

ALBERT RECKITT ARCHAEOLOGICAL LECTURE

## Early and Medieval Merv: A Tale of Three Cities

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### Introduction

‘NOWHERE ELSE IN ALL CENTRAL ASIA are ruins so abundant or so vast’, wrote the American archaeologist R. Pumpelly in the early years of this century when describing the historic urban centre of the Merv oasis. This series of adjacent walled city-sites occupies more than a thousand hectares and, in Pumpelly’s time, ‘In preservation . . . reach from Bairam Ali’s state of brick-robbed walls and still-standing battlements, with gates and inner streets that may yet be ridden through (Figure 23) to the round-worn mounds of far more ancient cities’ (Figures 3 and 4; 1908: 333). The earliest of the city-sites was founded in the sixth century BC, and the largest became the capital of the empire of the Great Seljuks, an empire which stretched from Central Asia to the Mediterranean. The much smaller post-medieval foundation demonstrated Merv’s relative decline by the fifteenth century.

The reason for Merv’s long and distinguished history can be accounted for by its strategic position in a large and fertile oasis in the Kara Kum desert in present-day Turkmenistan (Figures 1 and 2). Today the oasis supports a population in excess of a million. Before modern transport it was the last major centre before caravans embarked on the long stage ‘across the sorriest waste that ever met the human eye’ to Amul (modern Chardzjou or ‘Four Canals’), some 180 km distant.

Read at the Academy 21 May 1996. © The British Academy 1997.

**Figure 1.** Map of western Central Asia, north-eastern Iran and western Afghanistan. (From Bader, A. N. and Usupov, Kh. 1995, 'Gold Earrings from NW Turkmenistan' in Invernizzi, A. (ed.), *In the Land of the Gryphons, Papers on Central Asian Archaeology in Antiquity* (Turin), 29.)

Amul is built at a crossing point of the Amu Darya, the Greek River Oxus, or in the flowing prose of Curzon ‘the broad bosom of the mighty river that from the glaciers of the Pamir rolls its 1,500 miles of current down to the Aral Sea’ (Curzon 1889: 140, 143). From Amul it is an easy stage to Bukhara and points east on the so-called ‘Silk Road’, or downstream to Termez. In Achaemenid times Amul was on the way to the satrapies of Bactria and Sogdia. The importance of Merv’s location, widely appreciated during the years of the ‘Great Game’ (Hopkirk: 1990, 408–17), was demonstrated as recently as the 1980s, when the oasis formed one of the bases for the Soviet invasion of Afghanistan.

The Merv oasis is formed of alluvial silts deposited by the River Murghab. This rises in the Afghan mountains, crosses the desert and enters the oasis at its southern end, where it is dammed—today there are no less than six dams, although previously there was probably only the Sultanband dam<sup>1</sup>—eventually drying up in the desert to the north. A little-known Chinese source written by Du Huan, in 765 after his return from ten years in captivity at Merv described ‘a big river which flows into its territory, where it divides into several hundred canals irrigating the whole area’.<sup>2</sup> Agriculture in the Merv oasis is totally dependent on irrigation, as is evident today, in medieval sources and earlier.

Since 1954 the oasis has also been watered by the Kara Kum canal, which enters the oasis on the east, traversing it before crossing the desert to form a large reservoir on the edge of the Tedzhen oasis and continuing westwards (Figure 2). The arrival of the canal has greatly increased the potential for irrigation in both oases. As a result, the Merv oasis is probably at its maximum extent, measuring on a map of 1991 in the region of 85 × 74 km. This area has since been enlarged, for areas in the north, unused since the Bronze Age, are being irrigated. Interestingly, the 1991 oasis is similar in size to that measured by Du Huan, ‘the area of this kingdom from east to west is 140 *li* [70 km] and from north to south 180 *li* [90 km]’.<sup>3</sup>

Archaeologically, the oasis is one of the most intensively studied regions in Central Asia. In the 1950s, M. E. Masson of Tashkent

<sup>1</sup> For a vivid description of the dam in 1880 see O’Donovan 1882: 184–5.

<sup>2</sup> Du Huan wrote a book about his experiences on his return to China. Unfortunately, this has been lost: what survives is a synopsis written by an uncle. We are grateful to Professor Liu Ying Shen of Nanking University for drawing our attention to this source. Dr Oliver Moore of the British Museum is currently studying the text, and we thank him for this preliminary translation.

<sup>3</sup> See above, n. 2.

**Figure 2.** Satellite image (Landsat TM 1988) of the Tedzhen (bottom left) and Merv oases. The courses of the Murghab river and Karakum canal are recognisable, as is the reservoir on the edge of the Tedzhen oasis. The historic urban centre of the Merv oasis is visible as a white dot on the central eastern edge: the modern centre, Mary, is on the western side.

University set up the YuTAKE, the South Turkmenistan Multi-Disciplinary Archaeological Expedition of the Academy of Sciences of Turkmenistan, which from that time has undertaken campaigns throughout southern Turkmenistan, including many both in historic Merv and in the oasis.<sup>4</sup> The oasis is also the focus of a series of major survey and mapping programmes. These include:

**1** A long-running programme, mapping the pre-Timurid sites of the Merv oasis and excavating a Partho-Sasanian fort at Gobekli, initiated in 1980 by Professor G. Koshelenko of the Moscow Institute

<sup>4</sup> The YuTAKE published their work in *Trudy Instituta istorii, arxeologii i etnografii AN Turkmenskoj SSR*, usually abbreviated to *Trudy YuTAKE*, the last volume of which, 19, was published in 1989. Shortage of funds is currently preventing further publications.

of Archaeology (Academy of Sciences of the USSR), with the collaboration of the Moscow State University and the Turkmen State University (Gubaev *et al.* 1990; Koshelenko *et al.* 1991; Bader *et al.* 1992).

2 A survey of sites of the Bronze and Early Iron Ages on the edge of the Central Kara Kum, in progress since 1989, by Professor V. Sarianidi (Moscow Institute of Archaeology, Academy of Sciences of the USSR) and I. Massimov (Institute of History, Academy of Sciences of Turkmenistan). Their programme includes excavations at the extensive Bronze Age centres of Togoluk and Gonur (Hiebert and Lamberg-Karlovsky 1992; Sarianidi 1993; Hiebert 1994: 15–38).

3 Surveys of early sites in the north by a team from Instituto Italiano per il Medio ed Estremo Oriente Rome (IsMEO), directed by Professor Maurizio Tosi, with Professor A. Gubaev of the Turkmen State University, begun in 1989.

Work by these teams continues to refine our understanding of the ancient settlement patterns in the Merv oasis. The surviving Bronze Age settlements were located in the north, where the Murghab fanned out into a delta. It was not until the development of more sophisticated irrigation techniques that occupation developed further to the south and east. This shift occurred in the Late Bronze and Early Iron Ages or Yaz Depe I–III periods (Gubaev *et al.* 1990; Koshelenko *et al.* 1991; Bader *et al.* 1992). It was during Yaz II–III that the first of the historic urban centres of Merv, a polygonal walled city known today as Erk Kala, was founded in the sixth century.

