

HUMEIMA HYDRAULIC SURVEY, 1989 PRELIMINARY FIELD REPORT

by
John Peter Oleson

Introduction

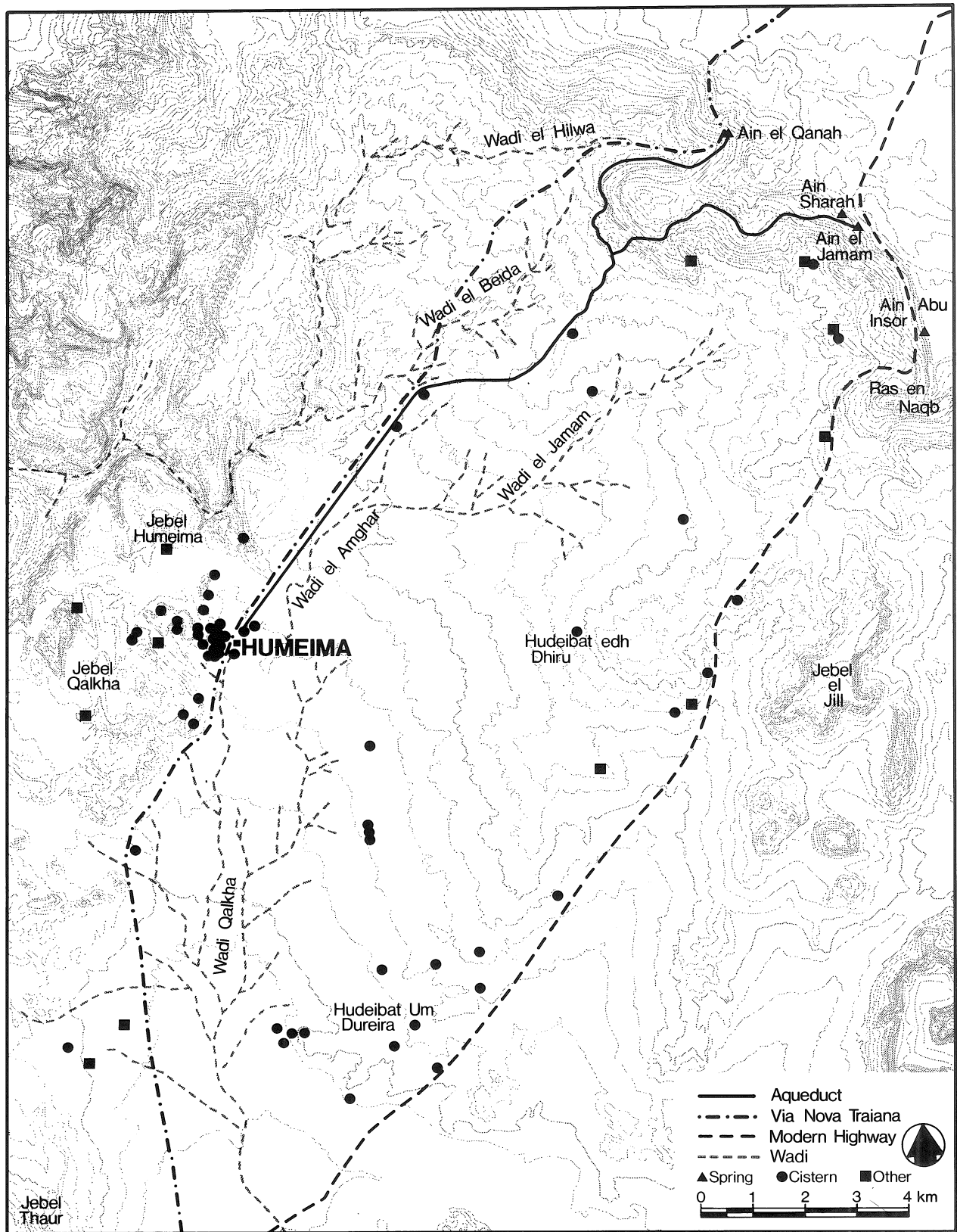
The third field campaign of the Humeima Hydraulic Survey took place from 12 June through 7 July, under license from the Department of Antiquities of Jordan, and accredited by the American Schools of Oriental Research.¹ Previous field research at Humeima, the ancient city of Auara, by this project has focused on the structures in and around the settlement concerned with its water supply.² The first season, completed in 1986, involved the careful survey of the natural catchment area of Auara, 240 square kilometres outside the actual habitation centre, to locate and catalogue all water resources and the structures associated with their exploitation (Fig. 1) (Oleson 1986, 1987a, 1987b, 1987c, 1987d). The second season, which took place in 1987, involved searching out and cataloguing all such facilities within the habitation area proper, particularly the cisterns and reservoirs (Oleson 1988a, 1988b). Where necessary, excavation was carried out to determine the nature of the internal distribution system and its chronology.

Between the 1986 and 1987 seasons of excavation, the remains of a structure northeast of the settlement centre were revealed by the activity of clandestine diggers (Fig. 2.77). They revealed the presence of a small room measuring approximately 2.5 m square (subsequently named Room A) with four vertical recesses built into the walls. Hundreds of fragments of terracotta flue-tiles with a rounded-rectangular cross section suggested that the vertical recesses were designed to accommodate tiles that carried off the smoke from a hypocaust furnace, and to transmit heat to the walls of the hot room in a bath. The proximity of the overflow aqueduct also suggested that this was an appropriate location for a bath. Excavation in 1989 was focused on this structure, since it clearly was related to water use within the city, and thus to patterns of water supply. One alternate goal was determination of the chronology of several of the cisterns in the habitation centre that have roofs supported by transverse arches. The two large, rectangular cisterns at the very centre of the habitation area (Fig. 2.67-68, Pl. I,1) were of particular interest. The

