

The Mystery of the Indus Valley Toilets



Why were they so unique?

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ILLUSTRATIONS



Fig 1. Garderobe - Manorbier Castle. Photograph: M. Gallagher



Fig. 2. A piece of broken pottery like this could be used as a makeshift receptacle, then disposed of, by the poorer classes in Egypt. Pottery sherd part of the collection at the Ancient History Museum, Macquarie University, Sydney, Australia. Photograph: M. Gallagher.



Fig. 3. Domestic toilet, Mohenjo-Daro.
(Wheeler 1976: Plate XVI)



Fig. 4. Mohenjo-Daro street with drains.
(Wheeler 1976: Plate XIII)

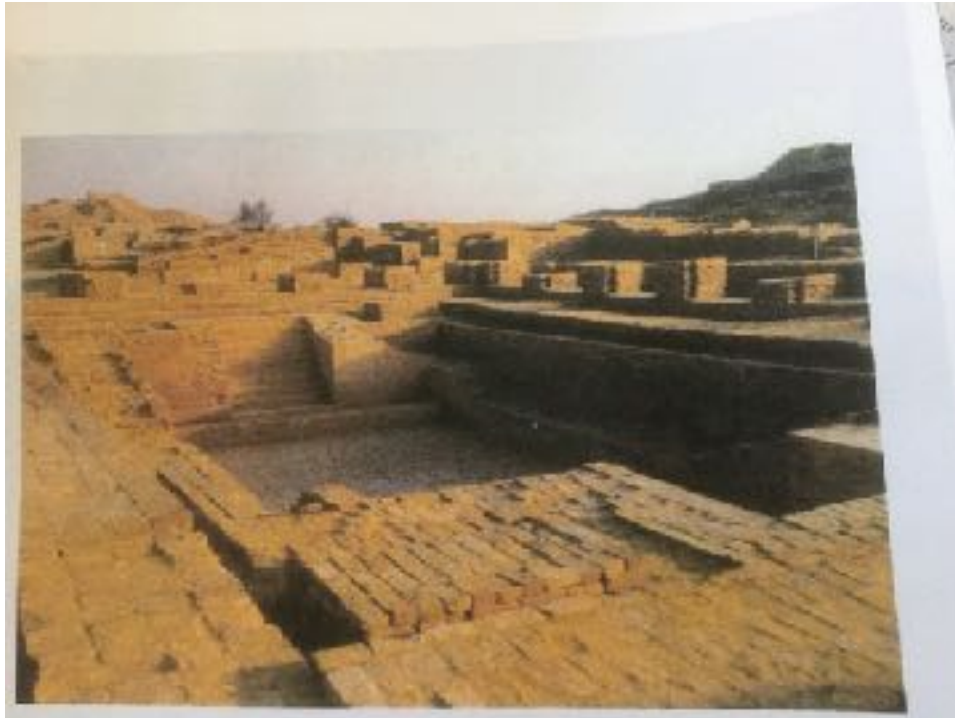


Fig. 5. Mohenjo-Daro - the Great Bath.
(Lawler 2013: 35)

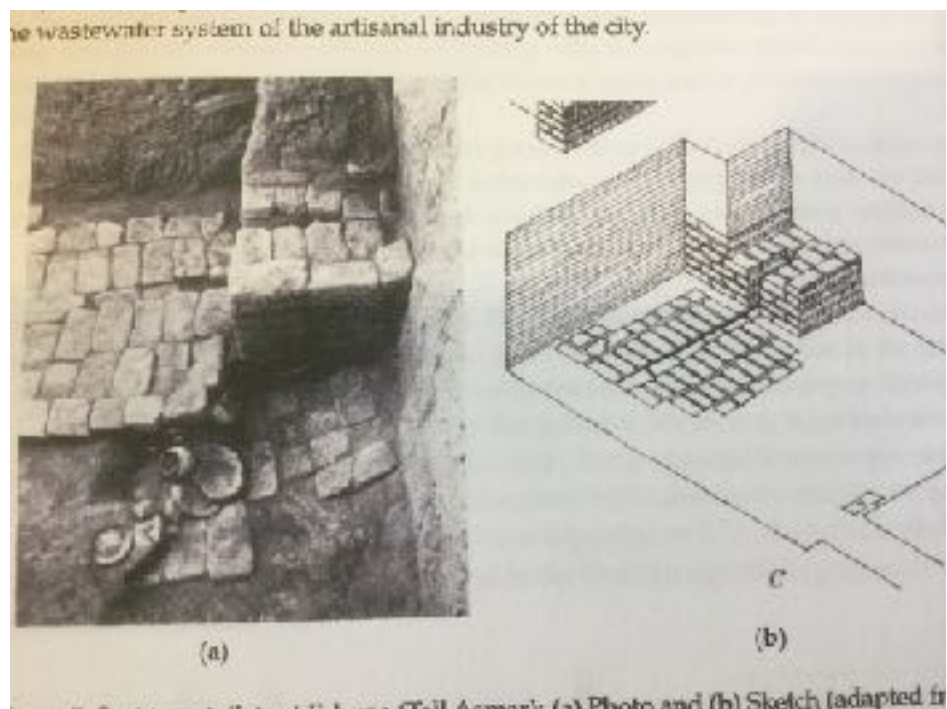


Fig. 6. Seat toilets at Eshunna (Tell Asmar).
(Antoniou et al 2016: 8)

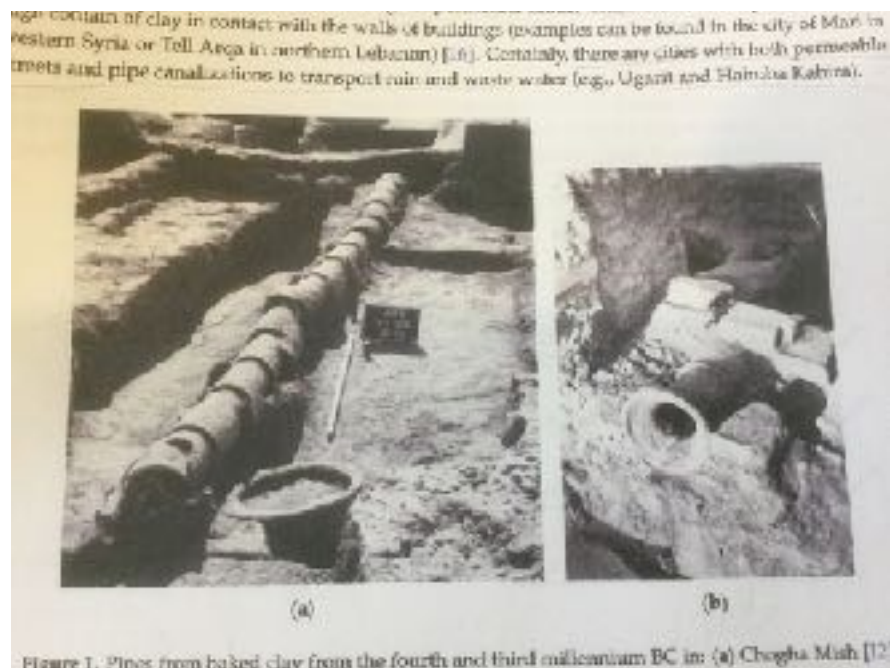


Fig. 7. Baked clay pipes from Choga Mish (L) and Eshunna (R).
(Antoniou et al 2016: 4)



Fig. 8. Main sewer from the Great Neo-Assyrian House, Assur.
(Bagg 2006: 274)

