Ḥammat al-Qāᶜ: an early town in Southern Arabia

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By autumn 1999, a team from the Oriental Institute, University of Chicago had conducted five seasons of survey and soundings in the Yemen highlands around Dhamār. This work has provided a basic archaeological and environmental framework for the region as well as some general information on the nature of the landscape within which the archaeological sites were found. In 1999 we then started more specialized studies, initially with the site of Ḥammat al-Qāᶜ, the ground plan of which was recorded stone-by-stone to reveal a complex and dense pattern of buildings over an enclosed area of 3 ha, and a total site area of 5 ha. Chronological control is provided by radiocarbon assay of excavated charcoals and a local ceramic sequence. We also supply data on the agrarian economy using off-site features from relict terraced fields and threshing floors and then estimate the cultivated area required by the inhabitants in order to attempt a preliminary reconstruction of the Bronze Age land use.[1]

Introduction

Although there is no evidence for towns in Arabia before the third millennium BC, by the end of that millennium large settlements were evident at Tārūt Island in Saudi Arabia (Potts 1990, i: 66–67, 105–109), Qalᶜat al-Bahrain (Højlund & Andersen 1994; 1997), Saar (also on Bahrain: Crawford, Killick & Moon 1997), Tell Abraq (Potts 1991) and Hili in the UAE (Cleuziou 1982), and Bāt in Oman (Frifelt 1976) (Fig. 1).

In Yemen, pre-Iron Age settlement was first documented in 1981 (de Maigret 1984), in the Khawlān district of the eastern highlands, where an Italian team investigated numerous small third millennium settlements (de Maigret 1990). Similar small sites sharing the same architectural and ceramic tradition appear on the desert fringes of interior Yemen (e.g. Blakely, Vitaliano & Brinkman 1996; Cleuziou, Inizan & Marcolongo 1992; Breton & Darlès 1994). On the Red Sea Tihama coast, unrelated pottery appears in large shell middens of the second (and perhaps third) millennium (Zarins & Zahrani 1985; Zarins & al-Badr 1986; Tosi 1986), and recent investigations at Ṣabir near Aden have revealed a massive town of the late second millennium and early first millennium BC (Vogt & Sedov 1998).

In those parts of Yemen where rainfall in excess of 300 mm per annum falls on intermontane plateaux between 2000 and 3000 m above sea level, archaeological surveys suggest the existence of numerous small Bronze Age towns. Unlike the settlements of the Gulf and south-east Arabia, those of Yemen are on hilltops and are distinguished by the clarity of their building layouts which consist of alignments of collapsed and heavily weathered walls. A key factor for settlement is that, as a result of their location in the zone of summer monsoonal rainfall, these highlands are the best watered part of the Arabian peninsula. The potential for significant crop production is high as long as there is sufficient soil for cultivation, a deficit that is usually addressed by the construction of terraced fields.

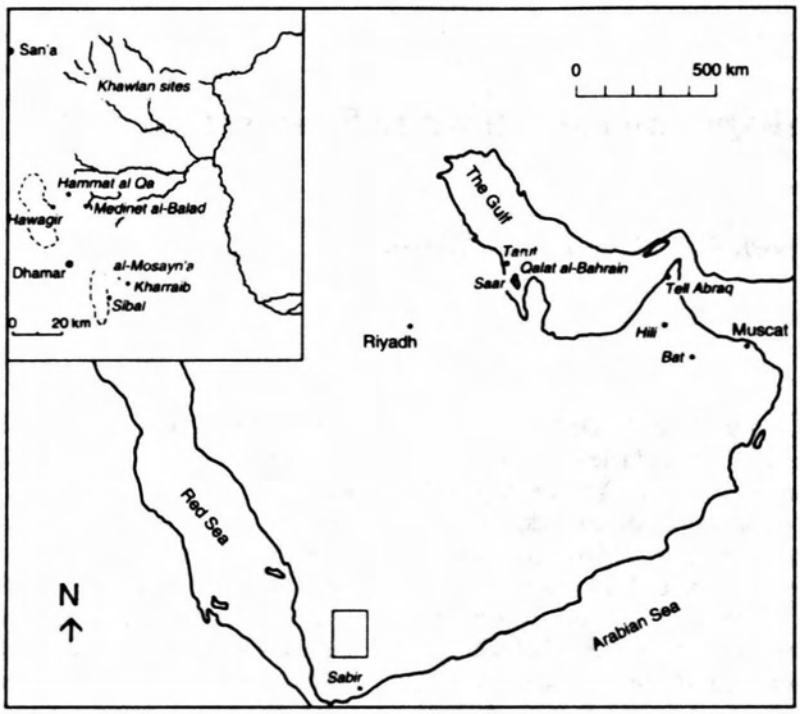

FIGURE 1. *Location of key sites mentioned in the text. Inset shows the location of the Khawlān sites and some of those of the Dhamār Project. First published in* Antiquity *74, 2000.*