1. The Director was Prof. John P. Oleson, of the University of Victoria. The Department of Antiquities Representative was Dr. Wael Rashdan. Staff included Dr. Robert Schick (Field Supervisor), Dr. S. Blétry-Sébé (survey of settlement pattern and house design), Mr. Erik De Bruijn (Field Supervisor), Mr. Dan Ritsema (Architect), and Mr. Essam El Hadi (Field Supervisor). In Victoria, Chris Mundigler assisted with the preparation of plans and drawings. As in earlier seasons, support was received from the Social Sciences and Humanities Research Council of Canada and the University of Victoria. Research in the field this season was greatly facilitated by the assistance of Dr. Ghazi Bisheh, Director of the Department of Antiquities, by Dr. Bert De Vries, Director of the American Center of Oriental Research, and by the ACOR Administrator Sally De Vries. Dr. Khairieh 'Amr kindly

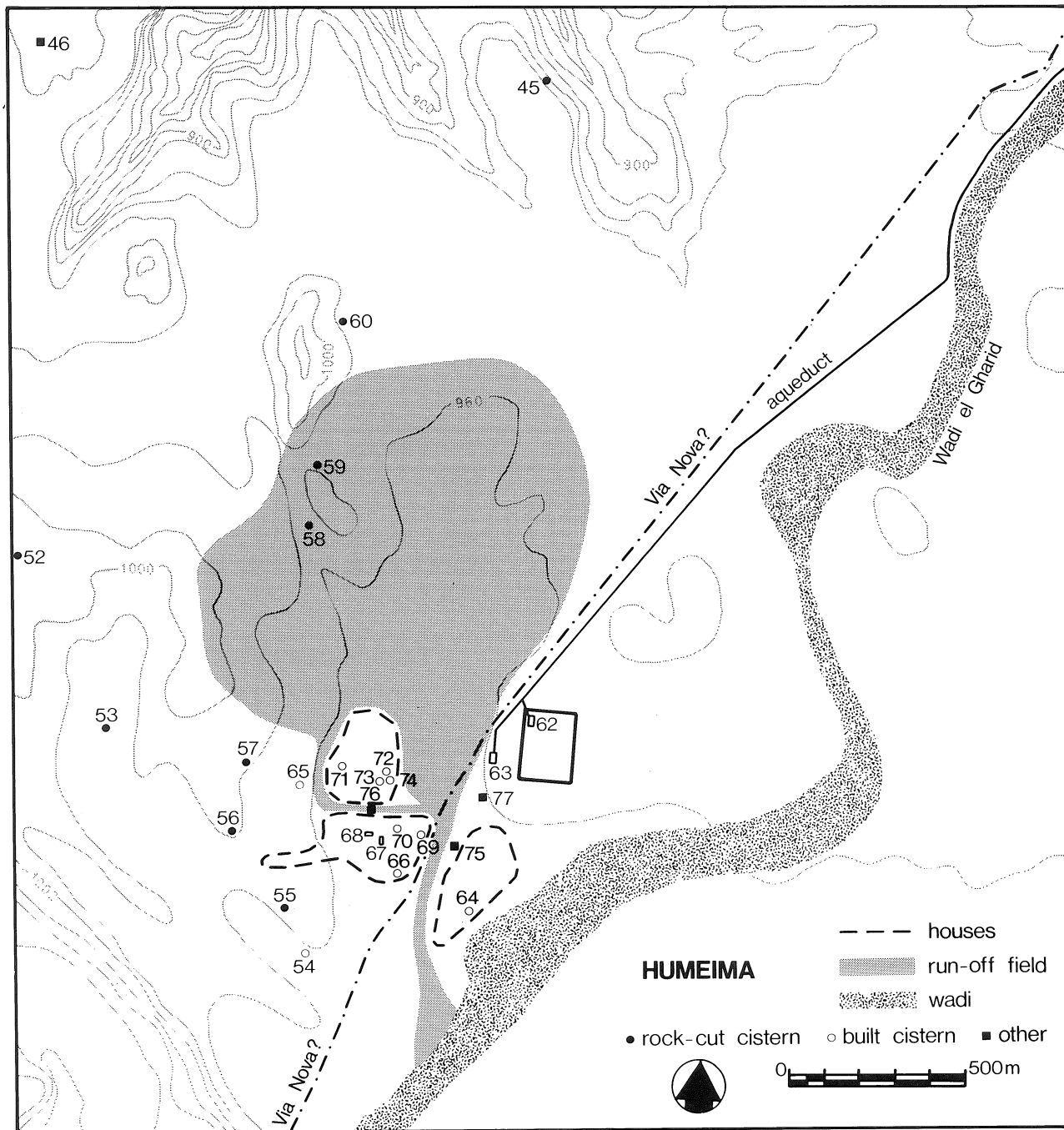
agreed to examine some of the ceramics found in 1989, and Mr. Kevin Reilly has undertaken study of the bones from the three field seasons. The Director of the al-Muraghah Secondary School very kindly allowed us to stay in the school dormitory, and Hurtig Publishers Inc. generously provided some text books for the school's library. It should be noted that beginning with this season the transliteration Humeima has been used for the modern Arabic name of the site, in place of Humayma. The original transliteration was chosen in 1981 when a team of scholars began research at the site. It subsequently became clear that the transliteration was not the best one, but it was retained for two seasons for the sake of continuity.

2. For an historical introduction to Auara, and general bibliography, see Eadie and Oleson 1986; Oleson, Graf and Eadie 1989.



Chris Mundigler

Fig. 1. Humeima: Map of survey area.



