

SOCIETAL CHANGE AND SUSTAINABILITY WITHIN THE CENTRAL PLATEAU OF IRAN: AN ARCHAEOLOGICAL VIEWPOINT

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Introduction

Archaeologists and ancient historians have traditionally explained examples of societal collapse and cultural discontinuity, and engaged in more general discussions of the long-term viability of communities, with reference to external factors, be they invasions, migrations or natural disasters, rather than through attempts to identify continuity in populations, ideologies and technologies.

Perhaps the most famous example of a collapsed past civilisation is that of the Roman Empire, whose demise was traditionally attributed to invasions of Visigoths, Vandals and Huns following a general decline in civic and military standards (Gibbon 1841). Subject to a heavy degree of romanticisation by Victorian scholars, in reality the Roman Empire continued to flourish in the eastern portion of the Empire for many more centuries, albeit in a slightly different guise, and the western areas had already been overrun several times before they were finally lost (Tainter 1988: 11). Likewise, the palatial Bronze Age Minoan Civilisation of the eastern Mediterranean was originally thought to have rapidly collapsed after a series of earthquakes, tsunamies and ash clouds associated with the eruption of Thera c. 1500 BCE, coupled with the expansion of the Mycenaeans to the Cyclades and Crete (Marinatos 1939). However, more recent scholars have stressed the effect of more complex environmental stresses which led to a decline in agriculture, the abandonment of major elite settlements, including the palaces (Antonopoulos 1992). As is clear from these earlier studies, the traditional focus of archaeologists and ancient historians has been identifying the point of collapse, attributing responsibility to single human or natural events with little focus on the adaptability or sustainability of the society or community under scrutiny.

These early studies were entirely in line with the dominant theoretical model in Anglo-American archaeology, the Cultural Historical, which promoted a concept that past cultures only

changed through external factors, such as human or natural factors (Renfrew 1973). In contrast, the succeeding dominant model, known as New Archaeology or Processual Archaeology, concentrated far more on the impact of feedback, both negative and positive, on communities, which were themselves viewed as closed systems (Trigger 1989). This shift in focus from external to internal factors has, in turn, shifted academic focus to a consideration of continuity rather change and an awareness of issues of longevity, resilience and sustainability.

This chapter will present a number of recent examples of how our understanding of sustainability within past communities is developing with reference to case-studies from across the globe before examining the Central Plateau of Iran in more detail and, in particular, the archaeological sites of Tepe Pardis in the Tehran Plain and Sialk in the Dasht-e Kashan. We will argue that rather than portraying past societies and civilisations as victims of environmental, political or societal collapse, we may instead trace how communities have managed their landscape, developed new technologies and, when necessary, moved in order to survive. Whilst less dramatic in terms of narrative, this chapter will highlight the ingenuity that characterises humankind, and the instinct for survival. Finally, by viewing the past through the lens of sustainability, we can begin to approach present-day environmental challenges in the same manner and make lessons from the past relevant to the present.

Archaeology and Sustainability

The notion of sustainability has become more prominent in recent years within both the academic and public sphere. Climatic variability is becoming both more severe and more frequent, and questions are being asked over the continued reliance upon fossil fuels for generating power, and growing problems of access to reliable water supplies for much of the global population. This latter issue is not just restricted to developing countries, such as Sub-Saharan Africa, but is also of concern in developed countries such as the USA. The Colorado River, provider of water to many of the south-western states is a prominent example in the USA, where projected water demand will soon exceed supply (Morrison, Postel and Glock 1996). Further global warming will only exacerbate this situation, as well as have knock-on effects on wetlands and groundwater supply. However, such issues are often

viewed as a symptom of modern lifestyles, a rapidly increasing global population and moves towards urbanisation and industrialisation, whereas archaeology teaches us that sustainability was important in the past.

Central here is the need to define exactly what we mean by sustainability when talking about past communities. Bogucki states that "why a ... community chose *not* to continue living in a particular location is as important as why that community chose to settle in that spot in the first place" (1996: 289). One of the most widely read volumes reviewing the issue of past sustainability is Jared Diamond's *Collapse* (2005), in which he argues that societies make conscious decisions as to their long-term viability and that, more often than not, societies within the past have chosen to fail. This book focuses primarily upon the issue of climate change and landscape manipulation in addressing the question of archaeological and historical sustainability. Diamond's critics have, amongst other things, focused on his categorisation of societies as failures or successes (McAnany and Yoffee 2010: 5) and they suggest that ideas of collapse stem from notions of complete abandonment, that is: "the complete end of those political systems and their accompanying civilisation framework "(Eisenstadt 1988: 242, cited in McAnany and Yoffee 2010: 5). Indeed, they come to the conclusion that the "overriding human story is one of survival and regeneration" (McAnany and Yoffee 2010: 5).

For example, Diamond argues that the Mayan Civilisation collapsed due to a combination of an increasing population stripping the landscape of resources with the resultant deforestation and landscape degradation leading to decreasing quantity and quality of farmland. This in turn led to increasing levels of internecine fighting as people compete for the diminishing space, all framed within a period of climate change leading to droughts and water scarcity further compounding the situation (Diamond 2005: 176f). However, Diamond crucially blames the short-sightedness of the Mayan rulers, "[t]heir attention was evidently focused on their short-term concerns of enriching themselves, waging wars, erecting monuments, competing with each other, and extracting enough food from peasants to support all of these activities" (*ibid.*: 177). This is the classic example of Diamond's society, or at least those in power, that *chose* to fail through their inability to plan for long-term survival, and a focus upon short-term issues. But the Maya region did not witness widespread depopulation, population replacement or the introduction of new political or economic systems

(McAnany and Negrón 2010). Instead, the Mayans appear to have adapted to the changing situations, which resulted from their own actions (i.e. deforestation) and those out of their hands (i.e. climate change). Maya society changed to cope with these problems, and with it - perhaps more crucially from a modern perspective - so did the archaeological signature of Mayan society.