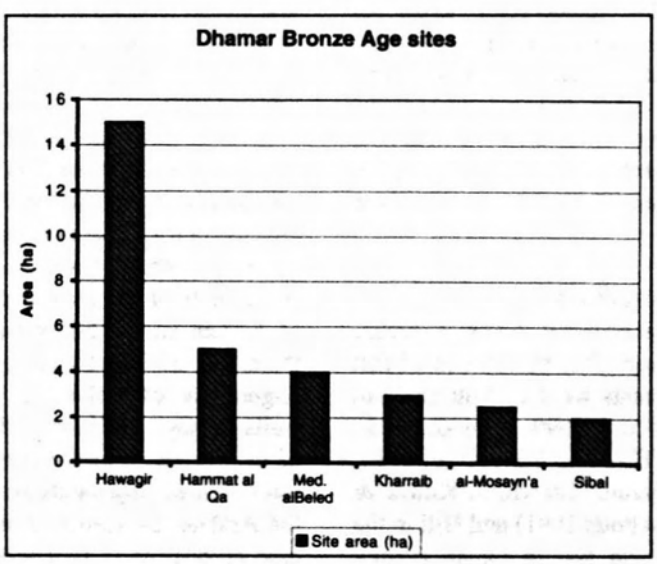

FIGURE 2. *Bar chart showing relative areas (in ha) of the major Bronze Age sites in the Dhamār area.*

To date the Oriental Institute Project for the Archaeology of Yemeni Terraced Agriculture has recorded 56 Bronze Age sites, several of which exceeded 3 ha in area. Noteworthy sites include: Kharraib (DS 228), Medinet al-Balad (DS 187), al-Sibal (DS 66), Hawagir (DS 293), al-Mosaynᶜa (DS 268), and Ḥammat al-Qāᶜ (DS 101) (Figs. 1 and 2). The local Bronze Age pottery belongs to the same tradition found in the drier eastern highlands and into the interior desert fringe (Khawlān, Jawf, Wādī al-Jūbah, Wādī Markha) although the Dhamār pottery also displays some distinctive characteristics (Edens 1999).

The Dhamār sites occur mainly in the semi-arid part of the highlands where today mean annual rainfall is between 250 and 350 mm. In the north-east part of the survey area where rainfall is less, scattered Bronze Age villages are evident, whereas to the south-west where rainfall is higher Bronze Age sites are less visible. This is because in the wetter highlands where terraced fields extend up to the hill summits, sites have been transformed as a result of taphonomic processes such as the removal of stones for the construction of the walls of fields.

For the most part, the Bronze Age sites are shallow and lack later occupation. Where adverse taphonomic effects have not occurred, the stone architecture of many sites is readily apparent and therefore large portions of these sites can be mapped. Ḥammat al-Qāᶜ provides an exceptionally well-preserved example of this kind.

Ḥammat al-Qāᶜ: The site

Ḥammat al-Qāᶜ was discovered by analysis of aerial photographs prior to the 1995 field season. The survey team visited Ḥammat al-Qāᶜ in 1995, and dated the site to the third millennium BC by comparison of surface pottery with that of the Khawlān sites (Wilkinson, Edens & Gibson 1997). The site sits upon a gently inclined but otherwise flat-topped hill the summit of which is 50 m above the level of a narrow plain (Fig. 3). This surface is the remnant of a basalt flow that overlies, in turn, a conglomerate of alluvial cobbles and a basic igneous formation. The basalt cap provided building material for the town, and the conglomerate felsite offered cobbles for a chipped stone industry.

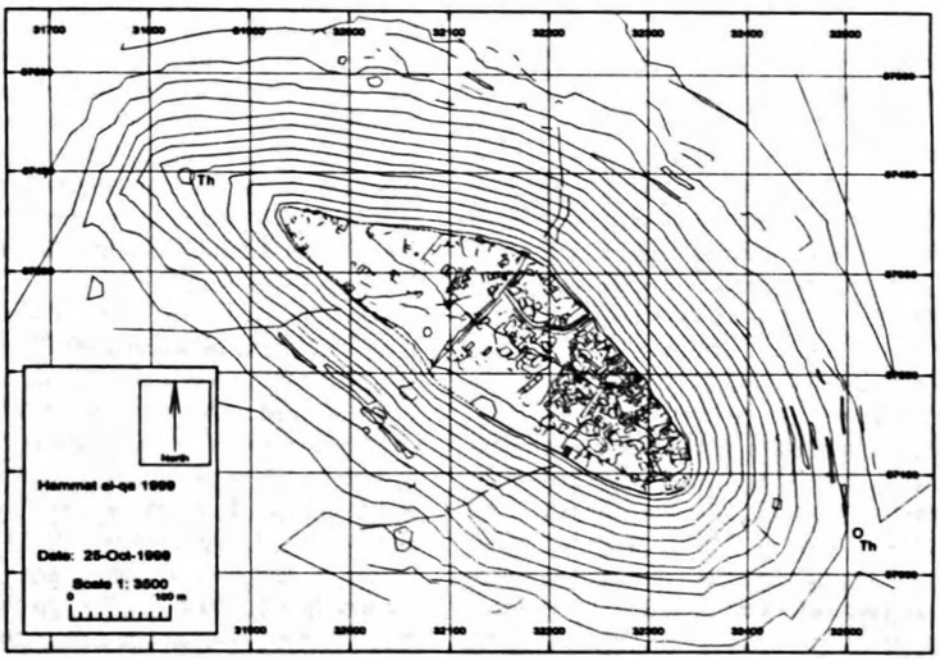

FIGURE 3. *Site of Ḥammat al-Qāᶜ and adjacent off-site areas on slopes. Contours at 5 m intervals; Th= Threshing floor. First published in* Antiquity *2000.*

