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Agro-pastoralist colonization of Cyprus in the 10th millennium BP: initial assessments

EDGAR PELTENBURG, SUE COLLEDGE, PAUL CROFT, ADAM JACKSON, CAROLE MCCARTNEY & MARY ANNE MURRAY*

Unexpectedly early evidence for the precocious spread of farming has recently emerged in Cyprus. It is argued that the transmission occurred as a result of migration related to ecosystem stress in the Levant. So strong are the connections of the colonists with the mainland that we suggest the term Cypro-Pre-Pottery Neolithic B to describe what has hitherto been a major lacuna in Cypriot prehistory. Consistent dates from key sites and the evolution of material culture indicate that this Cypro-PPNB sequence represents the hitherto elusive ancestry for the Khirokitian.

Key-words: burial, colonization, Cyprus, domestication, Pre-Pottery Neolithic, wells

A startling variety of new evidence from Cyprus demonstrates that the introduction of the Neolithic occurred in the 10th millennium BP, over a millennium earlier than often assumed in studies of Mediterranean island colonizations (e.g. Stanley Price 1977; Cherry 1990). On the basis of evidence summarized below, we propose that the introduction of agro-pastoralism was by migration rather than a result of adaptations by indigenous foragers. The process does not fit the wave of advance model used to account for the spread of farming in Europe (Ammerman & Cavalli-Sforza 1984), nor its modification, jump dispersal (Van Andel & Runnels 1995), but is the outcome of regional environmental change. All dates in this paper are uncalibrated BP.

Low visibility sites of agro-pastoralist colonists

The origins of the Aceramic Neolithic Khirokitian culture have long been debated (Held 1992; LeBrun 1989; Stanley Price 1977; Watkins 1973). Cherry (1990: 194) suggested that relevant evidence belonging to the period between the 11th-millennium BP foragers of Aetokremnos (Simmons *et al.* 1999) and the 8th/7th-millennia BP Khirokitian might be found on low visibility sites that had escaped detection. Such sites have recently come to light. The earliest, and currently the most informative sites, Kissonerga-Mylouthkia (hereafter Mylouthkia) and Parekklisha-Shillourokambos (hereafter Shillourokambos), were founded in the second half of the 10th millennium BP (FIGURES 1, 2).

Mylouthkia is a multi-period coastal site in the southwest of the island. Lemba Archaeological Project excavations from 1989 to 2000 revealed five wells, a semi-subterranean structure and three pits belonging to the Aceramic Neolithic. Period 1A well 116 has a coherent set of three later 10th-millennium BP AMS dates from barley and other short-lived cereal grains (FIGURE 2). AMS results from charred seeds in Period 1B well 133 date it to the late 9th millennium BP. The wells are thus amongst the earliest known in the world. Details are reported in Peltenburg *et al.* in press; forthcoming a; forthcoming b.

Since 1992, Jean Guilaine's excavations at Shillourokambos have also yielded mainly