Invariably, Diamond's reasoning behind collapse came down to environmental stress, either through climatic change or landscape degradation. What Diamond did not acknowledge is that in many cases, people and societies have thrived for long periods in subprime environmental conditions. In order to do so, they have both altered and managed, as well as adapted to, the landscapes around them. Archaeological and palaeoenvironmental investigations in the North Atlantic, namely the Faroe Islands, Iceland and Greenland, have traced the development of sustainable agricultural practices during the Norse colonisation of them in the ninth and tenth centuries AD, before their eventual abandonment in the sixteenth century (Adderley and Simpson 2006: 1666-7). Early settlements within Greenland were entirely dependent upon artificial irrigation for the creation of pasture lands but this was not necessarily the case for early Iceland farms, where irrigation was used to enhance rather than create agricultural landscapes (*ibid.*: 1677). Landscape degradation within the North Atlantic Norse islands was often thought to have resulted from the over-grazing of domestic livestock by these early colonists (Simpson *et al.* 2001: 179). However, the abandonment of settlements on the islands appears to be linked to upland soil erosion during the eighteenth century (McGovern *et al.* 2007: 45-6). Mediaeval documentary evidence highlights the use of regulations to limit the amount of livestock allowed on the more environmentally fragile upland regions, and environmental reconstructions have demonstrated that there were sufficient resources available to support them (Simpson *et al.* 2001: 186f).

These early Norse settlements also survived the other classic cause of collapse - natural disasters - in this case volcanic eruptions at the beginning of the eleventh and thirteenth centuries AD (Dugmore *et al.* 2007). Indeed, climatic instability and the introduction of ocean-going vessels that could bypass these islands, and thus nullify their social and economic importance, are perhaps greater reasons for the stresses on and eventual abandonment of some of the settlements (McGovern *et al.* 2007: 45-6). This evidence suggests that, rather than conforming to Diamond's notion of societal

collapse, the Norse island colonisation presents a picture of long-term ecological sustainability through landscape and resource management in an environmentally fragile area, only to succumb at a later date to external social and technological changes.

The Central Plateau of Iran

The focus of this chapter is the Central Plateau of Iran, a semi-arid area flanked on the west and north by the Zagros and Alburz mountain ranges and the south and east by the upland areas of Baluchistan (Figure 1). It incorporates the modern cities of Tehran and Isfahan, as well as major features such as the Dasht-i-Kavir, the large low-lying arid salt plains east of Kashan, formed by the evaporation of landlocked surface water. These inhospitable desert landscapes are fed by large volumes of melt-water from the mountainous edges of the Central Plateau. These fertile river valleys are home to most centres of modern occupation (Fisher 1968). Their true agricultural potential was realised with the introduction of *qanats* - subterranean irrigation channels - during the first millennium BCE. *Qanats* are artificial tunnels dug into sloping alluvium in order to transport subsurface water to areas without ready access to water. They are designed with a gently sloping tunnel directing water from the base of a 'mother' or head well to the mouth or end of the *qanat* tunnel, creating in effect an artificial spring (Figure 4). They are constructed by digging a series of vertical shafts every 20-80 metres to allow access for the initial digging of the tunnel and for later maintenance (Beaumont 1968: 171). The use of *qanats* allows for the supply of water all year round to areas with little or no access to natural water. However, the discharge of *qanats* is related to the height of the water table at its source, thus is greatest in winter when water is needed the least, and results in large volumes of water being unused during these months (Beaumont 1968: 172). *Qanats* are located primarily along large alluvial fans, such as the Jajrood, and can have mother wells that are 275 metres deep, as the example near Birjand, and tunnels extending as far as 70 kilometres, as near Kerman (Beaumont 1971: 42).

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Figure 1. Map showing the location of the Central Plateau of Iran

The first evidence of sedentary communities within Iran is found at sites, such as Ganj Dareh, Ali Kosh and Choga Bonut, all located in the upland areas surrounding the Central Plateau and dating from 8,000 BCE (Hole 2004). These sites are associated with the domestication of sheep and goat, and the increasing husbandry of crops, in particular wheat, barley and lentils. However, little is known about the early phases of the Neolithic within the Central Plateau itself with only Late Neolithic occupation levels identified at sites such as Sialk near Kashan (Ghirshman 1939), Cheshmeh Ali near Rayy (Fazeli *et al.* 2004; Schmidt 1935) and Tepe Ebrahim Abad and Charboneh in the Qazvin plain (Majidzadeh 1981; Malek 1977, Fazeli *et al.* 2009). These sites, dating to the sixth millennium BCE, have no evidence of Early Neolithic occupation. In order to rectify this, a series of joint British and Iranian archaeological investigations were initiated during the 1990s.

Motivated by the destruction of archaeological sites within the Tehran Plain by industrialisation, intensive farming, artefact looting and the spread of residential occupation, this collaborative project between UK and Iranian universities was established to study a large area, both temporally and spatially, in order to trace the origins of sedentary communities and socio-economic complexity (Coningham *et al.* 2004; Coningham *et al.* 2006; Fazeli *et al.* 2007). Work in the Tehran Plain began in 1997 with the excavation of Cheshmeh Ali (Figure 2), in order to establish a chronological sequence for the plain, supported by radiocarbon dates. A single season of settlement survey (Fazeli, Coningham and Pollard 2001; Fazeli, Coningham and Batt 2004), allowed archaeologists to model the development of craft specialisation, standardisation and networks of exchange (Fazeli, Donahue and Coningham 2002). A more substantial program of archaeological survey between 2003 and 2007 followed on the plain southeast of Varamin, encompassing a number of environmental zones - upland and piedmont areas, the alluvial plain and arid desert areas. It aimed to determine whether prehistoric and historic settlement was located, as it is today, mainly within the agriculturally fertile river valleys, and less in the more environmentally marginal zones. The survey identified sites for further detailed studies and test excavations to recover additional radiocarbon dates.