### The International Merv Project

The International Merv Project (IMP) is a collaboration between the Institute of Archaeology, University College London, and YuTAKE, the Academy of Sciences of Turkmenistan (1992–7): for the first three years the Institute for the History of Material Culture, St Petersburg, also formed part of the collaboration, which was established with the assistance of Professor V. M. Masson, Director of that Institute. The reasons why we chose to work at Merv were varied. One was the opportunity to work as an international team in an area of major significance to Iranian studies at a time when Iran itself was and remains largely closed to foreign archaeologists. Another was Merv's location as a 'gateway' to Central Asia: control of Merv is an indicator of the relative power of

states to east and west. For instance, Merv was an important administrative and military centre in the north-east quarter of the Achaemenian, Seleucid, Parthian and Sasanian empires (Frye 1984: 112, 173, 295, 298), although control may have been lost for a while to the Greco-Bactrian kings (Frye 1984: 180), in late Parthian times when the kings of Merv minted their own coins (Frye 1984: 202; Loginov and Nikitin 1993*a*), and again by the Sasanian king Peroz to the Hephthalite Huns in the fifth century (Frye 1984: 322; Loginov and Nikitin 1993*b*). The last Sasanian king, Yazdigird III (633–51), fled to the oasis where he was murdered, prior to Merv's conquest by the Arabs (Le Strange 1905: 400). With Nishapur, Herat and Balkh, Merv was one of the principal cities of Khurasan, the 'Eastern land' of the early Islamic empires (Le Strange 1905: 382) and was a capital city of the Abbasids. Arab domination was followed by Turkic, and it was under the Seljuk Sultans that Merv achieved its high-point in the eleventh and twelfth centuries.

Equally decisive in our choice of Merv was its unusual pattern of urban development. A consecutive series of city-sites gradually developed on adjacent virgin sites, protected from recent development by the Soviet and Turkmen authorities. These extensive remains offered a unique opportunity to record the varying plans of the cities, since their walls define their size and general layout, and it is usually possible to identify gateways, principal roads, some buildings, and the courses of some canals. From an archaeological point of view a number of periods can be examined near surface. Merv presented, therefore, the possibility of surveying urban development through time, up to the present day if the modern Soviet-style city, Bairam Ali, is included.

Obvious problems in working at Merv include both the sheer scale of the site and the degradation of the immediate suburban hinterland caused by nearly half a century of Soviet-style agriculture and collectivisation. The landscape has been brutalised to achieve large fields for the intensive monoculture of cotton: entire tell sites, together with many ancient buildings, have been swept away. This environmental degradation must have transformed the ecology of much of the oasis, which was regularly praised for its fertility in medieval sources. The Chinese Du Huan wrote that 'villages and fences touch each other and everywhere there are trees [growing close together]'.<sup>5</sup> Islamic scholars commented on the productivity and variety of the crops of the oasis: the tenth century Ibn Hawkal claimed that the fruits of Merv were finer than those of any other place

<sup>5</sup> See above, n. 2.

(Curzon 1889: 113), while Mustawfi reported that seed-corn gave a hundredfold the first year (Le Strange 1905: 402–3). Earlier, Strabo noted the size to which the vine grew (XI.10.2). Just how different the oasis may have been is indicated by Ibn Hawkal who claimed that in no other city are to be seen such palaces and groves, gardens and streams (Curzon 1889: 113). An idea of what these were like was suggested by our visits to the Bairam Ali sanatorium, built early in the twentieth century as a palace for Tsar Nicholas II. The numerous trees and running water in the gardens created a different world, cool and pleasant.

Another problem affecting our work is the high water-table caused by irrigation using the resources of the Kara Kum canal. This has changed the arid conditions which once preserved the cities and their associated standing monuments: in YuTAKE reports of the 1950s the surface of the cities was bare, while today large areas are obscured by dense scrub. The surfaces of low-lying mounds and depressions within the sites are heavily salted, and the uppermost deposits have deteriorated into a soft dust below a puffy crust. In the late 1950s when the canal was opened, these low areas were flooded. The situation was improved, although not solved, by cutting drainage channels.

When starting work at Merv, we had to decide whether to focus on a single problem or city or to undertake a more broad-brush approach. Since Western awareness of the site is limited and long-term access can never be taken for granted, we chose a broader approach aiming at obtaining an overview of the occupational history of these important centres. As much information as possible about all the cities is therefore being collected and prepared for publication. The cities consist of ancient Gyaur Kala with its citadel Erk Kala, medieval Sultan Kala, and post-medieval Abdullah Khan Kala with an eighteenth-century extension, Bairam Ali Khan Kala (Figure 3). Another ‘city’ of Merv was a square walled area of some 110 ha, 1 km south-east of Gyaur Kala, known today as Shaim Kala and now almost totally destroyed (Herrmann *et al.* 1995: 57–9).<sup>6</sup> The cities are being mapped, a number of surveys and selective excavations undertaken and a gazetteer of the standing monuments in and around the cities and in the oasis prepared.

<sup>6</sup> Although initially considered to date from the Seljuk period, Shaim Kala may have been an eighth-century Arab military camp.

**Figure 3.** Site plan of the ancient city-sites of Merv, the monuments and IMP excavation trenches: map drawn from geo-rectified satellite images and air photographs (G. Barratt in Herrmann *et al.* 1997: 3).

### The Early City, Erk Kala and Gyaur Kala

The longest-lived of the cities of Merv was Gyaur Kala and its citadel, Erk Kala (Figures 3 and 4). Erk Kala, the first ‘city’, was founded in the sixth century BC at a time which may have coincided with the arrival of the Achaemenian Persians, or possibly their predecessors, the Medes.<sup>7</sup>

<sup>7</sup> Only the western boundary of the Median empire is known with any certainty. However, two factors suggest extensive Median possessions to the east: first, their access to fine horses and lapis lazuli (Kuhrt 1995: 480). The Central Asian republics are known for their horses, while the principal ancient source of lapis lazuli was the mine at Sar-i Sang in Badakhshan, north-east Afghanistan. The Medes gave both horses and lapis lazuli as tribute to the Assyrian kings—specific references to Median gifts of lapis lazuli occur in the reigns of Tiglath Pileser III, 300 talents (Luckenbill 1926: I, 768); and Esarhaddon (Wiseman 1958: 1), although there are also references to ‘heavy tribute’ without further definition in the reigns of Sargon and Sennacherib. Secondly, the fact that Cyrus II, having conquered more of the ancient world than any other king, with his control of the Median, Neo-Babylonian and Lydian empires, undertook campaigns in Trans-Oxiana may have been because he was reclaiming former Median territory, which was attempting to regain its independence.



**Figure 4.** Aerial view of the early city, Gyaaur Kala, and its citadel Erk Kala (c.500 BC–1100 AD) from the east (1992): in the distance the walls of the medieval city, Sultan Kala. The mound of the Buddhist stupa can be seen in the bottom left, south-east corner of Gyaaur Kala: the Oval Building near the wall in the north-east quarter. The old east–west road dividing the city is also evident.

Achaemenian control of the oasis, known as Margiana, was established by Cyrus II the Great (559–530 BC) (Dandamaev 1989: 33; Kuhrt 1995: 660). The first historical reference occurs in the trilingual inscription of Darius the Great at Bisitun near Kermanshah in Iran (Kent 1953: 131), where he recorded the defeat of the Margian rebel Frada (Dandamaev 1989: 125–6). At this time Margiana formed part of the satrapy of Baktra (Frye 1984: 112), continuing earlier close cultural links between the two areas in the Bronze Age (Hiebert 1994: 174–8).