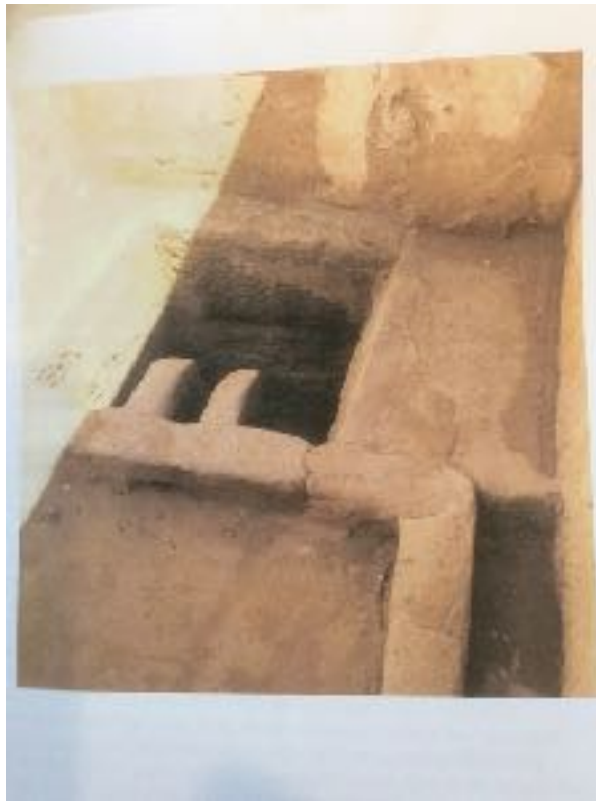


Fig. 9. Squat toilet and shower tray, Medinet Habu.
(Nioche 2015)



Fig. 10. Squat toilet and shower tray, Elephantine.
(Bridgeman Education 2018)

ABSTRACT

The response of British archaeologists, like Marshall and Wheeler, to the incredible discovery of cities in the Indus Valley which, uniquely across the known world at the time, had city-wide drainage systems and a majority of houses with indoor toilets and bathing facilities, was one of absolute amazement. It seemed to be the total antithesis of the typical action of a highly hierarchical society, yet all the early archaeologists, and many of the current ones, have been keen to stick that label onto the Indus Valley Civilisation.

So I wanted to find out more; to discover any possible rationale which would explain the differences between the Indus Valley and both Mesopotamia and Egypt, contemporary cultures which were both highly stratified and which seemed to have done little or nothing in the way of providing sanitation services for their populations.

The research was literature-based and included both primary and secondary sources. Some were not particularly reliable, as information on toilets outside of the Indus Valley was difficult to find, as they were often not a popular or interesting find for many archaeologists.

I discovered that all three civilisations did have toilets and bathrooms to some degree, however in the case of Mesopotamia and Egypt, they were all for the ruling class. Mesopotamia was more sophisticated, having the technical skill to build drains, but did not expand their drainage system much beyond the homes of the elites, even in later times. Although they did provide cesspits and wells in their cities, so there was some attempt at a wider provision of sorts. The Egyptians were different again, they even put toilets and bathrooms in their tombs, but provided nothing whatever for anyone not part of the ruling class.

When looking at possible influences on decision making with respect to the provision of sanitation, it became apparent that climate may have had some impact, but medical knowledge appeared to have little or no influence, at least in Egypt or Mesopotamia. However the political

structure of each location by far the strongest influence, with respect to what, if anything was provided - and to whom.

The evidence on the Indus Valley does make me wonder if they had any knowledge of cause and effect with respect to the link between good sanitation and public health and I have recommended this as a possible further line of research.

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Chapter 1 - INTRODUCTION

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"Again and again, there is nothing that we know of in prehistoric Egypt or Mesopotamia or anywhere else in Western Asia to compare with the well-built baths in commodious houses of the citizens of Mohenjo-Daro. In those countries money and thought were lavished on the building of magnificent temples for the gods and the palaces and tombs of kings, but the rest of the people seemingly had to content themselves with insignificant dwellings in mud. In the Indus Valley, the picture is reversed and the finest structures are those erected for the convenience of the citizens. ... The Great Bath at Mohenjo-Daro and its roomy and serviceable houses, with their ubiquitous wells and bathrooms and elaborate systems of drainage, evidence that the ordinary townspeople enjoyed here a degree of comfort and luxury unexampled in other parts of the then civilised world."

(Marshall 1931: Vol 1, p. v.)

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Overview

Every urbanised civilisation, no matter when it existed, will have had to deal with the practicalities of day to day life in an urban setting, which includes how human waste is managed. As soon as a large number of people are living in the close quarters of an urban environment, the options available in the countryside are no longer practical - or sanitary. The smell, the flies, the disease, can all become problematic issues as the population increases, and not every civilisation does a good job of dealing with it effectively, for a variety of reasons.

Certainly, when growing up in western society, we learn at school that our own, ostensibly advanced, culture has not managed this activity well until very recent times. Although the wealthy had some options not available to ordinary people - for instance, most late medieval castles had garderobes (Illustrations: Fig 1), and Queen Elizabeth I even had a flushing toilet in the 16th century (Landau 2009: 19) - the majority of people dumped their waste out of their windows and doors into the streets, into cesspits or into waterways, or buried it in the back garden, up until very recent times. The availability of well-constructed, effective sewers, and widely available flushing toilets, albeit out of doors for the less well-off, only occurred less than two hundred years ago (Landau 2009: 18-19). In fact, those of us who have owned older homes in Britain, know from personal experience that very many ordinary people's houses still did not have bathrooms or indoor toilets until after World War II.

So the discovery, only around 90 years ago, by Western archaeologists that nearly 5000 years ago, there were people in the Near East living in cities with city-wide, complex and sophisticated drainage systems, and indoor bathrooms and toilets, would have been surprising, to say the least. Also, uniquely to the Indus Valley, the vast majority of the citizens had all of this available to them, not just a rich and powerful minority.

The above quote from John Marshall, the excavator of Mohenjo-Daro, indicates the astonishment of those who made this discovery in a location which, until then, had been lost from human memory for well over 3000 years. The Indus Valley Civilisation (IVC) was and is both a surprise and a mystery. This is very clearly shown when looking at their waste management and public health system. The technology necessary to design and construct the sort of plumbing and drainage system the IVC had, in addition to the town planning skill to design the cities themselves, involved a high level of engineering and mathematical knowledge. This was no mere craft specialisation. Along with this expertise was needed

the will of whoever was in charge, whether individual or group. A formal decision was made, and it was one that benefitted the whole citizenry. It meant that serious resources were invested in the process, both human and material, in every major centre; the older ones, as well the newly-created. But this did not happen elsewhere, outside the IVC. I wanted to try to understand why this was so.

This paper has two aims:

1. The main aim was to take a closer look at the IVC, and its unique sanitation and drainage network, in order to attempt to understand why it was constructed. I also investigated both Egypt and Mesopotamia, civilisations both extant and functional at the same time as the IVC, in order to see how they dealt with their human waste during the same time period. I then attempted to discover, or at least hypothesise, a possible rationale for the differences between them, whether they may have made a pragmatic, social or political decisions, or even related to public health. It was not possible to draw any firm conclusions, as there is limited data available in some of these areas, particularly with respect to health and public health, but further possibilities for research have become apparent as a result of this work.
2. The secondary was initiate discussion about this subject, with the perspective of asking 'why?', not just describing 'what'. What people do in a particular situation is much more interesting when we can understand why, or at least attempt to do so, particularly when one group of people choose a totally different and unique way of dealing with a practical problem that every group has to manage. It can give a fascinating insight into how people thought and what was important to them, and what different influences they may have had to cope with, as well as what technology they may have shared.

Rationale

There have been a number of studies on the presence and use of drains and sanitation in a number of past societies. The main focus of most has been descriptive and/or comparative. Differences between contemporary cultures are apparent, but no attempt appears to have been made to understand why those differences existed. Yet clearly the technology was available at the time, or it would not have been used in the cities of the Indus Valley as well as parts of Mesopotamia, and it is known that there was contact between many civilisations at that time, Mesopotamia having contact, at least via trade, with both Egypt (Spencer 1993: 41,58) and the IVC (Kenoyer 1998 : 24-5).