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Figure 2. General view of the spring at Cheshmeh Ali, Rey, now a public park

Sustainability within the Central Plateau of Iran

We look at the question of sustainability within the Central Plateau during the Late Neolithic and Transitional Chalcolithic period (c. 6200 – 4300 BCE), specifically at the Tehran and Kashan Plains, and two sites in particular - Tepe Pardis and Sialk (the former excavations were supplemented with an extensive archaeological survey of the Tehran Plain). The Tehran Plain is drained by the Jajrud River, which flows south from the Alburz Mountains forming an alluvial fan. Annual rainfall on the plain near Varamin is 150mm (although variations from 54 to 230 have been recorded) and is concentrated in the winter months between December and April. Annual temperatures fluctuate between 3.7°C in January to 28.9°C in July, with extremes of -17°C and 47°C recorded (Beaumont 1968: 169). Dry winds from the south-east bring large volumes of dust from the Dasht-e-Kavir, which is dumped across the landscape. Along with this coarse sandy topsoil are thin layers of coarse gravel that lack organic material near the mouth of the river, and deep sandy and silty loams to the south of the alluvial cone. The former soils are poor agriculturally, whilst the latter is exceptionally good, although lack of perennial water supplies can lead to salination, and ephemeral surface vegetation makes them prone to wind erosion (*ibid.*). The low rainfall means that agriculture can only be carried out with the aid of irrigation, traditionally through the use of *qanats*, but more recently pumped from wells and then distributed through lined irrigation canals. The subprime nature of the environment was ably summarised by one of its earlier archaeological pioneers, Roman Ghirshman, who stated that: “The physical aspects of the Plateau was harsh and austere. The oases were dispersed over difficult country, the population was sparse and scattered. As a result the urban revolution was retarded, and society continued in its prehistoric stage for centuries” (1954:42).

A total of 193 archaeological sites were identified within the Tehran Plain during the three seasons of survey, a breakdown of which is in Table 1. Both archaeological and modern sites were recorded during the course of the survey. The single Palaeolithic site, as well as the Neolithic and Chalcolithic sites are concentrated in the eastern section of the survey zone at the well-watered

junction between piedmont terraces and the plain itself but there are some exceptions, particularly during the Chalcolithic period with sites such as Tepe Pardis (A006), Tepe Daoudabad (A050) and Deh Mohsen (A020), all substantial tepes or tells located on or close to the alluvial fan of the Jajerud River. Tepes or tells are large mounds of human material representing the repeated rebuilding of structures on top of each other over time. A number of other smaller tepes, namely Fakrabad (A031), Tepe Tar (B118), B027 and B028 are located within the plain proper. By the later historic periods, and onwards, there is much more substantial occupation, in both number, size and function of the settlements, in this latter area.

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Table 1. The periodisation of archaeological sites, and categorisation of modern sites recorded during the Tehran Plains survey between 2003 and 2007. (The number is greater than 193 due to some multi-period sites)

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Table 2. Prehistoric Chronology of the Central Plateau of Iran

In order to understand the changing settlement patterns of the Tehran Plain, and in particular its early occupation, it is helpful to consider the evidence from the site of Mafinabad (Figure3) - a Chalcolithic tell west of Tehran. A large section of the tepe had been cut away in preparation for construction work, revealing a complex sequence of migratory and braided river channels, sandwiched between layers of Chalcolithic pottery. This suggests some irregularity regarding water resources and Fazeli (2001) suggests that unreliability of water has constrained the development of settlement within the Tehran Plain during the Neolithic and Chalcolithic. This point is supported by the thoroughly documented site of Cheshmeh-Ali, near Rayy, which has a sequence stretching from the Late Neolithic to the Chalcolithic period and is located immediately next to the spring which gives the site its name (Fazeli *et al.* 2004). The distribution of sites revealed by the survey supports such a pattern as few sites appear to support more than a single phase of Neolithic or Chalcolithic settlement.

This is a consequence of human communities shifting as the water courses shift, such that social complexity and the permanent occupation of locations was largely delayed. These early communities were sustainable through their ability to move across the landscape, as and when they needed. Indeed, it is only with the later advent of *qanat* technology that we find the growth and spread of substantial permanent occupation in the Tehran Plain during the Historic and Islamic periods.

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Figure 3. General view of palaeochannels visible in the section of a building site close to Mufinabad

Excavations at the site of Tepe Pardis have revealed an anomaly to this general pattern of early communities as it is a long-lived prehistoric settlement in this marginal zone. These excavations have revealed an unbroken sequence stretching from the Late Neolithic to the Late Chalcolithic, with later sporadic Iron Age, Parthian and Islamic occupation. Tepe Pardis was identified during the 2003 survey season and identified as a site that was in danger of being destroyed (Coningham *et al.* 2004). Located in the western outskirts of the city of Garchak, it had been very badly damaged by a road on its eastern side and on its other three sides by a quarry extracting clay for brick manufacturing (Figure 4). The site consisted of a mound seven metres in height above the surrounding ground level with an additional 3.5 metres of depth revealed where the quarry had cut into the tepe, giving a combined depth of occupation of 10.5 metres.