Chris Mundigler

Fig. 2. Humeima: Plan of settlement area.

location and design of these two cisterns suggested to the principal investigator that, like the Nabataean reservoir and the long aqueduct that served it, they were part of the original water-supply system of Auara constructed by the founder of the settlement, King Aretas III (87-62 B.C.). Excavation in 1987 had proved the Nabataean origin of the aqueduct and its reservoir, but there had not been time to excavate around the other cisterns in the habitation area. In addition to the two large cisterns, which clearly were intended for public use, there was also the question of the chronology of the nine smaller, round (with one exception) cisterns scattered around the habitation centre in association with the courtyards of what appeared to be domestic structures. It was part of the research model that these were domestic cisterns constructed one by one by private individuals in the decades following the foundation of Auara. A high priority was given in 1989 to the recovery of ceramic material from the foundation levels of several of these cisterns (Fig. 2.69 and 2.64). Finally, Dr. Blétry-Sébé carried out a careful survey of the structural remains visible on the surface over the entire habitation area, assembling data for a provisional analysis of the size, orientation, and (where possible) plans of all public and private structures, the routes of passage through and around the settlement, and the relationship to the water-supply system (see article by Blétry-Sébé in this volume, p. 313-317).

Excavation at Cistern no. 68

The large, rectangular Cisterns nos. 67 and 68 are located in the centre of the settlement area of Auara (Fig. 2.67-68, Pl. I,1). They seem to form a pair, for they have virtually identical dimensions (no. 67: 19.74 x 7.04 x 3.57 m; no. 68: 20.05 x 6.95 x 3.83 m), and they are oriented at right angles to one another: the long axis of no. 67 at a bearing of 344 degrees and that of no. 68 at 70 degrees. In addition, it was noted that the modern, or rebuilt, overflow

channel for no. 67 diverted the water in the direction of the intake channel for no. 68. Each cistern was roofed by long stone slabs resting on 16 arches that bridged its short axis. All but two of these arches in Cistern no. 67 were removed during its renovation in the 1960's. Two main problems had to be resolved: 1) the date of construction of at least one of the cisterns, and 2) the interrelationship between the overflow of no. 67 and the intake of no. 68.

In view of the renovations that had taken place around no. 67, and because of the constant use of this cistern by local Bedouins as a water source for themselves and their animals, it was decided to carry out a sounding at no. 68 in an attempt to reach the foundation level outside the east wall. A sounding was made at the very end of a narrow, east/west trench excavated over the eastern half of the cistern in 1987 (Fig. 3, arrow). This earlier trench had reached the edge of the cistern roof and what seemed to be a pavement 0.20 m lower, extending 0.90 m beyond it on the exterior.

The sounding revealed that this "paving", constructed of large, flag, irregular slabs of sandstone and limestone, was actually the upper part of a very wide east reservoir wall (Th 2.14 m). The wall was framed on the exterior by irregular sandstone blocks up to 0.80 m long, with well-trimmed, flat exterior faces that often carried the fine diagonal trimming considered to be typical of Nabataean stoneworking. The interior of the wall was composed of irregular, fist-sized rubble and small pebbles set in a crumbly grey mortar that contained numerous nodules of lime and a very high proportion of ash particles. Removal of some of this mortared rubble packing (Locus 5) yielded five small potsherds (Bag 50). Three certainly were derived from Nabataean fineware cups, and two very probably from Nabataean coarseware vessels. Although the chronology of Nabataean pottery is still in need of refinement, one consultant would place one of the painted bowl fragments in

