment for supporting families no longer tied to access to agricultural land, attracting more entrepreneurial individuals to the centre. These pull-factors would be complemented by push-factors, as palace-sponsored, increasing access to animal traction for cultivation, reduced the human labour that was required for rural agriculture. The migration of many young individuals from small rural communities to the expanding centres would have undermined local social structures, possibly reflected in the decline of rural cemeteries as community foci (Legarra Herrero 2016) and the abandonment of most traditional communal tombs during the course of the Protopalatial period (Legarra Herrero 2014). These local social structures were likely gradually superseded by expanding palatial involvement in the administration of rural communities, actively through the imposition of palatial control, as documented by LM IB in the Linear A archive at Hagia Triada (Weingarten 1987; Militello 1992; 2018; Schoep 1999; 2001; Privitera 2014). They were also more passively eroded through the extension of economic market networks, particularly pulling-in subsistence resources to support the increasing and concentrated populations of the urban centres (Whitelaw 2019). The movement of individuals between the major urban centres and the small rural communities in their expanding hinterlands, established or extended and broadened the social and economic channels along which material, people and ideas could move, in both directions.

With large and socially differentiated populations, urban centres were hot-houses for social interaction and competition (Lobo *et al.* 2020), and will have become focal points for the generation and outward diffusion of innovations in artefact technologies and styles, and standardised products, into their surrounding hinterlands and beyond. The urban centres became the foci of expanding dendritic regional economic networks, linking into and re-focusing the pre-existing, low-volume economic and social networks that were essential for the demographic, social and economic viability of small communities (Whitelaw 2015). These will have shifted from largely social to primarily economic channels, serving the increasing and concentrated consumption needs of the urban centres, pulling resources into the centres, with specialised, finished products distributed outwards to rural communities.

Technological and stylistic innovations, particularly relevant in the dynamic, competitive social environments of the expanding urban centres, could be selectively adopted and adapted by at least some producers and consumers in rural communities. These included those returning to their natal hamlets after adopting some urban ways of life, and local elites, within or beyond the expanding polities, emulating the elite courtly fashions of the palatial centres.

Urbanism and change in pottery production and consumption in Protopalatial Crete

Because of the specialisation of Minoan ceramic studies by period, detailed and systematic inter-period comparisons can be difficult. Working with deposits spanning the prehistoric periods at Knossos, my impression is that from EM IIA through MM IA there was a significant reduction in the number of different fabrics used, and in the alignment of fabrics with specific categories of vessels. There was also a contraction in the variety of decorative treatments, and most markedly, a reduction in the range of vessel shapes produced. This simplification in all characteristics of the pottery assemblages is particularly acute during EM III-MM IA (*cf.* Momigliano 2007: 83-84). From that point, the diversity of shapes and decorative schemes and motifs progressively increases through the Protopalatial phases. This impressionistic assessment for the MM phases at Knossos receives some support from the tables of shapes and decorative motifs assembled by Walberg (1983: 29-34; 1987: 44-73, 109-121) for Kamares ware, by Van de Moortel (1997: 865-889) for Phaistos and Kommos, and documented by Levi and Carinci for Phaistos (1988).

The Late Prepalatial simplification in the pottery assemblages corresponds with the massive and rapid expansion of the future palatial centres, at Knossos from a maximum of *ca.* 6.5 to a minimum of at least 40 ha., representing a population expansion I have reconstructed as from *ca.* 950-1,200 to *ca.* 6,500-10,000 (Whitelaw 2012; Whitelaw *et al.* 2019). This very dramatic expansion in population will have rapidly and significantly increased the demand for pottery, almost certainly encouraging increases in production efficiency and experimentation aimed at mass production. Simplification of the range and standardisation in products would help potters address this roughly ten-fold increase in demand over *ca.* 250 years. Consumers would need to adapt to the availability of a more limited range of increasingly standardised products. The extension and broadening of economic interactions with communities in the hinterlands of the centres could also have expanded the markets for urban potters' products, further increasing demand. Urbanisation and increasing occupational and social differentiation, as well as expanding palatial economic importance – processes developing from the Late Prepalatial and continuing through the Protopalatial periods – will also have increased demand for specialised and elaborated products, seen in a diversification of pot forms and decoration from MM IB.

The development of increasing specialisation in pottery production took place in the context of wider social and occupational specialisation which invariably accompanies urbanisation. This change in the scale of demand is likely to have produced a shift in the relationships between producers and consumers, and the transformation from potting as a socially-embedded craft, toward a commercial industry. This process is likely to have been exacerbated by the diverse urban population, with immigrants to the city coming from disparate communities throughout the centre's hinterland, separating economic transactions from the local social networks that craft production had been embedded within, in small rural communities.

The scale of demand in the urban context would allow or encourage sub-specialisation, with individual potters concentrating on making only part of the full ceramic repertoire (potentially increasing efficiency), as regularly

documented in ethnographic studies (*e.g.* Rye & Evans 1976; Arnold 1985; Kramer 1997). Specialisation is likely to divide by different clay fabrics and major classes of vessels, such as small domestic consumption and serving vessels, cooking pots and storage pithoi (likely to have different fabric recipes and firing regimes). Another major distinction between producers is by technical differences in production, with individual potters experienced with different forming techniques involving significantly distinct conceptualisations of the *chaîne opératoire,* as well as intuitively learned, routinised bodily actions and motor control. In Protopalatial Crete, this is likely to have meant some potters produced vessels thrown on the wheel (using rotative kinetic energy), while others continued with hand-building or various hybrid (wheel-assisted) techniques, distinct again from those potters using slow rotation to produce large pithoi.[2] Specialisation is also likely to have involved the emergence of middle-men distributing pots, particularly with the roughly tenfold increase in production rates enabled by throwing on the wheel (**Fig. 9.8**) for smaller vessels during the Protopalatial period (Knappett 1999b; Jeffra 2013), expanding the number of consumers most potters served beyond the scale of face-to-face social familiarity.

A likely consequence of these significant increases in consumer demand is the sudden proliferation of mass-produced goblets at Knossos and generally in North-Central Crete, which show the earliest experimentation with wheel-assisted manufacture, from the Late Prepalatial period (Knappett 1999b: 119-121; Momigliano 2007: 83-84). Contemporary experimentation is documented with moulded vessels (Todaro 2021) and the later development of wheel-thrown conical cups at Phaistos and in South-Central Crete (Caloi 2011; 2019; 2021; 2023), simple vessel types mass-produced in highly standardised forms and consumed in large quantities. These experiments in wheel-forming of simple shapes were likely aimed at increasing production rates to meet expanding demand, but will also have contributed to increasing standardisation of the products, and for consumers, an expectation of standardisation. Demand for these new, mass-produced forms, spread out into the immediate hinterlands of the major urban centres (Caloi 2023).

Producers, consumers, pottery use-life and annual demand

To explore pottery production, distribution and consumption in Protopalatial Crete, and to bring people into the picture, requires some idea of the scale and spatial distribution of production and consumption within and between urban and rural communities in a region. As a foundation, we need an understanding of the amount of pottery produced and consumed in different communities, even if only gross estimates are possible. To generate estimates about production, I use ethnographic data on the time taken to produce different types of vessels using different techniques. Such information is rarely systematically documented, particularly not for the entire product range or production sequence, so relevant data are patchy and of varying detail and reliability, but broad patterns can be recognised. For estimating consumption demands, we need information on community population, household assemblage composition, and estimates of vessel use-lives, since the number of potters producing pottery in a community will relate to the annual replacement needs, not assemblage size *per se*, for example at the time of context destruction or abandonment, which will include vessels produced over a number of years. For the first two variables, we can use information from Protopalatial sites; for pottery use-life, ethnographic information. The latter data have not always been documented consistently, but sufficient studies exist to produce informative expectations.