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Figure 4. General view of Tepe Pardis showing the modern brick quarry in the foreground, and the step trench excavated into the cut away section of the tell

The initial excavation sought to establish a chronological sequence and, in the process, uncovered part of a hearth or kiln. Extending the trench revealed a large complex of ceramic kilns and ovens, as well as evidence of a potter's slow-wheel (Fazeli *et al.* 2007) (Figures 5 and 6). The three slightly later kilns in Trench IV (Kilns 5, 6 and 7) were single-chamber updraught kilns with domed

roofs and measured between 1.30 and 2.08 square metres. Fireboxes were situated at the front of the structure and vessels were fired on the raised floors behind. The earlier kilns from Trench III (Kilns 1, 2 and 4) were much bigger with areas of at least 12 square metres each. Indeed, cubic capacity highlights this difference as Kiln 4 was also at least 1.5 metres high. At a minimum capacity of 18 cubic metres, it is much greater than other known examples of a similar age, presaging the large installations which, in Hansen Striely's words, are "generally connected in later periods with palace or temple economy" (2000: 80). Kilns 3 and 8 were smaller and less well preserved. The presence of a terracotta slow-wheel, the world's oldest example, is particularly interesting as, before this discovery, the earliest known previous example was from Ur (Woolley 1956: 28), dating to c.3250 BCE. The development of the potter's wheel has been viewed to represent a shift towards the mass production of ceramics between the Ubaid and Uruk periods in Mesopotamia (Oates 1960: 39) dated to c. 4100 BCE, and roughly equating to the Chalcolithic-Early Bronze Age transition. Roux and Courty support this fourth millennium BCE origin of wheel-thrown pottery and equate it with the rise of urbanism (1999: 747-748, 761). As such, Tepe Pardis hosted an intensive industrial area covering over 60 square metres dating to c.5000 BCE and the investment in permanent terracotta slow wheels and large kiln structures is suggestive of significant settlement specialisation during the Transitional Chalcolithic (Fazeli *et al.* 2007: 268-270).

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Figure 5. Detailed view of Transitional Chalcolithic kilns at Tepe Pardis. The kiln floors are visible on the right hand side, whilst broken pots are scattered across the floor.

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Figure 6. A terracotta slow wheel found at Tepe Pardis, the oldest known example in the world, dating to the fifth millennium BCE

In addition to the ceramic vessels manufactured within the kilns of Tepe Pardis, a large number of other terracotta artefacts were recovered, including spindle whorls, slingshots and beads,

indicating the presence of a substantial craft specialism based on one of the key resources available to the inhabitants of Tepe Pardis - the surrounding clay deposits. That the modern industries of Garchak also rely heavily upon the natural clays for brick manufacturing testifies to the importance of raw materials to human settlements both past and present. It also provides an indicator as to why the early inhabitants of Tepe Pardis elected to reside in what is today an environmentally subprime location. However, in order to do so they had to manipulate the landscape, and in particular the water resources, around them in order to be able to sustain the settlement.

Pollen analysis from the Late Neolithic levels at the site have yielded evidence of pine and olive species. However, crucially they also identified a plant fungus and soil fungus which are indicative of soil erosion (Gilmore *et al.* 2009: 294), indicating that the early inhabitants of the site faced soil erosion problems. Also interesting is the identification of an artificial water channel at the site dating to the Late Neolithic. The channel's triangular profile (Figure 7) differed significantly from several other natural channels identified at the site, and ran perpendicular to them. Radiocarbon dates taken from immediately above and below the channel date it to between 5220 and 4990 BCE. As such, it represents one of the earliest examples of artificial irrigation within Iran and the Near East. The deposits within its sedimentary sequence indicate alternating periods of shallow relatively quiet flow and periods of drying out (*ibid.*: 298). The presence of irrigation technology points towards a substantial investment in infrastructure at the site, and demonstrates an attempt at informal landscape manipulation in order to ensure the prolonged sustainability of the site.

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Figure 7. Detailed view of artificial water channel at Tepe Pardis. The triangular profile indicates that it is not naturally occurring

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Figure 8. General view of desert to the south of the Tehran Plain

Further parallels can be drawn at the site of Sialk, located in the western suburbs of Kashan, 160 kilometres south of Tepe Pardis. It is another large tell site with Late Neolithic and Chalcolithic occupation. The site is situated on the Dasht-e-Kashan (Figure 8), which forms part of the Central Plateau of Iran and is located to the west of the Dasht-e-Kavir, or Great Salt Desert. It can be divided into three major environmental sectors, the western mountainous region, the plain and desert. Reaching a maximum height of 3900 metres, the Karkas Mountains (Figure 9) form the western boundary of the Dasht-e-Kashan. To the east is the plain or *dasht*, formed by a series of alluvial fans spreading out from the Karkas Mountains. With its semi-arid conditions and an elevation of between 1200 and 1000m, the plain is similar to the Tehran Plain to the north. It has a seasonal rainfall pattern, and modern cultivation is aided by both *qanat* systems and modern pumps. Settlements within the plain are located along *qanat* systems and close to natural springs (Figure 10). The desert or *kavir*, forming most of Iran's Central Plateau, starts east of the town of Arun. Standing at c.1000m above sea level, it is characterised by mountain ridges, fans and marshy basins of mud and salt. Its lack of water, swift evaporation and high temperature extremes make it unsuitable for cultivation and it is sparsely settled.

