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KHOR ILE-SUD, QATAR:
THE ARCHAEOLOGY OF LATE BRONZE AGE
PURPLE-DYE PRODUCTION IN THE ARABIAN GULF

By CHRISTOPHER EDENS

During six seasons between 1976 and 1982 the Mission Archéologique Française à Qatar, directed by Jacques Tixier, investigated a number of prehistoric, protohistoric and Islamic sites across the Qatar peninsula. The pre-Islamic archaeological investigations concentrated on the area of al-Khor on the north-east coast, where various members of the team excavated several sites with 'Ubaid pottery and a number of undated cairn burials (Tixier 1980, Inizan 1988, Midant-Reynes 1985). As part of this team the author investigated two second-millennium BC sites during the three winter seasons of 1980–2. This report gives an account of one of these sites; a separate article will consider issues arising from the other site.

The site is located on a small island at the margin of the intertidal zone within the lagoon of Khor Shaqiq, on the north-east coast of Qatar (Fig. 1). Under present conditions a mangrove swamp lies off the east and south-east end of the island, open tidal mud-flats extend around its northern shore, and the deeper water of the bay lies to the west and south-west. Outcrops of Eocene limestone form the island core, around which lie cemented mid-Holocene beach-deposits and uncemented Holocene beach-lags (Fig. 2 inset). The latter, formed as thin alternating beds of silicate and skeletal carbonate sands, provide broad and fairly level expanses between the island shoreline and the limestone outcrops; these flats are the favoured location of human occupation. Uncemented sands, forming a chenier spit, front the south side of the island. The island lacks a permanent source of water and supports a very thin cover of xerophytic species of the Chenopodiaceae, Boraginaceae, Plumbaginaceae and Gramineae families.

Aside from several cairns of undetermined age and recent Islamic sherd scatters, several datable episodes of occupation are evident on the island. Two overlapping sites on the northern beach have the name Khor Ile-Nord. The earlier of these occupations, dated to the early second millennium BC, amounts to a pair of standard red-ridge ware jars of the Barbar II period, buried to their rims in the beach-lag. In addition, a thin scatter of red ridge sherds is associated with a weakly-developed buried paleosol in the vicinity. Besides the distinctive pottery, three radiocarbon determinations place this Barbar site in the 18-17th centuries BC. The pair of jars and the sherd scatter reflect an ephemeral presence of people, perhaps transient fishermen based on Bahrain. Several similar scatters of Barbar II red-ridged sherds are present on the mainland coast between Khor Shaqiq and Khor Dakhira to the north. These scatters are the only reported early second-millennium sites on Qatar's east coast.

A much later site sits immediately adjacent to the Barbar presence. This later occupation consists of two large circular stone structures, formed by concentrically placed small beachrock slabs in the shape of bowls, two to three metres across and half a metre deep. Although the structures went through several phases of repair, their purpose remains unclear. Associated artefacts are limited to a small number of heavily eroded and undatable glazed body sherds; a single radiocarbon date indicates these structures were in use around AD 1400. Oyster shells, concentrated below the upper floor of one structure, are the only other contents.

The second occupation consists of half-a-dozen rectangular structures, associated features and a shell midden, located on the south-east side of the island. This site, Khor Ile-Sud, is the focus of this discussion.

Description of the site

The occupation on the southern side of the island consists of architecture and ancillary structures unevenly distributed over an area roughly 200 × 40 m (Fig. 2). These structures form two clusters at each end of this rectangular area, with other remains more thinly scattered across the remaining space. Excavation concentrated on the eastern cluster, to which alone applies the name Khor Ile-
Sud; the more limited soundings elsewhere in the southern beach revealed occupation that may be unrelated to Khor Ile-Sud (and of a more recent date).

Khor Ile-Sud contains five rectangular semi-subterranean structures, several formal hearths and stone cists, a large extra-mural activity surface, and a shell midden together with various smaller piles of shell. These different units of the site all occur on the same surface of beach-lag, either built up on it (the shell midden and small shell piles) or dug into it (the structures and remaining features). Although not particularly prominent, most components of the site were readily apparent on the surface because of slight topographic visibility, lines of stone walling protruding from the surface, and the red-brown colour of aeolian fill within structures (denoting the higher moisture content of these fine sands). While some units can be stratigraphically related to one another, most of the site exists as independent units of structures, features and midden, whose contemporaneity can be demonstrated only by the similarity of the associated artefacts, especially pottery.

Three of the five structures on the site were entirely excavated (Structures A–C), while a fourth (D) was partially uncovered (Fig. 3); the remaining structure (F) was not tested (E is a formal hearth, described below). The structures are formed as rectilinear pits dug 20–75 cm into the Holocene beach-lag. Slabs of beachrock laid nearly upright against the sides of the pits stabilized their edges. The structures formed in this way vary in size from 2·0 × 2·0 m to 6·0 × 2·5 m. While similar in their basic plan and execution, variation in details distinguishes them — Structures A and B are open to the south, permitting access by a sloping surface; A and C present low platforms of beachrock slabs laid flat against their north wall; and B is divided into two chambers by a partition of vertical beachrock slabs. Four small pits appear in the floor of the southern chamber of Structure B. The floors of the structures are unpaved, and are marked by charcoal and ash, faunal debris, pottery and other artefacts that form a thin occupation-deposit mixed with the sand and small shell of the beach-lag. Aside from the pottery, the artefacts from the structures are
Fig. 2 General plan of Khor Ile-Sud.