During the 1996 season preliminary mapping identified the basic architectural components of the site, and five soundings acquired pottery and radiocarbon samples in association with the town wall and several buildings. In addition, a preliminary site map identified the basic components of the site. Two additional soundings and detailed mapping of the entire site and its surrounding area in 1999 completed the field investigation to date. These investigations date the site to the late third and first half of the second millennium BC (2320 to 1410 calBC; Wilkinson & Edens 1999, table 2), that is a little later than the Khawlān sites (de Maigret 1990) and al-Sibal in the Dhamār area, and somewhat earlier than Kharraib and Hawagir in the Dhamār area (Wilkinson & Edens 1999, Edens 1999). A sounding excavated next to the south-west town wall revealed two phases of construction separated by a spread of rubble. The rubble contained a mix of Bronze Age and later pottery, suggesting that the wall was rebuilt early in the first millennium AD or even later. Occasional Iron Age and Himyarite sherds on the surface, a single first millennium BC radiocarbon date, and the apparent remodelling of some architecture also indicate that there was some late re-use of the site. The excavations provided a faunal assemblage of sheep/goat (90%) and cattle (10%), but recovered no archaeobotanical remains besides rare wood charcoal.

Town Fabric

The site exhibits several features that are characteristic of an urban layout rather than a village, namely: a surrounding wall with gates, a dense layout of buildings and a possible subdivision into quarters (Fig. 4). An outer defensive wall, 1.8 m wide, is visible almost continuously around the south-eastern half of the hill but only intermittently around the northwestern perimeter. A 1.4 m thick cross-wall runs from north-east to south-west across the hill, cutting the site into two unequal parts (Fig. 4). The dense architecture of the main site covers the larger south-east area of 3.0 ha, while a thinner scatter of buildings characterizes the remaining 1.9 ha of the hill (the north-west site). Ash middens that run up against the interior face of the perimeter wall on the north-east side of the main site provided two radiocarbon dates in the range 1410–1960 calBC (trench 3; Fig. 4: T3), firmly relating this wall with the Bronze Age town. Although the cross-wall, with its different construction style, has not yet been directly associated with the town, the adjacent Bronze Age structures were not robbed of their stones for construction of the wall, strongly suggesting that it too belongs to the Bronze Age settlement.

Two gates offer access through the north-east perimeter wall. Both are framed by large orthostats, the more northerly gate 1 being 3.2 m across, and the more southerly gate 2 1.5 m wide (Fig. 4: G1 and G2). A less obvious gate (G3) punctuates the south-west perimeter wall where a stairway of several risers leads up to a gap in the wall. Since this part of the wall was rebuilt long after the Bronze Age, this gate does not certainly belong with the Bronze Age town.

Despite first impressions of disorder, the town is well-structured at several levels. Built-up zones alternate with streets and open spaces to impose a perceptible order to the site as a whole. A wall curves westward from the perimeter wall to the cross-wall, closing off the northern corner of the town, the highest point of the butte (Fig. 4: W). A street runs along the outside face of this wall from gate 1, and a topographic indentation half way along the wall may mark the entrance to this upper compound from the street. A strip of buildings on low terraces extends along the perimeter wall south-east of gate 1, forming a distinct zone about 80 m long and 25 m deep. In contrast, the south-west perimeter wall borders a large zone of open space in the north-west quadrant of the site, and a scatter of buildings farther south.

Between these two sides of the town, seven elongated blocks of housing 40–60 m by 25–30 m, alternate with streets and strips of open space, all being oriented with the site slope. The blocks each contain from two to seven buildings; the strip south-east of gate 1 encompasses at least nine buildings and the remaining zones each hold another four or five structures. Open strips, 10–15 m wide and devoid of architectural rubble, separate the north-western blocks while NE–SW streets run between the remaining blocks; NE–SW streets delimit the blocks from architecture along the north-east and