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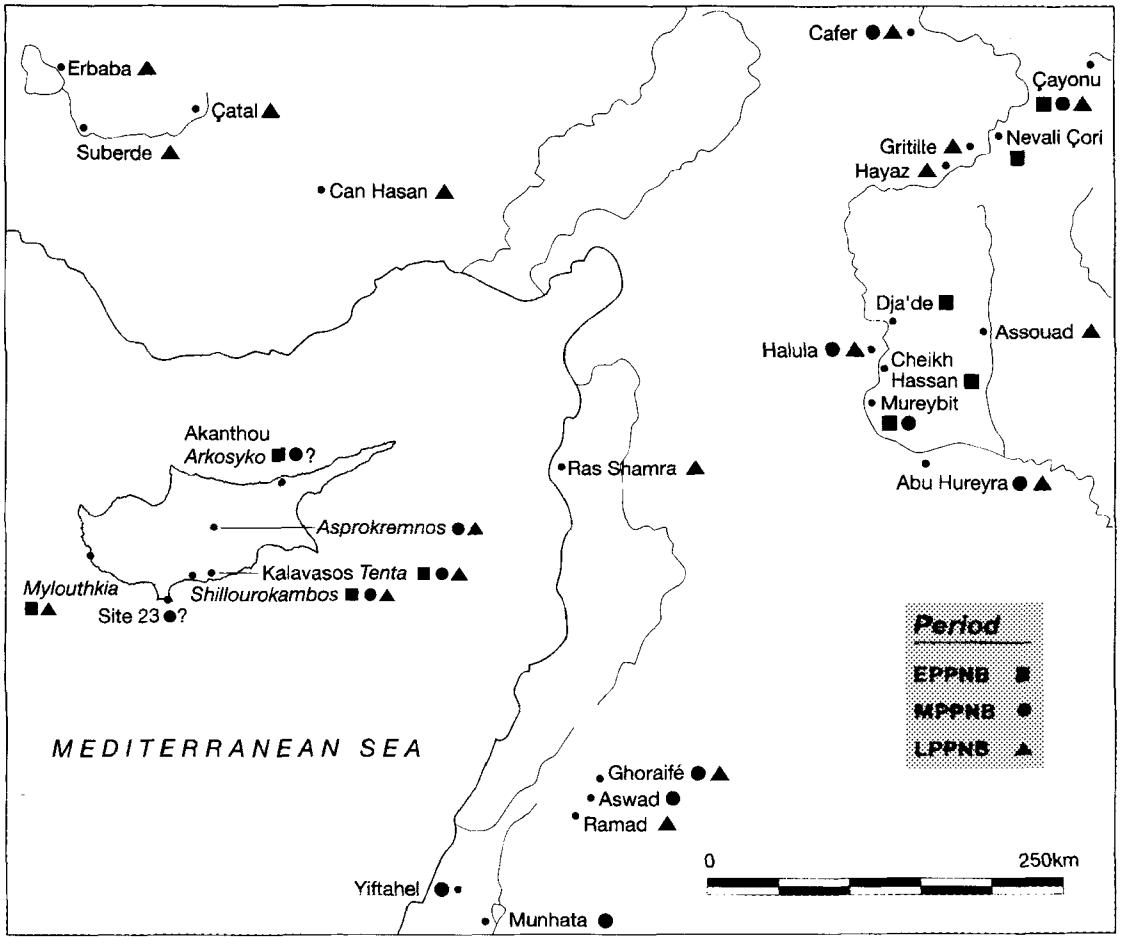

FIGURE 1. *Distribution of Pre-Pottery Neolithic B sites in Cyprus and the adjacent Asiatic mainland.*

negative features including probable wells, pits and posthole alignments (Briois *et al.* 1997; Guilaine *et al.* 1998; 2000). Thirteen charcoal-derived ^{14}C dates belonging to the 10th–9th millennium BP point to a long continuity of occupation which the excavators have divided into four periods (FIGURE 2 and Vigne *et al.* in press). Of particular note are a 76-sq. m enclosure defined by palisade trenches and a feline head sculpted in serpentine. Upstanding curvilinear stone architecture appears at least by the Late Phase, dated to the end of the 9th millennium BP.

As argued elsewhere (Peltenburg *et al.* forthcoming b), four other sites shown on FIGURE 1 may now also be considered as pre-Khirokitian. Kalavasos-Tenta (henceforth Tenta) 'top of site' has dates consistent with Mylouthkia 1B and Shillourokambos Middle/Late Phase (FIGURE 2). Its hierarchically organized settlement plan was ultimately derived from PPNA Syria (Todd 1987: figure 20; *cf.* Stordeur 1999: 142, figure 8b).

Other southwest Asiatic introductions, some discussed below, concern symbolic behaviour (maceheads, engraved pebbles, figurative artwork and skull treatments) and the economic sphere (an unalloyed Neolithic subsistence package of plants and animals). The integrity of what is essentially a PPN economic and cultural system point strongly to a transfer of EPPNB agro-pastoralists from southwest Asia. There are no signs of restructuring by putative indigenes to suit their own ideology.

In order to assess this case for migration, we comment on salient features of the new sequence: water wells, the chipped stone, mor-