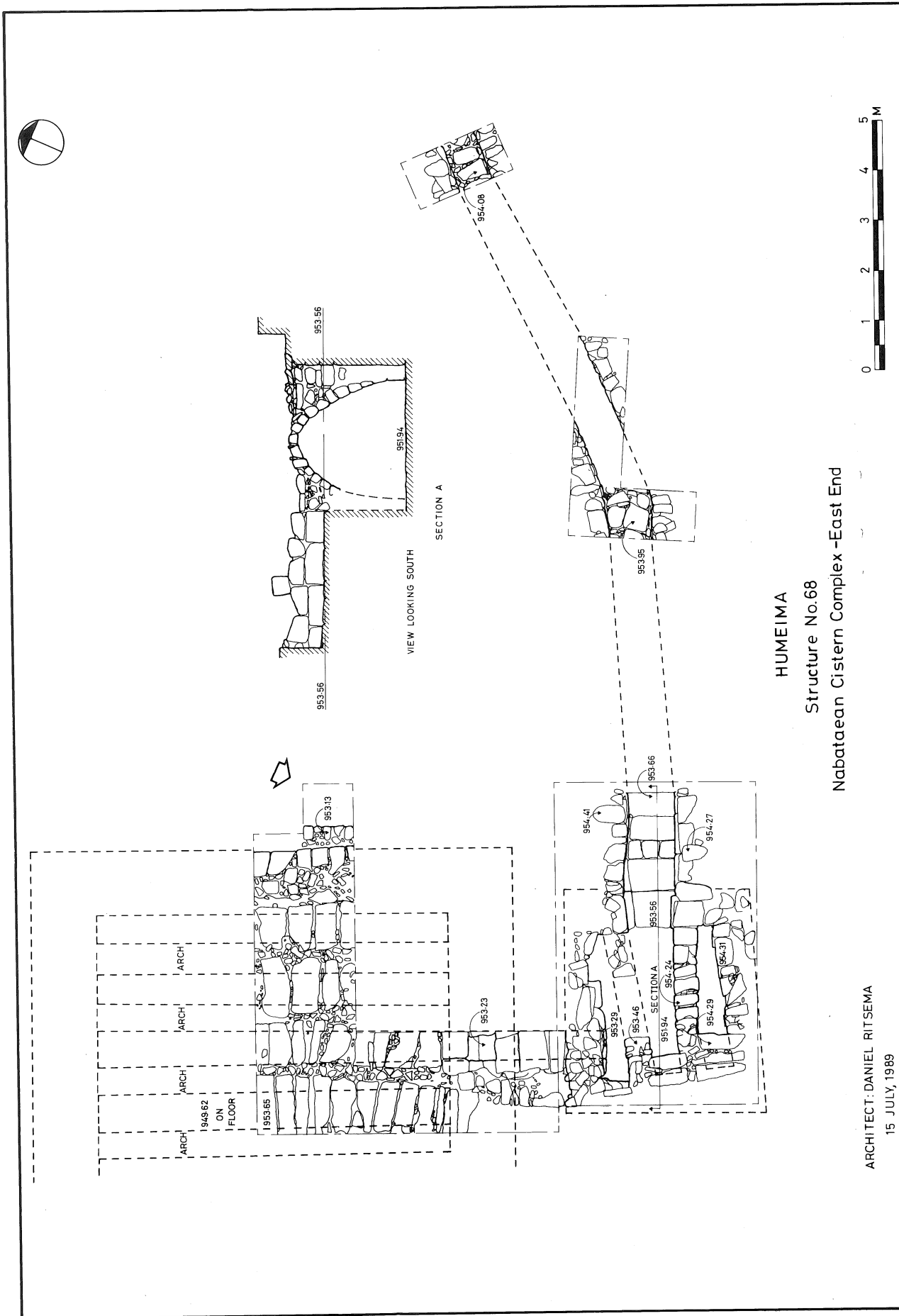


Fig. 3. Cistern No. 68: Plan.

the first century A.D.³ The sounding was excavated to 2.25 m below the upper surface of the wall, exposing in top plan and in section the foundation trench within which the wall had been constructed. The fill was composed of four major strata of sand and gravel mixed with a packing of fist-sized pieces of sandstone and limestone rubble (Fig. 4). These strata (comprising Loci nos. 10-19), had been deposited into a foundation trench cut into the sterile, coarse, red-brown sand that constitutes the original soil at this point in the site. The fill had been poured into the trench after construction of the wall, and the strata consequently sloped downwards slightly towards the wall face and terminated on it without a break.

In section, the profile of the trench could be seen (Fig. 4). This profile made clear that an enormous, rectangular, east/west hole with slightly sloping sides had been excavated for the cistern, probably 26 x 13 m. The lowest 1.3 m of the inner face of the wall was then built of regular, carefully trimmed blocks of sandstone (inside dimensions of 20.05 x 6.95 m), which then served as a retaining wall for a solid packing of rubble mixed with mortar thrown into and completely filling the approximately 1.0 m wide trench between the wall and the boundary of the excavation. Above this point the rubble packing was faced with relatively large limestone and sandstone blocks (up to 0.75 x 0.25 x 0.25 m) that were not, however, laid as isodomic ashlar courses. Between this solid outer facing and the carefully-built inner cistern wall, the packing probably consisted of the mortared rubble seen in the upper part of the wall. From a point 1.3 m above the cistern floor it was possible to build the outer wall face more carefully, because from this point up to the roof the face of the excavation into which the

structure was built sloped outwards slightly, allowing the masons room to manoeuvre. The profile of this trench could be seen in the north and south baulks of the sounding: it met the face of the outer wall at a point 2.60 m below its upper surface (1.3 m above the cistern floor), then sloped outward to a distance of 0.75 m from the wall, where it terminated in what seems to be the ancient ground level (0.30 m below the top of the wall). At a point 0.10 m below this possible ground surface, the wall is offset to the west 0.50 m, leaving a step 0.45 m high to the top of the wall — which at this point is 1.15 m thick.

The loci in the foundation trench yielded a small number of Nabataean sherds (Bag nos. 85, 93, 101, 102, 103bis, 108, 116-119, 129, 133), along with two possibly Late Byzantine body sherds in Locus 11 (the fill just east of the curb; Bag 102) and Locus 16 (fill from 2.0 m below top of wall; Bag 118).⁴ The sherds are very worn and small and include very few diagnostics. In combination with the controversies concerning the chronology of Nabataean ceramics, these factors bring a certain amount of doubt to the dating. To be sure, several of the more characteristic sherds in the foundation levels are clearly early first century B.C. in date. By itself, this fact does not prove that the cistern was constructed during the first century B.C., but comparison with the ceramics found in the mixed surface fill above the foundation suggests strongly that construction was completed before the Roman period. Loci 1-2, 6-8 all yielded an enormous amount of ceramic material of the Nabataean, Roman, Byzantine, and Umayyad periods (Bag nos. 6, 59, 69, 76, 77, 86). This material was not found in successive occupation levels, but occurred in the form of small, worn sherds mixed uniformly in thin, alternating layers of water and wind-

3. The pottery from this season of excavation will be published fully along with the pottery from previous seasons, in the final report volume that is now in preparation.

4. Bag 102.3: very small body sherdy (Th 3.5 mm)

of a coarse but hard sandy ware with a few white specks; core red (2.5YR 5/8); outside surface grayish brown (2.5Y 5/2). Bag 118.2: slightly ridged body sherd (Th 3.5 mm) of a very coarse, laminar sandy red (2.5YR 4/6) ware with dark gray (N 4/0) outside surface.