It would be reasonable to assume that, whether or not the technology was shared, there were conscious decisions made by those in charge of each culture as to how they would manage their sanitary arrangements, by which methods, and for whose benefit. The key then was to look at the other options for dealing with human waste at the time, which one/s were selected by each culture, along with who was given access to them. Then to consider possible influences on the decision-making process in each case, in order to identify those which may have been most significant in each culture, and why this may have been the case.

Methodology

- a) Literature review: The starting point was a search of the available literature, on a range of subjects, not just sanitation and drainage. For this information primary sources from archaeological digs and books written by those who have worked the sites were an important focus. Also secondary sources, particularly those providing deeper analysis, which can sometimes provide more depth of information in the case of this particular subject. Toilets and sanitation are not usually the main focus for archaeologists so oftentimes this kind of information may be limited or absent, even in a published site report

or memoir. Consequently, outside of the IVC, information was much more difficult to find and secondary sources that focus on the subject of sanitation directly proved to be more useful in getting more detail, as were generic publications written for the mass market. However, not all secondary sources are created equal and some information was not entirely accurate. I aimed to find corroboration wherever possible, and noted this whenever I referenced one of these sources. The other research was around the various possible influences on each culture's decision-making process with respect to sanitation. Consequently I researched (mostly) secondary sources for information on relevant parameters: health, morbidity and mortality, political and social structure of each culture, and also climate and environment - all with a view to discovering whether the motivation behind each society's choices may have been practical, political or health-related.

- b) Analysis and comparison of results, then discussion and synthesis of hypotheses: using the information drawn from the research, I have drawn comparisons, and analysed and discussed possible hypotheses for the cultural differences.

Challenges:

1. There is a complete lack of information available from the IVC in comparison to Egypt or Mesopotamia. This is mainly due to there being no written records, along with our inability to read what we do have of their script. This hampered gaining concrete knowledge of their understanding of health and disease, as well as any direct understanding of their own perspective on their culture. I was restricted to reports on the archaeological record, plus secondary references and their analyses, in order to gain any clues about both areas of interest.
2. As mentioned earlier, the comparative lack of information generally, about sanitation and drainage, was an issue and what there was, was patchy. This is changing over time but sanitation was a subject that

was of passing interest at best (partly out of distaste in the case of earlier generations) to many archaeologists over the years.

3. There was limited information on knowledge of causation of disease processes in Egypt or Mesopotamia - and none at all for the IVC. There has been a small amount of research involving research on skeletal remains, trying to establish the sex, and their age at death, along with DNA testing aimed at discovering a cause of death and thus possible reasons for any trends in life expectancy.
4. As also mentioned earlier, there is incorrect information being presented in some secondary sources, including in the field of sanitation, which then puts into question the veracity of other information within those documents.
5. There is also an issue with synchronicity between the three civilisations, as they were not all at their height at the same time and, in the case of both Egypt and Mesopotamia, they had many periods of political change and fluctuations in fortune during their history. This included the time the IVC was at its height. So, whereas the IVC's timeline was a single life cycle, with no major deviation from: growth, height, decay, the variations in life cycles in the other two civilisations, due to political change, will have impacted many aspects of life. Certainly, as the centre of power shifted to different major centres at different times, the life cycles of growth and decay of the urban centres will have been chaotic, rather than linear. Therefore, while my main temporal focus was the time the IVC was at its height, I have noted historical fluctuations when comparing both historical and sanitation-related evidence.
6. I found there was an unconscious bias of many academics towards the belief that highly stratified societies were universal, which means looking for or assuming evidence which does not exist, as well as trying to make what evidence does exist, fit their pet theories.

Chapter 2 - BACKGROUND TO THE RESEARCH

Rationale.

This chapter aims to provide some background information. The first three sections contain a short overview of each civilisation. The fourth section gives a short overview of trade links between the three civilisations, while the fifth gives an overview of the types of toilet found at the time. The information included here is not part of the data collection, but will help to give it context.

Time period for the research.

The key civilisation in this research is the IVC, so the time period I focused on for data collection for all civilisations was the time that the IVC was at its height, which was approximately 2600-1900BC (Kenoyer 1998: 24-5), but I have extended the timeline where necessary to allow for relevant local information.

Indus Valley

Timeline and developments: The IVC began as a food producing culture across the Indus and Saraswati River regions, from the Himalayas to the sea. The earliest known major settlement was Mehrgarh, founded around 7000BC. Over the centuries the IVC slowly matured into a sophisticated society, which supported craft specialisation at an industrial level and a trade surplus from its agriculture. The civilisation reached its prime around 2600BC, with this stable period lasting for around 700 years during which time its major urban areas thrived and grew. Around 1900BC the civilisation began to regionalise and the cities and their infrastructure slowly degenerated, becoming more unsafe and less populated, until they were eventually abandoned. The IVC finally disappeared as a civilisation around 1300BC but, at its height, it encompassed territory from Iran to Afghanistan, including most of

Pakistan and a sizeable area of northern and western India, and the population may have totalled as much as a million (Lawler 2013: 34).

Urbanisation: At its height the civilisation had centralised into a society with well over 1500 cities, towns and villages - most located strategically near water sources, for agriculture and ease of travel as well as use by the people. Many of the large urban areas grew from earlier, pre-urban settlements, but both the matured and newly-constructed cities and towns were designed with an educated understanding of town planning, having streets oriented towards compass points, and standardised measurements for houses, rooms and bricks, while all large cities had city-wide water and drainage built in. Even in smaller centres, a formal, organised system for managing sanitation was in place. The residential areas consisted of mixed neighbourhoods with small and larger houses all together, indicating the lack of a strongly delineated class structure. There were status differentials evident in the archaeology, but not major ones. Houses for all were similar in quality and it appears that all citizens had a good standard of living, encompassing both lived environment and diet (Lawler 2013: 34; Jansen 1985: 165-7; McIntosh 2008: 209; Robinson 2015: 46-61; Ross and Steadman 2017: 179; 187-8, 192-3). Some major centres were Mohenjo-daro, Harappa, Dholavira, Lothal, Mehrgarh and Rakhigarhi and every city was surrounded by extensive hinterland dedicated to food production (Kenoyer 1998: 49-52).

Egypt

Timeline and developments: The society in Egypt evolved from groups of nomadic hunter-gatherers into a sedentary agricultural one. Holocene climate change brought a much drier climate resulting in a subsequent reliance on the Nile for survival, the Nile Valley being the only remaining reliably habitable place in Egypt. With a more sedentary society, the scene was set for development into a more complex, sophisticated and ultimately urban society. Irrigation and agriculture were already ongoing in pre-dynastic times, as was social stratification and trade (Filer 1995:

10). Egypt began as two separate entities, upper and lower, and there is some discussion about the timing of them first being joined - whether it was under Narmer in Dynasty 1, or 100 years earlier, during Dynasty 0 (Ross and Steadman 2017: 91-100). Hieroglyphics matured from pictograms into a full written language to support the growth of the state and its the control of taxation, resources and infrastructure. The building of monumental architecture was part of this control, especially the tombs, temples and pyramids which were linked with preparation for the afterlife for the ruling class, telling the stories of the state and the gods, and supporting the status quo and the state religion, which was central to life for everyone.

When the Indus Valley was reaching its peak, it was the time of the 4th dynasty in Egypt, so it was still relatively early developmentally. In the subsequent 700 years, the Old Kingdom ended, the First Intermediate period, a time of chaos and regionalisation, came and went, and the Middle Kingdom and 12th dynasty, with its strengthened, re-centralised civil service and administrative structure, had been in power for around 140 years (Knapp 1988: before preface). The height of the civilisation come with the 18th dynasty and the New Kingdom, by which time the IVC had almost disappeared.