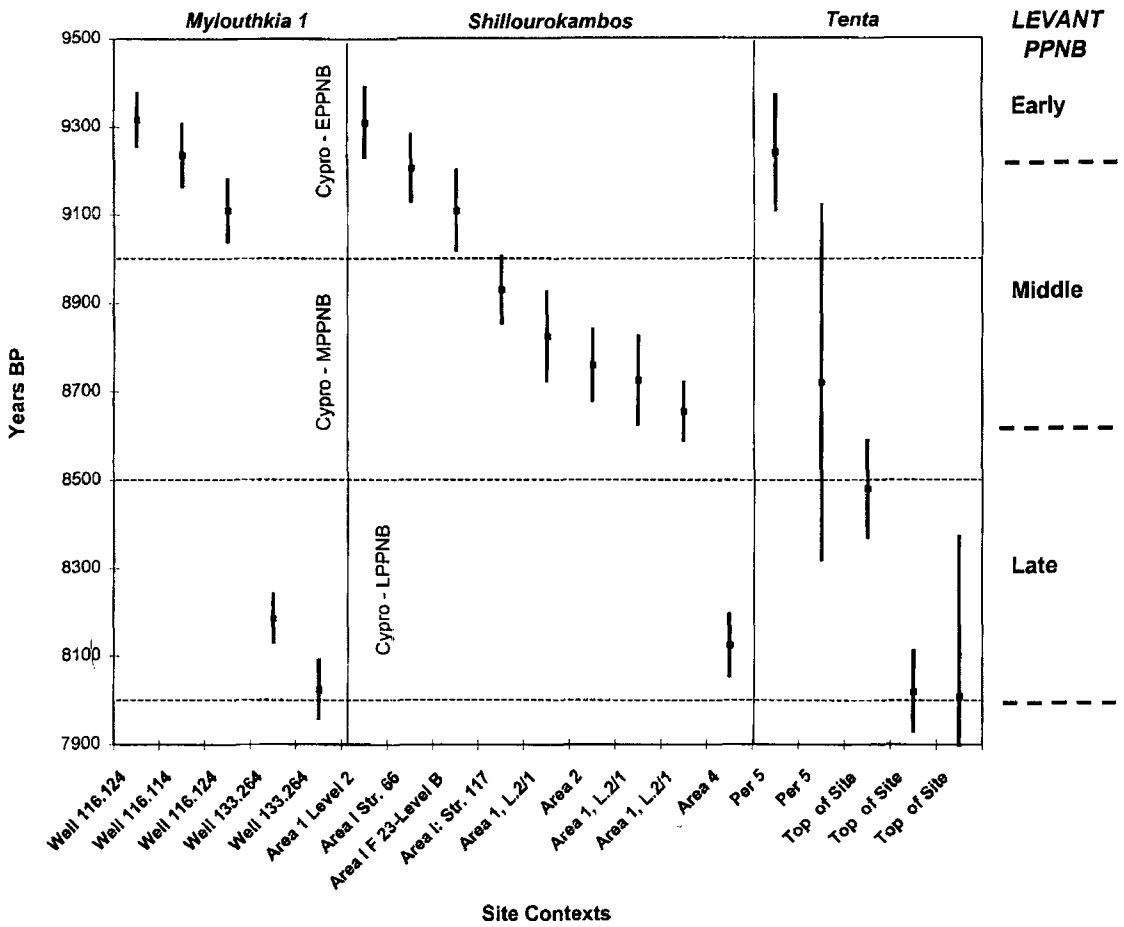

FIGURE 2. *Radiocarbon ^{14}C determinations (single s.d.) from sites of the Cypro-Pre-Pottery Neolithic B period, c. 9500–8000 BP. Dates from Guilaine* et al. *2000; Peltenburg* et al. *forthcoming a; Todd 1987. Column on right shows conventional mainland PPNB phase divisions.*

Note: *Relevant dates from four other sites are excluded from this diagram. One Khirokitia date, 8850±650 (Ly 4785), may prove significant but its large range does not inspire confidence and it lacks supporting evidence; at a single s.d., two other dates from this site extend into the late 9th millennium BP. Akrotiri Site 23 produced a date of 8350±250 (UCL-307, shell, uncorrected for reservoir effect); it seems a multi-component, but disturbed site with earlier and later material. At a single s.d., Dhali-Agridhi P-2775, and at two s.d. Ais Yorkis DRI-3441, also extend into the late 9th millennium BP. It should be noted that there are many more relevant dates from Shillourokambos (see Vigne* et al. *in press).*

tuary practices, flora and fauna. To provide a framework for discussion, we use the term Cypro-PPNB shown in the proposed chronological scheme of FIGURE 3. It emphasizes the combined insular and southwest Asiatic characteristics of the period (*cf.* Peltenburg *et al.* in press).

Wells

Of the features belonging to the earliest traces of Cypriot farming communities, the wells are most extraordinary. Two Mylouthkia examples, wells 116 and 133, consist of cylindrical shafts a minimum of 8 and 7 m deep with hand/foot-holds cut into unweathered shaft walls to facilitate climbing in and out (FIGURE 4). In well 133, the 43 preserved examples are systematically distributed in fairly vertically aligned, approximately opposed ranges. Both wells are cut into the soft, homogeneous bedrock to tap the flow of small underground watercourses (now dry) which flowed in pipe-like channels some 20–40 cm in width towards the seashore (FIGURE 5). Subterranean stream channels at least

