Wells as Signatures of Social Change

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Abstract

In arid regions, access to water resources was, and continues to be, of vital importance to nomads and sedentists. Where palatable surface water is limited, the digging of wells was one of the techniques developed to facilitate human existence. Wells as a type of installation and the history of their development, however, have received little attention in the archaeological record – greater emphasis has been placed on their often extraordinary contents, which largely accumulated after their primary function declined or became redundant.

Well digging is a labour intensive and dangerous activity, yet access to well-water seems to vary from communal to restricted. The hypothesis that I would like to propose is that wells and well-related architecture can be considered as indicators of social complexity and behaviour. If so, it may be possible to interpret changes in wells and well-related architecture as reflecting social changes.

This paper presents some preliminary data from four case-study sites (Garama, Hacılar, Mohenjo-Daro and Nimrud), in an attempt to investigate the hypotheses and develop statistical indices, which could then be applied to well-related architecture at numerous other sites. Studies of the ideology, rituals and texts associated with wells, and their contents, will be presented in the future.

Introduction

The availability of water has played a central role in the settlement patterns of the Near East and North Africa. Along with food acquisition, which has generally received more attention, Clark describes
water as “...that other necessity of life, bound up so intimately with the distribution and density of human settlement” (Clark 1944: 1). This is a commonly accepted view (Miller, 1980; Trigger 1968: 61), although Wagstaff does not regard water availability as a major determinant in settlement location (Wagstaff 1985: 51).

No settlement, however, whether permanent or seasonal, can exist without some form of access to water. Surface water, in the form of streams / rivers, lakes, channelled and collected rainwater and natural springs, was obviously the most readily accessible source of water, but over time subterranean water resources were also tapped by wells. As a distinct class of installations, however, wells remain little studied in general and are often regarded merely as a nuisance by excavators (Bibby 1970: 159).

The core hypothesis to my on-going research is that wells and well-related architecture can be considered as indicators of social complexity and behaviour. By definition, a well is simply “a deep hole in the ground from which water, oil or gas can be obtained” (Cambridge International Dictionary of English - online). The majority of wells, however, are more than simple, isolated holes in the ground such as those found at Kissonerga-Mylouthkia (Peltenburg et al. 2000: 846) and wells F7010-7013 at Hala Sultan Tekke (Åström 1997: 66), both on Cyprus.

Some wells are found in central, open spaces within a settlement, such as at Megiddo in Israel (Lamon 1935) and thus it seems reasonable to classify them as being communal installations, with unrestricted access. The location of other wells, however, in a variety of enclosed spaces ranging from domestic buildings (at Garama in Libya and Mohenjo-Daro in Pakistan, for example) to ritual buildings (at Hacilar in Turkey) and palaces (at Nimrud in Iraq), suggests that access rights to their water may have varied considerably. As Kramer notes in her ethnographic study of a village in Iran:
'The fact that they [wells and latrines] are differentially distributed throughout the village suggests the possibility that they reflect economic variation among households' (Kramer 1982: 131).

If access rights to well-water did vary as a result of social differentiation, based on wealth, ideology and/or power, and if this is reflected in the surrounding architecture, then wells can be considered as indicators of social complexity. Their potential value as signatures of social complexity will be greatest where wells can be analysed through time and space, both at a macro, regional level and at a micro, intra-site level. In such cases, an excavated sequence of wells and well-related architecture may provide evidence of social change through time.

This paper will attempt to outline the techniques employed to tap subterranean water, the distinction between pits and wells, and the various well construction types. It will then summarise the ‘time-depth’ or history of wells, and demonstrate how access to water has often been a contentious issue, before outlining a classification system for wells and discussing preliminary data from four sites, which exemplify the main classification types. It will conclude by suggesting potential avenues for further research, in the light of the currently available data.

Tapping subterranean water

Water availability depends heavily on the local geomorphology, as well as hydro-technology. A selection of accounts from 19th and 20th century travellers, such as Rogers in Palestine (Rogers 1989 [1862]: 266, 289) and Stark in Iraq (Stark 1947: 92-93), provide us with detailed anecdotes on wells in the age before the widespread use of diesel pumps. The ‘by-wells’ recorded in Arabia (Doughty 1936 [1888], II: 355) resembled little more than wide sand pits, excavated to clay level, similar to the shallow wells dug daily by Stein’s companions in Inner Asia and the Taklamakan Desert (Stein 1928: 316; Stein 1996 [1912], II: 386) and the ‘sip-wells’ in the Kalahari (van der Post 1958: 216).
In these ethnographic cases, detailed environmental knowledge enabled indigenous people to locate water in apparently waterless environments, although as Miller points out, the digging of shallow pits to reach subterranean water in deserts is a practice not restricted to humans (Miller 1980, 333).

Elsewhere, the customary mixture of luck, experience and trial and error doubtless played its part in finding subterranean water. Peltenburg et al. suggest that the precision required to hit the water channels at Kissonerga-Mylouthkia is evidence of possibly the earliest known water divining / dowsing (Peltenburg et al. 2001: 48), whereas Jansen proposes that the knowledge of subterranean water in the Indus Civilisation may have originated as a fortuitous by-product from digging deep pits for potters’ clay (Jansen 1989: 180).