Urbanisation: Egypt's long and colourful history meant that the creation, growth and decay of individual towns and cities changed over the centuries, due to changes in both leadership and power base, plus whether it was a united Egypt of Upper and Lower - and if it included Nubia. Union and extended borders tended to occur during times of stability under the rule of strong dynasties. At other times power regionalised and was more chaotic. This was often due to the failure of the Nile inundation and thus the crops.

In pre-dynastic times Naqada became an important centre, while in dynasties 1-2 Abydos and Saqqara were the heart of the funerary culture, which meant local elites in Abydos, and the ruling class in Memphis (near Saqqara), along with those who worked on the elites' tombs, were living

in the general area but, unlike their tombs, their homes were not built to last, so much material evidence has been lost over the centuries. During the Old Kingdom, centres like Memphis and Heliopolis in Lower Egypt and Thebes in Upper Egypt may have come into being, although there are indications that they may have pre-dated even this early time. Memphis was the capital of Lower Egypt more than once over the centuries, while Thebes came into prominence during the Middle Kingdom, due to its proximity to Karnak. Other cities also came into being in later times. Kahun began life as a workers' village for tomb builders at the time of the 5th Dynasty, growing in importance later on, while Amarna was created by Akhenaten during the New Kingdom and, along with Deir el-Medina, these three sites were the only urban locations which were planned, as opposed to growing organically, by accretion and encapsulation. Despite this lack of urban planning, Egypt was a highly urbanised culture, having cities, large and small settlements and small villages all connected to and overseen by the comprehensive state bureaucracy, while also having a strong agricultural focus, alongside varying levels of craft specialisation and state employment (Brewer & Teeter 1999: 66-7; Cox and Peel 1972: 29-30; Kemp 2006: 203-211; Knapp: 1988: before preface; Uphill 1988: 47-66; <http://www.ucl.ac.uk/museums-static/digitalegypt/themes/record.html#1>)

Mesopotamia

Timeline and developments: Urban cultures in this region developed from nomadic hunter-gatherers to settled agriculturalists. As the population grew settlements also grew and, in the latter part of the 4th millennium BC, urbanised centres began to appear. Key developments included the building of monumental ceremonial architecture, technological innovation, craft specialisation, metalworking and cuneiform script, which eventually became the alphabet for a range of languages across the region. The Early Bronze Age heralded the growth of Sumerian City States, when both Temple and Palace were powerful. This period began around 2900BC and

lasted approximately 600 years, so was still ongoing when the IVC was at its height. During this time, climate change and drought had an effect on most of the country and the state stepped in to develop and manage the massive water management projects which were necessary to support the growing agricultural endeavours, as well as craft manufacturing, and the exponentially growing population.

Urbanisation: Many Mesopotamian (Sumerian) cities and city states either came into being or grew during this time, including Uruk, Eridu, Ur, Nippur, Lagash, Nineveh and Kish. Sargon of Akkad then came to power, creating the Akkadian Empire, and his city of Akkad, while Ur and Kish remained major centres. Sargon was followed by his grandson, after whose death the empire collapsed, to be replaced by the third dynasty of Ur. They were Sumerian kings who ruled until the destruction of Ur, around 2000BC. City states battled for the next 100 years or more until, around the time the IVC was starting to decentralise, the Amorites became the founders of Babylon's first dynasty, which lasted for 300 years (Bertman 2003: 55-6; Knapp 1988: before preface; Ross and Stedman 2017: 64-72).

Trade links

The IVC: There were trade links by land and water across the region, into central Asia, Mesopotamia, Iran and the Arabian peninsula as far as the mouth of the Red Sea (Possehl 2002: 1). Indus seals and carnelian beads, along with IVC standardised weights, have been found in Kish and Ur. Shell bracelets, made from locally sourced shells have also been found in Mesopotamia and Oman, while trade records found in Mesopotamia refer to a land called Meluhha, which is believed to have been the IVC. There is currently no evidence of any direct or indirect trade connection between the IVC and Egypt (Kenoyer et al 2013: 2286; Wright 2010: 230-2, 336-7; <https://www.harappa.com/answers/there-any-evidence-trade-egypt-and-minoan-crete>).

Egypt: There is evidence that Egypt had trade links with southern Mesopotamia and Elam at least as early as the Naqada II period, and continued, in various forms and with varying trade partners, from then on, details of which are beyond the scope of this paper (Kemp 2006:74; <http://www.ucl.ac.uk/museums-static/digitalegypt/naqadan/chronology.html>).

Mesopotamia - was a major crossroad of trade between east and west, including into Anatolia, the Levant, Egypt and the Mediterranean, as well as Arabia, the IVC and central Asia. As well as found material evidence, their own cuneiform records provide much detail, but it is beyond the scope of this paper (Bertman 2003: 255; Knapp 1988: before preface).

Toilets and sanitation options

There are a number of methods for managing public and private sanitation which have been used across the millennia. Most were very practical and obvious and so it is not surprising that people in many cultures have used similar methods. In this section I will describe them, so that all the detailed information is recorded in one place, for comparison.

Go where you are. This is normally an outdoor option (i.e. not in the home), whereby individuals relieve themselves when and where they need to. This can be either in private or in public, varying with local custom.

Direct use of a receptacle. This is normally a domestic option and the receptacle can be anything from broken pottery containers, to specialised chamber pots or their equivalent. This can then be emptied in one of a number of locations, depending on local habitus. Most common are: a cesspit within or outside the home area, as fertiliser for crops, in the street, into local waterways.

Indirect use of a receptacle. This again is normally a domestic option, but includes the use of a seat, usually wood or stone, or a commode-style stool, beneath which is an empty-able receptacle, similar in function to a

chamber pot, into which the waste drops. All of the above options for disposal still apply for emptying receptacles.

Pit toilet. This usually consisted of a stone or wood seat, or stone footpad in the case of a squat toilet, set over a deep hole: either earth (or sand) closet or cesspit. This would allow the liquids to drain away, while the solids would build up until the pit was closed off and another dug, in a new location.

Indoor, purpose-built, water-flushable toilet, connected to external disposal facilities. This could be a direct channel through city walls to the external environment, a pipe or channel to an outside collection point or cesspit, or a direct connection to a public drainage system.

Chapter 3 - THE DATA

This chapter presents and comments upon data, and some theories, on sanitation and drainage provision, climate and environment, politics and culture and also health and mortality - for the IVC, Egypt and Mesopotamia. As previously mentioned, sources have been decidedly eclectic.

Archaeological Remains of Sanitation and Drainage.

Indus Valley: The vast majority of houses had water-flushed toilet (Illustrations: fig 3) with wooden seats, along with indoor bathing/shower platforms, most of which fed into brick-built, city-wide drainage systems (Illustrations: fig 4). This was the arrangement in all the large cities, which had a highly engineered network of drains situated under and parallel to the streets, two feet below ground level. These were lined with uniformly sized, baked bricks, which fitted together almost perfectly. They had u-shaped bottoms and were covered with stone slabs to facilitate access for cleaning, as the base of each drain was punctuated regularly with sumps, placed to collect any solid waste not caught earlier. There were also deeper cesspits at crossroads where drains met, which had steps down for access to clean. Pipes were earthenware, which were made to standard sizes with flanged ends to fit them neatly together and they were sealed with bitumen. The IVC cities also were well provided with wells. In Mohenjo-Daro there were at least 700, which equated to around one for every three houses, while some were actually located within houses (James & Thorpe 1994: 359, 362, 442; Jansen 1989: 17-180; Lofrano & Brown 2010: 5256; Webster 1962: 118-122). The smaller of the IVC cities did not always have the full sanitary provision of Mohenjo-Daro and Harappa. Dholavira, instead of drains, had jars and sumps, and massive water reservoirs as well. Rakhigarhi had both domestic and public drainage. Other major centres had variations on these provisions, but there was always something and it was provided for

the populace, not left to them to manage individually (McIntosh 2008: 209-217).

