In the desert regions of Northern Kuwait throughout antiquity, water was the most important factor conditioning the growth of civilization. Access to groundwater, mastering well-drilling and methods of gathering and storing rainwater in desert cisterns were crucial skills for survival both of semi-settled inhabitants of the region and of nomads crossing the desert plateau. The latter's routes, just as ancient trade routes, usually followed the coast of the Persian Gulf, where a relatively dense net of wells was built beside natural reservoirs. Both kinds of water sources were located in depressions of the terrain, often at the mouths of desert *wadis* flowing down towards the coastal plain. The ancient climate in the region is assumed to have been more humid, with a larger amount of precipitation. Also today, the average yearly rainfall in Northern Kuwait is larger than in other parts of the Arabian Peninsula, reaching 100-130 mm. No wonder, therefore, that throughout Northern Kuwait, from Medinet Al-Kuweit, through Jahra, Muheita, and Mugheira, to Dubaij, over 40 wells or water reservoirs have been recorded.



Model of a modern Arabic well. The stone curb and oval plan of the shaft resemble traditional desert wells from Northern Kuwait. (Reconstruction in an ethnographical exhibition of the Qasr Al-Ahmar (Red Fort) Museum in Jahra.

It is possible that some of the wells in As-Sabbiya may have been located at water sources used through the ages by local populations, beginning with inhabitants of Neolithic settlements, through nomads of the 3rd and 2nd millennium BC, to temporary residents of the coastal strip from the Sassanian and Early Islamic periods. The presence of stone curbs and walls surrounding the excavated well complex SM 12 proves that they were designed for a long usage by a people with a highly organized social structure. Such wells were most



certainly used by itinerary merchants and, in the Islamic period, by pilgrims traveling to Mecca. Some of them remained in periodical use until mid-20th century, as evidenced by recent renovations and modern finds. The wells' reason for existence ended with the onset of modern water supply techniques. Deserted wells disappeared under modern infrastructure; others have been filled in with stones. Finally, desert sands covered them so completely that an archaeological survey was required to record the surviving relics. So far, three such features, located in the Muheita and Dubaij regions, have been excavated and studied by the *KPAM*.

General view of the SM 12 site in the Muheita region before the start of excavations in 2008

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Well-cistern SM 12

The excellently crafted, strikingly large and finely preserved well SM 12 was discovered in the Muheita region, in a hollow of a desert plain sloping towards the sea coast. The site, first noted by Mr. Sultan Ad-Duwaish, was studied by the Polish-Kuwaiti Archaeological Mission in 2008-2010. After some conservation work and other necessary arrangements, the excavated well is to be one of the attractions of an Archaeological Park planned in As-Sabbiya.

The craftsmanship of the well shaft clearly shows that it was built by a team of highly skilled masons. The wall of the shaft consists of 22 layers of sandstone blocks set without mortar. All the stones come from a single local source. By choosing blocks of similar measurements, a largely regular arrangement of the horizontal layers was maintained. Rather flattish stones were selected as building material; they were arranged in a "stretcher bond", in which stones are overlapping midway with the courses of stones below and above. This technique consolidated the whole stone structure. Throughout its entire height, an oval horizontal section was kept without disturbing the inclination of the wall, which is additional proof of the builders' expertise.

Section through the SM 12 cistern's shaft. The 3.25 m deep shaft's diameter reaches 3 m at the top but only 1.35 m at the bottom. This gives the well's section almost the shape of a truncated cone, with walls roughly vertical at the bottom, then gradually flaring out towards the top.





The crown of the shaft's wall, built of a double row of stones, was flush with the surrounding ground, which facilitated collection of rainwater from a nearby wadi. When fully filled, the well could have held c. 10 cubic meters of water; however, judging by the state of preservation of the blocks in the wall, which are smoothed by water just in the lowest parts of the shaft, such a high level of water must have occurred only occasionally.

The well could be accessed from the south by three, now ruined, steps made of large sandstone blocks. The outer wall surrounding the well formed a circle with diameters of c. 9 m (N-S axis) and c. 8 m (E-W axis). The foot of the, more than half a meter high, wall was founded over the crown of the well curb. The wall was rather carelessly built of small sandstone fragments laid without mortar in two or three layers. It served the double purpose of fencing off the deep, and potentially dangerous, shaft and protected the well against sand brought by desert storms.