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Figure 9. General view of the Karkas Mountains, with the excavations at Sialk in the foreground

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Figure 10. General view of the *qanat* mouth at Bagh-e-Fin, Kashan. The water supplies the former royal pleasure gardens

The site of Sialk was initially excavated during the 1930s by a team of French archaeologists led by Roland Ghirshman, who famously stated of its sequence, spread across two separate tepes, that one "follow almost without interruption the progress made by the inhabitants of the Iranian Plateau." (Ghirshman 1954:29). He opened three trenches on the North Mound or tepe (Figure 11) which he dated to the Neolithic and Chalcolithic periods, and four trenches on the South Mound which he attributed to later Iron Age occupation at the site. Sialk has been central to any attempt to define the

prehistoric chronology of the Central Plateau of Iran, partially due to the 12 metre deep Late Neolithic deposit complete with mudbrick structures and objects of copper and marine shell. Ghirshman also demonstrated that the site developed slowly from a Late Neolithic village to a small Chalcolithic town, with cultural continuity demonstrated through ceramics and architecture (Ghirshman 1939). Ghirshman suggested that the occupation at the two mounds was separated by an occupational hiatus, perhaps caused by natural disaster or environmental stress, a more recent scholar, Majidzadeh, proposed that the shift from the Northern Mound of Sialk to the Southern Mound was due to intrusive migrations of people into the Central Plateau of Iran - "Plum-Ware people", so titled because the shift appeared to be associated with the introduction of a new form of ceramic at the base of the new settlement on the South Mound (1981: 142f).

New excavations, undertaken by the same Iranian and British team who worked together at Tepe Pardis, focused on the North Mound with the aim of characterising the social and economic transformations which enabled the early communities of the Dasht-e-Kashan to establish and develop one of the earliest nucleated settlements on the Central Plateau of Iran in the Neolithic period. This began with a deep excavation on the North Mound, cutting a 2.5 by 2 metre step trench (Trench 5) into the south section of Ghirshman's original Trench II, an eroded and partially filled cutting measuring some 20m by 8m. Trench 5 was excavated down to a depth of 11 metres, and was augmented by a second step trench, Trench 6, in the base of Trench II excavated in order to sample and date the earliest occupation levels at the site (Figure 12). This smaller trench measured 2 x 1 metres and was excavated to a depth of four and half metres, giving a combined total of 15.5 metres of continuous sequence - one and half metres deeper than Ghirshman's original excavations.

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Figure 11. General view of the North Mound of Sialk

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Figure 12. Detailed view of the excavations at the North Mound of Sialk, showing Trench Five cut into the section, and Trench Six cut into the floor of Ghirshman's old trench

Geoarchaeological investigations within another deep trench, Trench B, situated between the North and South mounds at Sialk have identified a changing pattern of river management during the Chalcolithic. At the base of Trench B were natural alluvial deposits, typically gravels, sandy silt loams and silt loams. Above this, were alternating phases of cultural occupation and finer alluvial deposits, possibly representing phases of reduced river flow during which occupation is evident, punctuated by high energy events, such as flooding (Ian Simpson, Pers. Comm.). Over time, these high energy events become less evident, and are replaced by the detritus of cultural activity, such as pottery and charcoal, and thin bands of silty clay sediments derived from irrigation activity. Again, like Tepe Pardis, this demonstrates that the Chalcolithic inhabitants of Sialk were managing and altering their landscape in order to achieve the long-term survival and sustainability of their settlement.

Furthermore, radiocarbon dates indicate that the North Mound was occupied until 4900 BCE, at which point there was a large amount of sedimentation build up, possibly indicative of flooding. Occupation of the South Mound begins approximately 4100 BCE, and this shift from the North to the South Mound has traditionally been viewed as a hiatus in occupation, although the reasons behind the move are still debated. It may well be that the landscape became uninhabitable due to floodwaters, or the sedimentation may reflect a breakdown of water management in the region. However, whatever the reasons, people returned to the site ensuring occupation of the site from the Neolithic and Chalcolithic Periods, between the seventh and fifth millennia BCE, through to the Iron Age in the second millennium BCE.

Conclusion

The early communities within the Central Plateau were restricted in their choice of settlement location by access to water. It is clear that Ghirshman's hypothesis that the "harsh and austere" physical aspects of the Plateau resulted in the settlement of human communities close to dispersed oases (1954: 42) was an accurate prediction of the archaeological signature of the early occupation of the Central Plateau. However, it appears that he was wrong in thinking that that population was sentenced by those physical aspects to continue in a "prehistoric stage for centuries" (Ghirshman

1954:42). The survey work undertaken within the Tehran Plain shows a concentration in the early periods, of sites on the fringes of alluvial fans or at the interface of plain and upland areas. The central plain and desert areas were sparsely occupied. This pattern changes significantly in the Historic and early Islamic periods with an expansion of settlements into these previously unoccupied areas. This expansion of settlements was facilitated by the introduction of *qanat* technology.

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Figure 13. Top: General view of qanats on the Dasht-e-Kashan. Bottom: Overview of how qanats work (after Beaumont 1968: 171, Figure 2)

Although the exact date of the adoption of *qanats* within the Tehran Plain is not known, it allowed the occupants of the plain to concentrate population in one area, cultivating larger tracts of land and increasing numbers of animals. The access to reliable, perennial water sources led to permanently settled locales, rather than the itinerant settlement patterns of prehistory influenced by a dependency on shifting water courses. The Tepe Pardis and Sialk projects have helped archaeologists begin to develop an understanding of how early sedentary societies within the Central Plateau of Iran have utilised and manipulated their landscape in order to ensure their long-term sustainability. Drawn by large deposits of clay, the inhabitants of Tepe Pardis developed craft specialisation and began to adapt their marginal environment to meet their needs as indicated by the presence of early irrigation channels dating to the Late Neolithic (one of the earliest examples in Iran). This major investment in specialised pottery production and artificial irrigation indicates the sophisticated nature of settlement in the Tehran Plain during the Transitional Chalcolithic and demonstrates that human communities have often adapted and thrived on what may today be thought marginal or subprime environments through the development of technology.