Egypt: The earliest known surviving toilets are within 2nd Dynasty tombs at Saqqara. Toilets and bathrooms were built within the actual tomb structure near to the burial chamber, for use in the afterlife (Emery 1961: 129). Cox and Peel (1972: 32) describe the toilets as 'sand latrines', which would equate to a pit toilet. As the afterlife was meant to echo everyday life, even the subterranean tombs were created to reflect a house plan, complete with rooms and contents - all ready for the deceased to enjoy. Unlike tombs, homes were not usually stone or subterranean structures, and have not survived so well, hence the comparative lack of domestic evidence until later times.

A surprising find was metal pipes in Pharaoh Sahure's mortuary temple in Abusir. Dated around 2450BC, in the 5th Dynasty, they were approximately 400metres long and made from folded copper sheeting (James & Thorpe* 1994: 362). [*This book is a generic publication for the general public, but there is corroboration.] Verner (2017: 89) refers to 'an ingenious drainage system' that included reservoirs for both run-off water and rain - which also included 'metal' pipes. These reservoirs were located in the offering hall, as well as other areas in the temple. This begs the question about their overall function. Being included as part of the drinking and bathing offerings for the afterlife seems logical, particularly as it would be a regularly refreshed supply, but further research is needed. Certainly this proves the Egyptians had this kind of technology.

Evidence of toilet facilities from later times has also been found. Houses in Amarna, from around 1450BC, had stone toilet seats underneath which would have been placed an empty-able vessel, and they also had earth closet-style toilets (using sand) while, in Deir el Medina, at around the same time, the tomb TT8 (O'Connor & Cline 1998: 118), that of Kha, the director of the Royal Works in Deir el Medina, contained a stool commode

(James & Thorpe* 1994: 443-4). Antoniou et al (2016: 2) also mention both Abusir and Kha - and their information is more detailed - but their only reference is James & Thorpe*, so it appears that they have somewhat embroidered the information, or not included all their sources, despite it being footnoted. They describe 'cesspool lavatories indoors in wealthy houses and temples' in 'Ancient Egypt' (no dates), while outdoor cesspools were available for poorer people. They also say that sand was used to cover the evidence or else it was taken away and used for fertiliser. But they have not referenced any of it. This is the sort of issue that comes up time and again as so little professional archaeological work has been done in this area.

There has also been found the stone footplate of a squat toilet and shower in the model palace at the temple of Rameses III at Medinet Habu, built in the 12th century BC (Illustrations: fig 9), and in Elephantine, also built in during the Middle Kingdom (Illustrations: fig 10). No evidence of what was beneath it was visible, although probably a pit. Was it meant to be used and, if so, by whom? If only a model, surely it would have reflected palace reality, since elite houses have been found with superb facilities. Lofrano & Brown (2010: 5256) detail Breasted's 1906 description of sanitation facilities, from around 2100BC. He describes elites' houses as having limestone toilet seats and shower stalls, linked via drainage channels through the outer wall of the house into the sand, or a vessel, which would presumably be emptied by someone of a lower social class. Those who were not part of the elite class, but still well-to-do, often used the same commode system as in Kha's tomb. They had to dispose of the contents themselves, and this were usually emptied into cesspits outside the walls of the home, or into the streets or local waterways.

Apart from the elites, people in Egypt had to make their own arrangements for disposal of their wastes. According to Dixon (1989: 194), people pretty much did what they liked, where they liked - including in the streets, village ponds or watercourses - or the open desert, where

the sun would desiccate the evidence fairly quickly (Illustrations: fig 2, for example of broken pottery for use as receptacle).

Mesopotamia: Lofrano and Brown (2010: 5256) describe Mesopotamia, between 3500 and 2600BC, as being the first civilisation to take formal steps to deal with urban sanitation. In later times, both Babylon and Ur had elite homes with indoor toilets with terracotta ring-drains lining 10 metre deep shafts dug into the ground. Some houses also had ring-drains in the courtyard for run-off, and waste water. Only 6% of the houses in Ur had these; the ordinary folk were not catered for, either for sanitation or fresh water. So the poor had, by necessity, the same throwaway habits with their personal waste as Egypt: out into the streets, the waterways, or the fields (George 2015: 76-79).

According to Antoniou et al (2010: 3-7), sewer pipes were present from as early as the 4th millennium BC at Tell Asmar, and Choga Mish (Illustrations: fig 7). These pipes took water-flushed sewage, from elite residences, outside the walls of the city. There was also a sewer in the area where royalty lived in Ugarit, in northern Mesopotamia. Sewage went outside city walls if it was from elite residences, into cesspits for the most part for the rest of the population who had access in later times, or else into gutters in the streets. They note also that, in Ugarit at least, the cesspits in the city were often located very close to wells. Otherwise wastewater and rainwater were kept separate within separate 'conduit' systems. Generally, cesspits dealt with the majority of human waste in Mesopotamia, as the remains of them have been found across the entire region.

The palace at Mari, which was founded around 2400BC, had bathrooms complete with two baths and simple, squat toilets (of the kind still in use in the middle east today) as well as toilets with seats. The toilets fed into a cesspit below or nearby, via a sloping conduit that fed into the street or a canal. There were also floor drains feeding into ceramic pipes which, even when rediscovered in recent times, were still in working order. The

system in Eshunna (Illustrations: fig 6) was very similar but with brick-built sewers and Akkad also had them (Illustrations: fig 8) (Antoniou et al 2016: 6-7; Gray 1940: 939; McMahon 2015: 23; Mendenhall 1948: 8). In Nuzi, which was founded by the Akkadians in the late 3rd millennium BC, the palace contained bathrooms, including toilets which were flushed using rainwater, the result of which flowed into brick drains that were lined with bitumen. These flowed into larger drains which led away from the mound on which the palace was built. These drains had regularly placed shafts enabling access to clear any blockages, so were very similar in standard and design to the IVC, but only for palace residents (Starr 1930: 183-4, 189-90). According to McMahon (2015: 19-30) some cities, over time, developed a small-scale sewer system which serviced up to around 35% of the population, so not just for the elites and perhaps a result of a growing middle class.

Climate / Ecology

Indus Valley: Climate was temperate and semi-arid in the more riverine south with its massive alluvial plains, and colder and drier in more northerly areas, where it was bounded by mountains to the north, east and west. It was watered by monsoon systems in summer and winter, triggered by the presence of the Himalayas, resulting in seasonal river flow and alluvial run-off providing rich soil which made the area very productive all year around. Because of the distance and different geography across the IVC region, it meant that if one area was in scarcity, it could be supported by the others. It was a breadbasket 5000 years ago and its produce was a big part of the IVC balance of trade. However new research has recently discovered that there was a 900 year drought, affecting rainfall in the north west Himalayas, from 2350BC, which was the cause of the decline and eventual fall of the IVC (www.archaeologynewsnetwork.blogspot.co.uk/2018/04/900-year-drought-ended-indus.html; G.R.Schug: www.harappa.com/answers/

what-do-we-know-about-ecology-indus-valley-and-adjacent-areas-during-period-which; Wright 2010: 334-7).

Egypt: Climate change during the Holocene from more temperate to hyper-arid climate, which has remained the case since early dynastic times. Nile River yearly floods totally dominate life, and are dependent on rains upriver in sub-saharan Africa. All humanity, apart from nomads, live near the river. The Nile brings water and nutrients with the yearly floods and rich, fertile silt. Egypt is able to grow crops and to thrive as a result. Floods have not always been reliable and periods of drought have led to political instability, as the Pharaoh was held totally responsible for the yearly inundation (Brewer & Teeter 1999: 17-25).