Fig. 3 Excavated structures and other facilities at Khor Ile-Sud.
limited to a copper/bronze ring, a series of natural pebbles and ventifacts of non-local stone, several grinding stones, and flint flakes and burnt flint chunks. Blown sand and other natural fill cover the occupation deposits; the fill is generally free of cultural materials.

Structures A–C partially enclose a sloping surface dug into the beach-lag (Fig. 3). To the west and north this extra-mural surface connects the entrances of Structures A and B; to the east it approaches Structure C, sloping downward from a low beachstone curb near the surface next to Structure A to a point 30 cm lower near Structure C. At least eleven pits and depressions marked this eastern edge of the extra-mural surface, extending up to 50 cm below the surface. Frequent intersection of these pits reveals several generations of excavation and fill. Large lenses of ash intermittently covered the extra-mural surface, and concentrations of sherds from large deep basins lay scattered across its western and central portions; the base of an additional deep basin was still sunk into the surface. Other artefacts are uncommon, limited to sherds from several jars and a bowl, several pieces of worked flint and a relatively small amount of shell fish. The pits at the eastern end of the surface held variable amounts of beachrock blocks, sherds, burnt flint chunks, blocks of bitumen (one of which bears a basketry impression), animal bones and abundant shellfish.

Several less salient features appear south and east of Structure C. A surface jumble of beachstone slabs, accompanied by a scatter of sherds, immediately south-east of Structure C, seemed to mark a structure of some kind. Excavation uncovered several thin patches of ash, one of which was bounded on one side by an arc of small beachrock slabs set on edge (possibly an informal hearth), but the area contained no coherent structure. The beachrock slabs may have served as a stockpile of building material. A formal hearth, designated Structure E, lay ten metres east of Structure C. The hearth consisted of two large beachrock slabs laid on edge parallel to one another and buttressed on their outer face by smaller slabs laid flat. The inner face of the large slabs was darkened by fire, and ash lay 10 cm thick at the base of the chamber. Nearby, an arc of small slabs bordered another patch of ash.

The shell midden lies about 10 m south of the structures and extra-mural surface. This accumulation forms a 10 × 15 m oval with a maximum thickness of 50 cm, and totals 19-9 cubic metres in volume. The midden comprises three stratigraphic units (Fig. 4): a superficial zone of gray-to-brown aeolian sediment mixed with shell and artefacts (Level 1, up to 7 cm thick); a zone of densely packed lenses of, and occasional small pits filled with, shell, bone, stones, sherds, and ash and charcoal within a matrix of sand and small beach shells (Level 2, with a maximum thickness of 30 cm); and a basal deposit of crushed shell with a limited admixture of sand and a minute amount of other cultural material (Level 3, with maximum depth of 45 cm). The midden was formed directly upon the original beach-surface. Levels 2 and 3 are overlapping units, horizontally offset so that the upper level lay at one side, and across one lateral slope, of the lower level. Although Level 3 is the lowest stratigraphic unit of the midden, it was still forming when Level 2 was being deposited, as indicated by several zones of lateral interdigitation. Several sherds found at the base of Level 3, resting directly on the clean sand of the beach, are identical to the pottery typical of Level 2, and of the site as a whole; this ceramic bracketing of Level 3 indicates that the formation of the entire midden was contemporary with the occupation of the structures and use of the extra-mural surface.

In addition to the principal midden, several small piles of shellfish are scattered throughout the site area. One of these piles lies directly south of the formal hearth (Structure E). Three more form a chain running south-west of the principal midden, spread over a 50 m distance, with a fourth near the modern shore over 160 m away. While the pile adjacent to Structure E is quite small, the others are more substantial (2-0–4.6 m in diameter).

Pottery

The sherds recovered in the excavation represent at least 73 vessels, judging by variations in form, size and fabric. The pottery appeared mainly in Structures A–C and the adjacent extra-mural activity area; lesser numbers of sherds occurred in the midden, the remaining structures and on the site surface. The Khor Ile-Sud assemblage presents a limited variety of fabrics and forms: four fabrics are attested by the great majority of the wares, while a fairly uniform series
of jars, deep basins and bowls provide most of the forms. Each of the different basic vessel-forms
draws preferentially on one or two of these fabrics. The four fabrics are as follows:

Fabric 1. A fairly porous chaff-tempered ware, predominantly pale green to light yellow in colour.
This fabric is the most common in the assemblage, and shows variations in amounts and size of
temper, porosity and hardness that reflects functional variation (e.g. jars versus deep basins).

Fabric 2. A red ware with round quartz temper, the grains of which are often surrounded by
redeposited calcium carbonates. The surfaces of this fabric are often light yellow, but not slipped.

Fabric 3. A fairly hard and dense red-brown ware, often with buff surfaces, containing small
amounts of mixed vegetal and grit temper, the former predominant. The fabric seems basically to
be a variation of the common Fabric 1.

Fabric 4. A hard dense tan to brown (both body and surfaces) ware with mixed chaff and grit
temper, now very small in size and often seemingly lacking altogether.

Jars typically possess a band to triangular rim (diameter 10–15 cm), a short and outward-sloping
neck that is often but not invariably marked off from the vessel body, a sack-like body with
maximal diameter occurring near the bottom, and a rounded base; the vessels stand up to 50 cm
high (Fig. 5). These vessels occur in Fabric 1, and occasionally also in Fabric 2. The jars are
constructed on a wheel, as indicated by the horizontal alignment of chaff, spiral shrinkage cracks
on the interior base and horizontal ridging on the middle third of the interior surface; the round
bases were finished with the jar upside down, leaving finger impressions on the lower third of the
interior surface and a small depression at the bottom where the vessel was closed off.