Together, these two sites of Tepe Pardis and Sialk are helping archaeologists develop a new understanding of how past communities have attempted to ensure their long-term survival. Whilst stories of invasion, catastrophe and societal collapse may be more dramatic and exciting, the overriding narrative within archaeology is one of survival and development. From the icebound valleys of

the North Atlantic islands, to the jungle cities of the Maya and the semi-arid deserts of the Central Plateau of Iran humans have adapted both themselves and their environment to ensure their survival. With environmental issues rising to the top of the modern global political agenda, such tales of localised sustainability rather than widespread collapse may provide a more positive vision for the future.

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Bibliography

- Adderley, W.P. and Simpson, I.A. 2006. Soils and palaeo-climate based evidence for irrigation requirements in Norse Greenland. *Journal of Archaeological Science* 33: 1666-1679.
- Antonopoulos, J. 1992. The great Minoan eruption of Thera volcano and the ensuing tsunami in the Greek archipelago. *Natural Hazards* 5: 153-168.
- Beaumont, P. 1968. Qanats on the Varamin Plain, Iran. *Transactions of the Institute of British Geographers* 45: 169-179.

- Beaumont, P. 1971. Qanat systems in Iran. *Hydrological Sciences Journal* 16 (1): 39-50.
- Bogucki, P. 1996. Sustainable and unsustainable adaptations by early farming communities of northern Poland. *Journal of Anthropological Archaeology* 15: 289-311.
- Coningham R.A.E., Fazeli H., Young R.L. and Donahue R.E. 2004. Location, Location, Location: a pilot study of the Tehran Plain. *Iran* 42: 1-12.
- Coningham, R.A.E., Fazeli, H., Young, R.L., Gillmore, G.K., Karimian, H., Maghsoudi, M., Donahue, R.E. & Batt, C.M. 2006. Socio-economic transformations: settlement survey in the Tehran Plain and excavations at Tepe Pardis. *Iran* 44: 33-62.
- Diamond, J. 2005. *Collapse: How Societies Choose to Fail or Succeed*. Penguin: London.
- Dugmore, A. J., Church, M. J., Mairs, K-A., McGovern, T. H., Perdikaris, S. & Vésteinsson, O. 2007. Abandoned farms, volcanic impacts and woodland management: revisiting Þjórsárdalur, the 'Pompeii of Iceland'. *Arctic Anthropology* 44 (1): 1-11.
- Eisenstadt, S.N. 1988. Beyond collapse. In *'The Collapse of Ancient States and Civilisations'* eds N. Yoffee and G.L. Cowgill, pp. 236-243. Tucson: University of Arizona Press.
- Fazeli, H. 2001. Social complexity and craft specialisation in the Late Neolithic and Early Chalcolithic period in the Central Plateau of Iran. PhD Thesis: University of Bradford, UK.
- Fazeli, H., Coningham, R.A.E. and Pollard, A.M. 2001. Chemical characterisation of Late Neolithic and Chalcolithic pottery from the Tehran Plain, Iran. *Iran* 39: 55-72.
- Fazeli, H., Donahue, R.E. and Coningham, R.A.E. 2002. Stone tool production, distribution and use during the Late Neolithic and Chalcolithic on the Tehran Plain, *Iran*. *Iran* 40: 1-14.
- Fazeli H., Coningham R.A.E. & Batt C.M. 2004. Cheshmeh-Ali Revisited: towards an absolute dating of the Late Neolithic and Chalcolithic of Iran's Tehran Plain. *Iran* 42: 13-23.
- Fazeli, H., Coningham, R.A.E., Young, R.L., Gillmore, G.K., Magshoudi, M., and Raza, H. 2007. Socio-Economic Transformations in the Tehran Plain: final season of settlement survey and excavations at Tepe Pardis. *Iran* 45: 267-286.
- Fazeli, H., A. Beshkani, A. Marghussian, H. Ilkani, R. A. Seresty & R. L. Young. 2009. The Neolithic to Chalcolithic transition in the Qazvin Plain, Iran: chronology and subsistence strategies. *Archaeologische Mitteilungen Aus Iran und Turan* 41: 1-21.