Mesopotamia: The Tigris and Euphrates Rivers dominate and their flooding and silt deposition changed the landscape regularly. Some of the major cities sited on the alluvial plains were affected by both alluvial deposition and naturally-occurring changes in river's path. Drier climate before and during the time considered meant southward migration, and the need for sophisticated water management, including the construction of canals, in order to sustain agriculture, industry and life (Bertman 2003: 3-4).

Political / Cultural Background

Indus Valley: It was a civilisation unlike others at the time. It had some of the usual hallmarks, like craft specialisation, monumental architecture and a large scale economy which traded widely, but no massive palaces, no monumental temples and no hoards of weapons, despite having metal tools and metallurgical skills. The civilisation itself covered a massive area of over 1,000,000 square miles and encompassed a diverse population. Yet it appears to have been a civilisation, or state, which had the sociocultural features of a co-operative heterarchy, despite being both

urban and sophisticated, as demonstrated by their town planning and engineering expertise.

There is some argument about the use of the word 'state' when describing the IVC. Usually the 'state', is an entity within a civilisation - the organisational and controlling arm of the ruling class. Very visible and very powerful and often populated at the top levels by the priesthood along with, or in lieu of, members of the ruling dynasty. A 'state' under this definition also will have a stratified, expert, careerist bureaucratic class administering the business of those in charge, controlling resources at home, commissioning the temples, palaces and tombs, controlling the food supply, the trade and the taxes. The display and use of force is the main means of social control and of conducting international relations, when deemed necessary.

However the IVC has none of these features. It was certainly organised, and the standard features of the society (drains, indoor facilities, weights and measures, etc.) were evident across the entire region, but there is no evidence of any imposition by force. It seems more likely that each of these aspects worked for the greater good of the community, and so were adopted as a matter of course, being a practical solution to a community problem. And sanitation was not the only public service provided for the community. Gray (1940: 940) reports that houses also had chutes for rubbish, which fed into bins in the street, and there were also public rubbish containers in the streets as well. Just like the drains, it was a practical provision for the benefit and use of all and, again, unique to the IVC. There was obviously political and community will to create and maintain the infrastructure of both the cities and the wider civilisation and there is no evidence of coercion.

As for who was in charge of making this happen, there appears to be a theoretical fixation on priests, kings and obsessive control - as if this is the only viable system. But was this the case? There could easily have been a cross-community kinship or a craft guild-related structure; somewhat stratified, as suggested by Kenoyer (1998: 44-5), but one

whereby people with the appropriate knowledge, experience and ability shared in decision-making and oversight, within and across regions, taking responsibility for the whole community, and acting for the benefit of the many, not just the few...

Every successful society needs functional adults working within an organisational structure, and with a strategy, to keep things running smoothly, but its form does not have to be abusive or coercive to achieve community goals, neither does it have to include massive inequalities in status. It has also been suggested that the IVC was, perhaps a little more realistically, a co-operative of city states, with five 'polities' being the central regional points of shared overall organisation and responsibility for things like sanitation, water management, trade, weights and measures and civic order, alongside local management and decision-making ability with respect to local issues and conditions - perhaps it may have even been a federation (Possehl 2002: 56-7; Ross and Steadman 2017: 192-202; Wright 2010: 329-36). More evidence is needed.

Kenoyer goes on to suggest that house size and complexity also indicate social stratification, and perhaps it does to some extent, or perhaps the larger constructions indicate an extended family or craft guildsmen all under the same roof. The use of seals was also posited as proof, but they may well be regional or craft-related, rather than individual, as trade within and without the IVC was a major source of revenue and goods of exchange. More evidence of this is also required.

There is also a theory: 'wasserluxus' (water splendour), posited by Jansen and supported by Possehl (2002: 57-58; 2005:69-83), which suggests that the strong focus on provision of clean water, and disposal of waste water, along with the existence of the 'Great Bath' in Mohenjo-Daro (Illustrations: fig 5), means that there is some kind of hierarchy-driven, symbolic and ritualistic philosophy surrounding the idea of water management and what he believes to be excessive cleanliness. He suggests that this formed part of a new philosophy of self-identity and group affiliation, moving on from the earlier sociocultural norms of

farmers and pastoralists. The theories of Ernest Mackay were often referenced by Possehl to support his arguments, but Mackay was an archaeologist who excavated in Mohenjo-Daro in the early days. He was of the same generation, and had the same colonialist world-view, as Marshall and Woolley. Their default was to see archaeological remains as proof of an elite-driven social hierarchy. One theory, that the Great Bath, being set in a separate, higher section of the city away from the main residential area was 'reserved for the elites of the city' (2002:57). But the high mound contained community-related buildings generally, and if everything else water-related was available for the entire citizenry, why not the Great Bath? An assumption too far, I think, without further evidence. Symbolic ritual, focused on regional bonding, there may have been, but there seems no reason to assume it was selectively practised. He also mentions the hiding away of waste water and its disposal, as if it is part of a cleanliness fetish, instead of sound good sense. The stench, the flies, the rats, and attendant disease, are surely enough reason for anyone to dispose of sewage quickly and effectively, as far away from people as possible.

The idea of body regulation has also been raised, with respect to the location of toilets and bathrooms in IVC houses (Rizvi 2011: 230), but while this control theory works very well for some contexts, I think she is stretching the metaphor too far in this case. There is no evidence that the agenda was about body control and regulation, the choices were purely pragmatic and practical. Toilets stink. Logically toilets would be secluded in the home so the smell (during and after) was less likely to pervade the rest of the building. More importantly, they were located alongside walls which faced onto the streets, which was where the drains were. Because it was the shortest journey for the liquids and solids from bathroom and toilet to the street drains, so much less water is needed to wash the poop through the pipes, only a small gradient is needed for such a short journey, and there is much less likelihood that anything would get stuck in pipework within the precinct of the home. Basic plumbing 101.

Scarborough (2003: 145-6) also tries to mansplain the Harappans' pragmatic, all-in-it-together sanitation choices as 'practising a monastic-like control of community resources', in a feeble attempt to claim the existence of hardline, hierarchical, societal control, as if this kind of system is the only option available. But it could just have been that they were thinking like women, or farmers, and making sure that society worked for everyone - without resorting to smiting, or its monastic equivalent.

Egypt: Egypt was clearly a stratified society with the pharaoh at the pinnacle, as befits a living god, with the rest his family, priests and elites below him in levels of importance and power, including senior court officials, scribes and those at the top levels of the administrative structure. Egyptian art, in tombs and temples, always presented a very clear and unmistakeable image, for all to see, who were the gods' favourites, who was in charge and doing the smiting - and who was dirt under their feet (<http://www.ucl.ac.uk/museums-static/digitalegypt/social/index.html>). State bureaucratic administration is a key part of a stratified society, being the structure that keeps it together and functional, and even in the Old Kingdom, Egypt's administrative systems were comprehensive and managed from the top down. Their priorities were temple and tomb building as well as control of the granary, taxation and treasury. At local level the nomes were in charge of the local lower level functions, including the local granary and treasury-related activities, and they reported back up the chain of control. During the First Intermediate period this system collapsed and regionalised, but was tightened up, with more over-arching central oversight and management of local level activity, during the Middle Kingdom. However that period of decentralisation provided a major impetus behind a slow but sure development of a new sub-stratum of society - a middle class of professionals, craftspeople and merchants, with the means to pay for

what they wanted. And that included toilets. (Richards 2005: 7; <http://www.ucl.ac.uk/museums-static/digitalegypt/administration/index.html>)

Mesopotamia: They had a stratified society with royalty, priests and wealthy elites at the top. Kingship was bestowed by the gods, and kings were beholden to them (Bertman 2003: 62-3). Many documents have been discovered which give an insight into the beliefs and priorities of those in charge and, like Egypt, a very strong and stratified state bureaucracy was managing affairs. In this instance, the major civic priorities involved building city walls, building and refurbishing canals for irrigation purposes and, most importantly, building and maintaining temple complexes. So the main focus was keeping the elites visibly in power and the economic engine running smoothly. There is no written or physical record of any public works undertaken for the wider community, such as clean water, paved streets, sewers or toilets (McMahon 2015: 19). However, over the centuries, the make-up of society changed a little. Prosperity, driven by trade and craft specialisation increased social mobility, created a new middle class and, as with Egypt, this group of people had the means to improve the quality of their lives, including domestic sanitation (Richards 2005: 15).