Stage	Phase	Dates BP	Dates cal BC	Populations
Akrotiri		10,665*	9703*	Exploration: Hunter-gatherer visitors
Cypro-PPNB	Early	?-9000	?-8000	Colonisation: First agro-pastoral settlers
Cypro-PPNB	Middle	9000-8500	8000-7500	Consolidation: Establishment of farmers
Cypro-PPNB	Late	8500-8000	7500-7000	Adaptation: Distinctive economy
Khirokitian		8000-6500	7000/6500-5800/5500	Development: Efflorescence of Aceramic Neolithic

* average of large series of dates (Simmons 1999)

FIGURE 3. *Chronological scheme for the Aceramic Neolithic and Akrotiri phases of Cyprus.*

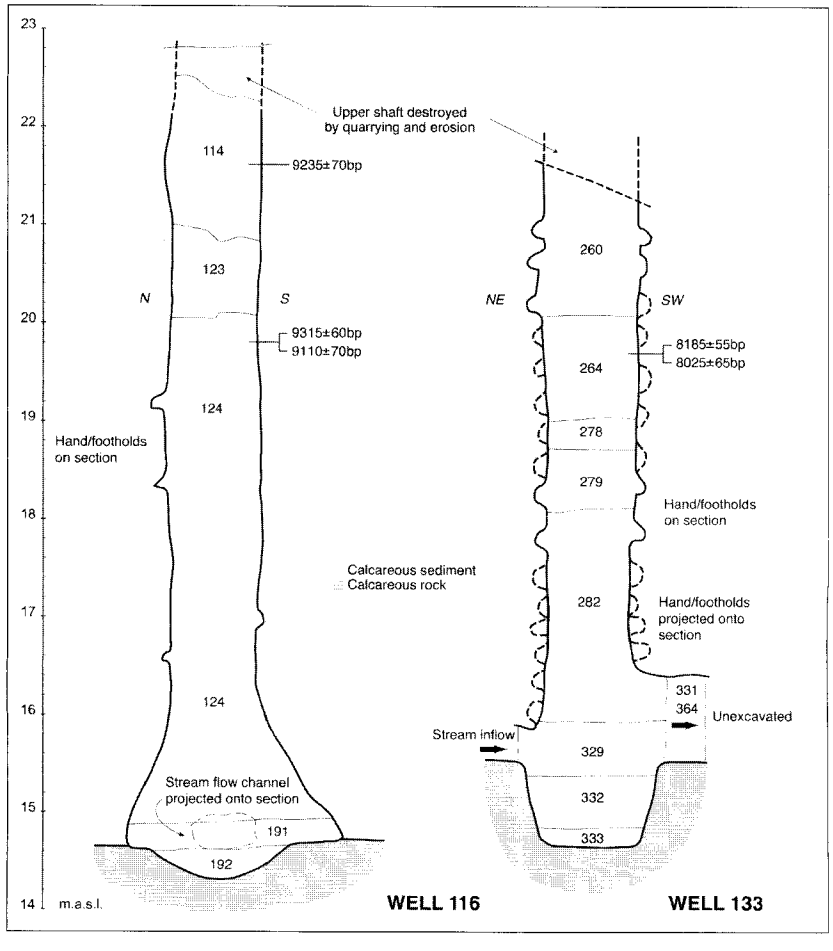

FIGURE 4. *Kissonerga-Mylouthkia wells 116 and 133 of the later 10th and 9th millennia BP respectively. Profiles show hand/footholds, major deposits with locations of samples for AMS dates and tapped stream flows.*