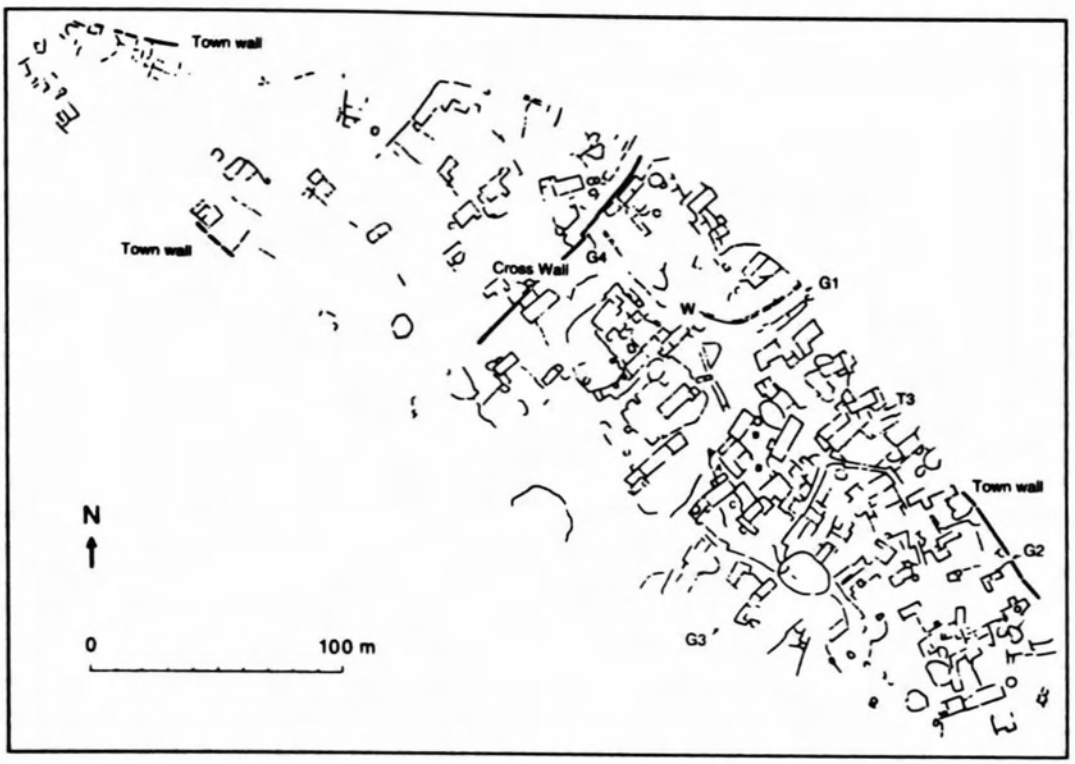

FIGURE 4. *Overall map of the site showing all extant walls and gates G1-G4. Note that only those parts of the town wall that were mapped in 1999 are indicated. W is the perimeter wall of the northern quarter of the settlement; T3 refers to Trench 3 excavated in 1996; G refers to Gates. First published in* Antiquity *74, 2000.*

south-west perimeter wall. The streets generally have gravel and fine rubble surfaces and boundaries of low curbing or retaining walls.

Individual houses mainly consist of free-standing rectilinear structures separated one from another by irregular intervals; nearly all are oriented north-east/south-west in accordance with the site slope (Fig. 5). Some buildings are linked by retaining walls or rough lines of stones that run perpendicular to the slope. These linkages, together with the arrangement of buildings within blocks, hint at the existence of supra-residential social units. One block in the central main site offers a view of this organization. Here 6–7 houses are grouped around a central open space (Fig. 5: B), with a lane entering the open space from the street to the north (A), and three retaining walls (a stepped terrace?) connecting the two houses at the south-west end of the block (C).

Outside the cross-wall to the north-west, the density of structures is much less. Between 16 and 22 buildings are scattered through this north-west site, with relatively dense clusters occupying the western point of the hill, the eastern corner near the cross wall, and the central area (Fig. 4). The layout of individual houses is far less obvious than in the main site, and there is less wall collapse and rubble. This absence of stones and rubble suggests that the component stones have been robbed out, perhaps for use in other parts of the site.

Unambiguously complete plans are available for 16 houses in the main site and another seven for the north-west site. Almost all the complete houses are simple rectangular or 'L'-shaped structures. The basic house is rectangular, with the interior space either being a single room or sub-divided into several rooms by cross-walls. Buildings are typically narrow (2–5 m), but may be up to 30 m in length. Outer walls are of basalt blocks laid in courses or slabs set on edge; they are usually one course wide resting upon a foundation of smaller stones.