- Fisher, W.B. 1968. Physical geography. In *'The Cambridge History of Iran, Volume 1: the land of Iran'*, ed W.B. Fisher, pp. 3-110. Cambridge: Cambridge University Press.
- Ghirshman, R. 1939. *Fouilles de Sialk, près de Kashan 1933, 1934, 1937*. Volume 1. Paris: Musée du Louvre, Department des Antiquités Orientales.
- Ghirshman, R. 1954. *Iran: from the earliest times to the Islamic conquest*. London: Penguin.
- Gibbon, E. 1841. *The History of the Decline and Fall of the Roman Empire*. Harper: New York.
- Gillmore, G. K., Coningham, R. A. E., Fazeli, H., Young, R. L., Magshoudi, M., Batt, C. M. and Rushworth, G. 2009. Irrigation on the Tehran Plain, Iran: Tepe Pardis — the site of a possible Neolithic irrigation feature? *Catena* 78: 285-300.
- Hansen Streily, A. 2000. Early pottery kilns in the Middle East. *Paleorient* 26.2: 69-81.
- Hole, F. 2004. Neolithic Age in Iran. *Encyclopaedia Iranica*, Online Edition 20 July 2004, available at www.iranicaonline.org.
- McAnany, P.A. and Negrón, T.G. 2010. Bellicose rulers and climatological peril: retrofitting twenty-first century woes on eighth century Maya society. In *'Questioning Collapse: Human Resilience, Ecological Vulnerability and the Aftermath of Empire'*, eds P.A. McAnany and N. Yoffee, pp. 142-175. Cambridge: Cambridge University Press.
- McAnany, P.A. and Yoffee, N. 2010. Why we question collapse and study human resilience, ecological vulnerability and the aftermath of empire. In *'Questioning Collapse: Human Resilience, Ecological Vulnerability and the Aftermath of Empire'*, eds P.A. McAnany and N. Yoffee, pp.1-17. Cambridge: Cambridge University Press.
- McGovern, T.H., Vésteinsson, O., Friðriksson, A., Church, M.J., Lawson, I.T., Simpson, I.A., Einarsson, A., Dugmore, A.J., Cook, G.T., Perdikaris, S., Edwards, K.J., Thomson, A.M., Adderley, W.P., Newton, A.J., Lucas, G., Edvardsson, R., Aldred, O. & Dunbar, E. 2007. Landscapes of settlement in northern Iceland: Historical Ecology of human impact and climate fluctuation on the millennial scale. *American Anthropologist* 109 (1): 27-51.
- Majidzadeh, Y. 1981. Sialk III and the pottery sequence at Tepe Ghabristhan: the coherence of the cultures of the Central Iranian Plateau. *Iran* 19: 141-146.

- Malek, S. 1977. *Tepe Zagheh: a sixth millennium BC village in the Qazvin Plain of the Central Iranian Plateau*. PhD Thesis, University of Pennsylvania.
- Marinatos, S. 1939. The volcanic destruction of Minoan Crete. *Antiquity* 13 (52): 425-.
- Morrison, J.I., Postel, S.L. and Glock, P.H. 1996. *The Sustainable Use of Water in the Lower Colorado River Basin*. Oakland: Pacific Institute for Studies in Development, Environment, and Security.
- Oates, J. 1960. Ur and Eridu, the prehistory. *Iraq* 22: 32-50.
- Renfrew, A.C. 1973. *Before Civilisation: The Radiocarbon Revolution and Prehistoric Europe*. Harmondsworth: Penguin Books.
- Roux, V. & M.-A. Courty. 1999. Identification of wheel-fashioning methods: technological analysis of 4th–3rd millennium BC oriental ceramics. *Journal of Archaeological Science* 25: 747-763.
- Schmidt, E. 1935. The Persian expedition. *Bulletin of the University Museum* 4 (5): 41-49.
- Simpson, I.A., Dugmore, A.J., Thomson, A. and Vésteinsson, O. 2001. Crossing the thresholds: human ecology and historical patterns of landscape degradation. *Catena* 42: 175-192.
- Tainter, J.A. 1988. *The Collapse of Complex Societies*. Cambridge: Cambridge University Press.
- Trigger, B.G. 1989. *A History of Archaeological Thought*. Cambridge: Cambridge University Press.
- Wooley, C.L. 1956. *Ur Excavations: the early periods IV*. London: British Museum Press.

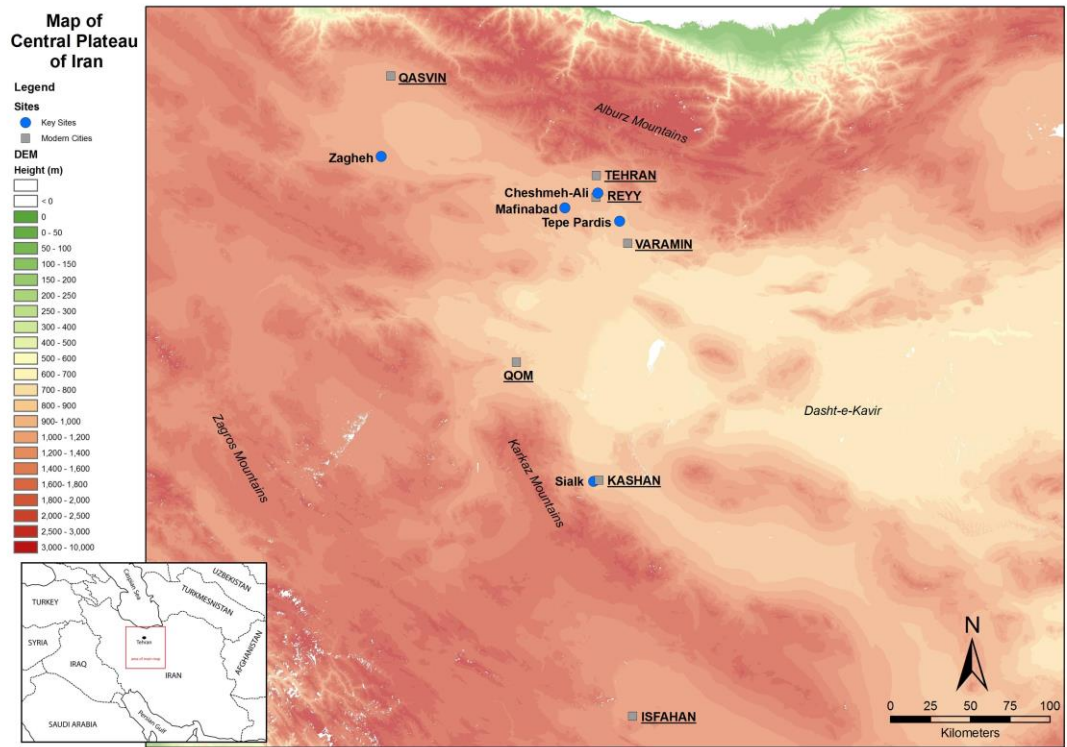


Figure 1. Map showing the location of the Central Plateau of Iran



Figure 2. General view of the spring at Cheshmeh Ali, Rey, now a public park



Figure 3. General view of palaeochannels visible in the section of a building site close to Mufinabad



Figure 4. General view of Tepe Pardis showing the modern brick quarry in the foreground, and the step trench excavated into the cut away section of the tell



Figure 5. Detailed view of Transitional Chalcolithic kilns at Tepe Pardis. The kiln floors are visible on the right hand side, whilst broken pots are scattered across the floor.