The deep basins are quite variable in rim morphology, these generally showing thickened triangu-
lar rims below which are more or less prominent ridges and grooves (Fig. 6). The deep basins seem
to have ring bases, although no complete example is extant, done in a slightly coarser fabric and attached to the vessel bottom with the aid of cross-hatching incised around the zone of attachment. These vessels are very large, with rim diameters ranging from 40 to 85 cm and vessel heights (estimated) from 40 to 100 cm. The deep basins are primarily in Fabric 1, here the softer and more heavily coarse-tempered variety. The vessels seem to be assembled from short cylindrical sections, marked by thickened walls at their junctions, these sections perhaps constructed on a slow wheel, since horizontal chaff alignment is present but not well developed. Both jars and, especially, deep basins usually have a bituminous coating applied to interior surfaces, particularly near the bottom of the vessel.

The third common form is a shallow bowl with disc base, simple rim and straight to slightly flared walls (Fig. 7: 1–6). Vessel size is highly variable, the maximum diameter in the range of 13–33 cm; all examples appear in Fabric 3. Several disc bases in this fabric belong to other forms, perhaps deep bowls (Fig. 7: 12–14). The bowl bases are not string cut. Less frequent forms include a small series of cups or bottles in Fabric 4 (Fig. 7: 8–11); the weathered base of a solid-footed chalice in Fabric 1, a surface find (Fig. 7: 7); and several atypical jar rims.

Surface elaborations in this assemblage are minimal. While slipping is absent, four deep-basin sherds bear painted designs in a bituminous paint applied directly to the vessel surface. These designs are generally isolated and sloppily executed, with no comprehensive decorative scheme evident in the limited sample (Fig. 6: 2). Three bowls and a jar bear rectilinear signs incised on the dried or fired vessel (Fig. 7: 1–3).

Other artefacts

Other than pottery, Khor Ile-Sud presented relatively few artefacts. Metal is confined to a single copper ring, with a diameter of about 3 cm, made of two twists of thick wire. Fragments of
bitumen lining from basketry appear in numerous contexts in the structures, extra-mural surface and midden. In one instance, bitumen lined the sides of a small pit within Level 2 of the midden. The abundance of this material accounts for two impossibly old radiocarbon determinations run on samples from the base of Level 2 of the midden (22000 and 21100 BP; GIF-5622 and GIF-5623 respectively). Chipped stone is relatively common, but largely as fire-shattered chunks and non-descript flakes; no retouched tools are noted. Small grinding stones, made of sandstone, appear in several structures. Structure C held the previously mentioned series of smoothed pebbles of igneous and metamorphic rock, some of them so-called dreikanters (i.e. formed by wind erosion).
Fauna

The site produced animal bone in moderate quantities, notably from the midden (Level 2). This fauna has not been analysed in detail; sheep/goat is definitely present, as are several birds and a very small amount of fish; crab and cuttlefish also appear. Shellfish contributes the most conspicuous component of the faunal assemblage.

The midden presents two very different kinds of faunal assemblage. In the aggregate, fifteen shellfish species appear in the Level 2 assemblage (mni = 6384),\(^1\) with *Thais savignyi* (40 per cent), *Circe callipyga* (30 per cent), and *Turbo coronatus* (16 per cent) making the largest contributions, and none of the remaining dozen species accounting for more than five per cent each. These figures, however, are misleading. Level 2 is composed of lenses and other features, variously composed of ash and charcoal, fire-cracked rock, burnt flint, sherds and organic debris. These stratigraphically distinguishable components reveal the formation of the level by incremental deposition, often identifiable as individual events. These events strongly tend to involve a limited range of materials, sometimes largely ash and charcoal or fire-cracked rock, and at other times dietary refuse. Among the latter were counted two concentrations mainly of mammal bone and fifteen concentrations mainly of shellfish (Fig. 8). The packets of shellfish are themselves highly varied — six contain mainly the clam *Circe callipyga*, two the snail *Turbo coronatus*, one the scallop *Chlamys senatorius* and one the snail *Thais savignyi*. While the remaining five packets contain a more balanced variety of species, these too may have formed as coalescing single-species deposits, as suggested by concentrations of the oyster *Pinctada cf. radiata* and the jewel box

\(^1\)Mni is calculated simply as half the total number of anterior canals/anterior columellae for gastropod of umbos for bivalve species, and the total number of species.
*Chama pacifica* within otherwise undifferentiated masses of shell. As a result, *C. callipyga* makes up 80 per cent of several depositional episodes, and *T. coronatus* and *T. savignyi* each 90 per cent of others.

Level 3 presents an entirely different character, being composed almost exclusively of the crushed remains of one species, *Thais savignyi*. These shell fragments form a homogeneous mass, diluted only by a small amount of sand, several small lenses of ash, and the occasional presence of other fauna (fewer than 100 shells of other species, and several animal bones). Artefacts are limited to several sherds at the bottom of the level, resting directly on the sand of the original beach-surface. A volumetric calculation, extrapolating the ascertained rate of 233,000 individuals per cubic metre across the 12.34 cubic metres of Level 3, indicates that Level 3 represents about 2.9 million individuals of *Thais savignyi*.