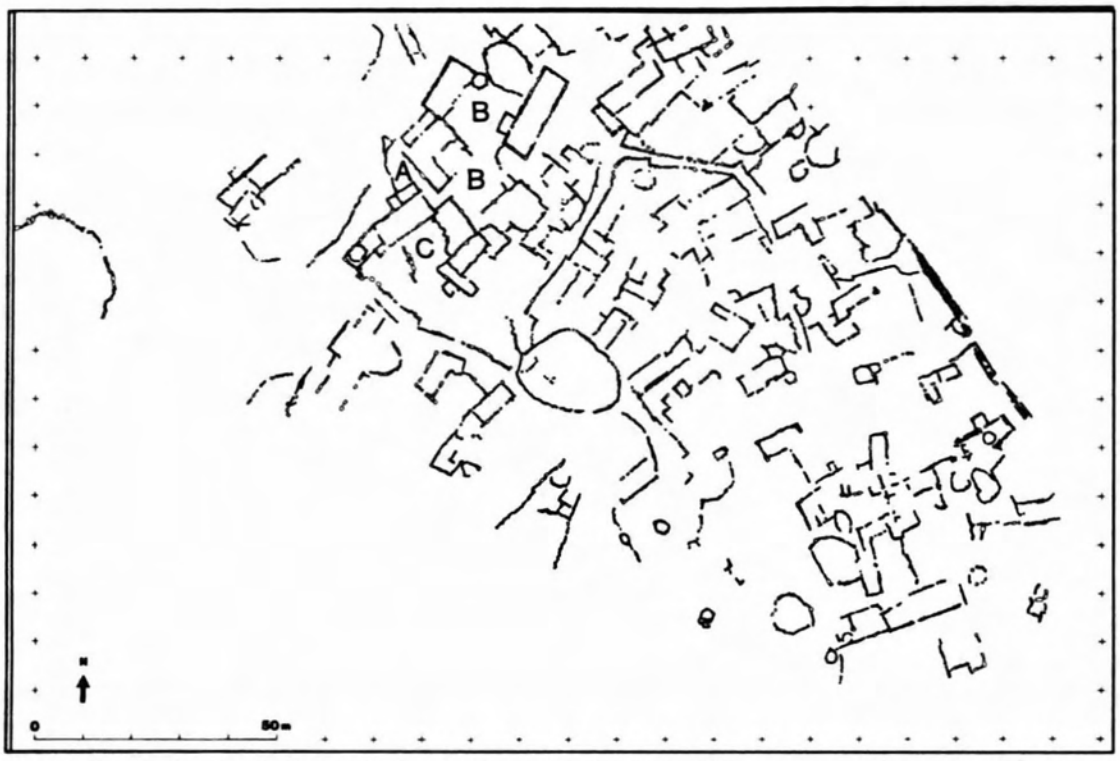

FIGURE 5. *Detail showing buildings in the south-east block of site. Only representative parts of the town wall are indicated.*

Entrances are near the centre of the long south-east wall and are usually framed by orthostats. Small square or rectangular box-like annexes several metres across are frequently attached to the long north-west wall.

The houses vary considerably in size, and in the sample of complete structures, the smallest covers 20 and the largest 112 sq. m. The rectangular houses are larger than the 'L'-shaped houses (averaging 64 and 52 sq. m respectively); houses in the main site tend to be larger than those of the north-west site (62 $\pm$ 28 versus 52 $\pm$ 26 sq. m) but this difference is not statistically significant. Several of the largest buildings (all rectangular) seem to include a walled open space at one end, a feature that also occurs in an excavated house at the late 2nd millennium site of Kharraib (Edens 1999).

Additional small structures are associated with the houses. These include square structures, roughly 2 m across, or more frequently circular structures 1–3 m across, which sometimes abut the house wall. These structures resemble the stone-lined hearths or possibly silos of the kind excavated at Bronze Age sites in Khawlan and elsewhere in the Dhamar area (de Maigret 1990; Wilkinson & Edens 1999). However, not all of these circles belong with the Bronze Age town. Some are within houses, filling the available space of rooms, and others are embedded in apparently remodelled walls of Bronze Age structures or rest partly on aeolian silts that post-date the Bronze Age occupation.

Frequently rough curvilinear walls frame extensive patches of aeolian silts in a terrace-like fashion. Soundings show that the silt of one such 'terrace' covers Bronze Age walling and wall collapse and that similar silts bury occupation deposits within houses. Such walling therefore probably represents a post-Bronze Age remodelling of the site in an effort to retain the silts for agrarian uses. Several curvilinear walls, more carefully

constructed, extend downslope from groups of Bronze Age houses at the open western end of the main site; these walls may have been fenced enclosures for animals and for outdoor domestic activities attached to the Bronze Age residences.

FIGURE 6. *3-D reconstruction of Ḥammat al-Qāʿ viewed from the east. First published in* Antiquity *74, 2000.*

The agricultural system

Since the first field season in 1994 it had been suspected that the Bronze Age sites of the highlands were associated with relict terraced fields. Although it is not possible to date such systems directly, the Ḥammat al-Qāʿ relict fields form a coherent set of features that appear to have been in use during the Bronze Age occupation of the site. Such an early date for terraced agriculture in the area is not surprising given the recent discovery of a valley bottom terraced field buried below some 6 m of valley fill and dated by radiocarbon-dated charcoal from the associated soil to 4960 ± 80 BP (3955–3630 calBC [Beta 117431]; Wilkinson 1999: 186).

The agricultural features at Ḥammat al-Qāʿ lie on hill slopes that today consist of a veneer of stony debris, but which originally appear to have been covered by a thicker humic loam palaeosol. Relict terrace walls appear as horizontal lines of heavily weathered stones, which are now eroded virtually flush with the slope. Excavation in 1996 showed these to have the characteristic features of field terraces, namely a collapsed terrace wall and a supporting mass of fist-size stones immediately upslope (Wilkinson 1999: fig. 4). Such relict terraces remain on the south-west, east and north-facing slopes of the hill (Fig. 3). The two last named groups are situated near the base of the slope where they would have benefited from runoff received from the large area of hill slope above. In contrast, those terraces on the south-west-facing slope were positioned half way up the slope, perhaps in part because they would have received additional runoff from the hilltop, thus rendering unnecessary a long catchment on the slope itself.

Additional off-site features include eroded masses of large, heavily weathered stones, 20–25 cm across, which appear to have formed flattened platforms on the north-west and south-east spurs (Fig. 3: Th). By analogy with modern installations, and relict features associated with sites of the first millennium BC and AD, these platforms are interpreted as threshing floors. They are situated on eminences that would receive winds suitable for winnowing grain, and would have been conveniently located for the fields themselves (Fig. 6).