Figure 6. A terracotta slow wheel found at Tepe Pardis, the oldest known example in the world, dating to the fifth millennium BCE



Figure 7. Detailed view of artificial water channel at Tepe Pardis. The triangular profile indicates that it is not naturally occurring



Figure 8. General view of desert to the south of the Tehran Plain



Figure 9. General view of the Karkas Mountains, with the excavations at Sialk in the foreground



Figure 10. General view of the *qanat* mouth at Bagh-e-Fin, Kashan. The water supplies the former royal pleasure gardens



Figure 11. General view of the North Mound of Sialk



Figure 12. Detailed view of the excavations at the North Mound of Sialk, showing Trench Five cut into the section, and Trench Six cut into the floor of Ghirshman's old trench

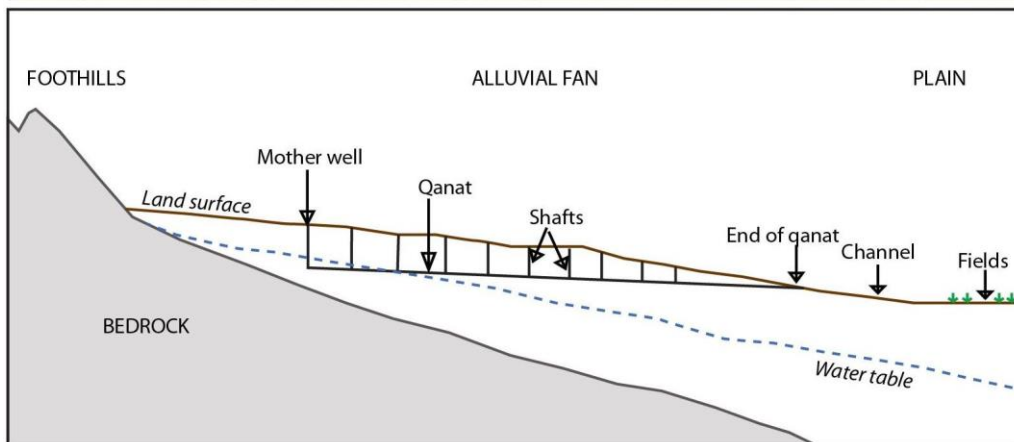


Figure 13. Top: General view of qanats on the Dasht-e-Kashan. Bottom: Overview of how qanats work (after Beaumont 1968: 171, Figure 2)

Period	Number of sites
<i>Archaeological Periods</i>	
Palaeolithic	1
Neolithic (6000-5200BC)	18
Chalcolithic (5200-3400BC)	13
Iron Age (2000-550BC)	2
Parthian (247BC-AD224)	1
Sasanian (AD224-651)	3
Historic (500BC-AD650)	31
Islamic (AD 650-1700)	59
<i>Modern Sites</i>	
Landlord Villages	15
Ceramic Scatters	22
Evidence of modern pastoral communities	22
Undiagnostic sites	15
TOTAL	202

Table 1. The periodisation of archaeological sites, and categorisation of modern sites recorded during the Tehran Plains survey between 2003 and 2007. (The number is greater than 193 due to some multi-period sites)

Period	Date BC	Qazvin Plain	Tehran Plain	Kashan Plain	Damghan / Shahrud
Early Bronze II (Kura-Araxes)	<i>2900-2000</i>	Shizar Doranabad	Arasto Tepe	?	Hissar III
Early Bronze I (Proto-Literate)	<i>3400-2900</i>	Shizar	Tepe Sofalin Chogali	Arisman C Sialk IV	Hissar IIB
Late Chalcolithic	<i>3700-3400</i>	Ghabristan III-IV Ismailabad Shizar	Cheshmeh-Ali Tepe Pardis Sofalin Chogali	Arisman B Sialk South 6-7	Hissar IIA
Middle Chalcolithic	<i>4000-3700</i>	Ghabristan II Shizar	Cheshmeh-Ali Tepe Pardis Chogali	Sialk South 4-5	Hissar IC
Early Chalcolithic	<i>4300-4000</i>	Ghabristan I	Cheshmeh-Ali Tepe Pardis Chogali	Sialk South 1-3	Hissar IA-IB
Transitional Chalcolithic	<i>Late 4600-4300</i>	?	Cheshmeh Ali Ismailabad Kara Tepe Chogali	?	Shir Azhian Aq Tappeh
	<i>Early 5200-4600</i>	Ebrahim Abad Zagheh	Cheshmeh-Ali Tepe Pardis Ismailabad	Sialk North Period II	"Cheshmeh Ali" Phase
Late Neolithic	<i>Late 5600-5200</i>	Chahar Boneh Ebrahimabad	Cheshmeh-Ali Tepe Pardis	Sialk North Period I, 4-5	Sang-I Chakhmaq
	<i>Early 6000- 5600</i>	Chahar Boneh	?	Sialk North Period I, 1-3	"Djetun" Phase

Table 2. Prehistoric Chronology of the Central Plateau of Iran