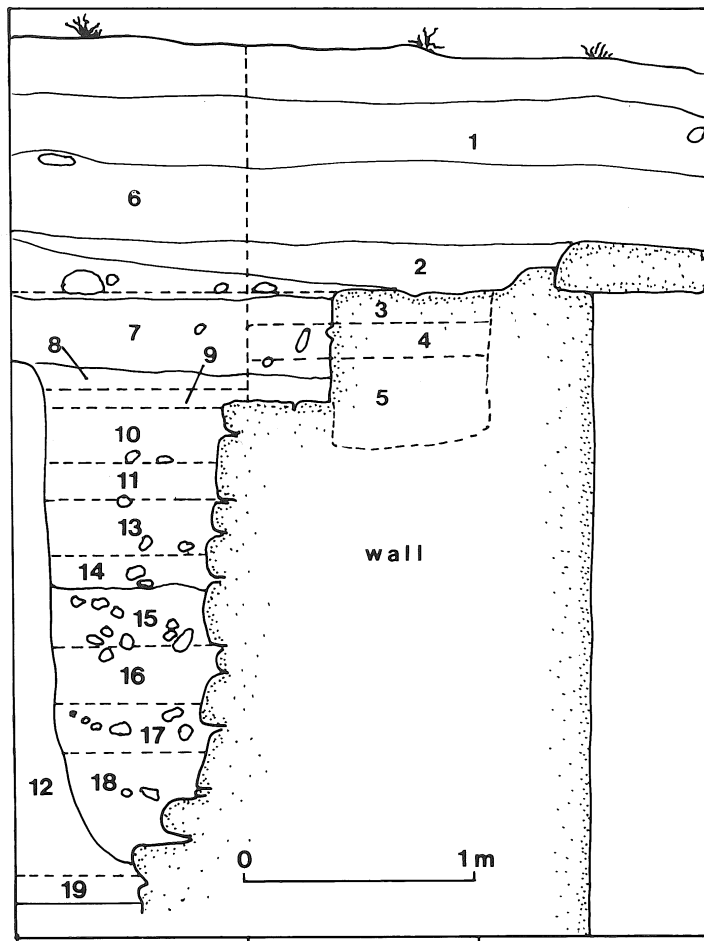


Fig. 4. Cistern No. 68: Section of probe, south face.

deposited sand, silt, and clay that slope downwards from east to west over the cistern wall and the roof beyond. This deposit, which is typical of most of the site, represents the mixing and spreading of cultural material typical of the centre of a busy habitation area over a long period of time. If the cistern had been built or even repaired subsequent to the first century B.C. or A.D., much clearer ceramic evidence of the Roman or Byzantine period could be expected from the lower levels. The presence of a possible Byzantine body sherd in Locus 16 is disturbing, but in view of its small size and doubtful character, and in view of the enormous amount of Byzantine material found in the surface levels, it cannot be accepted by itself as proof of a late date for the cistern.

The second problem was the relationship between Cistern no. 68 and Cistern no. 67. The survey in 1987 noted the presence of a rebuilt overflow channel for

Cistern no. 67 that seemed to direct the surplus water from this cistern to no. 68 (Pl. I,1). Excavation of the settling basin for no. 68 in 1987 revealed that the intake channel for that cistern extended eastward for at least 3.0 m — up to the east baulk of the excavation area. It was consequently assumed that no. 68 was filled with the overflow from no. 67, a relationship indicating the unified character of the complex. There were, however, several problems with this hypothesis. One was the presence of the settling basin associated with no. 68: if the water entering Cistern no. 68 had already been allowed to settle in the basin associated with the no. 67 intake, the second settling basin was redundant. Furthermore, in view of the infrequent character of the run-off in this region, it seemed a risky strategy to wait for one major cistern to fill before beginning to fill a second one.

The four soundings made in 1989

revealed that Cistern no. 68 had its own separate intake system (Fig. 3). A probe was made at the intersection of the projected lines of the modern overflow for no. 67 and the ancient intake for no. 68 to a depth of 1.0 m below the modern soil surface without revealing the presence of any connecting conduit. Subsequently, a probe located 5 m east of the last visible section of the intake for no. 68, on line with the bearing of the course (70 degrees) located the well-preserved remains of the intake channel just below the modern surface. This stretch of the intake channel, however, also revealed that the channel was curving off to the northeast, at a bearing of 45 degrees. A second section of the channel was located 3.5 m further on. At this point the channel had swung around to the east, to a bearing of approximately 34 degrees. The channel could not be traced in a third sounding 10 m to the northeast. It seems likely that it either terminated at a reinforced intake somewhere between these two probes, or that it has been lost at this point due to water damage or stone robbing.

In any case, it is now clear that Cistern no. 68 had an intake system independent of that of no. 67. This arrangement makes sense in the context of the Nabataean habit of alleviating the risk of complete failure to intercept sufficient run-off water by using multiple water-catching and water-storage structures, with independent catchment areas. The large public Cisterns nos. 67 and 68 were located close to one another in the centre of the settlement, and they have the appearance of a single, unified construction project. They also diverted their water from the same basic wadi system, fed by the large, protected run-off field to the north of the settlement. Their intakes, however, were not built side by side or in series, but were designed to intercept run-off from two opposite sides of a low rise near the apex of the run-off field. Today, the stronger flow runs past the intake for no. 67, and the general topography of the area suggests that the same was true in antiquity. If this was in fact the case, Cistern no. 68 may have been in-

tended to serve as a back-up to no. 67: it might not have filled as quickly as its neighbouring counterpart or have filled to capacity as consistently, but the intake system may also not have been as susceptible to damage by the full force of a wadi system carrying a greater than usual flow of water. In view of all these factors, it seems likely that the overflow channel from Cistern no. 67 is completely modern in character. The absence of an overflow channel associated with the better-preserved Cistern no. 68 supports this interpretation.

Excavation at Cisterns nos. 69 and 64

The initial research model for the Humeima project postulated that the aqueduct (survey no. 1), Nabataean Reservoir (no. 63), and the two large cisterns in the settlement centre (nos. 67-68) were all planned as part of an integrated system by Aretas III and built at the time of Auara's foundation. In contrast, it seemed likely that the other cisterns in the settlement area and in the catchment territory around Auara were built over a period of time (from the Nabataean to the Byzantine periods) by private individuals as the settled population in the settlement centre increased and the nomadic population frequented the region in greater numbers. It was consequently one of the priorities of the 1989 season to excavate around one of the round cisterns located within a domestic structure in the settlement centre to determine both the chronology of the cistern and its relationship to the house. A sounding was attempted at Cistern no. 69 (Fig. 2.69), a round cistern built of blocks, with a well preserved slab roof supported by transverse arches, located approximately halfway between Cistern no. 67 and the Bath Building. The area immediately above the slab roof had been cleared of blocks, since the cistern is still in use as a water source, but the tumbled remains of the house in which it was located can still be identified around the flat, open space. The cistern itself was approximately 7 m in diameter (the interior was not accessible

for exact measurement) and 5.92 m deep, with four or five arches extending north/south across segments of the circle to support the roofing slabs. At present, access to water is provided through a square shaft (0.65 m sq.; 1.10 m deep) built of blocks.