Estimates of site population, potential sustaining areas and land use model

The well defined architecture of Ḥammat al-Qāʿ enables us to make rough estimates of site population based on the number of visible houses, which in 1999 was estimated to fall in the range 46 to 57 (Fig. 7). Each domestic unit appeared to consist of a nuclear house together with ancillary structures which included sub-rounded storage units and various types of unroofed courtyard space, as discussed above. Estimates are made for the main walled settlement area, the north-west town outside the cross wall, and total site area, that is the sum of the two (Fig. 7).

	Min. no. of houses	Max. no. of houses	Min. pop. 5/house	Max. pop. 5 /house	House area Est. 1	House area Est. 2	Pop. 10 sq m / person	Pop. Est. Using Est. 2
Main town	46	57	230	285	2960	3534	296	353.4
NW town	16	22	80	110	957	1144	95.7	114.4
Total site	62	79	310	395	3917	4678	391.7	467.8

FIGURE 7. *Ḥammat al-Qaʿ. Population Estimates based on extant architecture.*

Minimum estimates count the number of distinct and unambiguous housing units, whereas the maximum allows for more latitude in estimates, assuming, for example that certain missing walls can be reconstructed. If each house is assumed to have been occupied by a nuclear or a small extended family of five (Steffen 1979: II/127) we get estimates of between 230 and 285 persons for the main town, and 310–395 for the total site area (Fig. 7). Alternatively using measured house size and house area, and assuming a living space of 10 m^2 per person (Kramer 1982), population estimates fall in the range 296–353 persons for the main town and 392 to 467 for total site area. The above approximations are thought to under-estimate the total number of houses, because there is evidence for considerable stone robbing, especially for the north-west area. The estimates suggest population densities in the range 77–118 persons/ha for the main town and 62–94 persons/ ha for the north-west area, which are on the low side of population estimates from elsewhere in the Near East (Sumner 1989).

Calculations of potential sustaining area are more hazardous than population estimates because they themselves are based on estimates of population. Furthermore, estimates have to be made of the contribution of cereals to the diet and cereal production per cultivated hectare, assuming that, as in the Khawlān area, the Bronze Age communities cultivated a mix of wheat, barley, and perhaps sorghum (Costantini 1990). The following provisional estimates are therefore made simply to establish whether there was sufficient available land for the settlement, and how that land use may have been configured. Today in this heavily populated landscape mean landholding size per household is around 1.4 ha. On the other hand, mean rainfed wheat and barley yield is today around 800 kg per ha. If mean family size in residence is five persons and cereal requirement is around 250 kg per annum, then, to subsist, each family would require around 1.6 ha. For the estimation of Bronze Age sustaining areas we have realistically chosen a slightly more generous land holding of 2 ha per household to allow for additional flexibility in cropping patterns. This figure, when applied to the number of houses and estimated population, results in a range of 122–156 ha of cultivated land for the settlement. Given that the area of land within an arbitrary 1 km is 314 ha, and the total area of the hill around the base is 31 ha, a circular area of 1 km radius would provide some 283 ha of cultivable land (Fig. 8). Because there appears to have been some cultivation on the hill slopes and not all land within 1 km was good cultivable land, we can assume that cultivation probably spread slightly further into the basin (the *qaʿ*) to the south of the site. Clearly however, the area available on the plain was more than sufficient to provide the cultivation needs of the community. It is therefore significant that the inhabitants chose to situate some fields on the hill slopes below the town, presumably because that formed a convenient location for fields.