▲ When is a hole in the ground a well?

Sip-wells and by-wells are difficult to find in the archaeological record and highlight the fact that the recognition of wells is not always as simple as it might seem. At the prehistoric site of Beidha in Jordan, Miller notes that there may have been similar, temporary well pits dug into the wadi floor (Miller 1980, 331), although Kirkbride and Byrd only refer to the present-day, local springs (Byrd 1989, 17; Kirkbride 1966, 71; 1968, 264).

Both pits and wells can be lined, so accurate information on water-table fluctuations is required, if self-reinforcing arguments are to be avoided (for example, the pits / wells at the Chalcolithic site of Teleilat Ghassul in Jordan – Bourke pers. comm. - and at Tell Brak in Syria – Oates et al. 2001: 26).

Thus, the functions of holes in the ground cannot be assumed to be single nor constant – a hole being dug as a well shaft may collapse and thus be turned into a pit (‘well’ F7011 at Hala Sultan Tekke, for example - Åström 1997); similarly, a hole intended as a pit may hit water or a well may dry up and be converted into a latrine (‘well’ F1552 at Hala Sultan Tekke - Åström 1997: 26) or a rubbish pit. The North-
West Palace wells at Nimrud contained, among other things, large quantities of broken ivory furniture and writing boards, robbed of their presumed gold hinges, not to mention over 180 manacled bodies of young males in Well 4 (Oates and Oates 2001: 99-100) - perhaps the earliest example of an attempt to cover-up or at least dispose of a war-crime.

‘Constructed’ brick and stone-lined wells obviously require a greater investment of labour, preserve better and are consequently more visible in the archaeological record than un-lined holes in the ground. Putative reasons for the differential location of such wells relative to the surrounding architecture can, therefore, be investigated, if the local hydro-geology is relatively uniform.

▲ ‘Constructed’ wells

Clark rightly distinguishes between tapping existing springs and the “revolutionary innovation” of wells tapping subterranean water, indiscernible from the surface, while noting the potential difficulties in distinguishing between the two, especially if the spring is lined (Clark 1944: 6).

Most wells that tap deep water have reinforced sides, if only to prevent slippage of the well sides in unstable deposits. The Megiddo ‘well’ shaft, dug through 30 m of earlier habitations and bedrock, to tap water channelled along a 65 m long tunnel from the spring, required major retaining walls to prevent slumps (Kempinski 1989: 130-131; Lamon 1935: 14). The Kissoneraga-Mylouthkia wells, however, are merely cylindrical shafts, dug a minimum of 7-8 m deep into the ground and as such emphasize that relatively deep wells do not necessarily need constructed sides, where the geological conditions are sufficiently stable.

The sides of ‘constructed’ wells are usually lined by stone or baked mud-bricks, although several wooden well shafts dating to the Neolithic and later have been found in Central Europe (Baldia 2000; Clark 1944: 5, 6; Renfrew and Bahn 2000: 264).
The availability of wood and exceptional conditions required to preserve it doubtless skew its known distribution. This, however, does not preclude the likelihood that wood was used in well superstructures in less forested, more arid regions – for example fragments of wooden beams and several squared stones point to the existence of a wooden platform over the well shaft at Megiddo (Lamon 1935: 31-32).

Maintenance and extracting water became increasingly difficult as wells became deeper. Foot / hand-holes cut into well shaft sides are found at Kissonerga-Mylouthkia (Peltenburg et al. 2000: 846), Hala Sultan Tekke (Åström 1997: 67), Tell Brak and Garama (Figure 1). More durable steps have been found in the stone-lined well (BLDG 500) at Saar, on Bahrain (Farid and Killick, pers. comm.), and at the well at Masturah in Arabia, for the benefit of travellers without ropes (Lawrence 1935: 80).

Figure 1: Foot/hand holds in the central well at Garama - note also the remnants of the lower clay lining

Other, larger wells had rock-cut stairways - the well at the Kushite (8th Century BC) site of el-Kurru, in the Sudan (Welsby 1998: 128), the 3rd Millennium BC well at Diraz, Bahrain (Bibby 1970: 68) and the 12th Century BC well at Megiddo (Lamon 1935: 14). The most impressive access-route to a well, however, is the Iron Age stone staircase (Figure 2) at
Tell Es-Sa'idiyyeh in Jordan (Miller 1988). The durability of these access features suggests a high volume of usage over a long period. Some of the large wells in open areas were probably communal wells, although the hut associated with a well in the Southern Suburb at Tell El-Amarna in Egypt (Kemp 1977: 135) may indicate some form of supervision, if not toll.

The digging and construction of wells was a skilled craft (Stein 1928: 717), reserved for specialist well sinkers in parts of Arabia (Doughty 1936 [1888], II: 421), the Near East (Miller 1980: 339) and Iran (Kramer 1982: 70) [Footnote 1]. The inhabitants of Mohenjo-Daro can be regarded as the masters of well construction - an estimated 700 were sunk within the city limits, amounting to one well for every third house, on average (Jansen 1993: 118).