Protopalatial household assemblage composition

Very few near-complete Protopalatial household assemblages have yet been excavated and published in full. Some deposits are clearly fills or dumps, presenting several interpretive problems. First, they may contain material from

2 More subtle and useful distinctions have been developed, encompassing a range of forming techniques from pinching and coil building, through various types of smoothing, shaping and finishing coil-built vessels on a turning wheel, to exploitation of rotative kinetic energy to throw vessels (*e.g.* Roux & Courty 1998). These have been explored and adapted to the analysis of Minoan pottery (*e.g.* Knappett 1999b; Poursat & Knappett 2005: 30-35; Berg 2009; Caloi 2011; 2019; 2021; Jeffra 2013), however, the ethnographic examples analysed and applied analogically to Protopalatial pottery in this study, are not so subtly differentiated, so of necessity, I will use the broader categories of handmade, wheel-assisted, and wheel-thrown techniques throughout.

a variety of use contexts, so may not represent typical household assemblages. Second, if they are dumps that have accumulated over time, because different types of vessels break at very different rates, such deposits will tend to be dominated by small vessels such as cups and bowls that are used frequently and have relatively short life-spans, so accumulate more rapidly than other types of vessels. In addition, even for deposits that have the character of domestic assemblages, in most cases they have been only partially preserved, excavated or published. This affects most significantly the absolute size of assemblages, and rather less so their composition, as long as multiple contexts within a household have been sampled. I have tabulated the vessels published from 10 Protopalatial contexts that appear to represent substantial components of household assemblages: Apodoulou – House A (N=309; Venieri 2016); Malia – the four Quartier Mu Ateliers (N=233; Poursat 1996), and the Nord-est Abords Buildings 1 and 2-3 (N=265; Darcque *et al.* 2014); Phaistos – House C (N=240; Militello 2012), and Hagia Photeini (N=97; Caloi 2005); and Mochlos – House 1 (N=170; Doudalis 2022). Recognising that most of these deposits represent partially preserved assemblages, for calculations I will estimate a typical household assemblage as comprising 200 vessels. For assessing assemblage composition, I have also included the six partially excavated MM III Hillside houses at Kommos (N=298; Wright & McEnroe 1996). Averaging these assemblages (**Fig. 9.3**), for the following calculations, I will consider a model Protopalatial household assemblage to be composed of 71.4 % (N=142.8) small table, 9.3 % (N=18.6) cooking, 14.9 % (N=29.8) medium processing and transport, and 4.4 % (N=8.8) large storage vessels.

While these are large assemblages when compared with most ethnographic studies of household pottery inventories (*e.g.* Arnold 1985: 157; Rice 1987: 296-297), they fit with long-term Cretan prehistoric consumption norms, with EM IIB households at Myrtos Fournou Korifi having 100-160 vessels (Whitelaw 2014), and LM I houses with fully documented assemblages being substantially larger: Palaikastro: House N (N=594; Sackett *et al.* 1965; Sackett & Popham 1970); Petras: House I.1 (N=1066; Tsipopoulou 2021); Mochlos: Chalinomouri (N=172; Barnard 2003: 161-170), Artisans' Quarter A (N=1092; Barnard 2003: 113-131) and B (N=1289; Barnard 2003: 132-160); Zakros: Strong Building (2 houses: N=845; Gerontakou *et al.* 2020); and Galatas: House 2 (N=501; Apostolaki 2014; pers. comm.). In these LM I houses, some 21 to 73 % of each assemblage (average 53 %) are conical cups.

A. Household assemblages	Assemblage total	Table no. (%)	Cooking no. (%)	Processing no. (%)	Storage no. (%)
Apodoulou: House A (Venieri 2016)	309	203 (65.7)	45 (14.6)	37 (12)	24 (7.8)
Malia: Atelier de sceaux (Poursat 1996)	62	50 (80.6)	5 (8.1)	6 (9.7)	1 (1.6)
Malia: Atelier de potier (Poursat 1996)	113	57 (50.4)	8 (7.1)	33 (29.2)	15 (13.3)
Malia: Atelier de fondeur (Poursat 1996)	22	12 (57.1)	2 (9.5)	6 (28.6)	2 (9.5)
Malia: Atelier Sud (Poursat 1996)	52	43 (82.7)	7 (13.5)	2 (3.8)	0
Malia: NE Abords, Building 1 (Darcque et al. 2014)	71	52 (73.2)	2 (2.8)	17 (23.9)	0
Malia: NE Abords, Buildings 2-3 Darcque et al. 2014)	194	168 (86.6)	3 (1.5)	23 (11.9)	0
Phaistos: House C (Militello 2012)	240	182 (75.8)	12 (5.0)	44 (18.3)	2 (0.8)
Phaistos: Hagia Photeini (Caloi 2005)	97	52 (53.6)	16 (16.5)	21 (21.6)	8 (8.2)
Mochlos: House 1 (Doudalis 2022)	170	95 (55.9)	37 (21.8)	37 (21.8)	1 (0.6)
Kommos: MM III (6 houses ~ 50% excavated; Wright & McEnroe 1996)	298	249 (84.0)	15 (5.0)	16 (5.4)	18 (6.0)
Average (analysed / published) size / percentage composition:		71.4%	9.3%	14.9%	4.4%
Estimated vessels in model assemblage of 200 vessels:	200	142.8	18.6	29.8	8.8
B. Other assemblages					
Malia: Quartier Mu (Poursat & Knappett 2005)	1244	869 (69.9)	8 (0.6)	300 (24.1)	67 (5.4)
Malia: Quartier Nu (Schoep & Knappett 2003)	56	33 (58.9)	2 (3.6)	19 (33.9)	2 (3.6)
Malia: Quartier Pi (Knappett et al. 2017)	284	213 (75.0)	15 (5.3)	45 (15.8)	11 (3.9)
Phaistos: SW Quarter (Militello 2012)	791	532 (67.3)	21 (2.7)	192 (24.3)	46 (5.8)
Phaistos: Grand Frana (La Rosa 2011)	133	345 (86.3)	4 (1.0)	21 (5.3)	30 (7.5)
Phaistos: House B (Caloi 2013)	546	495 (90.7)	20 (3.7)	with Table	31 (5.7)
Phaistos: Vani CV-CVII (Baldacci 2017)	667	576 (86.4)	0 (0.0)	84 (12.6)	7 (1.1)
Kommos: (van de Moortel 2006)	1798	1506 (83.7)	127 (71)	6.2	53 (2.9)
Mochlos: all MM II deposits (Doudalis 2022)	518	342 (66.0)	80 (15.4)	18.1	2 (0.4)
Petras: Lakkos (Haggis 2007)		(*c.* 75%)	(*c.* 2%)	(*c.* 21%)	(*c.* 2%)
Percentage composition (excluding Petras Lakkos):		78.1%	5.9%	15.7%	4.5%

Fig. 9.3 Scale and composition of Protopalatial probable household, and major comparative pottery assemblages.