The midden is not the only place where this species appears in impressive numbers. The smaller shellfish piles strung out to the west of the site, and the tiny pile near the hearth (Structure E) are each exclusively composed of *T. savignyi*. One of the heaps near the midden contains crushed *T. savignyi*, the remainder whole shell. Judging by the density of shell in other contexts in the site, each of these shell-piles involves several tens of thousands of individuals. Elsewhere in the site, *T. savignyi* is again common, and is especially concentrated in Pit 11 of the extra-mural area. Although twelve shellfish species are present in this pit, only *T. savignyi* contributes more than half-a-dozen individuals (mni) to the nearly 38,000 mni total. The remaining pits at the eastern end of the extra-mural area all contain far smaller shellfish samples, but these again are predominantly composed of *T. savignyi*.

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2Calculated from the weight of crushed-shell samples cleaned of non-shell admixtures with known volumes relative to the weight of whole-shell samples from other contexts in the site.
Chronology

In addition to the previously mentioned pair of impossibly old dates, three radiocarbon dates are available for Khor Ile-Sud. All three of these determinations were run on shell samples (to avoid the previous problem of bitumen contamination), a material that gives notoriously difficult results. In this case, the three determinations give inconsistent results (Table 1). As reported, the GIF determination lacks correction for isotopic fractionation, leaving this determination non-comparable to the Geochron results. The isotopic inconsistency may be removed either by deducting the known fractionation values from the Geochron determinations or by adding a reasonable arbitrary value (e.g. $\delta^{13}C = +2.0\%$; or $410 \pm 70$ years; Stuiver and Polach 1977) to the GIF determination. Since standard calibration tables assume determinations normalized to $\delta^{13}C = -25.0\%$, the latter procedure is preferable. Following the global marine calibration model of Stuiver et al. (1986), the resulting calendrical dates have centroids of 1790 and 1635 BC for the Geochron results and of 1100 BC for the GIF result. These calibration results use the global average for the marine reservoir effect, even though this isotopic fraction effect varies widely, especially in regions of restricted circulation or of deep water upwelling (Gillespie and Polach 1979: 405). A correction factor ($\Delta R = 185 \pm 85$) calculated from paired terrestrial and marine dates from sites in the Gulf tailors the calibration routine to local conditions (the derivation of this $\Delta R$ will be presented in a separate article on Khor Ile-Nord); Table 1 shows the resulting calibration results. The persistent inconsistency may result from using different molluscan species, whose different crystalline structures and preferred marine habitats in life may introduce differences in apparent age, and post-mortem heating may also produce a false age (cf. Thommeret 1976).

The Khor Ile-Sud pottery assemblage fits comfortably within the late second-millennium BC sequence of the central and western Gulf, now better known thanks largely to Højlund's publication of Failaka and Qala'at al Bahrain pottery (Højlund 1986, 1987, Højlund and Andersen 1994, 1997), along with other contributions (Denton 1994, Kervran et al. 1987). These Gulf materials can be tied, in turn, into Kassite and post-Kassite materials of southern Mesopotamia, the sequence of which has been elucidated by several projects. More precisely, the Khor Ile pottery responds best to a comparison with Failaka Period 4A–B (Højlund 1987). The band-rim and triangular-rim jars correspond to Failaka Types 57A–B, the simple bowls to Failaka Type 68, and the chalice base to Failaka Type 81; all of these forms are commonest in Period 4A, though they are also present in Periods 4B and, to a lesser extent, 3B. The Khor Ile deep basin is most closely paralleled in Failaka Types 74 and 92, both commonest in Period 4B. However, the parallel here is not exact, while more comparable forms exist in the Qala'at al Bahrain IIIb pottery that Højlund (1986: 156, Fig. 706) suggests is contemporaneous with Failaka Period 4A. The formal similarity of the Khor Ile-Sud assemblage with the Failaka 4A material also extends to fabrics, manufacturing characteristics and aspects of surface elaboration. The dominant Fabric 1 at Khor Ile-Sud corresponds to Højlund's G-ware, while the minority Fabric 2 at Khor Ile-Sud corresponds to Højlund's F-ware; the Fabric 3 used for bowls at Khor Ile-Sud may correspond to Højlund's E-ware, though this equivalence is less certain. While the range of fabrics is similar in the two sites, the distribution of fabrics across vessel-forms is not. Specifically, the band-rim jars are almost exclusively in Fabric 1 at Khor Ile-Sud but in roughly equal proportions of E- and G-wares at Failaka; the bowls, on the other hand, are largely in Fabric 3 at Khor Ile-Sud but mostly in G-ware at Failaka. Within Failaka Period 4A, however, the proportion of wares is dependent on contexts (i.e. the F3 domestic architecture versus the F6 palace) and so respond to functional and/or social context (Højlund 1987: Fig. 461). The diagnostic indicators for the productive techniques of round-based G-ware vessels at Failaka (Højlund 1987: 170) are duplicated in the Khor Ile-Sud material; the manufacturing marks described for thrown bowls at Failaka (Højlund 1987: 165) are not apparent in the Khor Ile-Sud corpus. The incised marks in the Khor Ile-Sud assemblage are paralleled in a few examples at Failaka, Periods 3B–4B; an example from Period 4A (Højlund 1987: Fig. 716c) closely matches the marks on the Khor Ile-Sud bowls. The bituminous painted designs at Khor Ile-Sud seem unmatched at Failaka.