Erk Kala's massive mud-brick walls still stand some 30 m in height and enclose an area of some 20 ha. The highest point on the walls and in the area is the look-out tower in the south-east, which originally guarded the probable entrance to the citadel. This may have been via a ramp over the moat, leading to a gate set high in its walls, as can be seen in the citadel at Bukhara today. The southern half of the citadel consists of occupation build-up, including a platform to the west, once crowned with an administrative building of the early Arab period. This was excavated in the 1930s and removed in the 1980s prior to planning. To the north is one of the low areas, a feature of Central Asian cities.

According to the Arab geographers Istakhri, Ibn Hawkal and Muqaddasi, Erk Kala was still in use in the tenth century, when it was described as “high-built and itself of the size of a town”, surrounded by the inner city with its four gates [Gyaur Kala], beyond which again were extensive suburbs stretching along the banks of the great canals’ (Le Strange 1905: 398–9). By this time, however, occupation in the old city of Erk and Gyaur Kala was in decline, with an extensive medieval city developing over the canal to the west. The latest levels revealed by IMP's first excavation on the occupation platform adjacent to the east wall have been dated by the coins and ceramics to the sixth/seventh centuries. This multi-phase house was probably constructed during the reign of the successful king Khusrau I (531–79) (Herrmann *et al.* 1993: 50–5; 1994: 66–70; 1995: 34–7). A number of modifications and refurbishments were made in the following years, the house finally being abandoned after the conquest of Merv by the Arabs in the mid-seventh century.

The metropolis of Antiochia Margiana was founded by Antiochus I (281–261) (Wiesehöfer 1996: 108). In this new foundation, Erk Kala became the citadel of the Hellenistic city, modern Gyaur Kala. This walled city was essentially square, except for the west wall and the north-west corner which followed the course of the pre-existing Razik canal, and the curve of the citadel in the north wall. It measured approximately 2 km across. The walls still survive to a height of

some 20 m, with regular hummocks representing towers: the defences were reinforced by an outer moat. The gates were located in the centre of the walls, except for the north gate which was set to the east of Erk Kala, and were connected by roads which quartered the city. Occupation was essentially cruciform, concentrating on these major arteries and leaving the corners relatively empty. Since Gyaur Kala was a Hellenistic city, the occupied areas would probably have been laid out in a grid plan with regular blocks of housing and a series of public buildings, temples, an agora, theatre, gymnasia, bath houses, etc.

Since Gyaur Kala was occupied for more than a thousand years, through the Parthian and Sasanian periods and into the Islamic period, the Seleucid city-plan would obviously not have survived intact but would have changed organically. However, it may not have changed fundamentally, for traces of regular *insulae* can be seen from the air in the north-west of the site (Figure 5). This regularity is confirmed by Du Huan's description of Merv, which provides some fascinating details: 'Within the city [wall] there is a saline [or salines]. There are also two Buddhist temples. The [city] walls and houses are very thick and high. The urban quarters are very regular.'<sup>8</sup> Numerous low white saltpans or 'salines' still exist in the city today, one close to our Middle Sasanian excavation (Figure 6). Geoarchaeological borings were undertaken here in an attempt to determine the method of formation of this area, whether it was excavated for mud bricks or whether this was an unoccupied garden or pond (Barham and Mellalieu in Herrmann *et al.* 1994: 56–8).

One of the 'Buddhist temples' referred to by Du Huan was sited in a corner in the south-east of the city, close to the walls (Figure 4). The stupa and associated monastery/*sangharama*, excavated by M. E. Masson in the 1950s, has been variously dated to the first century BC, the first/second centuries AD, and recently, after reanalysis of the coins, to a much later date in the fourth century, a time of close contacts between Sasanian Merv and Bactria (Pugachenkova and Usmanova 1995). The stupa was reconstructed a number of times, and the *sangharama* considerably enlarged: the latest coin identified in the bricks of the staircase was one of Khusrau I (531–79). The remains of one or two more stupas outside the eastern wall of Gyaur Kala and dated to the sixth/seventh centuries were recorded in YuTAKE excavations of 1963 but have subsequently been demolished (Pugachenkova and Usmanova 1995: 76–7).

Another isolated structure was an unusual building in the north-east quarter of Gyaur Kala (Figure 6). The monumental 'Oval Building' was

<sup>8</sup> See above, n. 2.

**Figure 5.** The western half of Gyaur Kala from the north (1992). Traces of regular *insulae* can be seen on the surface of the occupation mound near the western wall. The trench cut through the walls of Erk Kala by YuTAKÉ is visible near the bottom left, as are Soviet excavations of the 1980s and early 1990s on the bulldozed flat top of the inner citadel.

**Figure 6.** The north-east quarter of Gyaur Kala from the west (1992). The Oval Building near the east wall, Soviet excavations next to the north gate and the low mound, Gyaur Kala Area 5, with Middle Sasanian settlement, currently being excavated by IMP, can all be seen: see Figure 3. The IMP excavations in Erk Kala can also be made out on the mound adjacent to the east wall. Note the white 'salines' in the vicinity of Area 5.

constructed on a platform, accessed by a ramp, and consisted of rooms built round a courtyard. M. E. Masson originally suggested that it was a Christian monastery, but this idea has been dismissed, both because of a lack of archaeological evidence and because most Nestorian monasteries are built some distance away from cities: Simpson considers a more probable use would have been as a storehouse (Simpson, forthcoming).

Even if the Oval Building was secular, literary sources provide evidence for a flourishing Christian community in Merv (Koshelenko 1995): bishops of Merv attended a number of Ecumenical Councils of the Eastern and after 485 the Nestorian Church (Asmussen 1983: 932; Fiey 1973). The position of the Christian community in Merv was sufficiently established to ensure that the local bronze coins of Yazdigird I carried the sign of the cross on their reverses (Loginov and Nikitin 1993*b*: 272, fig. 11, nos 10–29). A cross was employed on a jar handle reused as a mould for casting small pendants and found in the Erk Kala excavations (Figure 7), rare archaeological evidence of a Christian presence (Simpson 1996).

Cosmopolitan Merv also hosted a Jewish community, as has been shown by Jewish headstones. The variety of religions in the city, which would of course have included Zoroastrianism and Manichaeism, is

**Figure 7.** A jar handle reused as a mould for pendants found in the Late Sasanian house in Erk Kala: the cross is rare archaeological evidence for the presence of Christians at Merv.

reaffirmed by the range of burial practices discovered at an extramural necropolis, located 3 km to the west of Gyaur Kala. This consisted of the remains of seven built structures excavated in the 1950s with burials in ossuaries, built graves, ceramic coffins or jars, and bodies either on the floor or in mass burials (Grenet 1984: 187–97, pl. 18). The structures continued in use for some time.

A large low mound in the north-east quarter, not far from the Oval Building (Figure 6), was the location of our second excavation. This was chosen because of the absence of an Islamic overburden, a predicted date of the Middle Sasanian period, thus complementing work in Erk Kala, and the presence of near-surface buildings visible from the air and confirmed by a geophysical prospection (Figure 8; Strange and Falkner in Herrmann *et al.* 1994: 58–9). By the end of our fifth season in 1996 a programme of shovel-scraping had revealed a number of private houses separated by irregular, narrow alleys, a plan more typical of a medieval Islamic city than the Hellenistic grid suggested for the

**Figure 8.** Gyaur Kala Area 5: resistivity plan after interpretation. The hatched area represents the excavations (P. Strange in Herrmann *et al.* 1995: 38–9).