Clark, among others, associates the increased technological input required for constructed wells

Figure 2: Stone staircase from the top of the mound to the well at Tell Es-Sa'idiyyeh (photo: C. Thomas)
with the pressures of increased demand in urban areas (Clark 1944: 3; 1960: 198), although Peltenburg et al. point out that there is no evidence for such large settlements in the Cypro EPPNB associated with the Kissoonerga-Mylouthkia wells (Peltenburg et al. 2001: 34) and the inhabitants of many large settlements were able to supply themselves with sufficient water without resorting to digging vast numbers of wells.

The number and density of wells at Mohenjo-Daro is not even approached at any other archaeological site and the sudden florescence of their integrated water and sewage management system is made all the more remarkable by the fact that no wells nor drains have yet been found at either Pre- or Early Harappan sites (Jansen 1989: 179; 1993: 117). The number of wells at Mohenjo-Daro is also in marked contrast to other Indus Civilisation cities such as Harappa (Vats 1940: 13), where 8 have been excavated and an estimated 30 existed (Kenoyer 1998: 58); none have been found at the contemporary sites of Dholavira and Taxila (Marshall 1975: 95).

In his study of the water systems at Mohenjo-Daro, Jansen concludes that ‘... the only technically feasible manner of construction would be the “shaft-sinking” method’, which was still used until recent times (Jansen 1993: 118). This technique, known as ‘caisson-sinking’ in engineering (Watt and Wood 1979: 53-54; Thomas, A. pers. comm.), utilises the weight of the growing brick structure to sink the lining, as underlying earth is removed at the base.

An alternative method, known as ‘underpinning’, involves inserting the bricks at the base, as deposits are removed, but this would require one odd-shaped brick to complete each course, leaving the lining less stable; none of the wells investigated at Mohenjo-Daro provide evidence for this technique. The stability of the technique employed is demonstrated by the fact that shaft depths of over 20 m were reached at Mohenjo-Daro, as they were at Nimrud where the lining of two of the wells consisted of over 300 courses of bricks (Oates and Oates 2001: 92,
The ‘time-depth’ of wells and developments in lifting technology

The discovery of wells at Kissoneraga-Mylouthkia dating to the later 10th and 9th Millennium BP, the contemporary well at Shillourokambos, also in Cyprus (Peltenburg et al. 2000: 848) and the plausible claims for submerged wells at Atlit-Yam, off the coast of Israel, dating to the late Pre-Pottery Neolithic, c. 8100-7500 BP (Galili et al. 1993), attest to the long ‘time-depth’ or history of well-digging. Similarly, Miller (1980) provides an informative survey of wells dating from the Neolithic to the Bronze Age in Syria and Palestine.

Numerous Assyrian texts (published in the State Archives of Assyria series), the Epic of Gilgamesh (Gilgamesh and Akka 1-23) and the Old Testament of the Bible contain references to sites with wells (Anati 1963: 384; Keller 1958: 395; Herzog 1993: 167-9; Smith 1966: 440). The Akkadian words ‘burtu’ and ‘buru’ mean ‘well’, as does the Arabic word ‘bir’ and the Hebrew word ‘beer’, both of which are often found in place names – Beersheba, for example (Genesis 21: 22-31; 26: 33).

As rural villages developed into urban centres, complex water management and supply systems were devised, to satisfy the increased demand for water. The cities of Ugarit (Caubet 1995: 2672), Ebla (Miller 1980: 337) and Mohenjo-Daro (Piggott 1961: 135, 170) provide good examples of these systems, although Hughes questions the long-term ecological and sanitary consequences of reliance on well water in Greek and Roman cities (Hughes 1975: 83, 121). The platform beside the well at Tell Es-Sa’idiyyeh may have been built to reduce the risk of contamination (Miller 1988: 87), as may have the proposed platform at Megiddo.

The reign of Sennacherib (705-681 BC) saw the first introduction of the Egyptian ‘well-sweep’ to Assyria (Olmstead 1923: 331). The ‘well-sweep’ or ‘shaduf’ is...
used to irrigate land along the Nile and in large wells at Tell El-Amarna (Kemp 1991: 291). It probably complemented, rather than replaced, the rope and bucket ‘draw wells’ [Footnote 2], but after this, lifting technology did not advance for about another 500 years.

From about the 2nd Century BC the Greeks and Romans used the ‘Ktesibian machine’, a twin-cylinder type of pump, named after its supposed inventor, a 3rd Century BC Alexandrian Greek (Landes 1988: 343). Worked at a leisurely pace, the pump could raise around 1000 litres per hour, a significant improvement on the laborious task of manually drawing water [Footnote 3] and / or using teams of animals, which was costly and dangerous (Doughty 1936, II: 382, 497).

The increasingly mechanised extraction of well-water, particularly with the introduction of petrol pumps in the 20th Century, can be seen in the Fezzan, Libya, where animal draws were replaced by motor driven winches in deeper wells, which were in turn replaced by bore-holes. This ‘...pursuit of the falling water table by the successive introduction of different lifting technologies...' (Mattingly et al. 1999: 142), in many arid areas, has placed unparalleled demands on subterranean water resources, as can be seen, for example, in the rapidly falling water-tables in the Fezzan (Mattingly et al. 2000: 113) and in Bahrain (Larsen 1983: 16).