For comparison (**Fig. 9.3**), I summarise several deposits from major structures, more general soundings, or likely dumps: Malia: Quartiers Mu (N=1244; Poursat & Knappett 2005), Nu (N=56; Schoep & Knappett 2003), and Pi (N=284; Knappett *et al.* 2017); Phaistos: South-West Quarter (N=791; Militello 2012), Grande Frana (N= *c.* 503; La Rosa 2011), House B (N=565; Caloi 2013), and Vani CV-CVII (N=667; Baldacci 2017); Kommos: Building AA (N=1798; Van de Moortel 2006); and Mochlos: all MM II deposits (including House 1; N=518; Doudalis 2022), with the Petras Lakkos deposit added for comparison (Haggis 2007). The broad comparability of the composition of the assemblages, regardless of site or context, suggests the model assemblage composition used for calculations (even if including assemblages others might not consider to represent households) is robust, and reliable enough to support the general implications explored below.

Pottery production rates and labour investment

To estimate production labour, I have compiled ethnographic data from 80 communities distributed globally, on the time taken to produce different types of vessels, which is principally determined by the forming techniques used, the size of vessels produced (the amount of clay manipulated), and the degree of elaboration in surface finishing. Ethnographically, most data available are for hand-building. This technique applies to nearly all vessels produced during the Prepalatial and early Protopalatial periods. At the opposite end of the technical spectrum, the proportion of vessels thrown on the wheel using rotative kinetic energy expanded during the Protopalatial period, though this technique remained limited to smaller table vessels, including mass-produced conical cups (Knappett 2004; Jeffra 2013; Caloi 2011; 2016; 2019).

Through the period, increasingly large shapes were produced using various wheel-assisted techniques. A hybrid technique involving the wheel-throwing of a cylinder of clay, subsequently expanded and shaped using the paddle and anvil technique, is widespread and well documented ethnographically in South Asia, though not so far documented for Prehistoric Crete. The second phase normally takes considerably longer than the throwing stage, but overall, timing is fairly comparable to full forming on the wheel (medians 1.1-2.0 minutes/litre of vessel volume, compared with 7.6 minutes/litre for hand-forming). Unfortunately, the range of wheel-assisted techniques involving coil building with various degrees of wheel-forming or finishing, now widely recognised in the Cretan Bronze Age (Knappett 1999b; 2004; Jeffra 2013; Caloi 2016; 2021), is not well documented ethnographically through quantified studies on production rates. However, breaking this down analytically like the hybrid wheel and paddle/anvil technique, since the bulk of forming is done by hand, through pinching and coiling, with the wheel principally used for smoothing and finishing the vessel (Roux & Courty 1998), the most time consuming component of forming will be the hand-building stage. So the ethnographic data for the latter can be adapted to approximate wheel-assisted techniques.[3]

Comparable across all techniques will be the time expended in clay acquisition and preparation, vessel decoration and firing.[4]

The deployment of the different techniques is clearly size-dependent in the thoroughly documented assemblage from MM IIB Quartier Mu at Malia (**Fig. 9.4**; data from Poursat & Knappett 2005). Ethnoarchaeological documentation of the throwing of small vessels comparable in size and shape to MM II-LM I conical cups, indicates that up to 1,000 can be thrown by a skilled potter off a hump of clay in a day (Rye & Evans 1976: 87; Kramer

3 Very few studies present data on wheel-assisted forming and finishing techniques, now widely documented in MM and LM Crete. However, limited data presented in Roux & Courty's study (1998) suggest that at most, wheel-assisted coil joining and surface smoothing will shorten that production stage by about 50 %, while the time involved in clay acquisition, preparation, final decorating and firing will not be affected. So this might reduce overall production time of a vessel by less than 25 % compared with simple hand-making, incorporated in calculations for **Fig. 9.8** for wheel-assisted production as 1.33 times the rates of handmade production.

4 Many ethnographic accounts only document the forming and decorating stage of pot production, but examples with full documentation indicate that clay acquisition, preparation and firing, pro-rated for individual pots, can take as much time again as that spent forming and finishing the vessels. This is approximated in the calculations by doubling the production time for vessels, if only forming time was documented in the original study.

1997: 28; Winslow 2021: 262). The expansion of wheel throwing during the Middle Minoan period represents a tremendous increase in productivity, on the basis of the ethnographic data, approximately seven- to twelve-fold (**Figs 9.6, 9.8**), relevant to a significant component (*ca.* 71.4 %) of our model household assemblage.

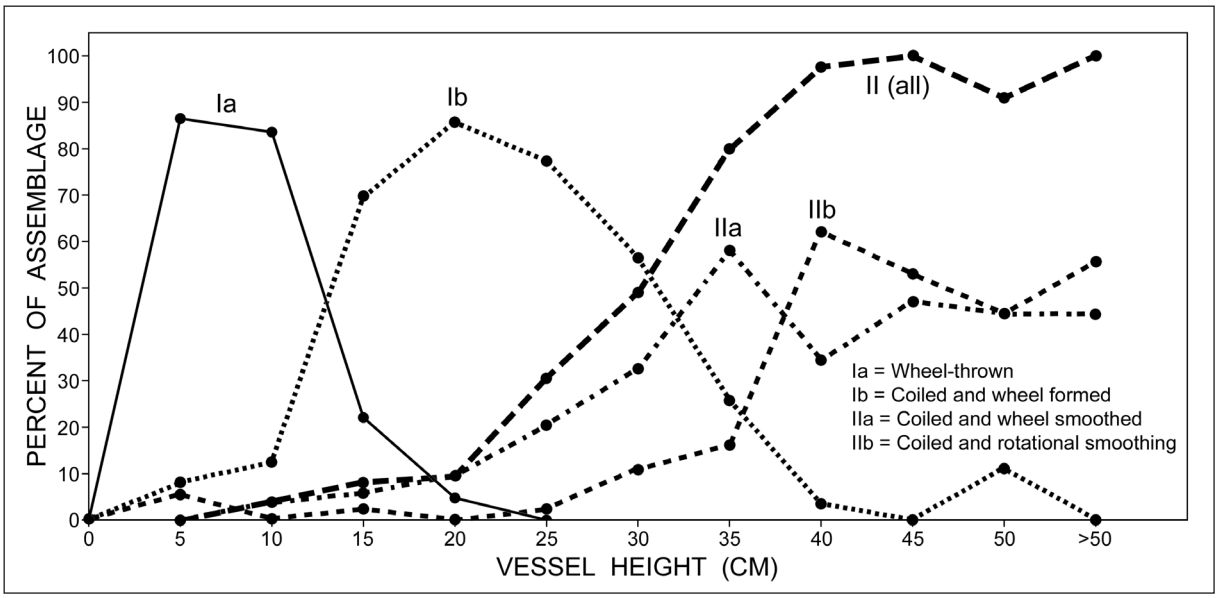

Fig. 9.4 Malia, Quartier Mu, production techniques for table and processing vessels, by vessel size (data from Poursat & Knappett 2005).

For analysis, ethnographically documented vessels are divided into size ranges that correspond with those that characterise the major functional classes of vessels in the well-documented MM IIB assemblage from Quartier Mu at Malia (**Fig. 9.5**). This allows the production time estimates calculated from the ethnographic data (**Fig. 9.6**) to be applied analogically to the model Protopalatial household assemblage (**Fig. 9.8**).