After cleaning of the surface debris, it became clear that the northwest corner of the court in its final stage of development included a stepped arrangement of walls above a curb wall that retained the earth fill over the cistern roof (Pl. I,2). There was a paving of sandstone slabs over the earth fill, which was 0.88 m deep at this point. The curb wall was built of carefully squared ashlar sandstone blocks with diagonal trimming, laid as stretchers with an occasional header block. There were traces of a second level of sandstone paving 0.50 m below the first, 0.25 m below the top of the curb wall and 0.40 m above the long, roughly-trimmed blocks roofing the cistern.

The loci above the paving (Loci 1-5) contained a rich assortment of ceramic material dating from the Nabataean through the Umayyad periods (Bag nos. 37-39, 41, 48, 49, 54). Excavation beneath the paving (Locus 6) yielded a significant number of badly worn sherds from the Nabataean, Roman, and Late Byzantine periods (Bag 63), probably indicating the history of occupation at the house. Unfortunately, the danger of damaging the roof, and the hazard to the people and animals using the cistern did not allow excavation into the deposits behind the cistern wall. Because of the character of the loci, the pottery recovered in this excavation obviously does not date the cistern to the Nabataean period — but the presence of Nabataean wares throughout the deposits excavated indicate that a Nabataean date for the construction of the complex should not be excluded.

In view of the impossibility of excavating at present to undisturbed deposits around Cistern no. 69, a second cistern associated with a presumed domestic structure was selected for investigation: Cistern no. 64. This is another built, circular

cistern located in the courtyard (approx. 6 m square) of a large, rectangular structure close to the southeastern edge of the settlement (Fig. 2.64). The cistern, its intake channel, and the associated settling basin are all well preserved, and the roof is intact. The interior of the cistern could not be examined because of the presence of numerous poisonous snakes, but the diameter seems to be 4 m; the depth is 4.5 m. The cistern was in use in 1983 but has been derelict for several years. The curb of the courtyard around and above the cistern seems to have been lost (although portions of it may in fact still exist beneath the surface fill), but the southeast corner of the courtyard above the cistern wall, adjacent to the intake channel, seemed relatively undisturbed, and it was not encumbered with rubble. A square 2 m on a side was opened at this point in the hope of uncovering some sealed foundation deposits outside the cistern wall (Pl. II,1).

Three levels of soil and rubble fill were identified (Loci 1-4) above and around the upper edges of the cistern wall and the south wall of the intake channel. Excavation of these strata also revealed the presence of an overflow conduit for the cistern: two aqueduct conduit blocks placed edge to edge form a passage through the wall, which then continues into the fill around the upper edge of the cistern as a slab-built conduit (W 0.44 m; H 0.40 m). The ceramics from these levels — as so often at Humeima — date from the Nabataean through the Late Byzantine or Umayyad periods (Bag nos. 65, 79, 99, 100, 104, 105). It is interesting to note, however, that the Nabataean ceramic material tends to be numerically more significant than the Roman or Byzantine. Locus 4, a soft, brown sandy deposit, rested on a layer of rubble (Locus 5) that served as a packing between the outside of the cistern wall and the exterior face of the south wall of the intake channel. The ceramics in the soil around this rubble (Bag nos. 106, 126) included Nabataean, Roman, and Early Byzantine wares. Beneath this rubble, however, a compact, darker brown sandy soil with an admixture of clay

extended between the exterior of the cistern wall and the lower portion of the intake channel (Locus 6). The ceramic material from this level (Bag nos. 110, 124, 125) is all Nabataean or Roman in date. The lower levels of this fill contained no sherds whatsoever.