Public Health, Medical knowledge and Mortality information

Cox and Peel (1972: 31-34) list some diseases which can come from living in insanitary conditions, such as: tuberculosis (of the spine or lungs), smallpox, typhus (from lice), typhoid, plague (from black rats), dysentery, hookworm, malaria, bilharzia (schistosomiasis), and recent research on the DNA in ancient skeletal remains shows that Hepatitis B may also have been prevalent in this, and connected regions, the past (<https://www.nytimes.com/2018/05/09/science/ancient-dna-bones-hepatitis.html>). There is little or no evidence currently available to confirm the presence or prevalence of most of these diseases, but that does not mean they were absent. What we also do not know is how much

each civilisation knew about disease transmission. But one thing that was very apparent in both Egypt and Mesopotamia, was the higher up the social structure you were, the greater the distance between your living and working quarters and the location of accumulated human waste - both your own and everyone else's (Rizvi 2011: 226).

Indus Valley: Due to the lack of any written material (or our ability to read it) we do not know very much about what the people of the IVC knew with respect to health care or public health issues. The ubiquity of their city-wide drainage systems, and the separation of the drains from their clean water system, and their desire to be clean, indicates that they may have had a cause and effect understanding around the connection between polluted water and disease, but we do not know for sure. The only information we have is from a limited number of skeletons from Harappa, which have been scientifically studied. From them we have gained a little, limited information on life expectancy, along with some causes of death, which illustrate the changes in society at the end of the mature period, and show a difference in mortality rates between earlier and later periods.

Three burial populations were studied, from cemeteries known to be from different time periods: urban (at its height), post-urban (when the civilisation was winding down), and some bones from an ossuary from much later again. The prevalence of disease was compared using non-specific infection, maxillary infection (dental disease), leprosy and TB as parameters. In every case, the urban period burial population showed the lowest incidence and, in the case of infection and TB, that was almost nil. The difference in age at death was also significant, with infant deaths and young adult deaths increasing in the later times, along with a massive decrease in the number of older adults, which possibly means there were less people surviving into old age (Schug et al 2013: 1-5). These results appear to show that the sanitation system had broken down along with law and order and it suggests that the city-wide drains could

well have had a major, positive effect on both health and longevity in the IVC.

Egypt: The Egyptians saw health care as a combination of art and science: the science of observable cause and effect (if the cause was observable), and the art of treating health problems believed to have a supernatural cause, and remedy. Certainly, in the case of bacterial infection after the trauma of an open wound, the symptoms were known in detail, but it appears they were seen as part of the picture of having an open wound. It did appear that they were aware, in some cases, of something entering the body and causing change, but not the actual source of it. Rather, they saw it as the 'breath of god' (Nunn 1996: 59-60). With respect to public health, the Egyptians were known to drink beer in preference to water and were fastidious about cleanliness, at least at elite level. They also used kohl around their eyes both as an anti-glare agent and a fly repellent. Whether they knew that flies were the vectors of disease that could cause eye disease and blindness is not known, and there is no evidence to suggest that they made any link between human waste in the water and infectious disease either (Allen 2005: 9-11; Booth 2011: 20, 26). Much of our knowledge of their mortality information comes from human remains and from that information it appears that from the Naqada period right through to the Second Intermediate period, there was a high level of maternal death during childbirth and a very high child mortality rate - both of which crossed all social classes. There was another spike of high mortality between late teens and late thirties. It was still relatively elevated between the age of five and the late teens, but after forty dropped off considerably, which may have been due to there being less people over forty left in the population (Kontopolis 2018: 1; <http://www.ucl.ac.uk/museums-static/digitalegypt/age/agedeath.html>).

It is known that there were individuals in the elite classes and the royal families who lived to great old age, even into their nineties. A higher

standard of living, both with respect to access to sufficient, good quality food and also the desire and facilities to keep the body clean may well have been the reason. But the elites, certainly royalty, are known to have had very poor dental health: worn teeth, severe periodontal disease and abscesses, due to their rich and sweet diet, a connection that seems not to have been made by their doctors. However evidence shows that the ideal life span, in the Egyptians' view, was 110 years - but whether this was based on hope or experience is not known (Filer 1995: 94; Kontopolis 2018: 3-5; <http://www.ucl.ac.uk/museums-static/digitalegypt/age/agelifespan.html>).

Mesopotamia: The culture was well endowed with medical texts, doctors, surgeons and spiritual healers. They had no diagnostic philosophy, rather a description of symptoms and treatment thereof. They had a negative view of cesspit toilets and rubbish piles, because the smell led them to believe these places were inhabited by demons with a bad attitude. However a text from Mari's palace archive recommends not drinking from the same cup as someone who was unwell, and a medical text recommends not touching the eyes with dirty hands, both of which were to avoid transmission of illness. I found no other evidence to demonstrate that they had any other knowledge of disease transmission or public health issues generally. Rather, illness was blamed on angry gods or deceased relatives with a score to settle (McMahon 2015: 21). Mortality information is limited but, based on two small samples of skeletons, it seems that life expectancy may have deteriorated over time, or between differing regimes. In 4th millennium Ubaid, 34% of the skeletons studied were from people over 60, while in a sample from Early Dynastic III period Kish, the average age at death was only 28 for women and 30 for men, while only 8% of the skeletons had belonged to people over the age of 35. Whether this difference between samples was due to urban environmental causes, war or disease is unknown (Curchin 1980: 61-2)

Chapter 4 - SUMMARY

Technology	Indus	Egypt	Mesopotamia
drains	- city-wide, for everyone - most large centres - took waste outside city	none	- individual elite houses, small neighbourhoods later - took waste to cesspits or outside city
indoor facilities	city-wide, for almost everyone - water flushed	for royalty and elites - living and dead - not water flushed	for royalty and elites - some were water flushed
cesspits	smaller cities and towns	unknown, but likely for non-elites, if they existed	- individual elite houses, - city-wide for public use
earth/sand closet	as for cesspits	elite homes and tombs	see cesspits
pipework	to drains and cesspits also for clean water	for clean water runoff	- to cesspits and, where available, drains. - clean water runoff
receptacle - indirect, with seat	not known, but perhaps domestically in some smaller cities and towns lacking drains.	part of elites' indoor facilities, emptied by servants	possible for non-elites - would empty into city cesspits
receptacle - direct	not known but unlikely unless in an emergency.	used indoors by the poor, emptied outdoors	probable for non-elites - would empty into city cesspits
seat / squat / commode	seat	all three - for royalty and elites	seat and squat - for royalty and elites
go where you are	not in cities - they had public toilets	the main option of the poor - the street, pond, watercourse, open desert	not known, but possible in locations with no city cesspits.
other	- in-home shower platforms for most - Great Bath in Mohenjo-Daro - hundreds of wells + water reservoirs	shower platforms for royalty and elites - in homes and tombs sunken baths in some homes, Middle Kingdom Kahun	- elites had baths, sometimes two of them - had rainwater management system and wells
For whom, and whose responsibility?	For everyone - by the community's governing body	For the elites, by the elites.	For the elites, by the elites.