**Figure 9.** Gyaur Kala Area 5: plan of a Sasanian residential quarter following scraping and partial excavation (Herrmann *et al.* 1997: 5).

main city (Figure 9; Herrmann *et al.* 1994: 69–70; 1995: 37–42; 1996: 4–8; 1997: 4–6). However, Area 5 is located outside the planned city in one of the ‘empty corners’, like the Buddhist stupa and ‘Oval Building’. Du Huan’s description of the houses of Merv—‘The wooden parts of



the [buildings] are elaborately carved and the mud parts are painted with pictures'<sup>9</sup>—may suggest their original appearance, with balconies overhanging the alleys as in old areas of Damascus.

Analysis of the tens of thousands of potsherds from these two excavations by St J. Simpson and Gabriele Puschnigg will provide the first reliable coin-dated corpus of Sasanian ceramics from the fifth to seventh centuries from this region and from Western Asia. The vessels were made locally and range from open lamps to tall elegant jars with long handles and curious rippled decoration on the shoulders, possibly inspired by fluted metalwork. Many sherds from the Erk Kala excavations belong to jars with knobbed handles, the most famous example of which is the 'Merv Vase' (Figure 10; Koshelenko 1966), found concealed near the Buddhist stupa (Pugachenkova and Usmanova 1995: 71–2). The similar form of the 'Merv Vase' to our Erk Kala jars reinforces the dating of the final phase of the stupa to the Late Sasanian period, a date otherwise based on numismatic evidence.

Moulded and handmade figurines are a relatively common find in Erk and Gyaur Kala, both on the surface and in excavation. One well-known type features a lady with a mirror, the so-called 'Great Margiana Goddess': the example illustrated in Figure 11 was found in Structure C of the area of Middle Sasanian housing. While ceramic is abundant at Merv, and glass in the later periods, glass is relatively rare in Middle Sasanian levels. This tiny figurine of a naked woman in the birthing position (Figure 12) is a unique find from Gyaur Kala Area 5, although it is a well-known type in India.

Our third excavation was in an industrial area on the main platform of Gyaur Kala. This area was identified by the Surface Artefact Team in 1992 because of the presence of numerous highly vitrified, crucible fragments (Tucker and Stoll Tucker in Herrmann *et al.* 1994: 59–61). It was the discovery of steel droplets in the glassy slags remaining inside the crucibles, found during analyses undertaken by Merkel, Griffiths and Feuerbach in the Wolfson Archaeological Science Laboratories of the Institute of Archaeology (Merkel 1989; Merkel *et al.* 1995: 12–14), that led to the excavation of this area. This resulted in the discovery, first, of two furnaces, the rims of which were just visible on the surface, and then to the excavation of the surrounding workshop and the recovery of a total of four furnaces (Figure 13; Herrmann *et al.* 1994: 70–1; 1995: 42–5; 1996: 15–16; 1997: 10–13).

<sup>9</sup> See above, n. 2.

**Figure 10.** The ‘Merv Vase’, found in the Buddhist stupa in the south-east corner of Gyaur Kala in the 1950s (Ashgabat Historical Museum).

The metallurgical remains are of particular interest because analyses showed that the crucibles were used for the production of steel by the co-fusion method, where wrought iron and cast iron are heated to some 1,200 degrees centigrade. This process is distinctly different from the

**Figure 11.** A moulded figurine, a 'mirrored lady', from Structure C in Gyaur Kala Area 5 (Mary Museum) (height 9.0 cm).

**Figure 12.** Glass was relatively rare in Middle Sasanian levels. This tiny female figurine in the birthing position was found in Gyaur Kala Area 5. Similar examples can be found in India (Mary Museum) (height 2.0 cm).

‘wootz’ method known from India and Sri Lanka, where wrought iron is packed with carbon to produce steel (Bronson 1986). According to Arab writers such as the twelfth century al-Biruni, the co-fusion method produces excellent steel with attractive ‘Damascus’ or watered patterning, and he refers to its production at another major city, nearby Herat (Allan 1979: 65–76). The furnaces at Merv have been dated to the ninth to tenth centuries AD by ceramic and numismatic evidence and are the first metallurgical remains to document the co-fusion process. Many questions remain to be resolved about this type of steel production, for our furnaces represent an accomplished, not a developing, technology. According to Professor James Allan, there are no known examples of cast iron objects from Early Islamic times (personal communication). However, cast iron was extensively used in China as early as the third century BC, and a Chinese text of the sixth century has described the co-fusion process (Wagner 1993: 335).

It is also noteworthy that steel production at Merv occurred in a city lacking all the relevant resources. There are no metal deposits in the oasis. The kaolin for the crucibles probably came from the only known source in Turkmenistan near Kara Bogaz Gol on the east of the Caspian Sea; while the wood for firing the furnaces has been identified by Rowena Gale as pistachio and juniper, used in twig form (Herrmann *et al.* 1996: 20). This too must have been imported, presumably from the Kopet Dagh or Badghiz, despite supplies of excellent timber such as saxaul in the oasis and surrounding desert. It may have been the presence of the relevant specialists at Merv that led to production in this great centre, where the technology may have been a closely guarded secret. Interestingly, the magnetometer survey undertaken in 1996 of areas adjacent to the workshop failed to identify further steel furnaces. It may be that only a few workshops at Merv produced such high-technology steel.

**Figure 13.** One of four closed-top 'steel furnaces' found in the industrial area, Gyar Kala Area 4. Air was blown into the furnace via the *hajère* at the bottom and vented through an exit flue near ground level.

## The Medieval City, Sultan Kala

In the eighth century a new suburb grew up to the west of Gyaur Kala along the banks of the Majan canal, and this gradually developed into the next 'city' of Merv, replacing the old town (Figure 3). The consequent decline of Gyaur Kala has been documented by an initial analysis of their results by the Surface Artefact Survey (Figure 14; Herrmann *et al.* 1993: 59–61), with occupation of the old city being heavily reduced and the centre being turned over to industry, such as the production of steel.

The new suburb developed into the Seljuk metropolis, known as Marv-ash-Shahijan or 'Royal Merv' (Le Strange 1905: 398), which became the capital of the Seljuk state and one of the most important cultural centres of the eastern Muslim world. This was the time of Merv's greatest glory, only terminated by the arrival of the Mongols in 1221. It was in Merv that the Seljuk sultans Toghril (1040–63), Alp-Arslan (1063–72), Malik-shah (1072–92) and, of course, Sultan Sanjar (1118–57) himself were buried. Of their mausolea, it is only that of Sanjar that survives above ground today. Merv was also the home of a number of outstanding medieval scholars, astronomers, philosophers, historians and poets, including the astronomer and poet Omar Khayyam (eleventh century) and the geographer Yaqut al-Khamavi (thirteenth century), who were attracted by its famous libraries and observatory (Le Strange 1905: 402).