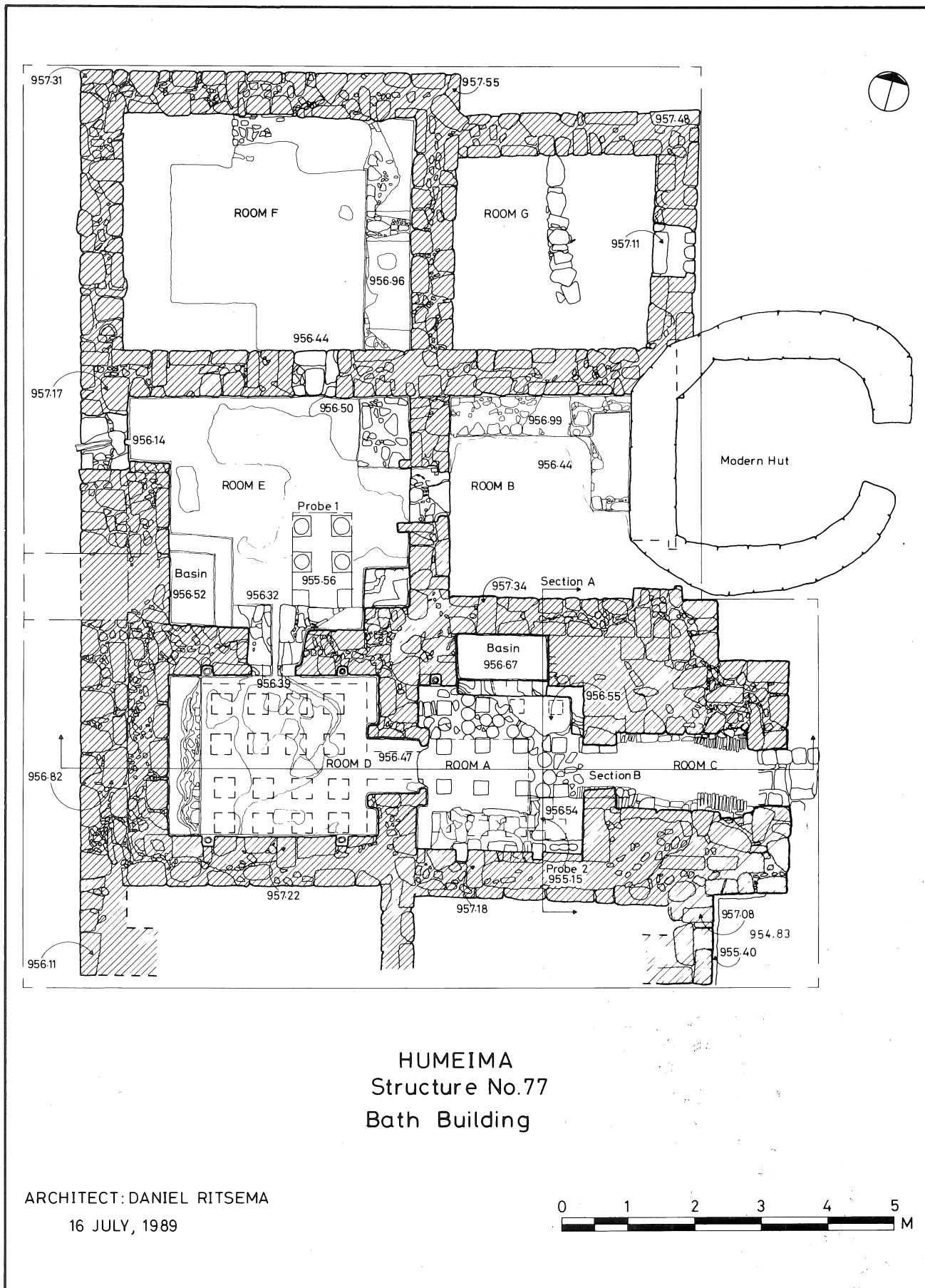
The probe at Cistern no. 64 reveals that it was constructed on an unoccupied site during the Roman period — probably in the first or second century A.D. The intake channel (and most likely the settling basin as well), and the cistern were constructed simultaneously of carefully cut blocks on the interior, faced on the outside with large, irregular pieces of limestone and sandstone rubble set in a grey mortar with flecks of ash. At a later time, probably in the Early Byzantine period, the upper levels of the foundation deposit were disturbed, most likely in connection with the repair of the cistern roof and the insertion of an overflow conduit. It is interesting that this structure on the periphery of the settlement was constructed at a date not too long after the foundation of Auara. It may well be that the entire habitation area visible at present filled up fairly rapidly after the foundation of the town and the construction of the public water-supply structures by King Aretas III. The overflow channel is a unique feature in the cisterns examined so far in the region of Auara.

Excavation of the Bath Building (Survey no. 77)

The Bath Building tentatively identified in 1987 is a small structure approximately 10 x 15 m in size, located 300 m northeast of the settlement, 100 m south of the Nabataean reservoir (Fig. 2.77). It was constructed on the edge of the eastern ridge above the settlement centre, at a level slightly lower than that of the Nabataean reservoir, and just west of the projected course of the overflow conduit fed by the reservoir. In view of its obvious importance for the history of water use at Auara, excavation of this structure was a major objective of the 1989 season. Sur-

face rubble and the spoil of the clandestine digging were cleared away first, revealing walls that suggested the presence of seven rooms (Rooms A to G) (Figs. 5-6). Excavation began with Rooms A and B, then Room C to the east, Rooms D and E to the west, and finally Rooms F and G to the north. Unfortunately, the fill above the plaster floors in Rooms B and D-G was a secondary deposit containing a modest assortment of sherds dating from the Nabataean to the Umayyad periods, along with thousands of fragments of flue tiles. The lower levels in Rooms A and C were intact. It was subsequently related by the local Bedouins that much (if not all) of this structure had been cleared out between 1948 and the mid-1960's by an individual named Abdul Aziz al-'Arabi, a Moroccan who built the small stone hut that still occupies the northeastern part of the Bath site. Subsequent digging in the building — particularly the destruction of much of the floor of the *calidarium* — is owed to the reputation Moroccans have locally as "magicians". They are frequently consulted in the search for treasure, and the locals assumed that the Moroccan's interest in this site stemmed from such a prognostication. Nevertheless, it was possible to determine the plan of the Bath Building, and several probes in undisturbed deposits beneath the floors and outside the walls of the structure have provided a tentative history of its construction and development. The structure will be described room by room, proceeding from the entrance area to the furnace, rather than in the order in which the rooms were excavated (Pl. II,2).

Excavation revealed that the Bath Building had been constructed within the remains of a substantial structure built of carefully cut sandstone blocks with diagonal trimming on their visible faces, laid as stretchers interspersed with occasional headers (Fig. 7.1). The original entrance to this structure seems to have been on the east, where a projecting entrance hall (preserved as Room C of the Bath) had an outer and inner door. The two lowest voussoirs of the arch that spanned the



HUMEIMA
Structure No.77
Bath Building

ARCHITECT: DANIEL RITSEMA
16 JULY, 1989



Fig. 5. Bath Building (No. 77): Actual state plan.