Water and disputes

‘I suppose that, after the passion of love, water rights have caused more trouble than anything else to the human species’ (Stark 1947: 106). Whether wholly accurate or not, the main causes of the disputes over water are its uneven distribution in arid regions and the resultant restricted access to water sources. The potential ‘flash-point’ for disputes at wells is noted in an archaeo-ethnographic study of a village in Iran, where Watson comments: ‘Apportioning the water is, of course, a serious problem (as the summer draws on, it may lead to bloodshed)’ (Watson 1979: 88).
Doughty records that the kellas, or fortified water stations, wells and cisterns on the Hajj route from Damascus to Mecca were jealously guarded and no Bedu was allowed draw water from them (Doughty 1936 [1888]: 47). Access to water on the main Hajj route from Iraq, the Darb Zubayda, which flourished under the patronage of the Abbasids, may have been more relaxed – it had 1300 wells, but only 54 guard stations (Insoll 1999: 111).

Nevertheless, the simmering regional tension between opportunistic nomads, like the feared Bedu, and sedentists (aptly characterised as ‘The Desert and the Sown’ by Bell - 1908), and the vital role of water, is documented during the revolts against the Assyrian king Ashurbanipal, who reigned from 668-626 BC (Olmstead 1923: 429). More recently, the governments of Niger and Morocco have attempted to exert greater control over nomads by digging wells or restricting access to existing wells (Arkell 1991: 164; de Felice-Katz 1980: 60; Slavin and Slavin 1974: 117). The on-going international disputes over water rights in the Middle East show how contentious the issue of access to water resources continues to be (Schneider and Schulte 1998: 79 ff.).

Access to well-water can be crucial during civil defence (Miller 1980: 337 ff.), as can be seen by the extraordinary efforts made to secure the water supply at Megiddo, where Lamon argues ‘... a supply of water inside the city wall was very nearly as important as the wall itself’ (Lamon 1935: 1). The role of water in apparently defensive locales, however, is not as straightforward as might be expected. Several of the fortified sites in the Eastern Desert in Egypt, surveyed by Wright and Herbert (1993: 7), and in Qatar (de Cardi 1978: 188, 191) overlook or are located close to wells, rather than enclosing them within their defensive walls [Footnote 4].

▲ Wells as potential signatures of social differentiation
The paper has thus far discussed the different types of wells and the development of well-related technology, summarised the long history of well-digging and cited examples of how access to water and wells is often disputed and may be restricted. It will now concentrate on the microsettlement pattern[Footnote 5] of wells and their surrounding architecture and outline the methodology used to investigate them as potential signatures of social differentiation.

If we consider wells as part of a settlement’s architecture, we can follow Cameron in arguing that: ‘Architecture communicates an abundance of cultural information to archaeologists’ (Cameron 1999: 201). Childe laid the groundwork for aspects of this type of settlement study half a century ago, when discussing 3rd Millennium BC Indus Civilisation: ‘Within the urban population itself architectural remains reveal differences in wealth, amounting to almost class divisions’ (Childe 1952: 175); Trigger (1968: 58, 60) concurs.

Childe noted that at Harappa an accommodation gulf existed between the two-roomed detached artisans’ houses below the citadel and the spacious two-storey houses that included courtyards, bathrooms and often a private well. A more recent corollary of such social differentiation and control of wells occurred on the Malabar coast of India, where wells were generally built in gardens and compounds surrounding the houses of landowners. The poor tenants and labourers were usually permitted to take water from them, when it was abundant, but in times of drought, they were obliged to take it from streams or stagnant pools, often at great distances (Forde 1934: 268). Thus, wells may contribute to the study of social stratification in societies and the emergence of inequality.

**Methodology**

The wells studied here will be classified according to the types in **Table 1**: the number and proportion of the different types of wells at a site can then be analysed in an attempt to compare social complexity.
The definition of any classification system is problematic and, to a certain extent, subjective - terms such as 'ritual' and 'palatial' are obviously interpretative and value-loaded. In many Mesopotamian cases, however, textual evidence does allow us to designate with confidence buildings, such as the North-West Palace at Nimrud, as palatial. More important than the arbitrary categories is a clear definition of the criteria used to assign these categories. For the purposes of this discussion, I will use the following definitions for buildings and spaces (more details of the defining criteria are given in Appendix I):

- **Defended** – a building which periodically acted as a refuge and whose walls extend beyond normal structural requirements
- **Domestic** [Footnote 6] – a small / medium building relating to a household or extended family
- **Palatial** – an elite building, whose size and layout go beyond mere residential requirements
- **Ritual** – a non-residential space for worship, with non-utilitarian installations / finds
- **Courtyard** – an open area, within walls
- **External Space** [Footnote 7] – an un-walled open area within a settlement
- **Internal** – a walled, roofed space
- **Open Space** – an un-walled open area, not associated with a settlement

Most classification systems would soon become unwieldy and defeat their purpose if they attempted to cater for all possible variations. The small well in the tablet room of Nabu temple at Nimrud, for example, seems to be associated with administration rather than ritual (Oates and Oates 2001: 115), while Trigger points out that 'gods' may have no temples, domestic buildings often have small shrines and ceremonies may be performed in open or public spaces that normally have other uses (Trigger 1968:...
The classifications outlined above, therefore, will be applied to what is designated as the primary function of the well building / space.