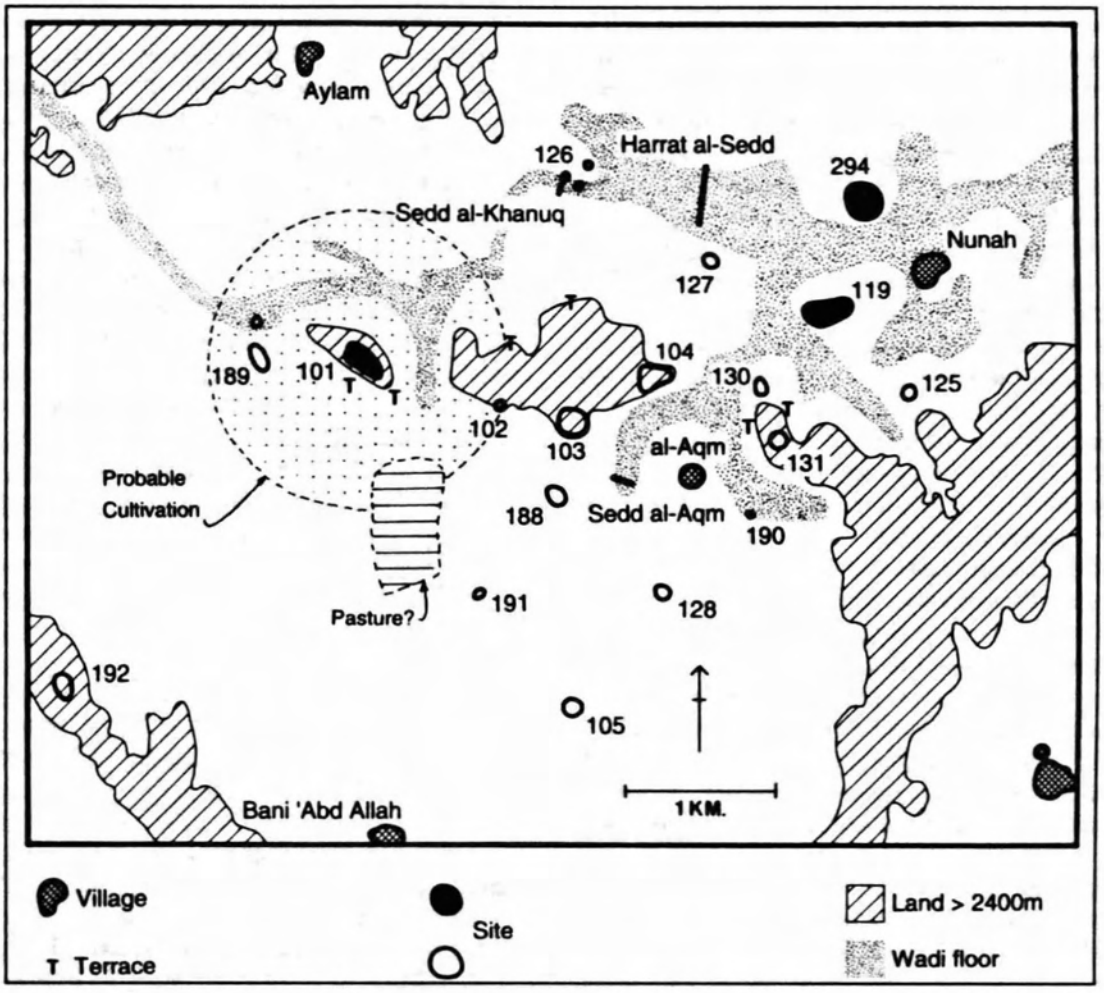

FIGURE 8. *Preliminary reconstruction of the Bronze Age land use around Ḥammat al-Qāᶜ showing the inferred location of some of the terraced fields, cultivation on lower slopes and adjacent plain, and valley floor pasture.*

Preliminary geoarchaeological studies of valley floor relict lake deposits suggests that during the mid Holocene (*c.* 8000–3000 BC) the central parts of many basins in highland Yemen held freshwater lakes or marshes (Wilkinson 1997). Furthermore, there is little evidence for either Neolithic or Bronze Age settlement within such basin centres. From these two lines of evidence it can be inferred that the basin centres would have been open space that remained as grassland or marsh into the third and second millennia BC, and thus would have provided valuable pastoral reserves (Fig. 8). Bronze Age land use around Ḥammat al-Qāᶜ, and in other basins can therefore be suggested to comprise: a) hill slopes adjacent to the settlement where some cropping and crop processing took place; b) lower slopes and plain margins devoted to cultivated crops; c) bottom lands of basins which remained as pastoral reserves.

Discussion

The perimeter wall, structured fabric and architectural density of Ḥammat al-Qāᶜ justify calling this settlement a Bronze Age town, despite its relatively small population. Although these characteristics are clearest at Ḥammat al-Qāᶜ, town-sized sites are relatively common in the central

Yemeni highlands. When compared with present day settlement Ḥammat al-Qāʿ can be seen to fall within one of the commonest size classes, namely the small rural town or large village with populations in the range 100–500, of which there were 11,000 in 1979, holding some 44% of the population (Steffen 1979: II/27). Unlike the first millennium BC towns of the desert fringe such as Shabwa, or Late Bronze Age Ṣabir on the Indian Ocean plain, the buildings at Ḥammat al-Qāʿ show very little variation in size or apparent status. On the other hand the settlements of Khawlān, just 50–60 km to the north-east, make a strong contrast in a different way (de Maigret 1990). These sites are smaller (none exceeding 1 ha) and contain compounds of contiguous curvilinear rooms set around a central space; this architectural form seems to reflect lineage residential groups. The architecture and the significantly drier environment of the eastern highlands suggest that the Khawlān settlements belonged to communities that placed a greater emphasis on animal herding, perhaps seasonally more mobile and opportunistically farming. However, the evident contrasts with Ḥammat al-Qāʿ may mask similarities of social organization, with the linkages between houses and their arrangement around a common space within blocks serving as the seats of extended kin groups within the town. These groups probably would have pooled labor in the creation, use and maintenance of agricultural terraces, threshing floors and other facilities.

The settlement system evident in the interior of south-east Arabia provides another expression of a similar social organization within a different environmental regime. There, settlement was dispersed, with residential architecture and adjacent groups of collective tombs clustered around towers that were scattered through oases. These clusters of towers, houses and tombs probably contained extended kin groups that coordinated access to land and water, the latter deriving from a combination of run-off and ground water. This kind of dispersed settlement was in fact a recurrent urban feature of later periods across Arabia (Whitcomb 1996), and was a common response of kin organization to constraints of an arid environment.