Pottery use-life and replacement rates

To estimate the vessels that needed to be produced in a community each year, we need information on community population, household assemblage composition, and pot breakage (and therefore replacement) rates. Ethnoarchaeological studies indicate that different vessel types have very different survival rates, varying with production characteristics (vessel size, wall thickness and firing hardness), uses and use frequency, who they are used by (*e.g.* adults *vs* children), and their contexts of use (Foster 1960; David 1972; DeBoer 1974; 1985; DeBoer & Lathrap 1979; Longacre 1985; Nelson 1991; Shott 1996; 2022). Information from studies undertaken in 20 communities or cultures document that pot breakage relates directly to vessel size, since larger vessels tend to be thicker-walled, and therefore more resistant to fracture. Size also relates to function and use patterns, with small table wares used daily for eating and drinking, exposed to continual risk. They are also used by all members of a household, including children, and are usually used in fairly central, multi-functional spaces in houses and yards, where other activities (and sometimes domestic animals) may damage vessels during and between uses. Such small, versatile vessels are also regularly used in other tasks, such as craft production, animal feeding, *etc.*, exposing them to additional breakage risks. Such small table wares tend to survive for months, usually not more than a year.

Processing and serving vessels are generally larger and tend to be used less frequently, and less frequently by children, both in terms of the activities involved, and because of the weight of the vessels and their contents. Of a comparable size are transfer and transport vessels, the former comparable in use to other processing vessels, but

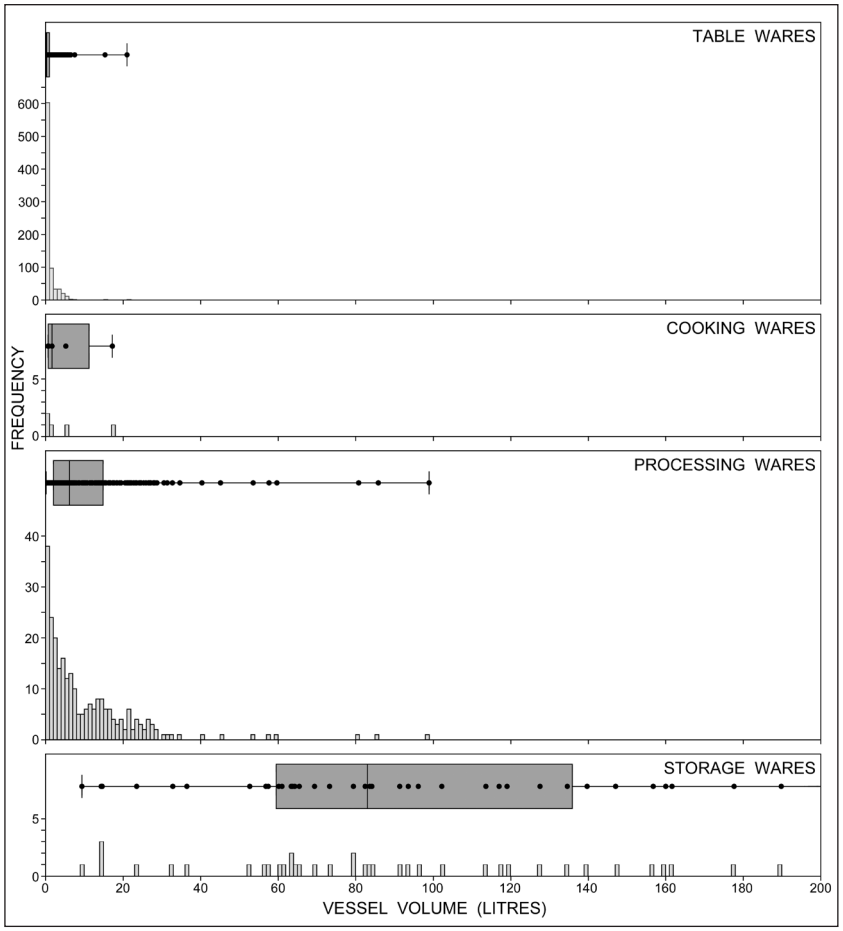

FIG. 9.5
MALIA, QUARTIER MU, MAJOR FUNCTIONAL CATEGORIES BY VESSEL VOLUME: HISTOGRAMS AND BOX-PLOTS OF MEDIANS AND INTER-QUARTILE RANGES.

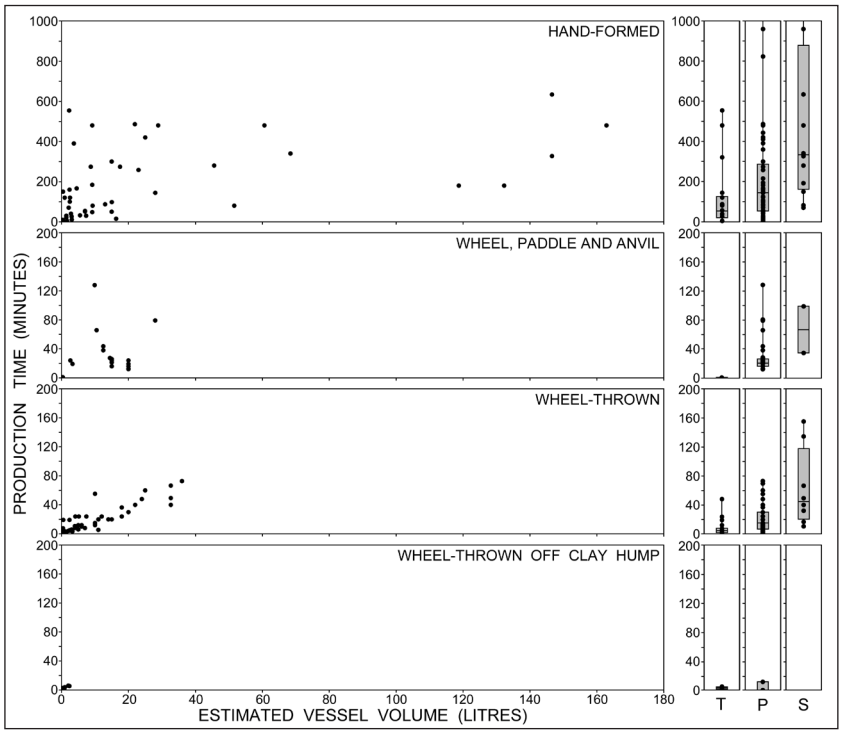

FIG. 9.6
ETHNOGRAPHICALLY DOCUMENTED POTTERY PRODUCTION TIMES BY VESSEL CATEGORIES (T=TABLE, P=PROCESSING, S=STORAGE), VESSEL VOLUME AND PRODUCTION TECHNIQUE: SCATTERGRAMS AND BOX-PLOTS OF MEDIANS AND INTER-QUARTILE RANGES.[5]

5 In Figs 9.6-7, the Box-plots of medians and inter-quartile ranges at the right, include additional vessels that can be ascribed to size category, but for which vessel volume could not be estimated, so could not be included in the Scattergram.

the latter often exposed to risk outside the household (*e.g.* collecting water), so are likely to have a wider range of use-life values.

Cooking pots are generally of a similar size to serving and processing vessels (large enough for multiple servings of food), but break more frequently since they are regularly less hard-fired, are subject to thermal stress, and may be relatively thin-walled, to conduct heat rapidly. They are also used frequently, often by adults, but manipulation of hot vessels will contribute to mis-handling and breakage.

Large storage vessels tend to be thick-walled and are usually used less frequently and only infrequently moved. They also tend to be stored out of the way, against walls or in dedicated storerooms, so they are relatively protected against accidental damage. They can last for decades or even generations.