The main city was much the same size as Gyaur Kala, c.400 ha, although its walls were less regular, reflecting its organic pattern of growth. By the tenth century the 'great Majan suburb . . . lay round the Maydan, or public square, on which stood the New Mosque, the Government-house, and the prison; all these having been built by Abu Muslim, the great partizan of the Abbasids' (Le Strange 1905: 399). Like many early Islamic cities, it was not walled until the eleventh century, when Sultan Malik-shah is credited with building the 'great wall round the city 12,300 paces in circuit' (Bosworth, 1968: 85; Le Strange 1905: 402). With the extensive suburban areas to north and south enclosed by Sultan Sanjar, the city occupied some 630 ha and was one of the largest of the medieval world. Sultan Sanjar was also probably responsible for walling an irregular area in the north-east corner of the city, the Shahriyar Ark or 'Royal Citadel' (Figures 15 and 16). The city's defences are impressive with massive, multi-phase

- Figure 14.** Preliminary surface survey distribution maps for Late Sasanian-Islamic periods of occupation in Gyaur Kala.
- A. Late Sasanian ceramic distribution, c.6th–7th century.
  - B. Early Islamic ceramic distribution, c.9th–10 century.
  - C. Islamic ceramic distribution, c.11th–12th century.
  - D. Early Islamic copper coin distribution, 8th–9th century. Open circle one coin; solid circle two or more coins (Tucker and Stoll Tucker in Herrmann *et al.* 1994: 60).

**Figure 15.** The northern half of Sultan Kala from the east, showing in the left foreground the Royal Citadel or Shahriyar Ark; part of the main city with the mausoleum of Sultan Sanjar at the extreme left centre; and the northern suburb to the right (1992).



**Figure 16.** The Royal Citadel or Shahriyar Ark, from remotely sensed images, verified by ground survey (G. Barratt in Herrmann *et al.* 1997: 19).

**Figure 17.** The eastern wall of Sultan Kala at its junction with the wall of Shahriyar Ark (1995).

walls, reinforced by towers and deep moats (Figure 17). In 1996 we began a study of the military architecture, starting with the walls of Shahriyar Ark (Brun and Annaev in Herrmann *et al.* 1997: 20–2): this survey should be completed in 1997.<sup>10</sup>

According to medieval accounts, the creation of the citadel caused major changes to the plan of the city centre. The royal residences, administrative buildings and the mint were moved to the citadel, while the centre was turned over to religious buildings, including the great Friday Mosque and the mausolea of the Seljuk sultans. Turkmen excavations beside the mausoleum of Sultan Sanjar have revealed buildings of the earlier, pre-Sanjar phase. To the left is a small house with elegant arched shelved niches and to the right a fine bathhouse (Figure 18). Information on these excavations, together with much other previously unpublished work, has been assembled and will form part of the IMP volume on the medieval city.

Divorced from the structures of which it once formed a part, the mausoleum externally looks rather like a sore thumb, although from the air, the outlines of the courtyard of the Friday mosque of which it once formed a part are clearly visible (Figure 18), as they are from the windows of the mausoleum. The mausoleum still remains a landmark today, while Yaqut commented that its high dome, originally covered with gleaming turquoise tiles, could be seen three days' march away (Le Strange 1905: 401). This outer dome has not survived although the magnificent inner dome of this spectacular and important early Seljuk building can still be appreciated. The dome is carried on four giant squinches, alternating with blind arches, both pierced with windows. The transition from the octagon to the circular base of the drum is made by eight stalactite pendentives, from which rise four radiating ribs forming an interlacing pattern making an eight-pointed star. Traces of painting remain on the ribs and walls. The mausoleum was built by the Serrakhs architect, Muhammad ibn Atsys, whose modest signature in a panel in the dome was hidden by plaster: it was only revealed in the 1950s (Masson 1969: 194–205).<sup>11</sup> Work was begun in 1140 and must have been finished before the invasion by the Ghuzz in 1153.

The Mausoleum of Sultan Sanjar is one of eighty standing monuments being recorded by Andrew Petersen as part of the IMP's

<sup>10</sup> A study of the less well preserved fortifications of Erk Kala and Gyaur Kala is being undertaken by V. Zavyalov.

<sup>11</sup> Ibn Atsys may have built a smaller unsigned version at Serrakhs.

**Figure 18.** The mausoleum of Sultan Sanjar (1993). The outlines of the courtyard of the Friday Mosque are visible, as are the excavations of the earlier bath-house between the mausoleum and the range of rooms to the right.

programme. This task is an urgent one. At Merv the contradictory pressures of tourism on the one hand and increasing religious fervour on the other are causing particular problems. Mausolea are being actively conserved and equipped with facilities for pilgrims. With the help of the officers of the Archaeological Park 'Ancient Merv', A. Annaev and R. Dzharpar, we are assembling old plans and preparing new, recording the current state of conservation and building up an archive of photographs.

Although the mausolea of the other Seljuk Sultans once built in the centre of the city have not survived, a fine example outside the walls is preserved and has been sympathetically conserved. This mausoleum was commissioned by Sharaf al-Din Abu-Tahir, Sanjar's vizier, and was constructed in 1112–13 in commemoration of the fifth descendant of Ali, Muhammad ibn Zayd, murdered in Merv in the eighth century. It forms the heart of a delightful complex within a sacred grove of saxaul trees, equipped with cistern, kitchen and guardian's house (all relatively late in date). Although the exterior is much restored, the unusual shell-shaped *mihrab* still preserves traces of painting and a superb inscription in cut brick-work written in floriate Kufic runs round all four walls (Figure 19).

The most distinctive buildings in the Merv oasis are the corrugated castles or *keshks*, referred to in the anonymous geographical work, the *Hudud al Alam*, compiled in 982/3: 'there are numerous castles (*kushk*)' (Minorsky 1937: 105). These fortified buildings were built on platforms with sloping sides: the walls were formed of large corrugations, probably crenellated at the top. They are of varying sizes, fulfilled different functions and continued to be built over a considerable period. *Keshks* can be found both in and around the walls of the Seljuk city and elsewhere in the oasis. One of the largest and certainly the best known is the Great Kiz Kala (Figure 20). Nearby is a second, smaller, corrugated building, unfortunately in a more ruined state. Both of these contained a central courtyard, surrounded by vaulted and domed rooms on the first floor.

According to written sources (Ibn al-Asir, Dzhuveini and Khafiz i Abru), Merv was laid waste by three successive invasions of Mongol forces in 1221–2, the population was slaughtered or driven out, the wealth and treasures of the city plundered, and the dam on the Murghab river destroyed. Ibn al-Asir refers to the invasion as a 'great disaster, the like of which neither day nor night had brought forth before', while Dzhuveini wrote that 'the city which had been embellished by great men of the world became the haunt of hyenas and beasts of prey'. More than a hundred years later, in the early fourteenth century when

**Figure 19.** Part of the floriated Kufic inscription running round the walls of the shrine of Muhammad ibn Zayd.

**Figure 20.** The Great Kiz Kala, one of the early Islamic corrugated buildings or *kes/hks* found in and around Sultan Kala and in the oasis (Chronos archive, State Hermitage Museum, St Petersburg).

**Figure 21.** A wall plaque found in the Mongol Buddhist Temple located in the southern suburb of Sultan Kala (Ashgabat Historical Museum).