Less contentious, hopefully, will be the indices used to quantify data about wells and their associated spaces and / or buildings:

- Well Shaft – the internal area of the well, indicating the size of the well
- Well Space – the area of the room or space around the well
- Building Area – the area of the building in which the well was found
- No. of Wells – the number of wells within the building
- No. of Rooms – the number of rooms in the building
- No. of Courtyards – the number of courtyards in the building

Steadman argues that as activities become more complex and numerous, so a greater degree of spatial specialization is required, often linked to residential expansion (Steadman 2000: 171). Thus, more complex societies tend to have larger buildings, with more rooms and courtyards, and these may be associated with more and / or larger wells.

We can also hypothesize that the proportion of internal to external wells will decline as the well space increases, given the difficulty of roofing wide spaces. Internal wells suggest restricted access, although wells in walled courtyards may be just as closed to the public.

If there is significance and validity to the classification system, data from similar types of wells / buildings should cluster together, thus potentially yielding information about unclassified wells, which might consistently cluster with wells from known palaces or temples.
Case studies

The sites of Garama, Hacılar, Mohenjo-Daro and Nimrud have been selected as case studies to test the hypotheses outlined above. They were chosen because they provide good spatial and/or temporal data on wells and represent examples of three of the four different categories of building – domestic, ritual and palatial. Data from fortified sites, such as those surveyed in the Eastern Desert of Egypt (Wright and Herbert 1993) are currently too incomplete to include in this analysis, although this is no reflection on their work.

Garama

Modern Germa / ancient Garama, capital of the Garamantian civilisation, is located about 900 km south of Tripoli, in the Fezzan region of Libya. Italian, Libyan and British teams have conducted intermittent excavations at the site since the 1930s (Ayoub 1967; Daniels 1989; Mattingly et al. 1997, 1998, 1999, 2000, 2001).

Prof. Mattingly’s recent Fezzan Project has located 7 wells at Garama, 4 during the survey of the standing buildings and a further 3 during the excavations. The sequence of wells in excavation area G1 will be considered in detail by the author in the forthcoming final publication of the Fezzan Project; suffice to say here, it seems to have been associated with relatively simple, domestic architecture.

Hacılar

The Late Neolithic / Chalcolithic levels (c. 5,600-5,000 BC) at the site of Hacılar, located in south-west Anatolia, Turkey, provide excellent spatial and stratigraphic information about wells and their related architecture. Mellaart excavated a series of large trenches at the site in the 1960s, which yielded a detailed impression of early urban life in the region, especially when coupled with Helbaek’s pioneering archaeo-botanical analyses. The wells were particularly rich in botanical remains. The sequence of buildings in the north east of the settlement in
Levels I and II, which Mellaart designated as a shrine (Mellart 1970: 35), is of direct relevance to this study.

**Mohenjo-Daro**

The proliferation of wells at the Indus Civilisation city of Mohenjo-Daro, in the Sind province of Pakistan, is in marked contrast to the other selected case studies, and indeed to most sites in semi-arid regions. The site, which flourished from 2500-2000 BC, was extensively excavated in the 1920s (Marshall 1973 [1931]; MacKay 1998 [1938]) and briefly by Wheeler (1953).

The majority of the buildings considered here appear to be domestic, with the exception of the ‘ritual bath complex’. The wells are in what have been interpreted as public and private contexts, although this is not a strict dichotomy, as some of private houses have well chambers accessible from the street (Marshall 1973 [1931]: 16).

**Nimrud**

The site of Nimrud (Biblical Calah – Genesis 10:11) in Mesopotamia has a long history of excavations, dating back to Layard in the 1840s (Layard 1853) and continuing to the present day with the work of the Iraqi Department of Antiquities (Damerji 1999). The site and its excavations have been admirably summarised in “Nimrud: An Assyrian Imperial City Revealed” (Oates and Oates 2001).

This study considers the four wells thus far exposed in the North-West Palace, which was founded by Assurnasirpal II in the 9th Century BC and continued in use until the fall of Assyria in 612 BC (Oates and Oates 2001: 68).

**Discussion of the data**

Summary data for the case study sites are shown in Table 2 and displayed graphically in Figs. 3-4. In the Figures, sites have particular symbol shapes (all Mohenjo-Daro symbols are triangles, etc.) and well
types are colour-coded (all Domestic Internal wells are brown, etc.). Where deemed appropriate, I have used logarithmic scales to produce meaningful graphs from large data ranges; these graphs have gridlines, to emphasize the logarithmic scale. Figure 5 compares the case studies’ summary data with that collected by Watson (1978: 155) for a sample of 6th Millennium BC sites in Anatolia and Mesopotamia.

**Figure 3** shows a clear difference between domestic and non-domestic Well Shaft areas, although Well Space areas are comparable, apart from for Nimrud, which is unsurprising given the size of the North-West Palace. Similarly, as expected, **Figure 4**, shows a significant increase in Building Area, No. of Rooms and Courtyards with the shift from domestic to ritual and palatial architecture. This trend is confirmed by comparing the data for Hacılar in **Figure 5**. This graph highlights the major leap in Building Area (and to a lesser extent in No. of Rooms, although this varies in the earlier settlements) at the 3rd Millennium BC city of Mohenjo-Daro and 1st Millennium BC palace of Nimrud.