In use-life studies, vessels are often identified by function (particularly cooking vessels), but if not, vessel size is a good predictor of their life-span (Shott 2022) (**Fig. 9.7**). For analysis, the size ranges of functional categories of vessels defined by the MM II assemblage of Quartier Mu (**Fig. 9.5**) have been used to divide the ethnographic data into relevant categories, if no functional identification was provided in the account. Combining the numbers of each vessel type in our model Protopalatial household assemblage, with the use-life information for vessels of comparable types or sizes, allows estimation of replacement rates for the pottery of an individual household in a typical year (**Fig. 9.8**). The replacement estimates for large storage vessels are undoubtedly significantly over-generous, given the large size, thick walls and long-life of large Minoan pithoi, usually situated relatively safely in dedicated storerooms or against walls (Christakis 2005: 53-54).

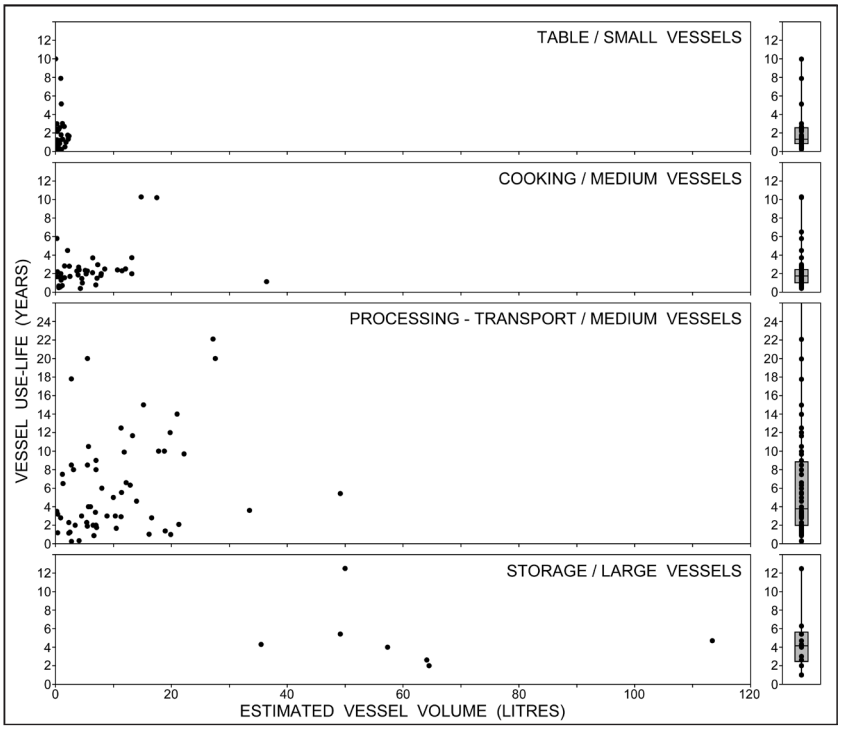

Fig. 9.7
Ethnographically documented vessel use-life by vessel volume: scattergrams and box-plots of medians and inter-quartile ranges by vessel categories.

	Percent	Vessels	Volume median	Use-life median (years)	Replacement per year	Minutes per vessel (hand-made)	Time total (hand-made minutes/year)	Minutes per vessel (wheel-assisted)	Time total (wheel-assisted minutes/year)	Minutes per vessel (thrown)	Time total (wheel-thrown minutes/year)
Table	71.4	142.8	0.27	1.34	106.57	53.7	5723	40.3	4292	4.4	469
Cooking	9.3	18.6	5.23	1.76	10.57	144.0	1522	108.0	1141	19.2	203
Processing	14.9	29.8	6.23	3.80	7.84	144.0	1129	108.0	847	19.2	151
Storage	4.4	8.8	83.00	4.15	2.12	333.0	706	249.8	530	44.7	95
Total		200					9080		6810		917
Annual full-time labour of one potter making the full range of forms:						6.0 % annual labour		4.5 % annual labour		0.6 % annual labour	

Fig. 9.8 Production estimates for a model Protopalatial household assemblage of 200 vessels by vessel categories: assemblage composition, estimates of use-life and replacement rates, production times by technique, and potter's time required.

Community scale, pottery consumption and production rates, and potters

Because of the different production and consumption rates of different types of vessels, in **Fig. 9.8** separate calculations are made for each category of vessels, produced by a range of techniques. We can aggregate these figures to estimate that an average early Protopalatial household assemblage would require 6.0 % of the annual labour of a potter making all forms of vessels (forming them by hand), so one potter working full-time would be able to satisfy the annual pottery needs of approximately 16.6 households. Re-scaling this for wheel-assisted production of the assemblage, closer to the situation in the later Protopalatial phase, one potter could service *ca.* 22.1 households. If all vessels were thrown on the wheel (they were not), a potter could provide for 163.8 households. These estimates simply provide an idea of the scope for transformation of pottery production during this dynamic phase, depending on the opportunities for individual potters and consumers as the socially-embedded technology developed. These calculations allow us to estimate very approximately the minimum number of potters that could have supplied communities of different scales with domestic pottery. These estimates are based on a potter working 313 days a year (equivalent to 6 days per week), 8 hours a day. This would vary culturally as well as individually. More significantly, pot production was probably usually a seasonal activity, as it often has been in the Mediterranean more recently, to adjust to seasonal variation in vessel drying, and also to the highly seasonal schedule of competing labour demands for agriculture.

Many or even most potters were probably not occupied full-time as specialist potters, engaging in at least some agricultural activities throughout most of the year, to contribute to their household subsistence needs, and/or taxation demands. But some potters in the major urban centres are likely to have been full-time, since not all households would have had ready access to fields around the largest centres (Whitelaw 2019). We do not know the balance of potters engaged variably in part-time or seasonal potting, so I simply present estimates for full-time engagement, which can be adjusted to consider alternative strategies, judged appropriate to specific sites (**Fig. 9.8**).

On these rough estimates, a single specialist potter working full-time using hand-forming could produce table vessels for *ca.* 26.3 households, or cooking and processing vessels for *ca.* 98.7-133.0 households, or large storage vessels for *ca.* 212.8 households. These rates would vary considerably for hand forming or wheel throwing, but on the basis of what we know about the use of the different techniques in the Protopalatial period (**Fig. 9.4**), hand-forming or wheel finishing is most likely for most medium-sized vessels (cooking and processing as defined in **Figs 9.8-9**), and all large storage vessels. Estimates for the numbers of families able to be serviced by a specialist potter just making one class of vessels, using wheel-assisted production would be: table: *ca.* 35.0, cooking or processing *ca.* 131.6-177.4, and storage *ca.* 283.6. In ethnographic examples, some storage jars were thrown on the wheel, but most of those were small compared with most MM pithoi. By the end of the period, at least in an urban centre like Malia, wheel throwing was probably used for most small vessels, such as cups, bowls and small serving vessels (Poursat & Knappett 2005) (**Fig. 9.4**). This is the category of vessels for which production technique will have changed most significantly during the course of MM I-II, from coiled to wheel-assisted to wheel-thrown, at least at some production centres. A potter throwing the table vessels in our model assemblage, could service *ca.* 320.4 families, a twelve-fold increase over hand-forming. The most relevant estimates overall for Protopalatial assemblages should be handmade and wheel-assisted forming for all vessels, but alternative schemes need to be considered for wheel-throwing table wares, particularly, I suggest, at major population centres and later in the phase.