On the strength of these formal and technological similarities, then, the Khor Ile-Sud occupation may be aligned with the Failaka Period 4, and especially Period 4A. In Højlund's scheme of
### Table 1: Khor Ile-Sud radiocarbon dates

<table>
<thead>
<tr>
<th>Sample</th>
<th>Material</th>
<th>Context</th>
<th>Reported</th>
<th>$\delta^{13}$C</th>
<th>Conventional (BP)</th>
<th>Calibrated (calBC)</th>
<th>1 $\sigma$ (calBC)</th>
<th>2 $\sigma$ (calBC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GIF-5898</td>
<td>Circe callipyga</td>
<td>Midden Level 2</td>
<td>2800 ± 70</td>
<td>Not reported</td>
<td>3210 ± 100</td>
<td>820</td>
<td>980–750</td>
<td>1160–500</td>
</tr>
<tr>
<td>GX-14777</td>
<td>Thais savignyi</td>
<td>Midden Level 3</td>
<td>3675 ± 80</td>
<td>3.7‰</td>
<td>3675 ± 80</td>
<td>1410</td>
<td>1520–1270</td>
<td>1680–1110</td>
</tr>
<tr>
<td>GX-14778</td>
<td>Thais savignyi</td>
<td>Extra-mural Area Pit 11</td>
<td>3805 ± 85</td>
<td>3.2‰</td>
<td>3805 ± 85</td>
<td>1530</td>
<td>1690–1410</td>
<td>1870–1280</td>
</tr>
</tbody>
</table>

Calibrated using the CALIB 3.0.3 computer routine for marine samples (see Stuiver and Braziunas 1993), using $\Delta R = 185 \pm 87$ (calculated from paired dates in the Gulf; this procedure will be presented in a separate article on Khor Ile-Nord).
ceramic periodization, Failaka 4A corresponds to Qala’at al-Bahrain IIIb.\textsuperscript{3} The Khor Ile-Sud pottery does differ importantly from that of the Qala’at al Bahrain IIIb (and also IIIc) in their respective wares, with the Bahrain material predominantly made of the aptly named “caramel ware” (Bibby 1971), a sand-tempered brown fabric that corresponds to Højlund’s E-ware. These alignments situate Khor Ile-Sud broadly in the 13–12th centuries BC range (see the appendix below for arguments for this absolute chronology), within the context of the increasingly Mesopotamian ceramic identity of the upper and central Gulf (see Højlund 1989, Højlund and Andersen 1994: 475–6).

The predominant forms at Khor Ile-Sud — the straight-sided bowls, band-rim and triangular-rim jars and ribbed deep basins — all fit comfortably in the formal repertoire of late Kassite Babylonia (e.g. Uruk: Finkbeiner 1985, Boehmer 1988, 1991; Babylon: Reuther 1926; Nippur: McCown and Haines 1967, Franke 1978, Armstrong 1993; Tell ed-Der: Minsaer 1991; several Hamrin sites: Armstrong 1982, Boehmer and Dämmer 1985). The goblet-base fragment at Khor Ile-Sud presents a solid foot, a characteristic of “late Kassite” assemblages dated to the 13th–early 12th centuries BC (Armstrong 1993: 71, Minsaer 1991: 43); this occurrence further suggests a similar or later date for the assemblage in Qatar. Boehmer (1991: 101) regards the multi-ribbed deep basin as a Kassite-period diagnostic that disappears from post-Kassite assemblages. The Khor Ile-Sud assemblage does lack several characteristic Kassite forms, including the small wavy-sided bowl, the button-based cup and the Kassite jars (following the terminology of Armstrong 1993). However, the evident special function of Khor Ile-Sud (see below) may account for the absence of certain vessel-shapes.

In sum, the Khor Ile-Sud pottery assemblage best fits a “late Kassite” designation, in absolute terms falling in the 13–12th centuries range. While the limited range of pottery leaves open the possibility of pushing the Khor Ile assemblage somewhat later in time, the absence of characteristic “post-Kassite” forms argues against a lower dating. Although the assemblages from Bahrain are geographically nearest to hand, the emphatic differences in fabric indicate that Failaka and Babylonia proper provide more pertinent comparative materials. For the same reason, Khor Ile-Sud as a site should be attributed to activities based in one of these latter two areas. The site represents one of the easternmost known extensions of this late second-millennium pottery family — the Kassite pottery and Mitanni seals at Tell Abraq (Umm al Quwain) mark the farthest extent of this complex (Potts 1991, 1993), but there denote interregional contact in an otherwise late Wadi Suq context rather than incorporation in the western Gulf sphere.

\textit{Functional interpretation}

In view of the massive numbers of \textit{Thais savignyi} in various contexts at Khor Ile-Sud, a functional interpretation of the site must deal centrally with this evidence. The interpretation offered here turns on the contrasts already noted between Levels 2 and 3 of the midden. These levels reflect two very different kinds of activity. Level 2 constitutes a classic case of dietary refuse deposited in middens. As has been observed ethnographically (e.g. Meehan 1982, Bigalke 1973), collection of marine shellfish often forms episodic events focused on targeted species which are collected, eaten and discarded as a chain of connected activities. This episodic and targeted process results in the formation of single-species shell middens, or of single-species lenses within multispecies shell middens, the latter formed by and reflecting individual episodes of shellfish consumption. Each formational variation is widely found in the archaeological record (e.g. Rosso and Petit-Maire 1978, Emperario and Laming 1956). Precisely the pattern of single-species lenses