Mustawfi and Ibn Battuta passed through Merv, it was still ‘one great ruin’ (Le Strange 1905: 402–3). Such accounts have led to the impression that Merv died as a result of the Mongol invasions. Certainly there is evidence for widespread burning in many areas of the city. However, Turkmen excavations have provided evidence for considerable post-Seljuk occupation, both inside and outside the city walls. A post-Seljuk building excavated by Professor Terkesh Khodjaniasov was located in the southern suburb of Sultan Kala. A small Buddhist temple was built on a platform and measured 11 m on each side. It consisted of two rooms, decorated with ceramic wall plaques, one of which is illustrated in Figure 21. Unusually, it was roofed with ridge tiles which show strong Chinese influence. Professor Khodjaniasov dates the temple’s destruction to Ghazan’s decree of 1295, ordering the destruction of all



non-Islamic religious buildings (Boyle 1968: 379–80). There is also over a metre of post-Seljuk occupation in excavations near the mausoleum of Kiz Bibi (Herrmann *et al.* 1996: 19).

### The Royal Citadel or Shahriyar Ark

The citadel is located in the north-east corner of Sultan Kala and is roughly triangular in form (Figure 15): it was mapped in 1996 from remotely sensed images, verified by ground survey. Surviving within it are the remains of a number of structures (Figure 16), the best preserved of which are all located on low mounds. They include an unusual and small version of a *keshk*, consisting of a single, long, vaulted room divided into three, with the remains of niches on surviving internal sections of the walls. This may have been the *kepter khana* or pigeon house—ready access to an independent communications system would obviously have been essential for any ruler. Parts of a surprisingly small four-iwan palace no larger than domestic structures elsewhere in the citadel have been identified as that of the Seljuk Sultans. The combination of its size and height above present ground level, as well as the presence of *balkhi* vaults, had already suggested that the date proposed could be too early, a hypothesis we hope will be confirmed by our excavations.

It was with this problem in mind—the date of the final phase of occupation in the citadel that excavation was begun in a corner of a relatively destroyed courtyard house (Herrmann *et al.* 1996: 17–19; 1997: 22–6). Most of the house was sub-surface, although some walls survive at the eastern end. In its final phase the house (35 × 25 m) probably consisted of two parts, a principal courtyard with four iwans, visible as shallow depressions, at the better preserved eastern end, and a secondary courtyard to the west surrounded by further ranges of rooms. Excavations in the poorly preserved north-west corner and the adjacent courtyard (c.45 × 35 m) have so far distinguished three phases. The latest, a squatter occupation, was characterised by small hearths cut into fallen mud-brick. The second phase, probably dating to the Timurid period, had plastered gypsum floors cut with a number of features, the most impressive of which was a large circular oven lined with fired bricks. This phase is some 2 m below surface. Only a little of the third phase has been revealed so far, but it is also post-Seljuk. This suggests that the standing walls in the ‘Seljuk’ citadel may all be post-Seljuk. The excavation is planned to continue in 1997.

Evidence both from our own work and from Turkmen excavations in the city, its suburbs and outside its walls all indicate post-Seljuk occupation. Certainly, parts of the medieval city were abandoned, or turned over to industrial processes; however, some reappraisal of the currently accepted post-1221 history of Merv should be considered.

Environmental studies of the medieval period have not been undertaken previously in Iran or Central Asia. An important question on which our archaeobotanical record may shed light is that of the degree of damage inflicted by the Mongols on Merv's vital irrigation systems (Le Strange 1905: 402). However, just as reports of the 'death' of the city may have been exaggerated, so may reports of the level of destruction of the complex water-management system. A programme of full environmental recovery based on large-scale water flotation has been underway since the outset and is now beginning to shed light on the irrigation history of the oasis (Nesbitt in Herrmann *et al.* 1993: 56–8; 1994: 71–3; and Boardman in Herrmann *et al.* 1995: 49–52; 1996: 19–20; 1997: 29–31). In addition to material from IMP excavations, archaeobotanical work has been carried out on Late Bronze to Early Iron Age samples from Tahirbaj, excavated by the IsMEO team, on Parthian (first century AD) samples from Gobekli Depe, excavated by G. Koshelenko, and on Seljuk, Timurid and later samples from Annaev's 1995 excavations at the Kiz Bibi complex to the west of Sultan Kala (Herrmann *et al.* 1995: 19). Also included are published results from Bronze Age Gonur Depe. Archaeobotanical analyses are therefore able to suggest trends in plant use in snapshot form for over 1,500 years.

Most striking is the consistency in the major species present, regardless of the number of samples collected per site/period. Free threshing wheat, hulled barley, broomcorn millet and grape have been recovered from samples from the Bronze Age to the eighteenth century. Barley is the most frequent crop at almost all sites. However, the presence of wheat throughout suggests that well-publicised problems associated with long-term irrigation agriculture, notably salinisation, were overcome at Merv. Regarding other crop plants, several species present at Gonur Depe, such as emmer wheat, chickpea and plum, have not yet been recovered elsewhere. In 1993 when records were only available for Erk Kala and Gonur Depe, Nesbitt noted that millet, while present throughout, was surprisingly sparse in the plant records for the oasis (in Herrmann *et al.* 1994: 73), an observation borne out by further work and reinforced by a seventh-century Chinese reference to the absence of millet and rice among the Persians (Miller 1959: 15).

From an economic point of view the most significant discovery has been that cotton, still the principal crop of the oasis, was a major summer crop at Merv by the mid-Sasanian period—the date of its introduction awaits definition through continued excavation. Since no cotton seeds have been recovered in samples from Achaemenian through Parthian levels (Gobekli and Tahirbaj Depe), this may be at some point in the early Sasanian period and may have been made possible by the introduction of the intensive irrigation agriculture practiced in the Sasanian empire (Adams 1962, 1965, 1981; Wenke 1975/76, 1987). Merv was, of course, famous in medieval sources for its textiles, both cotton and silk.<sup>12</sup>

Although our own and Turkmen excavations suggest the continued occupation of parts of Sultan Kala and its citadel into the Timurid period, it was said to be in 1409 that the Timurid ruler Shah Rukh (1408–47) built a new city, some 3 km to the south of Sanjar's Mausoleum (Figures 3, 22 and 23). This moated and walled city, known today as Abdullah Khan Kala, is considerably smaller than the earlier cities, occupying only a square kilometre. The reduced size of Timurid Merv thus illustrates the relative decline of the oasis at this time, reflecting both its loss of status to centres such as Samarkand and Herat and the effects on overland trade of the increased use of maritime routes. Interestingly, unlike the organic Seljuk city, Timurid Merv was regularly planned and square in form. Like Gyaur Kala it was quartered by the principal arteries, which ran to the four gates. The streets were laid out on a grid pattern; there was a mosque and madrasah in the north of the city, and a citadel with palace and caravanserai in the north-east corner. The plan was fairly typical for a fifteenth-century town of Khurasan.

The post-Timurid history of Merv is one of further decline and frequent conquest, finally by the Russians, who annexed the Merv oasis, together with the other Central Asian khanates in the 1880s (Hopkirk 1990). The Timurid city, already at least partially abandoned, was plundered for bricks for building the Tsar's Murghab estate and the Russian Orthodox Church. Apart from the city walls, little now survives. Fortunately the Russian scholar V. A. Zhukovsky (1894) recorded the remains at a time when much was still standing, as did G. Pugachenkova in the 1950s (1958).

<sup>12</sup> 'Marv produces good cotton, . . . textiles of raw silk (qazzin) and of mulham silk', *Hudud al-'Alam* (Minorsky 1937: 105).