	Urban sites (225 pop./ha.)			Dense villages (150 pop./ha.)			Small communities (100 pop./ha.)			
Site	Knossos	Malia	Phaistos	Mochlos	Myrtos Pyrgos	Sissi	Villages	Hamlets	Hamlets	Hamlets
Area (ha.)	70	50	55	1.5	0.45	2.5	4	1	0.1	0.05
Population estimate	15750	11250	12375	225	67.5	375	400	100	10	5
Households (average 5 persons)	2700	2250	2475	45	13.5	75	80	20	2	1
Pots in use (200/household)	540000	450000	495000	9000	2700	150000	16000	4000	400	200
Pots replaced annually	343170	285975	314572.5	5719.5	1715.85	9532.5	10168	2542	254.2	127.1
Potters to produce (handmade)	163.2	136.0	149.6	2.72	0.82	4.53	4.83	1.21	0.121	0.060
Potters to produce (wheel-assisted)	122.4	102.0	112.2	2.04	0.61	3.40	3.63	0.91	0.091	0.045
Potters to produce (wheel thrown)	16.5	13.7	15.1	0.27	0.08	0.46	0.49	0.12	0.012	0.006
Table vessels replaced annually	287739	239783	263761	4795.7	1438.7	7992.8	8525.6	2131.4	213.14	106.57
Potters to produce (handmade)	102.8	85.7	94.3	1.71	0.51	2.86	3.05	0.76	0.076	0.038
Potters to produce (wheel-assisted)	77.1	64.3	70.7	1.29	0.39	2.14	2.29	0.57	0.057	0.029
Potters to produce (wheel thrown)	8.4	7.0	7.7	0.14	0.04	0.23	0.25	0.06	0.006	0.003
Processing vessels replaced annually	21168	17640	19404	352.8	105.84	588	627.2	156.8	15.68	7.84
Potters to produce (handmade)	20.3	16.9	18.6	0.34	0.10	0.56	0.60	0.15	0.015	0.008
Potters to produce (wheel-assisted)	15.2	12.7	13.9	0.25	0.08	0.42	0.45	0.11	0.011	0.006
Potters to produce (wheel thrown)	2.7	2.3	2.5	0.05	0.01	0.08	0.08	0.02	0.002	0.001
Cooking vessels replaced annually	28539	23783	26161	475.65	142.7	792.75	845.6	211.4	21.14	10.57
Potters to produce (handmade)	27.4	22.8	25.1	0.46	0.14	0.76	0.81	0.203	0.020	0.010
Potters to produce (wheel-assisted)	20.5	17.1	18.8	0.34	0.10	0.57	0.61	0.152	0.015	0.008
Potters to produce (wheel thrown)	3.6	3.0	3.3	0.06	0.02	0.10	0.11	0.027	0.003	0.001
Storage vessels replaced annually	5724	4770	5247	95.4	28.6	159	169.6	42.4	4.24	2.12
Potters to produce (handmade)	12.7	10.6	11.6	0.21	0.06	0.35	0.38	0.094	0.009	0.005
Potters to produce (wheel-assisted)	9.5	7.9	8.7	0.16	0.05	0.26	0.28	0.070	0.007	0.004
Potters to produce (wheel thrown)	1.7	1.4	1.6	0.028	0.009	0.047	0.05	0.013	0.001	0.001

Fig. 9.9 Estimated scale of pottery production and consumption for indicative sites, calculated for full-time potters.

Fig. 9.9 estimates the number of full-time potters that would be required overall, and by types of vessels, to produce the pots for an illustrative range of Protopalatial sites. The estimates for alternative techniques allow readers to decide which assumptions they are willing to make, based on what is known of the production techniques used in specific assemblages, for what classes of vessels. While only very approximate, these estimates are provocative in a number of ways. Urban centres such as Knossos, Malia and Phaistos will have had a significant community of potters, and more of these potters are likely to have been full-time specialists than their rural counterparts. Such concentrated numbers of specialists will have encouraged specialisation in producing only components of the overall pottery assemblage, increasing production rates and the standardisation of their products. The divisions are likely to have been in terms of particular shapes, but are also likely to have respected production distinctions, for example different fabrics specialised for table and processing *vs* cooking *vs* large storage wares, or firing techniques, distinguishing the low-fired cooking from table and processing wares, or kiln sizes distinguishing large storage vessels, or skill and motor-control, distinguishing the making and decorating of the finest Kamares vessels. Divisions will also be likely in terms of forming techniques, with the broad categories of handmade, wheel-assisted and wheel-thrown vessels involving fundamentally different conceptualisations of the forming processes, as well as technique-specific routinised bodily actions and motor-skills.

Do such estimates matter? Putting even approximate figures on production and consumption provides a baseline to consider the scale and organisation of production or acquisition of pots. This provides potentially interesting perspectives on well-documented cases. At one extreme, considering the production of Maliote-style fine wares at Myrtos Pyrgos (Knappett 1999a), all the fine wares consumed in the community each year could have been produced by a single potter working half-time, or even visiting the community seasonally from Malia (though some differences in details differentiate the vessels at each site: Knappett pers comm.). At the other extreme, the high degree of variability in the pots consumed at a small community like Mochlos, while varying between phases (Doudalis 2022), may be evaluated against the suggestion that there were unlikely to be more than three full-time potters working in the community at any one time, potentially a potter and assistants they had trained to work in a similar way. This would lead us to expect a high degree of standardisation in the assemblage, so questions why the community imported such a range of vessels. Were the few studied households exceptional, or does the documented diversity suggest that there were no resident potters at that time in the community, and pots were imported from a range of different producers

in other communities? From the same perspective, the annual needs of an institution like Quartier Mu could have been produced by 30 % of the annual labour of one full-time potter, raising questions about the reasons behind the documented diversity of wares and imports consumed by this establishment (Poursat & Knappett 2005: 199-200).

The major urban centres could have kept multiple specialists fully employed producing every category of pots. In contrast, while villages like Sissi, Hagia Triada or Archanes could have employed one to three potters working full-time to produce the table wares required annually, any potters specialising in cooking pots or pithoi would have had to distribute their products to a number of other communities as well, or only work part-time. These contrasts are relevant to reconstructing mobile pithos producers in the Bronze Age (Christakis 1996).

The very different scales of consumer demand for different categories of vessels will mean that potters specialising in their production will have had very different numbers of consumers for their products, which would probably need to be distributed through different processes. Considering the sites identified by the Malia survey (Müller Celka *et al.* 2014) simply as an example of Protopalatial regional settlement structure, and extrapolating communities at a similar density across a minimum estimate of the extent of the polity (Whitelaw 2018: 232-233), the total numbers of consumers would have been fairly equally balanced between the residents of the city and the total for all rural communities. A comparable balance can be estimated for the Phaistos region extrapolated from the sites documented by the West Mesara and Kommos surveys. For an idea of the implications, we can notionally map potential potters – generalists or specialists – onto the regional distribution of sites of different sizes, as a basis to consider how urban centres and different scales of villages and hamlets (**Fig. 9.9**), might have variably interacted in the production, distribution and consumption of different types of pottery, made using different production techniques (**Fig. 9.10**).

Urban Malia could have supported a high degree of specialisation, with potters producing both for consumers in the city, but also, potentially, selectively exporting products to rural communities in its hinterland. While not needing to import foodstuffs into the city on the scale of Neopalatial Knossos (Whitelaw 2019), there will still have been a constant flow of donkeys carrying subsistence resources into the city from rural communities, which need not have returned home with empty paniers. Due to increasing transport costs with distance, nearby communities are most likely to have imported bulky goods like pottery from the centre, either the full range of pots, or those produced by more specialised potters, since villages and hamlets lacked the local demand to support such specialisation. Further away from the urban centre or markets linked to it, in some villages or groups of hamlets, a single potter may have been a generalist, producing the full range of pot types, though perhaps not with the skill or elaborations of more specialised urban potters, or following the most recent urban fashions.