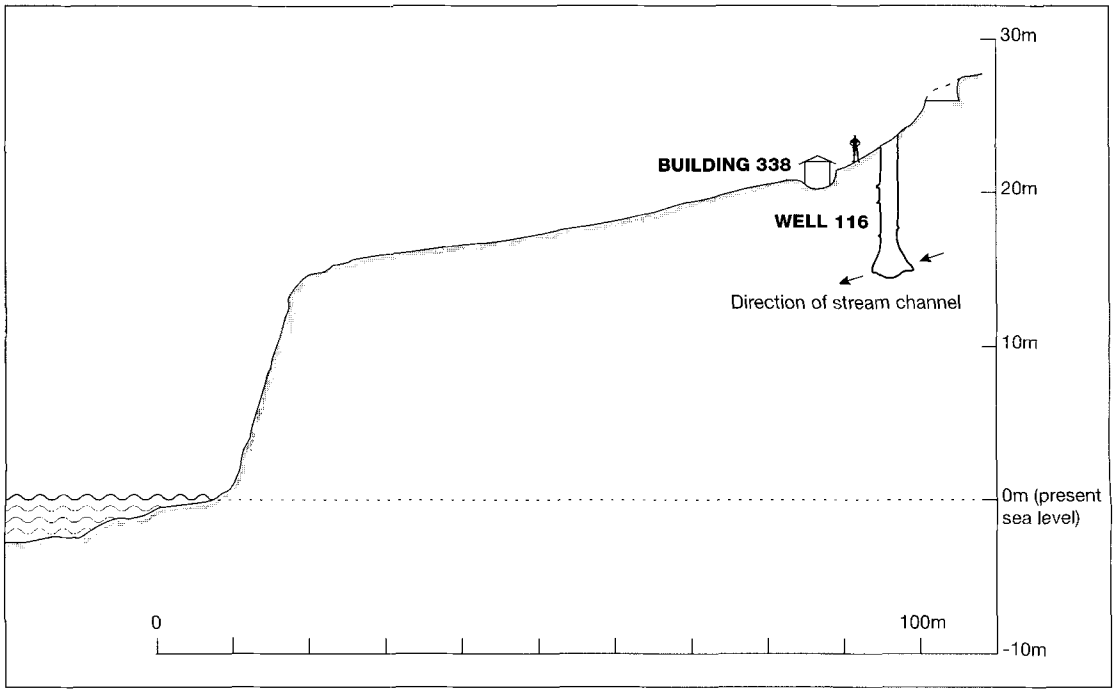

FIGURE 5. *Diagrammatic cross-section through coastal site of Kissonerga-Mylouthkia showing relationship of 10th-millennium* BP *well with present-day shoreline.*

8·5 m below the ancient ground surface would have presented no surface indications, such as vegetative indicators of the presence of water. Well-diggers therefore had to locate their shafts with great precision, probably by using water-divining above small, underground streams. Prolific fills include 449 fragments of limestone vessels and hammerstones. Shillourokambos also has deep features that are most likely water wells.

The chipped stone

Assemblages from Mylouthkia, Shillourokambos and Tenta show various links with the Asiatic PPN (Briois *et al.* 1997; McCartney in press; Peltenburg *et al.* in press). This prismatic blade industry, while possibly retaining 'archaic' Epipalaeolithic/PPNA traits, is clearly PPNB in character and shows a departure from the thumbnail scrapers and irregular blades described at Aetokremnos (Simmons *et al.* 1999: 143, 276–81).

Byblos points from Mylouthkia 1A follow the Syrian EPPNB pattern of flat retouch restricted to the tang. At Shillourokambos, we find more extensive pressure retouch on Byblos and Amuq points (*cf.* Cauvin 1973). By the Cypro-LPPNB and Khirokitian, Byblos and Amuq points show covering pressure retouch as on contemporary mainland examples.

Glossed tools provide a range of mainland parallels. Mylouthkia 1A finely denticulated glossed blade fragments are parallel to Levantine examples from the EPPNB onwards (Quintero *et al.* 1997: 267, 279; Cauvin 1983). At Shillourokambos Early Phase B, obliquely glossed crescents appear, suggesting 'archaism' or closer parallels with Eastern Anatolia (e.g. Rosenberg & Peasnall 1998: 204). Crescents also occur at Tenta in association with microliths and finely denticulated glossed blades and bladelets. By the end of the Cypro-PPNB, glossed tools in the form of retouched glossed segments and unretouched glossed blades proliferate at several sites. In sum, Cypro-PPNB glossed tools betray Levantine and Anatolian origins. To judge by the decrease in the occurrence of obsidian, and shifts in arrowhead and glossed tool types which follow general patterns evident in the Levant, direct contacts with Anatolia appear to have diminished after the Cypro-MPPNB.

Naviform blade core technology, the selection of high-quality chert and occurrence of

significant quantities of Anatolian obsidian are indicative of the Cypro-E and MPPNB. The use of naviform cores declined in the Cypro-LPPNB, with less attention paid to core preparation and the use of more moderate chert types. Bi-directional cores gradually gave way to uni-directional examples and the production of less standardized blanks by the Khirokitian, shifts that also took place in mainland assemblages from *c.* 8000 BP (Rollefson *et al.* 1992: 454–9; McCartney 1999). These changes in core technology may reflect the decline in arrowheads produced from thin standardized blade blanks (Gulaine *et al.* 2000: 80–81). The later Cypriot industry is defined by large tanged knives, backed blades and the glossed segments which continued to depend on a simplified blade technology within the small-scale agricultural subsistence system.