**Figure 22.** The Timurid city, Abdullah Khan Kala, from the north-east (1992). The walls of the citadel in the north-east corner still survive, although little remains of the buildings still standing at the turn of the century (Figure 23).

**Figure 23.** The buildings in the citadel of the Timurid city (Figure 22) at the turn of the century (Chronos archive, State Hermitage Museum, St Petersburg).

## The Mapping Programme

Working in a new area presents special problems. Initially, we were unable to obtain any maps or even coordinates. To unify the various aspects of our work, some of which have been mentioned above, we decided to undertake a cartographic programme to record the cities of Merv and the locations of the monuments in their environs. Fortunately, the virtual revolution in survey technology and portable computing power in recent years made it possible to create a digital map base for the cities based on earlier Soviet mapping (obtained in our second season), corrected satellite imagery and aerial photography (Figures 3 and 16: Barratt in Herrmann *et al.* 1993: 44–8; 1994: 55–6; 1996: 20–2; Barratt and Doyle in Herrmann *et al.* 1997: 19–20; Herrmann and Barratt 1995, 1996).

The use of satellite technology is well established in environmental and landscape studies, and with steadily improving resolution—it is already down to two metres<sup>13</sup>—such data seems certain to become a standard tool for city planning. Although such fine imagery was not available to the IMP, SPOT XS images, with a pixel resolution of 20 m, and hard copy of Landsat images of the oasis were obtained (Figure 2). Derrold Holcomb of ERDAS, USA, arranged to have Merv targeted by the NASA Shuttle in 1994 and subsequently interrogated the data. There was a possibility that the side scan radar of the Shuttle imaging platform might have provided useful sub-surface information. However, while this technique is one of proven value elsewhere, it was not particularly useful at Merv because of the alluvial mud of which the city is formed.

To combine information from satellite images and aerial photographs for mapping purposes it is necessary to geo-rectify them to a known or arbitrary coordinate system, and a series of ground control points were fixed by Total Station electronic theodolites and a Leica System 200/300 Differential Global Positioning System (GPS). The GPS was also used to carry out mobile mapping in kinematic mode, which allows continuous position fixing at pre-set time intervals, either from a car or on foot. Figure 3 shows the resultant field plot of the modern road system, created from GPS data in Leica Ski software. This application of GPS is comparatively new to survey and offers the ability

<sup>13</sup> Currently limited to military users. Soviet Soyuz images to 5 m resolution are, however, available for civilian use.

to record to a high resolution the ground surface of an archaeological site. Terrain models created by this method are arguably more objective and detailed than models created by more traditional levelling techniques. Work carried out at Merv using a combination of survey GPS and Total Station has allowed some conclusions to be drawn on their relative strengths in relation to the collection of archaeological survey data. Neither technology has all the answers desired by the field archaeologist, but in combination they provide a comprehensive data collection facility.

Much has been accomplished during our first five years at Merv: much remains to be done. In addition to the basic recording of cities and monuments and the collection of unpublished data, major contributions have been made in a number of areas. Considerably more is known of the final phases of occupation of Erk and Gyaur Kala, while our work in Shahriyar Ark may suggest a fundamental redating of the late occupation history of that area, with a consequent re-evaluation of historical 'facts' concerning the Mongols. We are assembling for the first time a coin-dated sequence of ceramics and other material culture from the Middle and Late Sasanian periods through the Early Islamic period. The archaeobotanic record, although sketchy in parts, is providing evidence of successful irrigation agriculture through time, while archaeometallurgical studies are illustrating advanced technology at an unexpectedly early date. We hope to continue work at Merv until 2000.

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I was honoured to be selected as a 1996 Laureate by the Rolex Awards for Enterprise on behalf of the International Merv Project. In addition to a valuable cash prize, this has resulted in world-wide publicity and numerous popular articles.

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Funds and equipment are only part of the story: team personnel are a major factor in any expedition's success and the IMP has been extremely fortunate in the dedication and hard work of its members. Direction of the project is shared by Georgina Herrmann and Murad Kurbansakhatov. The Islamic aspects of the project benefit from the advice of Professor J. M. Rogers FBA (1993). The excavation programme is directed by St John Simpson (1992–6, British Museum), who shares the overall direction of the project. The cartographic programme is directed by Glynn Barratt (1992–3, 1995–6). The Gazetteer is undertaken by Andrew Petersen (1994–6). Our skilled liaison officer is Kathy Judelson (1992–6). Many members participate in more than one aspect of the programme—names are only given once. Professor T. Khodjaniasov is an invaluable source on his excavations in Sultan Kala. S. Khamrakuliev (1994–6) represents the Ministry of Culture.

*Topographic programme:* C. Barratt Phillips (1992–3), P. Boyer (1992), S. Campbell (1995), S. Doyle (1996), M. Herrmann (1993), F. Litovchenko (1996, BRIDAS), D. Mackie (1992), E. Moth (1993), I. Peet (1993), D. Holcomb (1995, ERDAS, Atlanta, satellite imagery).

*Archaeologists:* T. Adams (1994–5), A. Berdiev (1992–6, YuTAKE), K. Bonner (1995), I. Cheyne (1995), R. Hobbs (1993), D. Jennings (1992, 1994–5), J. MacGinnis (1994), P. Murray (1995–6), A. Powell (1996), N. Redvers-Higgins (1996), A. Roy (1996), N. Savonidi (1992–3), K. Spandl (1994–5), J. Stedman (1995–6), J. Wright (1996), V. Zavyalov (1992–6, Institute for the History of Material Culture, St Petersburg).

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*Environmental programme:* M. Nesbitt (1993), S. Boardman (1994–6), I. Smith (1996).

*Survey programme:* D. Tucker and B. Stoll-Tucker (1992–4, surface artefact); A. J. Barham and S. Mellalieu (1992–3, geoarchaeological); P. Strange and R. Falkner (1993, geophysical); S. Bullas (1996, magnetometer survey).

*Archaeometallurgical programme:* J. Merkel (1993), A. Feuerbach (1994, 1996).



*House teams:*

*Illustrators:* K. Morton (1992), O. Smirnova (1992), A. Fisher (1993), J. Read (1993), D. Connolly (1994–5), J. Goddard (1996), F. Pewtress (1996).

*Ceramics:* A. D. Grey (1994), G. Puschnigg (1995–6), C. Davies (1996), D. Gilbert (1996).

*Gazetteer and survey of walls:* K. Agajanov (1992, 1996), A. Annaev (1992–6, Merv Archaeological Park), Pierre Brun (1996), F. B. Flood (1992).

*Architects:* R. Dzhapar (1992–6, Merv Archaeological Park), A. Kononenko (1993), H. Mahdi (1992).