Thinking about pot production by individually more or less specialised potters, pursuing different production and distribution strategies, embedded in a network of variably connected communities spread across a demographically and economically differentiated landscape, raises all kinds of possibilities for expecting and interpreting variations within and between site assemblages. These should be able to be monitored by comparing similarities, differences, and degrees of standardisation among the technical and stylistic characteristics of different components of assemblages at the point of consumption and deposition, as long as we can document large and representative assemblages. Hints of such variations were recognised in the contrasts in the degree of Maliote influence and diversity in the fine versus utilitarian components of the MM IIB assemblage at Myrtos Pyrgos (Knappett 1999a).

Pottery production, consumption and innovation in and beyond North-Central Crete

In wrapping-up this exploration, I want to raise several concerns relevant to stylistic and technological change and regionalism in Protopalatial pottery, and a focus on processes and people. Variations in pottery production in time and space can be inspired by the movements of pots, potters or ideas. We are developing an improving understanding of the movement of pots, through a focus not just on decorative styles, but also the provenance of clays and tempers, and increasingly, locally distinctive fabric preparation and manipulation, and fabrication and finishing details.

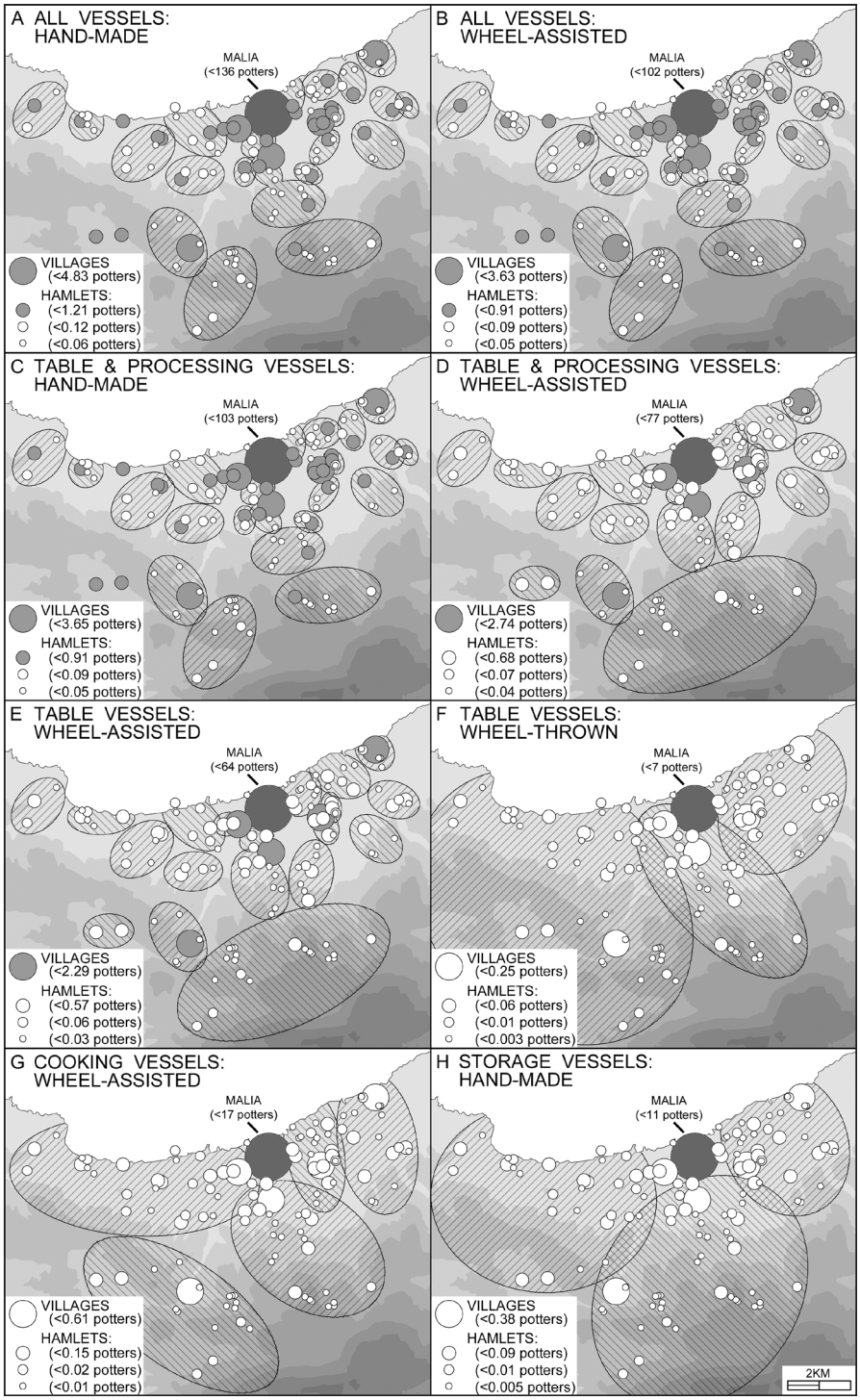

FIG. 9.10 MODELLED SCALE OF SUPPLY ZONES OF INDIVIDUAL FULL-TIME POTTERS, BY VESSEL CATEGORIES AND PRODUCTION TECHNIQUES, WITH MALIA SURVEY SITES REPRESENTING THE SPATIAL AND DEMOGRAPHIC STRUCTURE OF A PROTOPALATIAL CENTRE AND ITS HINTERLAND: A. ALL VESSELS (HANDMADE); B. ALL VESSELS (WHEEL-ASSISTED); C. TABLE AND PROCESSING VESSELS (HANDMADE); D. TABLE AND PROCESSING VESSELS (WHEEL-ASSISTED); E. TABLE VESSELS (WHEEL-ASSISTED); F. TABLE VESSELS (WHEEL-THROWN); G. COOKING VESSELS (WHEEL-ASSISTED); H. LARGE STORAGE VESSELS (HANDMADE). COMMUNITIES REPRESENTED BY FILLED CIRCLES COULD HAVE HAD ONE OR MORE FULL-TIME POTTERS PRODUCING THE SPECIFIED TYPES OF VESSELS.

In terms of ideas, some innovations can be learned and emulated by a potter observing a novel characteristic, but many others, particularly technical details and processes, need to be learned through practice, working alongside an experienced potter. Depending on how challenging the innovation is, it may be learned in varying amounts of time. But for innovations involving radically different concepts, such as the transfer of wheel throwing practices from Cretan to Cycladic potters, a lengthy apprenticeship is anticipated (Abell & Hilditch 2016). This implies some movement of potters, extended or permanent, between innovating and adopting communities. We have tended to think of these as infrequent events, though the surprisingly high level of non-local fabrics documented in Neopalatial loomweights across Crete and the Southern Aegean (Cutler 2019), should encourage a reconsideration of the frequency of such inter-community and inter-regional movements by individuals, potentially embedded in the exogamous marriage networks necessary to sustain small communities, which also promoted and facilitated exchange flows between communities in the Prepalatial period (Whitelaw 2015). Such ubiquitous, socially-based inter-relations among small communities across a region would have continued to be necessary throughout the Protopalatial period.