In the following paragraphs, and illustrated by **Figures 6 to 11**, the individual well type data from the case study sites is discussed in more detail. **Figure 6** shows the expected, broadly linear relationship between Building Area and the No. of Rooms. More significantly, however, some patterning does appear within this trend. Mohenjo-Daro Domestic Internal well buildings tend to be smaller with fewer rooms than Mohenjo-Daro Domestic Courtyard well buildings and Hacılar Ritual Courtyard well buildings have fewer rooms than might be expected, given their building area – this is possibly due, in part, to the different building functions and their significantly earlier date.

**Figure 7**, comparing Well Shaft and Well Space shows a more diffuse pattern, but once again with some separation between Mohenjo-Daro Domestic Internal and Mohenjo-Daro Domestic Courtyard well buildings. Non-domestic wells also continue to show more extreme values.
Figures 8 and 9 plot Well Shaft against Building Area and No. of Rooms [Footnote 8]. I consider Well Shaft to be a reflection of the volume of water being drawn and of the impressiveness of the well, but local geological factors are also likely to have been a significant factor. The majority of domestic wells form a loose cluster, but with several outliers (including most of the non-domestic wells). This suggests that there is no simple linear relationship between Well Shaft (nor indeed for the No. of Wells in a building) and Building Area or No. of Rooms. Non-domestic wells, however, do seem to be larger than domestic wells. A follow-up to this observation would be to re-assess whether the outlying large ‘domestic’ wells have been classified correctly.

A broadly similar pattern is visible in Figures 10 and 11, which plot Well Space against Building Area and No. of Rooms. Again, domestic wells cluster, with non-domestic wells having larger well spaces, but not necessarily larger Buildings, or a greater No. of Rooms. A clear distinction does, however, appear between Domestic Courtyard and Interior wells – Courtyard wells tend to be larger.

Detailed study of the sequence of well-related architecture at Garama is instructive as to how social change may be reflected through wells. Essentially the same well shaft was probably in use from the earliest occupation of the site, but definitely from the Classic Garamantian Phase 6 (4th-5th Century AD – Mattingly 2000: 136), through to at least the late Islamic Phase 3.

In Phase 7, the well is found in an open, possibly perambulatory area behind the stone-socle Garamantian temple (Mattingly et al. 2001: 138, Figure 4). Numerous rubbish pits were then dug in the open area, suggesting that the temple had lost some of its prestige and that the well possibly fell out of use. By Phase 6, however, the well had been re-dug and was integral to a ‘Classic Garamantian’ two-room house (Mattingly et al. 2001: 137, Figure 3). It nestled in the south-west corner of the larger room and clearly seems to have been appropriated by the
house’s occupants.

Little architecture survives for Phase 5 and the Phase 4 well was significantly affected by the Phase 3 re-build. The room’s surface dips towards the well and a neighbouring pit, suggesting that subsidence was a problem.

This subsidence may explain the fact that in Phase 3 the well was re-dug and the upper portions of the shaft were reinforced with a stone lining. An area of stone and compacted clay paving surrounded the well-head, which was located in a corner of a major complex of courtyards and rooms. In Late Phase 3, however, access to the well was clearly restricted again, with the blocking of a doorway leading from a large room to the east. By Phase 2, the well seems to have fallen out of use - its shaft became filled largely with sand and tumbled stones and was possibly converted into a fire installation. The restricted access and ultimate abandonment of the well may have been related to falling water levels, as the area continued to be occupied into Phase 1.

The Phase 6 and 3 Domestic Interior wells are comparable to similar wells at Mohenjo-Daro in Figure 3. In Figure 4, however, the Garama well-buildings are significantly smaller, possibly reflecting the lower level of social complexity – Figure 5 shows that the Garama buildings are analogous with 6th Millennium Domestic buildings from Hacılar VI, Sawwan and Hasanabad.

When actual data, rather than average data are compared, the Garama buildings appear at the low end of the cluster of Mohenjo-Daro Domestic Interior buildings in Figure 6, but in Figure 7 the ‘Classic Garamantian’ Phase 6 well is notably detached from the cluster of other Domestic Interior wells, in terms of both well shaft and well space. The small Building Area and No. of Rooms once again relegate the Garama well-buildings to the lower cluster of Domestic well-buildings in Figures 8 to 11, but the relatively large Well Space of the Phase 6 well is again notable in Figures 10 and 11.
The Garama example hopefully demonstrates that, where a sequence of architecture is available for analysis, in conjunction with other data, wells and their related architecture can be related to changes in social complexity.

**Conclusions and potential future research**

This preliminary analysis seems to confirm the validity of the classification system used, particularly as distinct well types tend to cluster and clear differences have emerged between Domestic Courtyard and Domestic Internal wells. Several of the expected relationships between the indices have proved to be correct – the building area, number of rooms and number of courtyards do seem to correlate, and the proportion of internal to courtyard wells changes markedly as well space increases. The data, however, show that there is no a priori direct correlation between building size and the number of wells within a building but that non-domestic wells do tend to be larger than most domestic wells.