Discussion

Looking at this summary it is clear that there is a major disconnect between the IVC's solutions and those of Egypt, with Mesopotamia falling somewhere in between, but nearer to Egypt. All of them had the knowledge and capacity to provide the basics for toileting and bathing -

up to at least cesspit/earth closet technology. They all had some kind of clean water management systems, they all had toilets and bathrooms, at least for some of the population - and both the IVC and Mesopotamia had the knowledge and capacity to build water-flushed drainage systems, but not everyone had access to them in Mesopotamia. And all three civilisations changed in some way, over the centuries, with respect to people's access to these kind of facilities.

There are obviously some questions to ask.

Why did Egypt not appear to have the technology to build drains, despite being able to construct effective pipe systems? Was it because they were not aware of it, or because their climate did not allow for the extravagance of a water-flushed system, or was it because those in charge saw no need for it? The needs of the elites may well have been perfectly satisfied by the more basic system they had in place and perhaps they saw no need to change that, or any necessity to provide any sanitation solutions for anyone else. Perhaps the cost and logistics were also a major issue. Not just because of their general spending priorities, but because the majority of their cities grew from small villages, subsuming the surrounding countryside, along with other settlements, from very early times. So putting in underground drains may have been a logistical impossibility, particularly when added to a probable lack of perceived need to do anything at all for the wider community. As for the growing middle class, as time passed, they began to copy the elites and made their own more sanitary arrangements, both at home and in their tombs, while nothing changed for the poor. However, leaving the poor to live in their own (and everyone else's) muck is the rule rather than the exception in most highly stratified societies, and would not have been seen as anything unusual.

And why did Mesopotamia, having apparently had the technology first, choose not to provide it city-wide? Even as time passed and the drains

emerged from being palace-only, connecting up the elites and, to a small extent, latterly a wider group of citizenry, they were never made available to all - but why were they extended at all? Was this because generous individual rulers made the choice to extend it as far as it did go, while others saw no need, or was it due to the growth of a middle class with a small voice in local government, or the material abundance to fund their own connection to the elite system? Was it the cost and logistics of putting in a full system? Was it because, for the elites, it was not their problem; that the ruling class, being effectively separated from the ordure, meant that it was an invisible issue? Or that they believed cesspits, and living near them, were more than enough for the lower classes? Or could it have been because the further away they were from shit, the higher their perceived social status, so providing high quality facilities for all, meant that their status might be lowered? And - did they come to learn, over the years, that those people who were separated from human waste got sick less often, or died later in life? Could that have been the reason that some of the drains were extended to provide for at least some others - whether extended family, friends or other favoured individuals?

Then there is the IVC. They had the technology, and the will, and they actively chose to make the decisions that created a most unique and humane solution. Why did they do everything so differently, was it an idea of shared humanity, control freakery, pragmatism or something more?

Chapter 5 - CONCLUSIONS

Any unmet need has to be recognised as such, and deemed important enough to address, in order for a decision to be made to meet it. This is as true on a personal level as it is on a national one. In a highly stratified society, where the ruling class is populated by individuals who have known only personal privilege, the elites generally perceive those beneath them socially as having little or no value, other than as a source of cheap labour, or war fodder, and there is little or no understanding of the sort of lives they live. Therefore any need they may have will be only be perceived, and addressed, if it is relevant to the agenda of the ruling class.

Based on my research, I believe that, while all three civilisations had technical capacity to undertake large water-based civic projects, and both Mesopotamia and the IVC had the actual knowledge and skills to construct a full drainage system, only the IVC perceived the unmet need of the entire community and chose to meet that need. And it was due largely to their differing social systems. However I also think that it *may* be possible the people from the IVC who made those decisions actually did have some kind of cause-and-effect knowledge about the spread of water-borne disease. Too many things do not add up otherwise.

In the case of Egypt, their arid climate, along with the randomness of many of their main centres would preclude any idea of providing a comprehensive drainage system even if it were considered. But it is very apparent from the evidence that the only choice made to collect and/or remove human waste, and to provide bathing facilities, was for and by the upper echelon of the ruling class. No drains were involved, just some form of seat and receptacle or sand closet, while servants dealt with the results. From the Middle Kingdom the evidence shows that the growing middle class were also able to provide for their own needs within the

home as well, removing them from the 'go where you are' cycle of living among waste, smell, and worse, to which the rest of the population remained exposed.

Mesopotamia, having a climate and physical geography similar to the IVC, had more water to work with and the knowledge and capacity to build drains, flushable toilets and pit toilets, and to install pipes and create both wells and cesspits. The drains, again for the highest elites, extended a little over time to include a few more people, while the rest of the population, in some areas at least, had access to the cesspits and could, if they chose, empty their waste there. But, like Egypt, the streets and waterways were still the main option for the poor as well as for emptying receptacles. The need was perhaps recognised by some, but not all, and provision still was not for everyone.

But the IVC was vastly different. Apart from the lack of palaces, temples and smiting equipment, they had both the perception and will to meet the needs of everyone in their urban communities, with respect to both sanitation and bathing facilities. This does not indicate a highly stratified society, or a highly controlled one, but a sensible and pragmatic one. When you consider all these things that were important to them, each is also important in modern times for the prevention of disease and promotion of good health. In many countries it is normal to bathe most days and not to live among your sewage - because we understand the consequences of not doing these things. And, just maybe, the people who made the decisions in that place, at that time, knew this, and put the systems in place for the benefit of the whole population. Certainly the mortality information demonstrates the difference between when the system was working and after it fell into disrepair. We need more information.

Recommendations

It was interesting to discover the similarities and differences between locations with the way they dealt with their waste, and to confirm how unique the IVC truly was, but it became clear that many researchers still are looking to prove the existence of a hierarchical society, generally based on very thin evidence. But, while I agree that all societies will have some level of stratification in order to be functional, I suggest that, in the IVC, it was comparatively limited, and based on maintaining stable community organisation and cohesion rather than the imposition of any heavy-handed control system, particularly a self-interested, elite-driven one.

The evidence presented so far, I believe, is not sufficient to justify the other assumptions made. I would want to dig deeper into the known evidence and the archaeology with an open non-hierarchical mind, along with more scientific and DNA research into both skeletal remains, and the contents of their drainage systems, in order to discern more possibilities about the behaviour of the civilisation and to discover any further evidence to support the health benefits of their choices.

Certainly, I would want to discover whether there is cause to consider whether my mutually supportive federation model has any other evidence to support it. I would want to learn more about how agricultural societies worked, and also female-led, goddess-worshipping societies, so as to identify any evidence of their philosophies having been in play.

Agricultural because they tend to be mutually supportive, and female-led because looking after others tends to fall to the women in most communities, so it would be interesting to discover the depth of involvement of women in both the religious and organisational structure in the IVC - and to assess whether this may have had an impact on how the society functioned overall. But if either does not fit the evidence, to look for alternative possibilities to more completely explain the unique and human choices these people made for the benefit of all in their community.

Chapter 6 - APPENDIX



Definitely more research needed!
(Facebook - Petrie Museum Unofficial Page)

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www.archaeologynewsnetwork.blogspot.co.uk/2018/04/900-year-drought-ended-indus.html (Note: this blog post is reporting on an article, by a group of scientists at the Indian Institute of Technology at Kharangpur, which is soon to be published in the Quaternary International Journal of Elsevier.)

www.bridgemaneducation.com.ezproxy.uwtsd.ac.uk/en/asset810469/summary Picture of shower and squat toilet in Elephantine, from the Middle Kingdom.

www.harappa.com (Note: This website is dedicated to the IVC, but is not a 'fan site'. All the main academics working in the area are involved in providing and supporting the content, and in the Q&A pages.)

www.icl.ac.uk

<http://journals.plos.org/plosone/article/file?id=10.1371/journal.pone.0195481&type=printable>

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