General view of the well-cistern SM 12 at the end of excavations, spring 2010



Bird's eye view of the SM 12 well-cistern's shaft after completion of exploration, spring 2010

The near excellence of the well's execution attests to the existence of a long tradition of masonry skills, which may even go back to the Sassanian or Early Islamic times. However, due to an almost complete lack of diagnostic archaeological material, the date of this structure's erection must remain hypothetical. The dearth of finds may be explained by the well's irregular usage, which caused it to be repeatedly filled in with sand and debris and then cleaned again. Certainly, the final filling of the shaft with stones took place sometime in the last century. Proof for this assumption was supplied by finds made in the lowest layers of the fill: a badly corroded metal container with an illegible trademark and a thick, rubber seal, definitely a mass-produced object.



Taking measurements inside the SM 12 well

DESERT WELL COMPLEX IN THE DUBAIJ AREA

A massive well-cistern, with a 4 m wide mouth, was dug in the middle of a small desert dale, surrounded on three sides by cliffs of the As-Sabbiya plateau. It collected water periodically flowing from the north in two *wadis* cutting the cliff. The well's curb was built so as to facilitate water collection: in the north, near the outlet of the *wadi*, the curb is flush with the surrounding ground, gradually rising towards the south, to a height of approx. 0.70 m. During excavations, at the depth of c. 2.90 m water appeared in the well, which proves that the well-cistern was fed not only by rain but also by groundwater.



Well-cistern SB 23-1 in Dubaij, before exploration

The shaft of the well was filled flush to the crown of its wall with rubbish, detritus of camp equipment and loose stones on top of which lay a 1.50 m worth of desert sand. Before it was fully filled, campfires had often burnt inside the well, as proven by a thick soot layer on the stones in the curb's upper part. The crown of its wall, consisting of a double row of stones, and the collar of the shaft wall were cemented over in the 1930s. The shaft is tapering downwards, so the diameter of the well's bottom is over a meter smaller than that of its mouth. As far as the quality of masonry is concerned, this structure cannot rival the SM 12 well. Although horizontal section of the shaft retains its oval shape, the builders did not succeed in keeping a neat, uniform surface of the wall. Many of the stones protrude from the face, other are set too deep, forming irregular recesses.

The wall of the SB 23-1 well-cistern consists of 23 layers of undressed stone, mostly pinkish and cream sandstone, set in tight rows without mortar. Sandstone was used in the lower parts of the shaft. Alternating layers of wide and narrow stones, visible in the picture, strengthened the structure. Just beside the well-cistern SB 23-1, there is a stone post and a small building reinforced with a buttress and filled up to its ceiling with stones. Both structures walls are covered with cement. They are modern auxiliary installations for pumping water from the well, probably serving some electrically powered equipment.

A small well SB 23-2 was dug in the vicinity of cistern SB 23-1. Its diameter at the mouth measures c. 1.25 m and its stone wall consists of 12 regular layers of limestone and sandstone blocks set without mortar, covering the shaft to the depth of c. 1.55 m. The deepest part of the shaft was hollowed out in rock. The smoothed surfaces of the stones in the shaft's wall prove that the well was permanently filled with water. Even nowadays, after sand had been removed during excavations, water appeared at the shaft's bottom. The well could hold c. 3.50 cubic meters of water. Enameled metal plates found near the bottom of the shaft attest to a recent date of the well's filling up. The proximity of this small well and the large well-cistern SB 23-1 suggests that the two structures may have functioned together as part of one complex.

The relatively narrow shaft is shaped like an inverted bottle, with the neck cut in solid bedrock. Bedrock was pierced by an oval, c. 0.70 wide hole, and the "bottleneck" continued over one meter down. This form helped to create underpressure in groundwater surfacing through the narrow opening. Horizontal corridors or fissures were found by the bottom of the shaft, leading sideways, presumably to underground water pockets.



Well-cistern SB 23-1 at the end of exploration, spring 2010