Kramer concluded on the basis of her studies that there was no apparent association between a household’s economic rank and the presence / absence of a well or latrine in their house (Kramer 1982: 131). This opens the way for other possible explanations. The staggering difference between the number of wells at Mohenjo-Daro and other Indus Civilisation sites is particularly puzzling. Kenoyer attributes this stark contrast to environmental and possibly social factors: Mohenjo-Daro received less winter rain and was situated further from the Indus, while in modern Brahmanical Hinduism higher castes do not drink water touched by lower castes (Kenoyer 1998: 58). Concepts of purity may have influenced the behaviour of the inhabitants of Mohenjo-Daro with regard to water to an extent not seen elsewhere.

The fact that one site so dominates the data presented here is an obvious weakness and I will
attempt to broaden the dataset, particularly to include data from temple wells such as the Anu-Adad Temple at Ashur, Ain Umm es-Sejour, Barbar Temple II, Balawat and Ur, the fortified wells in Oman and Egypt and the wells along the Hajj routes. It should be remembered, however, that building types mirror the pyramidal structure of societies, so it would be a mistake to focus too heavily on non-domestic, 'exceptional' well types to the detriment of the humble domestic well.

The quality and size of the Mohenjo-Daro data, however, is also a positive factor, allowing more complex statistical analyses, such as Principal Component Analysis of not just the 'well buildings', but also buildings without wells. Such analyses may indicate whether architectural data can explain why some houses at Mohenjo-Daro had wells and others did not. Similarly, Access Analysis, such as the studies conducted by Chapman on Chalcolithic settlements (Chapman 1990) and Foster on Iron Age structures (Foster 1989), may help to quantify which wells within buildings can be interpreted as public and which as private. The numerous wells found at Tell El-Amarna and the 32 wells reported at Enkomi in Cyprus (Åström 1997: 131) will hopefully provide good comparative datasets.

Watson found that intrasite differentiation was not demonstrable from architectural evidence (Watson 1978: 155), but this might have been because she restricted her comparative data to 6th Millennium BC sites; the broader temporal and social ranges of sites and well-related architecture considered here show clear intra- and inter-site differentiation and can only benefit from an expansion of the dataset and more detailed analysis.

⚠️ Acknowledgements

The following people have kindly provided information and / or insightful comments on my research into wells: Dr. Heather Baker, Dr. Jeremy Black, Dr. Stephen Bourke, Dr. Geoff Emberling, Shahina Farid, Dr. Robert Killick, Dr. Anna Leone, Prof. David Mattingly, Helen McDonald, Prof. David
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I was fortunate to have access to the University of Leicester’s computing and library facilities during the initial stages of research, and to the libraries of Cambridge University and Sydney University. The editorial team at Assemblage were also consistently encouraging and helpful.

I am very grateful to all those who have assisted my research; any persisting errors or misunderstandings are obviously my sole responsibility.

**Tables**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition of Well Type / Space</th>
<th>No. of Wells Analysed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Def Ctyd</td>
<td>Defended Courtyard</td>
<td>0</td>
</tr>
<tr>
<td>Def Int</td>
<td>Defended Internal</td>
<td>0</td>
</tr>
<tr>
<td>Dom Ctyd</td>
<td>Domestic Courtyard</td>
<td>24 (Gar 1; M-D 23)</td>
</tr>
<tr>
<td>Dom Int</td>
<td>Domestic Internal</td>
<td>34 (Gar 2; M-D 32)</td>
</tr>
<tr>
<td>Ex Sp</td>
<td>External Space</td>
<td>0</td>
</tr>
<tr>
<td>Op Sp</td>
<td>Open Space</td>
<td>0</td>
</tr>
<tr>
<td>Pal Ctyd</td>
<td>Palatial Courtyard</td>
<td>2 (Nim 2)</td>
</tr>
<tr>
<td>Pal Int</td>
<td>Palatial Internal</td>
<td>2 (Nim 2)</td>
</tr>
<tr>
<td>Rit Ctyd</td>
<td>Ritual Courtyard</td>
<td>4 (Hac 3; M-D 1)</td>
</tr>
<tr>
<td>Rit Int</td>
<td>Ritual Internal</td>
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</tbody>
</table>

**Table 2: Summary data**

<table>
<thead>
<tr>
<th>Site / Averages</th>
<th>Well Shaft</th>
<th>Well Space</th>
<th>Building Area</th>
<th>No. Rms</th>
<th>No. Wells</th>
<th>No. Ctyds</th>
<th>StDev Well Shaft</th>
<th>StDev Well Space</th>
</tr>
</thead>
</table>