\textsuperscript{3}The three main forms in the Khor Ile assemblage — the straight-sided bowls, band-rim jars, and ribbed deep basins — all continue into the Qala’at al Bahrain IIIc phase (Højlund and Andersen 1994, 1997, Kervran et al. 1987). However, numerous formal differences distinguish the Khor Ile-Sud materials from the Qala’at al Bahrain IIIc material so that the two seem not to be contemporary. The IIIc pottery includes some distinctive forms absent from Khor Ile-Sud, among them a jar with grooved or triangular rim (Højlund and Andersen 1994: Figs. 826–8), bowls with grooved or beaded triangular rim (ibid.: Figs. 830–8), basket handles (ibid.: Figs. 864–7, Kervran et al. 1987: Fig. 8: 9), and solid stump bases (Højlund and Andersen 1994: Figs. 804–6, Kervran et al. 1987: Fig. 7: 16); given the predominant forms in the Khor Ile-Sud assemblage, the complete absence of these Qala’at al Bahrain IIIc types implies non-contemporaneity. The Qala’at al Bahrain IIIc material published to date derives from secondary contexts, leaving little assurance that the phase is not a mix of earlier and later materials.
within multi-species middens is evident in Level 2 of the Khor Ile-Sud midden. The dominant characteristics of the level reflect normal episodic dumping of habitation debris, and especially of dietary refuse as part of a central-place foraging strategy (most recently, Bird and Bird 1997). The generally intact shells indicate that the animals were cooked by boiling, steaming and other similar methods appropriate to the relatively small shellfish species present in the Khor Ile-Sud midden.

Level 3, by contrast, lacks all these formational characteristics. Indeed, individual formation episodes are unidentifiable in this homogeneous mass of broken shell, and the absence of ash, charcoal, fire-cracked rock and the other detritus of domestic life also distinguish it from the Level 2 pattern. Moreover, the crushed state of the *Thais savignyi* in Level 3, matched by the condition of the shell in several of the small shell heaps around the site, offers another contrast with the generally intact (whole) condition of individuals of the same species from Levels 1 and 2 of the midden. Pit 11 of the extra-mural area and the remaining small shell heaps. Its sharp contrast in structure and content, and the crushed state of the shell, reflect a formational process very different from that of Level 2. In other words, Level 3 was not formed by the kind of patterned dumping of dietary and other domestic refuse that formed Level 2 — the *Thais savignyi* of Level 3 of the midden reflects some other activity.

Various observations and lines of argument point to production of purple dye, the Tyrian or royal purple of the classical Mediterranean world, as that activity. This argument can be made on both a positive and a negative basis. On the positive side, the species is appropriate for making this dye, the breakage patterns of the shell are consistent with this activity and required equipment is present on the site. At the same time, many alternative explanations for the shellfish and its depositional patterns can reasonably be excluded.

*Thais savignyi* belongs to the superfamily Muricacea, a group of stenoglossids characterized by hypobranchial glands in the pallial complex within the mantle cavity that contain the chemical precursors of the dyestuffs 6-6'-dibromoindigotin and indigotin. These photolabile precursors transform to the dyestuffs in complex chemical pathways that involve naturally present enzymes, light and air, the details of which are tangential to the present study. The resulting dye may be achieved directly, i.e. by smearing the contents of the hypobranchial gland on a textile or by vatting techniques that involve a saline solution of the chemical precursors. The latter approach permits a more uniform control over the resulting colour of the dyed textile, and may be further enhanced by introduction of mordants, alkalines and other additives that influence the final colour of the textile and the fastness of the dye. The achieved colour responds to multiple factors, including choice of molluscan species, control over the chemistry of the vatted dye, details of application of the dye, and the fibrous nature and preparation of the textile being dyed. The colour term “purple” in this context is nominal, since the actual colours may range from blue to very dark red in response to the technical factors just mentioned. The direct dyes of *Thais savignyi* fall in the red rather than the blue end of the purple spectrum, indicating a predominance of 6-6'-dibromoindigotin.

Classical literary sources describe basic alternative patterns in the initial steps of purple-winning, the choice of which responded to the size of the snails involved. In one process, a hole was picked through a body whorl through which the hypobranchial gland was extracted and then macerated for several days in a vat of salted water to release the dye precursors. In the alternative procedure, used on smaller individuals, the whole snail was crushed and the entire mass of body, hypobranchial gland and shell fragments was then macerated to release the dye precursors (thus Aristotle, *Hist. Anim.* V.15.547a; Pliny, *Nat. Hist.* IX.60.126 ff.; cf. Aelian, *de Anim.* XVI.1; Vitruvius, *de Arch.* VII.3). These different techniques leave distinguishable characteristic refuse-products, patterns which have both been observed in archaeological contexts: the largely whole shells of the middens at Sidon, Gythion, Tarento, Mogador and elsewhere (see de Sauly 1865: 285, Lortet 1884: 104 for illustrations) versus the crushed shell at Monte Circeo, Berenice, Delos and many other sites (see especially Blanc 1958: 192, Pl. 97; also the illustrations in Wilde 1844: 379, Bruneau 1969: Fig.1, Reese 1980: Pl. 5, Stern and Sharon 1987: Pls. 26a, 27C, Karmon and Spanier 1988). The crushed *Thais savignyi* in Level 3 of the midden corresponds closely both to the implied refuse-
products of the classical descriptions for dealing with small snails, and to archaeological examples of these refuse-products in the Mediterranean.

This line of reasoning indicates the congruence between the archaeological patterns at Khor Ile-Sud and purple-winning as described in classical and archaeological literature of the Mediterranean. At the same time, alternative interpretations of the Khor Ile-Sud evidence may be rejected. A dietary interpretation of Level 3 has already been excluded by comparison with the depositional structure and content of Level 2, in which Thais savignyi also occurs. Use of Thais savignyi as fish bait may also be excluded, given the paucity of fish bone (including otoliths) and the total absence of fishing equipment at Khor Ile-Sud. A third possible interpretation, that of jewellery manufacture, may also be rejected, since no part of the Thais shell is systematically under-represented in, or absent from, samples taken from Level 3.