Human remains

Skull caching was diagnostic of the PPN in southwest Asia (Bienert 1991). There is tenuous evidence that the custom may have been transmitted to Cyprus. One well (?) at Shillourokambos contained a contracted burial above cranial fragments of other individuals (Guilaine *et al.* 1998). Five individuals are represented in Mylouthkia well 133. An artificially deformed skull and portion of the 1st cervical vertebra of an adult male were recovered from its upper fill (FIGURE 6). Lower in the fill was a group of three crania and other parts of bodies with a unique macehead of pink conglomerate. Largely confined to the area between the upper and lower human remains was a discrete concentration of 22 originally whole caprine skeletons deposited as complete, unbutchered carcases. The juxtaposition of these carcases and purposefully deposited human remains suggests the sort of ritual behaviour seen in southwest Asia during the PPNB (*cf.* Goring-Morris *et al.* 1998; Galili & Nir 1993: 267–9).

Early domesticated plants

The Mylouthkia wells also contained well-preserved charred plant remains. Samples from Periods 1A and 1B comprise a wide range of taxa, including glume wheats (*Triticum* spp. — grains and chaff) and hulled barley (*Hordeum* spp. — grains and chaff), lentils (*Lens* sp.), large seeded legumes (*Lathyrus/Vicia* spp.), linseed/flax (*Linum* sp.), pistachio (*Pistacia* sp.),

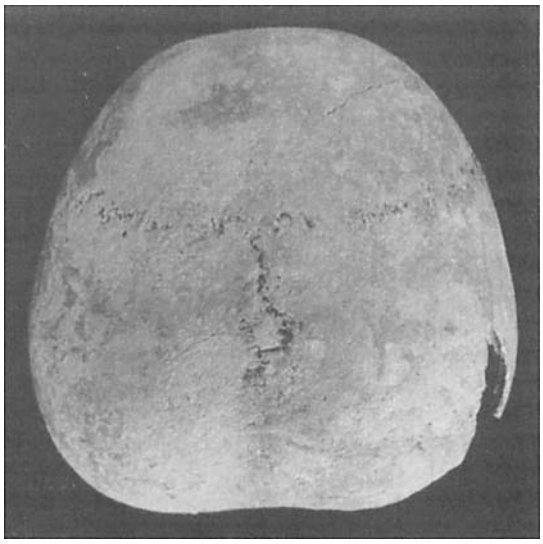

FIGURE 6. *Top view of Skull 1 from Kissonerga-Mylouthkia well 133 showing flattening of the occipital.*

roots/tubers and many weed taxa (particularly wild grasses). Of significance is the identity of the wheat and barley found in the samples. Differentiation between the wild (i.e. progenitor species) and the domestic species of both genera can be problematic because of the similarity in overall morphology of both grains and chaff. Distortion caused by charring can further hinder accurate identification and the typically smaller wild taxa can often mimic the larger domestic derivatives. Metrical analyses, for example relative measurements of length, breadth and thickness, have been used to aid the identification of cereal grains (e.g. van Zeist & Roller 1991–92 with references). On the basis of morphological assessments and of comparisons of the grain dimensions (Peltenburg *et al.* forthcoming b) we suggest that domestic wheat and barley were present during Periods IA and IB at Mylouthkia. Domestic einkorn-(*Triticum monococcum*) and domestic emmer-(*Triticum dicoccum*) types were identified together with domestic-type hulled barley (*Hordeum sativum*).[1] It appears, therefore, that from

1 The identifications are inevitably based on knowledge of the morphologies of present-day taxa and, as such, there is bound to be a degree of uncertainty about any classifications assigned to the species level — the 'type' suffix is an acknowledgement of the tentative nature of the identifications that have been made.

the earliest PPNB phase at Mylouthkia there is evidence, in the form of charred grains and chaff, of the three 'founder crop' cereals (Zohary 1996: 143–4).

Current consensus suggests that the first cereal domesticates had evolved in the south-central Levant (i.e. upper Jordan Valley/Damascus Basin) and possibly southeast Turkey by the early 10th millennium BP (Garrard 1999: 82; Harris 1998: 8). From this time onwards it appears that there was an increasing dependence on domestic crops. These conclusions are based partly on genetic studies of modern populations of wild progenitor species, from which it has been possible to suggest probable locations of the earliest 'domestication events' (e.g. Harris 1996: 5–7; Heun *et al.* 1997; Zohary 1996; Valkoun *et al.* 1998). The chronological framework for the evolutionary changes which culminated in the development of the Neolithic 'package' of crops (Zohary 1996: 156) is based largely on archaeobotanical evidence in the form of accurately identified grains/seeds found in samples from securely dated sites. The reported presence (or absence) of taxa, with correctly assigned domestic status, has thus formed the basis of our knowledge about the distribution of the earliest crops and also of their subsequent dispersion throughout the Levant, and beyond.