These low-level networks will have been to a degree re-focused, but also supplemented or over-laid by the new, more frequently reinforced economic networks that expanded through the Protopalatial period to supply the emerging urban centres with resources as well as labour. While driven by the needs of the expanding urban centres, they were two-way linkages, which also channelled products such as pottery and other crafted items, as well as novel ideas (technical, economic, social and ideological), out to rural communities. An outward emigration of limited numbers of potters skilled in new techniques and styles developed in the high-demand contexts of the urban centres, will have spread innovations and increasingly standardised pottery production, outwards through time from the few major centres.

Throughout, I have assumed that innovations were more likely among urban pottery producers. This is because they worked in close proximity to each other and to consumers who were serviced by different potters. Potters could readily observe innovations that improved production efficiency or appealed to consumers and learn from the innovator, if a complicated technique was involved. This process would be far more difficult for a rural potter, both to observe any innovation, but also to track down the source and visit and learn the relevant techniques. These dynamics also apply to consumers. In an urban context, they could see a variety of products in producers' workshops or stalls, as well as other consumers' homes, and demand potters supply the new fashions. In a rural context, only a limited number of non-resident potters, if any, are likely to supply their products to any individual hamlet, so the local potters and consumers will only encounter a limited range of innovations, filtered through the adoption decisions of any such visiting potter or trader. These are extreme scenarios, simply to illustrate the variations in contexts and processes that will have encouraged different production, distribution and consumption strategies and processes across even small regions in Protopalatial Crete.

Would the desire for innovations be driven by the producers making new forms available to consumers outside the innovating centres, or by rural consumers increasingly becoming familiar with and desiring novel urban fashions? There would have been a spectrum from more passive to more active processes, instigated by different groups of producers and consumers, with different motivations. These individual interactions between producers and consumers, along established and expanding social and economic networks, could also be supplemented by seasonal or annual events, for example periodic markets or fairs accompanying ritual events at regional extra-mural shrines, where innovations and individual variations might be exceptionally visible to large numbers of potential consumers from many communities.

Returning to our chronological resolution (**Fig. 9.1**), ideally, for some pottery-defined sub-periods within the Protopalatial phase, at some sites, we are able to refine our chronology to a couple of generations. This may seem a frustrating remove from individual decision-makers in the past, but the limited numbers of potters who will have worked in, or whose products will have been consumed in most communities, can help us focus on specific processes. If, at most sites, we are dealing with low numbers of potters, we could assess how variable or standardised the assemblage is (or specific components of the assemblage – *e.g.* table *vs* cooking pots). We

can then consider whether the degree of standardisation results from most pots of a specific type being produced by a single potter (in that or a neighbouring community), or was a consequence of a few potters sharing ideas (*e.g.* a potter and the apprentices they trained), or organised marketing or distribution to the community, or due to consumers wanting pots to satisfy narrowly defined desires. The patterns we can recognise may enable us to distinguish the consequences of production, distribution or consumption decisions, by different agents involved in different stages of the production to consumption sequence.

Recent studies, including chapters in this volume, have focused on villages like Sissi and Hagia Triada, only a short walk from major urban centres, and documented differences in at least some characteristics of their pottery assemblages. With only a small number of potters active in such villages, individual potters could have a very significant role in the adoption or resistance to innovations from potters in the nearby centres. If different potters specialise in the production of distinct types of wares, some potters may be more open to adopting such innovations while others are resistant, which should be apparent in discrepancies in innovation or adoption between different categories of vessels, and between imports and local products. Considering the time-scales over which we can monitor changes, potters teaching their apprentices over just three to four generations could maintain resistance and sustain a localised tradition through an entire ceramic period. Similarly, with few potters working in most communities, a single potter with novel or distinctive techniques moving into a community, could have a dramatic impact in spreading innovations or simply idiosyncrasies (*cf.* Lis *et al.* 2015; Choleva 2020). In contexts where small numbers of potters were involved, these possibilities bring the variations in the spread and adoption of new styles and techniques down to the scale of individual decision-making, by producers and consumers, and can significantly affect our models for understanding variations and changes.

So far, I have been considering the internal structure of a regional economic system of inter-connected sites. But during the dynamic Protopalatial period, these regional systems will have changed dramatically. With reference to the urban growth dynamic sketched at the start of this chapter, we can anticipate that the exchange networks focused on the expanding palatial centres would penetrate further into their hinterlands through time, and probably also beyond any short-term and shifting political frontiers. I suggested that the relatively informal and undifferentiated regional networks of the Prepalatial period would gradually become over-laid and modified by developing dendritic regional economic systems, centred on the expanding palatial urban centres. These need not have completely replaced the networks along which pots and ideas had moved earlier. But they will have added new, more complex, and potentially at least partially organised, and in terms of palatial taxation, administered economic structures, which will probably have accounted for an increasing volume of trade, and facilitated more effectively the sharing of materials and ideas.

If the numbers of urban and rural potters in the economic system were roughly balanced, as suggested above, urban potters are likely to have had significantly greater influence on changes in products across the region than their rural counterparts. While the expanding urban-rural networks were two-way, rural communities will primarily have channelled resources into the centres, while the principal returns will have been finished products, like pottery, propagating innovations developed by urban potters. These flows may have been easier or more intensive within a single political system, and may have variably extended as far as its (likely fuzzy) boundary, but likely also beyond. The innovations would be competing for adoption by rural potters and consumers with local traditions, and with innovations moving outwards from the few other innovating urban centres, processes that have been invoked in considering the sequence of influences on the pottery of the Pediada (Rethemiotakis & Christakis 2004; 2011), Lasithi (Betancourt 2007; Langford-Verstegen 2015), and the coastal region between Knossos and Malia (Christakis *et al.* 2024: this volume, § 5; Mandalaki 2024: this volume, § 6). Though note that the limited adoption of Pediada techniques and styles in the Agriana sequence (Christakis *et al.* 2024: this volume, § 5), indicates that urban centres were not the exclusive sources of novelty. There has been considerable discussion over whether the extension of Maliote ceramic characteristics into Eastern Crete represents some degree of political dominance by Malia (Knappett 1999a; 2012; Poursat 2010; Knappett & Ichim 2017; Doudalis 2022), also raised regularly in discussion at the workshop. An alternative is that there simply was no large urban, innovating centre east of Malia, as a source for significant competing influence.

Prospects

This exploration suggests multiple and diverse frameworks for thinking about the production, distribution and consumptions of pots, as well as the changing local and regional structures underlying the circulation of pots, potters, ideas and innovations – both technical and stylistic. Considering such interpretive frameworks can help us to contextualise the patterns we detect and consider processes to account for them. It can also encourage us to think of ways that we can monitor different processes through characteristics of the pots and assemblages, so we can engage more explicitly with processes and the people who enact them.

The presently limited number of sites anywhere on Crete for which we have large, published assemblages of Protopalatial pottery, severely constrains the degree to which such models can presently be explored and developed. Even more fundamentally, with fully published assemblages from only limited contexts at most sites, it is not possible to treat presently documented assemblages as fully representative of the range of products produced or consumed at a site, with any confidence. But the recent publication of a number of assemblages from Malia and Phaistos, studied and published in broadly comparable ways, is moving toward establishing site-wide signatures, as well as potentially allowing an assessment and interpretation of intra-site variability. But as these studies demonstrate, particularly to the degree that many are published by the same specialists working in close communication, comparative studies require standardised units, terminologies and documentation. Assemblages from a wide variety of contexts and types of sites, documented in comparable ways, will be needed to enable regional syntheses. A workshop like this and its publication, is essential to document the data needed to explore these concerns.

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