In sum, the following factors form a strong case for purple-winning as the principal activity undertaken at Khor Ile-Sud: Thais savignyi is a species suitable to purple-winning and is present in numbers consonant with that activity; the breakage pattern found in Level 3 of the midden conforms to that described in the classical literature for processing small muricids in dye-making, and is identical to the archaeologically observed breakage patterns in shell identified as purple-dye refuse in the Mediterranean basin; and the characteristics of the shell in Level 3 of the midden cannot plausibly be ascribed to another activity.

Discussion

The archaeological simplicity of Khor Ile-Sud disguises the complexity of its broader historical and sociological framework. The existence of this 13–12th century special-activity site on the east coast of Qatar raises numerous issues that can only be mentioned here. A certain amount of textual evidence, all ambiguous or fragmentary but collectively compelling, implies that Kassite Babylonia extended an administrative authority over Dilmun for several centuries, beginning by the end of the fifteenth century. The Mesopotamian nature of the Khor Ile-Sud pottery (fabrics as well as forms) suggests that purple-winning at the site was conducted within this administrative framework, perhaps directly by government officials. The ideological burden of purple-dyed (red and blue) textiles in classical antiquity (Reinhold 1970) had its roots in second-millennium western Asia (cf. Cassin 1968), where colour symbolism operated powerfully in representations of ceremonies, rituals and other public or private displays, in the legitimization of the “natural order” and in the negotiation among elites for political power (summarized in Edens 1987, 1994). The symbolic charge of colour provides an incentive for establishing a purple industry in the Arabian Gulf, whether this industry was under private or institutional control.

The production of purple at Khor Ile-Sud during the thirteenth century ranks as a relatively early instance of this industry, and the only one of its kind reported thus far in the Gulf. The earliest purple industry appears on Middle Minoan Crete (Stieglitz 1994); by the Late Bronze Age it can be found in many places throughout the eastern Mediterranean (see Reese 1987). Given this chronological priority, and barring independent invention, the purple technology was surely transferred from the Mediterranean. The transfer of craftsmen and other skilled personnel between palaces is a well-documented phenomenon of the Late Bronze Age (Zaccagnini 1983); technology transfers might also occur with deportation, slave-sales and successful flight of craftsmen. These channels of technological transfer functioned within the public sphere, and reinforce the ideological weight of colour to stress the role of institutional production. However, the evidence for technological transfers and colour symbolism is entirely textual, and so biased toward these same institutional contexts. The role of private entrepreneurial action cannot be assessed in a comparable way, and individuals may equally have accounted for the transfer of purple-production to Gulf waters. Although these issues cannot be resolved on the strength of the archaeological evidence available so far, future research on other production sites may clarify the historical context of this industry in the Gulf.

APPENDIX: Absolute chronology of the Gulf in the later second millennium BC

The absolute dating of Failaka Periods 4A–B and Qala’at al Bahrain IIa–c remains unsettled. Basing his arguments on associated cylinder seals, limited $^{14}$C data, and extrapolation from
Babylonian pottery assemblages, Højlund assigned Qala'at al Bahrain IIIa to the sixteenth century, Failaka 4A and Qala'at al Bahrain IIIb to 1475–1350, and Failaka 4B to 1350–1250; he placed the “post-Kassite” Qala’at al Bahrain IIIC around 1000 (these dates represent Højlund’s more recent assessment; compare Højlund 1993 and 1989 with Højlund 1986 and 1987; for the “post-Kassite” materials, see Højlund and Andersen 1994, Kervran et al. 1987). More recently, Højlund divided Qala’at al Bahrain IIIb into two sub-phases (Højlund and Andersen 1997), assigning IIIb1 to around 1400 (the main period of use for the central warehouse, with its small archive of cuneiform texts) largely on the strength of a single calibrated radiocarbon date, and IIIb2 to around 1200 on the basis of formal ceramic parallels with Tell ed-Der (Minsaer 1991).

Several observations suggest Højlund’s dating of Failaka 4A–B and Qala’at al Bahrain IIIb should be lowered by as much as a century. Almost all the comparative Babylonian evidence pertains to the thirteenth and early twelfth centuries, with only limited exposures at Nippur and Tell ed-Der of assemblages assigned a late fifteenth/early fourteenth century date (summarized in Gasche et al. 1998). Højlund’s proposed sequence thus identifies a 16–15th-century early Kassite assemblage (Qala’at al Bahrain IIIa) that lacks a Babylonian analogue. This proposition has met with skepticism from some scholars working in Babylonia (e.g. Armstrong 1993: n. 14, Gasche et al. 1998: 8), and the situation is, in fact, not clear. Several characteristic forms of the Qala’at al Bahrain IIIa assemblage are at home in late Old Babylonian assemblages (e.g. the triple-ribbed-rim jar [Failaka Type 56], the incurved-rim bowl [Type 67A], and the knobbed foot [Type 78]), suggesting that the “early Kassite” assemblages of the Gulf belong in the late Old Babylonian period.