Much scientific debate surrounds the contentious issue of 'how many times' the 'founder crops' have undergone domestication. In a recent paper, Zohary concluded that there was probably a single, or at most few 'domestication events' (Zohary 1996: 156). To date, the progenitor species of domestic einkorn, emmer and hulled barley, (wild einkorn (*Triticum boeoticum*), wild emmer (*Triticum dicoccoides*) and wild barley (*Hordeum spontaneum*)) have not been recorded in archaeobotanical assemblages from Cypriot sites. Whereas wild barley does grow on the island (Meikle 1985), there appears to be no evidence to indicate that the wild wheats were native taxa (Holmboe 1914; Meikle 1985; Zohary & Hopf 1993). Following Zohary's hypothesis of a limited number of 'domestication events', it would appear that the Mylouthkia evidence favours the theory that domestic crops were introduced from the mainland during the EPPNB, as opposed to the indigenous development of crop-based subsistence on the island.

The introduction of cattle, pig, sheep and goat in the Cypro-EPPNB

It has been generally accepted that the deer, pig, sheep and goat regularly present in the Khirokitian were deliberately imported to the island (e.g. Croft 1991: 63–4; Davis 1984: 147). Now there is explicit evidence that, in addition to these animals, cattle were also transferred to the island by the end of the 10th millennium BP, over a millennium earlier than the Khirokitian.

The faunal sample from Early Phase A at Shillourokambos includes pig, fallow deer and caprines in the approximate proportions 4:2:1, and also a few cattle bones (Vigne *et al.* in press). Contemporary Mylouthkia 1A produced caprine and pig remains, sufficient to indicate that these taxa already enjoyed a widespread distribution in the Cypro-EPPNB.

The presence of cattle in the 10th millennium BP is very unexpected. Their remains are most abundant in the Early Phase B phase at Shillourokambos, comprising 8% of 1110 identified specimens. Subsequent phases possess so few that cattle keeping presumably ceased there around the middle of the 9th millennium BP. Cattle survived elsewhere until the 8th millennium BP (Kritou Marottou-Ais Yiorkis: Croft 1998; Simmons 1998), but seem to have disappeared by the mature Khirokitian.

Metrical analysis indicates that the Aceramic Neolithic pig of Cyprus was somewhat smaller than western Asiatic wild boar, and might therefore already represent a primitive domestic breed (*cf.* Davis 1984: 156).

Fallow deer remained undomesticated in western Asia, and elsewhere, in prehistory. In a particular insular adaptation, Neolithic and Chalcolithic Cypriot subsistence economies relied heavily on this imported species. It is likely that fallow deer were free-living animals, subjected to controlled hunting within a system of game management (Croft 1991).

As Vigne *et al.* (in press) conclude, the introduced animals cattle, pig, sheep and goat were probably domesticated, even though morphological evidence is limited. Since some are only attested as domesticates later on the mainland, the Cypriiot evidence implies the existence of undetected earlier examples in the Fertile Crescent.

Discussion

We have seen that in the later 10th/9th millennium BP, communities with strong Levantine PPNB affinities existed on Cyprus. Their existence raises afresh interlocked issues of early island colonizations and the spread of farming practices.

Regarding the latter, Cyprus does not meet conditions appropriate to the indigenist model: a settled Mesolithic population, equivalent late Mesolithic and early Neolithic population densities and continuity in settlements across a region (Ammerman 1989: 164). The only site with earlier occupation is Aetokremnos, a transitory hunting camp which differs greatly in both subsistence pattern and material culture from the Cypro-PPNB. It may have been abandoned a millennium or more before the Cypro-PPNB. While other sites of that period may exist, equivalent population densities and settlement continuity, as required by the above model, are unlikely to be met. Our current understanding is that the island lacked a settled population before the introduction of the Neolithic package. Hence, the beginnings of the Cypriot Aceramic Neolithic culture that flourished for some three millennia resulted from the migration of a PPN group(s), one of the earliest successful overseas migration of farmers. We can only speculate on how the minimum 69-km crossing was accomplished. In the similar case of Crete a millennium later, Broodbank & Strasser (1991) suggest a single crossing. Conversely, Vigne suggests numerous return voyages from Cyprus to the parent body (Vigne *et al.* in press), a reconstruction supported by evidence for parallel major shifts in the chipped stone industry of Cyprus and the mainland.

That parent body remains elusive, even though it must lie in the PPN interaction sphere because of the many generic similarities between Cyprus and southwest Asia. Sea currents made the island more accessible from Palestine than distance alone might suggest, but the late start of the EPPNB in the southern Levant, low site densities in EPPNB Palestine and pervasive similarities with northern Syria make it an unlikely source (Goring-Morris & Belfer-Cohen 1997: 85). To the north, current dates for the Anatolian Aceramic Neolithic are too late. The probable source, western Syria, presents problems, since the nearest attested PPNA-EPPNB sites that could have served as population sources are found in the Levantine Corridor over 200 km inland (FIGURE 1). Nonetheless, it is there that we find the closest material culture and economic parallels for the Cypro-PPNB (Guilaine *et al.* 2000; Peltenburg *et al.* forthcoming b).