## References

- Adams, R. McC. (1962), 'Agriculture and Urban Life in Early South-western Iran', *Science* 136, no. 3511, 109–22.
- (1965), *Land behind Baghdad. A History of Settlement on the Diyala Plains* (Chicago).
- (1981), *Heartland of Cities. Surveys of Ancient Settlement and Land Use on the Central Floodplain of the Euphrates* (Chicago).
- Allan, J. W. (1979), *Persian Metal Technology, 700–1300 AD* (London).
- Asmussen, J. P. (1983), 'Christians in Iran', *Cambridge History of Iran* 3(2), ed. E. Yarshater (Cambridge), 924–48.
- Bader, A., Gaibov, V., and Koshelenko, G. (1992), 'Materials for an Archaeological Map of the Merv Oasis: Kōne Kishman', *Mesopotamia* 27, 225–50.
- Bosworth, C. E. (1968), 'The Political and Dynastic History of the Iranian World (AD 1000–1217)', *Cambridge History of Iran* 5, ed. J. A. Boyle (Cambridge).
- Boyle, J. A. (1968), 'Dynastic and Political History of the Il-Khans', *Cambridge History of Iran* 5 (Cambridge).
- Bronson, B. (1986), 'The Making and Selling of Wootz, a Crucible steel of India', *Archaeomaterials* 1, 13–51.
- Curzon, G. N. (1889: new impression 1967), *Russia in Central Asia in 1889 and the Anglo-Russian Question* (London).
- Dandamaev, M. A. (1989), *A Political History of the Achaemenid Empire* (Leiden).
- Fiey, J. M. (1973), 'Chrétientés syriaques du Horasan et du Segestan', *Le Muséon* 86, (Louvain), 75–104.
- Frye, R. N. (1984), *The History of Ancient Iran* (Munich).
- Grenet, F. (1984), *Les Pratiques Funéraires dans l'Asie Centrale sédentaire*, (Paris).
- Gubaev, A., Koshelenko, G., and Novikov, S. (1990), 'Archaeological Exploration of the Merv Oasis', *Mesopotamia* 25, 51–60.
- Herrmann, G. (1996), 'Merv, "Queen of the World", Uncovering a City on the "Great Silk Road"', *Minerva* 7/6, November/December, 15–22.
- *et al.* (1993), 'The International Merv Project, Preliminary Report on the First Season (1992)', *Iran* 31, 39–62.
- — (1994), 'The International Merv Project, Preliminary Report on the Second Season (1993)', *Iran* 32, 53–75.

- — (1995), 'The International Merv Project, Preliminary Report on the Third Season (1994)', *Iran* 33, 31–60.
- — (1996), 'The International Merv Project, Preliminary Report on the Fourth Season (1995)', *Iran* 34, 1–22.
- — (1997), 'The International Merv Project, Preliminary Report on the Fifth Season (1996)', *Iran* 35, 1–33.
- — and Barratt, G. (1995), 'The "Silk Road" Cities of Merv and "Space Archaeology"', *Bulletin of the Research Center for Silk Roadology, Silk Roadology I: Space Archaeology* (Nara), 71–84
- — (1966), 'Space Archaeology and the Cities of Merv', *Space Archaeology*, Vol. 1, no. 1, 8–9.
- Hiebert, F. T. (1994), *Origins of the Bronze Age Oasis Civilization in Central Asia*, (Cambridge, MA).
- and Lamberg-Karlovsky, C. C. (1992), 'Central Asia and the Indo-Iranian Borderlands', *Iran* 30, 1–15.
- Hopkirk, P. (1990), *The Great Game: On Secret Service in High Asia* (Oxford).
- Kent, R. G. (1953), *Old Persian* (New Haven).
- Koshelenko, G. A. (1966), 'Unikal'naja vaza iz Merva', *Vestnik Drevnii Istorii*, 92–105.
- (1995), 'The Beginnings of Christianity in Merv', *Iranica Antiqua* 30/2, 56–70.
- Bader, A. and Gaibov, V. (1991), 'Materials for an Archaeological Map of Margiana: The Changly Region', *Mesopotamia* 26, 165–86.
- Kuhr, A. (1995), *The Ancient Near East c.3000–330 BC* (London and New York).
- Le Strange, Guy (1905), *The Lands of the Eastern Caliphate* (London).
- Loginov, S. D. and Nikitin, A. B. (1993a), 'Sasanian coins of the third century from Merv', *Mesopotamia* 28, 225–41.
- — (1993b), 'Sasanian coins of the late 4th–7th centuries from Merv', *Mesopotamia* 28, 271–96.
- Luckenbill, D. D. (1926), *Ancient Records of Assyria and Babylonia*, I. *Historical Records of Assyria from the Earliest Times to Sargon* (Chicago).
- Masson, M. E. (1969), *Trudy Instituta istorii, arxeologii i etnografii AN Turkmenkoj SSR* 4, Ashgabat.
- Merkel, J. (1989), 'Experience with Refractories in Reconstruction Copper Smelting Experiments Based upon Archaeo-metallurgical Evidence from Timna', *Cross-Craft and Cross-Cultural Interactions in Ceramics, Advances in Ceramics and Civilization - I*, ed. P.E. McGovern (Westerville, OH), 217–34.
- Feuerbach, A. and Griffiths, D. (1995), 'Analytical Investigation of Crucible Steel Production at Merv, Turkmenistan', *IAMS (Institute for Archaeometallurgical Studies)* 19, 12–14.
- Miller, R. A. (1959), *Accounts of the Western Nations in the History of the Northern Chou Dynasty* (Berkeley & Los Angeles).
- Minorsky, V. (1937), *Hudud al 'Alam: 'The Regions of the World': A Persian Geography 372 AH–982 AD*, trans. and with a preface by V.V. Barthold (London).
- O'Donovan, E. (1882), *The Merv Oasis, Travels and Adventures East of the Caspian During the Years 1879–80–81, Including Five Months' Residence Among the Tekkés of Merv* (London).

- Pugachenkova, G. (1958), *The Ways of Development of the Architecture of South Turkmenistan in the Ages of Slavery and Feudalism* (Moscow).
- and Usmanova, Z.I. (1995), 'Buddhist monuments in Merv' in Invernizzi, A. (ed.), *In the Land of the Gryphons, Papers on Central Asian Archaeology in Antiquity* (Florence), 51–81.
- Pumpelly, R. (1908), *Explorations in Turkestan. Expedition of 1904 2* (Washington).
- Sarianidi, V. (1993), 'Excavations at Southern Gonur', *Iran* 31 (25–37).
- Simpson, St J. (1996), 'Digging on Iran's Backdoor', *British Museum Magazine* 24, Spring, 30–2.
- (forthcoming), 'Sasanian Merv' in Invernizzi, A. (ed.), *In the Land of the Gryphons, Papers on Central Asian Archaeology in Antiquity 2* (Turin).
- Usmanova, Z. I. (1992), 'New Material on Ancient Merv', *Iran* 30, 55–63.
- Wagner, D. (1993), *Iron and Steel in Ancient China* (Leiden).
- Wenke, R. J. (1975/76), 'Imperial Investments and Agricultural Developments in Parthian and Sasanian Khuzestan: 150 BC to AD 640', *Mesopotamia* 10/11, 31–221, figs 3–13.
- (1987), 'Western Iran in the Partho-Sasanian Period: The Imperial Transformation' in Hole, F. (ed.), *The Archaeology of Western Iran, Settlement and Society from Prehistory to the Islamic Conquest* (Washington D.C.), 251–81.
- Wiesehöfer, J. (1996), *Ancient Persia* (London).
- Willcox, G. H. (1992), 'List of Trees and Shrubs of Economic Importance in Iraq', *Bulletin of Sumerian Agriculture* VI, 101–4.
- Wiseman, D. J. (1958), 'The Vassal Treaties of Esarhaddon', *Iraq* 20, 1–100.
- Zhukovsky, V. A. (1894), *Antiquities of the Trans-Caspian Region, The Ruins of Old Merv* (St Petersburg).