back to Text
<table>
<thead>
<tr>
<th></th>
<th>Ctyd</th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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<tbody>
<tr>
<td>Garama: Dom</td>
<td>n/a</td>
<td>19.25</td>
<td>47.09</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>n/a</td>
<td>n/a</td>
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<td></td>
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<tr>
<td>Garama: Dom</td>
<td>0.54</td>
<td>13.04</td>
<td>51.05</td>
<td>3.00</td>
<td>1.00</td>
<td>1.00</td>
<td>0.36</td>
<td>10.52</td>
<td></td>
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<tr>
<td>Hacilar: Rit</td>
<td>1.22</td>
<td>32.71</td>
<td>290.67</td>
<td>4.00</td>
<td>1.00</td>
<td>1.67</td>
<td>0.59</td>
<td>6.80</td>
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</tr>
<tr>
<td>Mohenjo-Daro: Dom</td>
<td>0.78</td>
<td>31.11</td>
<td>373.18</td>
<td>12.69</td>
<td>1.07</td>
<td>1.43</td>
<td>0.89</td>
<td>56.09</td>
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<td>0.63</td>
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<td>280.79</td>
<td>12.31</td>
<td>1.23</td>
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<td>Mohenjo-Daro: Rit</td>
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<td>20.91</td>
<td>1726.82</td>
<td>23.00</td>
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<tr>
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<td>26325.00</td>
<td>116.00</td>
<td>1.00</td>
<td>9.00</td>
<td>0.49</td>
<td>81.32</td>
<td></td>
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</tr>
<tr>
<td>Nimrud: Pal</td>
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<td>71.00</td>
<td>26325.00</td>
<td>116.00</td>
<td>1.00</td>
<td>9.00</td>
<td>0.49</td>
<td>1.41</td>
<td></td>
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</tr>
</tbody>
</table>

#### Footnotes

[1] Qanats, which consist of a linear series of interlinked shafts designed to transport water from spring lines to fields, were also excavated by itinerant specialists, known as muqannis in Iran and Arabia (Wagstaff 1985: 60). Similar features are also common in the Fezzan, Libya, where they are known as foggara, (Mattingly et al. 1999, 2000) and in the Kharga Oasis of Egypt (Schacht pers. comm.).


[3] In Pre-Sargonic Lagaš, the drawing of water from wells was entrusted to the blind (Postgate 1992: 180), possibly including deliberately blinded prisoners-of-war (Postgate 1992: 255).

[4] The Eastern Desert sites of Bir Samut and the fortified well of 'Qariyeh al-Faysaliyyah' in Wadi Jirf, however, do have wells within their walls (Wright and Herbert 1993: 9), while other sites may enclose as yet unexposed wells. This apparent shift from Ptolemaic sites with external wells / cisterns to Roman sites with internal wells / cisterns may reflect increasing tension and / or militarisation in the region.

[5] The study of settlement patterns in archaeology is reviewed by Trigger, who proposes a distinction between microsettlement patterns, within a settlement, and macrosettlement patterns, between settlements in the wider landscape (Trigger 1968: 55).
As Oates and Oates note (2001: 78), it is easy to get into a semantic tangle with even the word ‘domestic’.

Kemp makes the useful distinction between positive space (areas deliberately enclosed and intended to form extensions to the living space) and negative space (which simply surrounds the structure but may be gradually diminished by the building of other structures and eventually merely applies to access routes, rubbish dumps, public wells and areas for communal activities) – Kemp 1977: 134.

In these Figs. the Nimrud Pal Ctyd symbols are obscured by the Nimrud Pal Int symbols. Removing the logarithmic scale does not radically alter the patterns depicted in these or any of the other Figs.

cf. Watson (1978: 132ff) for a list of potential discrete and continuous attributes when attempting to measure economic status by analysing architecture and possessions.

### Appendix I - building definitions

- Defended or fortified buildings have thick external walls and restricted access, often in the form of a gateway. They may be constructed from less combustible materials than ordinary domestic buildings and include an open space for livestock and access to water.

- Domestic buildings are defined as consisting of generally small rooms, possibly around a courtyard, with small installations such as hearths, bread ovens and / or small storage bins [Footnote 9]. Where extended families live together, sub-units may be discernible within the building.

- Palatial buildings are large, multi-roomed buildings, probably with a variety of room sizes and several courtyards. Ideally, they will include high status objects, although their size and wealth makes them prime targets for looters. Depending on the period and region, they may include administrative quarters, indicated by tablets, extravagant decoration, inscriptions and large-scale storage facilities. They do not necessarily imply regency; rather they point to an elite, whether based on wealth or lineage, who were not necessarily permanently resident.

- Ritual buildings are usually larger than domestic buildings, with a more complex layout and more ambiguous installations. These might include so-called ‘altars’ or podiums, decorative features, non-utilitarian / high status objects or abnormal deposits, such as bones.
with a skewed age/sex profile in pits. They may have a congregational space, with a smaller, restricted-access sanctuary; they may also include domestic quarters for initiates, but as with shrines in domestic buildings, these must appear to be subsidiary to the primary function of the building, if the building is to be classified as ‘ritual’.

▲ Bibliography

Printed Sources


**Electronic Sources**


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David Thomas is a freelance archaeologist, who initially specialised in Palaeolithic and Mesolithic Archaeology at Cambridge University. He then completed a MSc. in Computing and Archaeology at the University of Southampton, before becoming Computer Officer at the British Institute in
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He has participated in numerous archaeological projects in Europe, North Africa, the Near East and Central Asia, including those at Tell Brak, Pella, Kilise Tepe and Garama. He has worked as Research Assistant on the latter two projects and on the Nimrud Database Project. He hopes to continue his research into wells as a PhD thesis, funding permitting.

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