Van Andel & Runnels (1995) have dealt with the problem of significant spatial gaps in the distribution of early farming communities by proposing a jump dispersal model in which agricultural groups moved great distances to new homelands. As they recognize, this model does not explain why farmers failed to utilize suitable lands still available closer to home and how they knew about such distant appropriate soils.

Another approach contextualizes migration as a social process. One of the most common characteristics to emerge from systematic studies of migrations is that they stream towards known targets with information conveyed by kin or co-residents (Anthony 1997). Archaeologically, this means we should seek for evidence of prior contacts between the Mediterranean and the Levantine Corridor.

As early as the PPNA there is evidence of a network of reciprocal trade linking social groups over large distances. Gopher (1989: 91) proposed that during this period the Levant could be viewed as a single cultural system. The Mediterranean littoral also figured in this system since Mediterranean shells are found at inland sites like Hallan Çemi (Rosenberg *et al.* 1998: 31). However, agriculturalists on the coast nearest Cyprus are currently first attested only in the LPPNB, at Ras Shamra VC. This considerably postdates the existence of EPPNB agricultural communities now evident in Cyprus. While jump dispersal from the Levantine Corridor could account for this gap, we feel it is unlikely that such farmers would have had the necessary boat technology, maritime travel expertise and knowledge of their target to establish permanent bases on Cyprus. In short, the dynamics of island colonization in this case imply the existence of indigenous PPN coastal agro-pastoralists habituated to overseas enterprises and aware of the arable potentials of Cyprus.

The absence of relevant west Syrian sites may be due to a scarcity of intensive survey and sea-level changes. Marine transgression in this area occurred during the period under consideration. In general the shore-line was −25 m at

c. 8000 BP and –7 m at 5000 BP (Cherry 1990; Held 1992; Gomez & Pease 1992). That settlements along the decreasing Levantine coastal plain had to be abandoned because of inundation is confirmed by the remarkable PPNC site of Atlit Yam, now *c.* 8–10 m under water (Galili & Nir 1993). We may infer that Neolithic coastal communities suffered long-term loss of subsistence resources and ecological stress. One option was local migration to Cyprus.

Presently available settlement evidence on Cyprus conforms to Schwartz's model of successful colonization in which there are sequential stages of exploration, settlement, adaptation and development (Schwartz 1970). In this sequence (FIGURE 3), Aetokremnos represents island exploration and the generation of inter-regional and seafaring knowledge. Such background information was a pre-requisite for well-organized, purposive colonization. The new Cypro-PPNB dates now allow for more continuity than is immediately apparent. Colonization should therefore be seen as another episode in a continuum of contacts with the island, but one which was qualitatively different since greater control of subsistence resources permitted permanent occupation. The catalyst for wilful colonization may have been specific ecosystem stress, but incentives to travel to the island existed already. The migration should not be construed as the first step in the formation of a maritime voyaging ideology that led to further colonization of the Mediterranean. Later expansion into the Aegean seems unconnected. Migration to Mediterranean islands, therefore, was not part of an inevitable expansive disposition from the early PPN but was conditioned by local circumstances. What links the Cypriot and Cretan examples is the migration of farmers to essentially uninhabited islands. In the western Mediterranean, there was greater interaction with indigenous Mesolithic islanders.

The agricultural economies of Mylouthkia 1A and Shillourokambos Early Phase A, amongst the earliest in the Near East, indicate that they cannot be far removed from landfall or primary settlement dates. The new economy must have spread rapidly. In contrast to founder principle models that predict rapid change, the adaptation phase was prolonged, perhaps because protracted contacts suggested by chipped stone developments and obsidian imports re-enforced conservative tendencies. It is only by the Cypro-LPPNB some 1000 years after the intrusion that the chipped stone industry changes substantially, that cattle are missing from the Shillourokambos economy and that deer constitute a highly significant subsistence element. The Khirokitian, therefore, emerged as a truly independent culture only after long-term, insular evolution. Our previous ignorance of this evolution bedevilled attempts to account for its origins. These, as we now see, are not at the start of the Khirokitian (Stanley Price 1977) or pre-Neolithic (Held 1989: 8), but are fully Neolithic from the outset of the Cypro-PPNB in the 10th millennium BP.

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