In contrast with the towns of the Gulf coast of Arabia such as Qalʿat al-Bahrain, Saar, or Tell Abraq, where interaction with other parts of the Gulf, Iran, Mesopotamia and the Indus are manifest from the artifactual assemblage, those of the Dhamār highlands show little evidence of foreign contacts, imported materials or trade goods of any sort. This suggests that even if the Yemen settlements did not exist in isolation, external stimulus is unlikely to have been a determining factor in their formation. Rather, they appear to have developed in an area which provided excellent potential for food production, and population growth. These factors do not, however, provide sufficient reason for the growth of such towns, and although the labour requirement of terraced agriculture, or defense may also have contributed to the nucleation of population into such settlements, the precise reasons for their growth remains to be determined.

Notes

[1] A shorter version of this paper has been published in *Antiquity* (Edens, Wilkinson & Barratt 2000).

References

Blakely J., Vitaliano C. & Brinkman R. 1996. Bronze Age remains at Kawlah al-Lajamah, Yemen Arab Republic. Pages 309–333 in W. Overstreet & J. Blakely (eds), *Environmental Research in Support of Archaeological Investigations in the Yemen Arab Republic, 1982–1987*. Washington DC: American Foundation for the Study of Man.

Breton J.-F. & Darlès C. 1994. Ḥağar Ṣurbān 1 et 2: villages du Ğabal an-Nisīyīn. Pages 46–61 in N. Nebes (ed), *Arabia Felix: Beiträge zur Sprache und Kultur des vorislamischen Arabien. Festschrift Walter W. Müller zum 60. Geburtstag*. Wiesbaden: Harrassowitz.

Cleuziou S. 1982. Hili and the beginnings of oasis life in Eastern Arabia. *Proceedings of the Seminar for Arabian Studies* 12: 15–22.

Cleuziou S., Inizan M.-L. & Marcolongo B. 1992. Le peuplement pré- et protohistorique du système fluviatile fossile du Jawf-Hadramawt au Yemen. *Paléorient* 18/2: 5–29.

Costantini L. 1990. Ecology and farming of the protohistoric communities in the central Yemeni highlands. Pages 187–204 in A. de Maigret (ed.), *The Bronze Age Culture of Hawlan al Tiyal and al-Hada*. Rome: IsMEO.

Crawford H., Killick R. & Moon J. 1997. *The Dilmun temple at Saar, Bahrain and its Archaeological Inheritance*. London: Kegan Paul.

de Maigret A. 1984. A Bronze Age for southern Arabia. *East and West* 34: 75–106.

1990. *The Bronze Age Culture of Hawlan al-Tiyal and al-Hada*. Rome: IsMEO.

Edens C. 1999. The Bronze Age of highland Yemen: chronological and spatial variability of pottery and settlement. *Paléorient* 25/2: 105–128.

Edens C., Wilkinson T.J. & Barratt G. 2000. Hammat al-Qa and the roots of urbanism in southwest Asia. *Antiquity* 74 (286): 854–862.

Frifelt K. 1976. The evidence of a third millennium BC town in Oman. *Journal of Oman Studies* 2: 57–74.

Højlund F. & Andersen H. H. 1994. *Qala'at al-Bahrain*. i. (Jutland Archaeological Society Publications, 30/1). Aarhus.

1997. *Qala'at al-Bahrain* ii. (Jutland Archaeological Society Publications 30/2), Aarhus.

Kramer C. 1982. *Village Ethnoarchaeology*. New York: Academic Press.

Potts D.T. 1990. *The Arabian Gulf in Antiquity*. (2 volumes). Oxford: Clarendon.

1991. *Further excavations at Tell Abraq: the 1990 season*. Copenhagen: Munksgaard.

Steffen H. 1979. *Population Geography of the Yemen Arab Republic*. (Beihefte zum Tübinger Atlas des Vorderen Orients). Wiesbaden: Reichert.

Sumner W. 1989. Population and settlement area: an example from Iran. *American Anthropologist* 91: 631–41.

Tosi M. 1986. Archaeological activities in the Yemen Arab Republic, 1986: Neolithic and protohistoric cultures, survey and excavations on the coastal plain (Tihama). *East and West* 36: 400–415.

Vogt B. & Sedov A. 1998. The Sabir culture and coastal Yemen during the second millennium B.C. — the present state of discussion. *Proceedings of the Seminar for Arabian Studies* 28: 261–270.

Whitcomb D. 1996. Urbanism in Arabia. *Arabian archaeology and epigraphy* 7: 38–51.

Wilkinson T. J. 1997. Holocene environments of the high plateau, Yemen, recent geoarchaeological investigations. *Geoarchaeology* 12: 833–864.

1999. Settlement, soil erosion and terraced agriculture in highland Yemen: a preliminary statement. *Proceedings of the Seminar for Arabian Studies* 29: 183–191.

Wilkinson T.J. & Edens C. 1999. Survey and excavation in the central highlands of Yemen: results of the Dhamar Survey Project, 1996 and 1998. *Arabian archaeology and epigraphy* 10: 1–33.

Wilkinson T.J., Edens C. & Gibson M. 1997. The archaeology of the Yemen high plains: a preliminary chronology. *Arabian archaeology and epigraphy* 8: 99–142.

Zarins J. & Al-Badr H. 1986. Archaeological investigations in the Tihama plain II, 1985. *Atlal* 10: 65–107.

Zarins J. & Zahrani A. 1985. Recent archaeological investigations in the southern Tihama plain, 1984. *Atlal* 9: 65–107.

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