The next ceramic phases (Failaka 4A–B, Qala’at al Bahrain IIIb1-2) involve forms that match the Kassite-period pottery of Babylonia fairly well. The newly defined Qala’at al Bahrain IIIb1 presents good parallels with the “early Kassite” ceramic phase in Gasche et al. 1998, and can be assigned broadly to the fourteenth century. Højlund (Højlund and Andersen 1997: 61) appropriately cites parallels with Tell ed-Der “Ensemble I” (Minsaer 1991), but then argues that Ensemble I is more developed (closer to “late Kassite”) than the Qala’at al Bahrain IIIb1 assemblage, which should then be placed in the fifteenth century. This argument cannot be sustained. The radiocarbon determination of 3130 ± 110 BP, or 1400 calBC (K-827, on charred date stones, 2 sigma 1630-1060 BC, Højlund and Andersen 1994: Fig. 714, recalibrated according to the CALIB 3.0.3 routine), dates this assemblage in the “central warehouse” area; although this single date makes an apparently close match with the ceramic date, the large standard deviation actually leaves it very imprecise.

The following ceramic phase, Qala’at al Bahrain IIIb2 and Failaka 4A, compares well with the “late Kassite” assemblages of Babylonia, belonging to the thirteenth to early twelfth centuries (see Gasche et al. 1998 for summary of key forms). Failaka 4B then falls in the twelfth century. A radiocarbon determination from a IIIb context at the north wall falls in the mid-thirteenth century (3030 ± 80 BP, AAR-1132, on charred date-stones; calibrated to 1260 calBC, 2 sigma range of 1440–1000 BC; Højlund and Andersen 1994: Fig. 714). The illustrated pottery from this context (Højlund and Andersen 1994: 182–3) belongs to this “late Kassite” horizon, but again a single determination carries limited value.

Several other lines of evidence from Failaka reinforce the ceramic argument for lower dates. Potts (1988) has drawn attention to the chronological significance of the Failaka faience vessels associated with Period 4B; in recently reported Hamrin sites (Boehmer and Dämmer 1985) these faience vessels belong to the thirteenth and earlier twelfth centuries BC. The evidence scattered through Reuther’s (1926) Babylon report corroborates this temporal range: several graves that contain faience vessels may be placed, with greater or lesser confidence, in the mid-thirteenth century.

The Danish excavation recovered several cuneiform tablets from the floor deposit of the warehouse in the central sounding (Bibby 1971: 347, Eidem 1997), the principal available context for Qala'at al Bahrain IIIb1 pottery. Working largely from photographs, Nashif (1986: 354 No. 4) identified a Kaštiliasu on a date formula on one tablet. Assuming this ruler to be Kassite rather than a local namesake, the individual would surely be Kaštiliasu IV (1232–1225 BC), since the previous Kaštiliasu III (early 15th century BC) initiated the Kassite dynasty's conquest of the Sealands, a process completed by his successors. The text thus would suggest that Qala’at al Bahrain IIIb1 pottery continued to the late 13th century BC. However, Eidem’s subsequent examination of the tablets indicates that Nashif’s reading is unsupported, leaving the tablets without chronological implication.
century or later (e.g. Nos. 8, 10, 12), while another (No. 15) also contains a gold ring decorated in a manner similar to that of shell rings belonging to 13–12th centuries (cf. Boehmer 1982). Furthermore, Moorey suggests that sintered quartz (“faience”) products on Failaka were more closely related to the Middle Elamite faience and glass craft tradition than to that of Mesopotamia; Babylonian raiding seemingly brought to an end the former tradition towards the end of the twelfth century (Moorey 1985: 155). This comparative evidence urges us to extend Failaka 4B well into the twelfth century.

The cylinder seals on Failaka point to a similar conclusion. Højlund (1987: 160) remarks that seals of Mitanni style correlate with Period 4A/B pottery lots and also with Period 4 architecture. He draws on the strength of this correlation to ascribe the date 1450–1300 to Failaka Period 4. This inference is overly restrictive and incomplete on several grounds. The Mitanni Common Style cannot be confined by the end of the fourteenth century, but rather must be extended into the thirteenth century and even later (see Salje 1990, whose analysis includes the Failaka corpus). The Middle Elamite seals from Failaka further reinforce a lower chronology. These seals are only loosely correlated with Period 4 pottery lots, but are spatially correlated with zones of Period 4, and especially Period 4B, architecture. Here, six of nine seals that Kjaerum (cf. Højlund 1987: 160) assigns to the Middle Elamite style occur within areas of Period 4B architecture, the remaining three coming from areas of Period 4A architecture. This uneven distribution is accentuated when three fragments of faience cylinder seals with borders of hatched registers (i.e. typical Middle Elamite glyptic material and a common motif of this style) are included (Kjaerum 1983: Nos. 409, 415, 416) — all three fragments came from zones of Period 4B architecture. In other words, the distributional evidence of the Middle Elamite seals also suggests that Period 4B should be placed in the 13–12th centuries.

These arguments suggest that, in broad terms, Qala‘at al Bahrain IIIb1 should be placed in the fourteenth century, Qala‘at al Bahrain IIIb2 and Failaka 4A in the thirteenth century, Failaka 4B in the twelfth century and Qala‘at al Bahrain IIIc in the eleventh century (if this ceramic period in fact proves to be legitimate). The pottery of Qala‘at al Bahrain IIIa contains numerous late Old Babylonian forms, and may actually be correlated with this political-historical period. A radical revision of second-millennium chronology proposes to extend the Old Babylonian period, and its pottery, through the sixteenth century, dating the fall of Babylon to 1499 rather than the traditional 1595 of the middle chronology (Gasche et al. 1998). Doubtless this proposed redating of political history will meet considerable resistance. It does make a great deal of archaeological sense, here urging a fifteenth-century date for the Qala‘at al Bahrain IIIa assemblage.

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