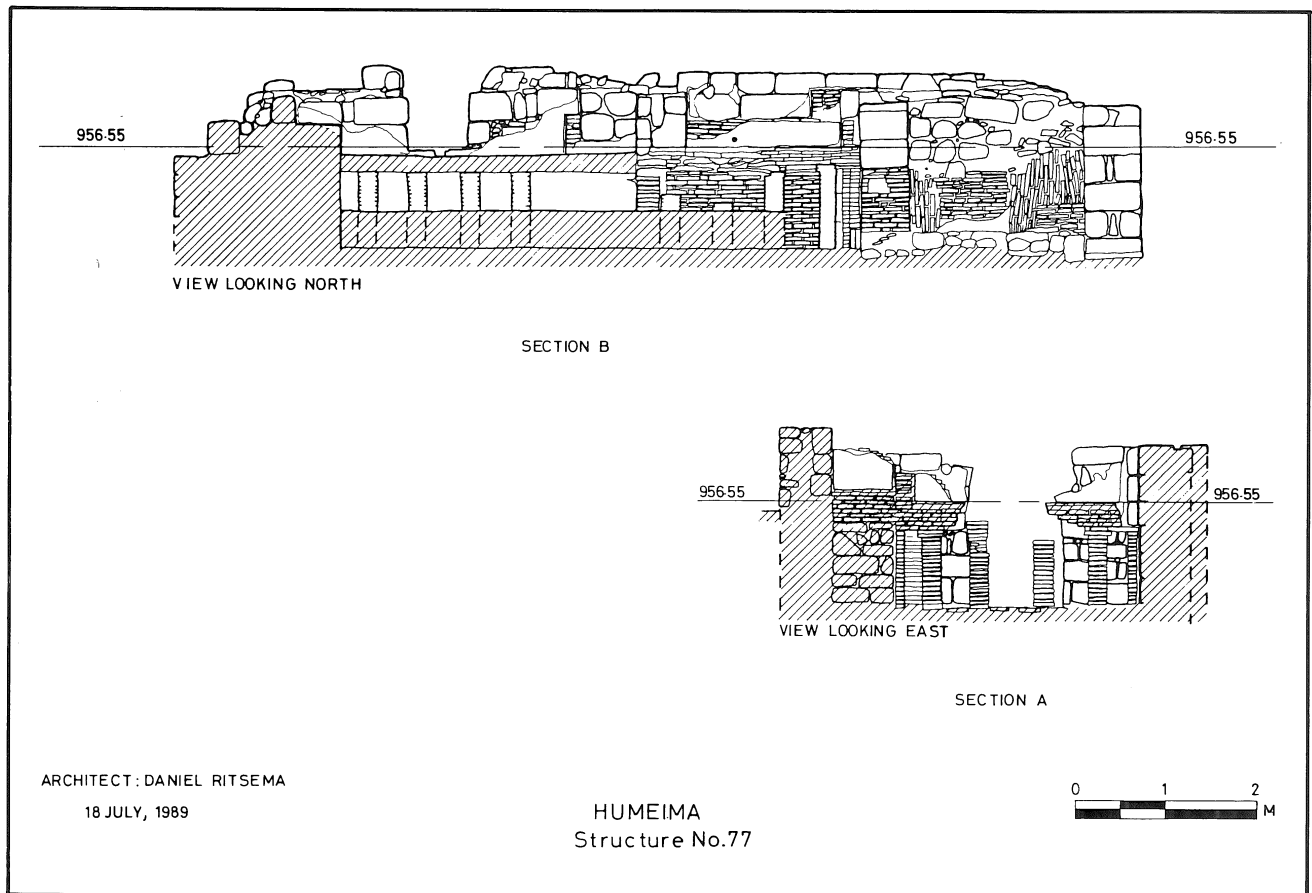


Fig. 6. Bath Building (No. 77): Sections A and B.

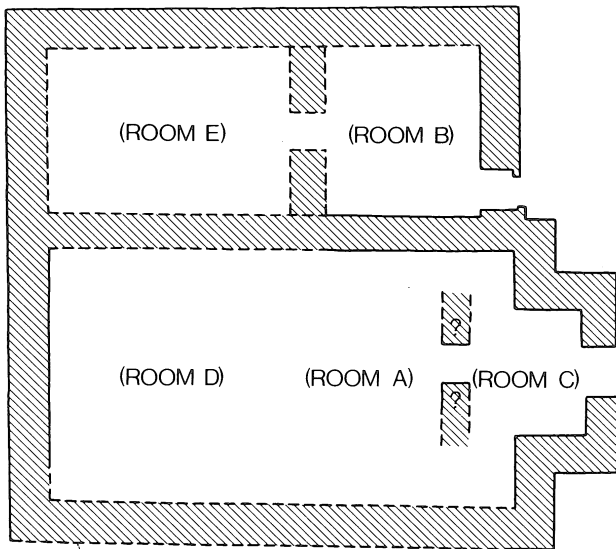
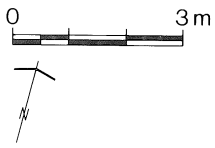
inner, western door are preserved (Pl. III,2), and it seems likely that both doors originally had arched lintels. A sounding at the corner of the structure south of the door to Room C exposed the bottom of the foundation at an elevation of 954.83 m — 1.72 m below the level of the floor in Room A, 2.55 m below present ground level. The fill just above the foundation (Locus 33) was a coarse, yellow-brown sand that yielded a single sherd: a fragment of the body wall of a Nabataean painted cup, possibly of the second century A.D. (Bag 122). The level immediately above the foundation offset (Locus 29), extending 0.30 m up the face of the wall, was composed of the same type of sand, but contained a large amount of Nabataean pottery possibly dating as late as the early second century A.D. (Bag 98). In view of the construction technique of the wall, the finishing of the stone surfaces, and the ceramic evidence, it seems very likely that the structure below the Bath was built by the Nabataean rather than the Roman or

Byzantine inhabitants of Auara. The original function of the early structure is no longer clear, and excavation of the interior would require the destruction of the Bath Building. In view of the excellent construction technique, proximity of the aqueduct, and later use as a bath, it is at least possible that the structure was designed from the beginning as a bath. The structure now seems to be isolated from the habitation areas of the site, however it is not impossible that it was a large house.

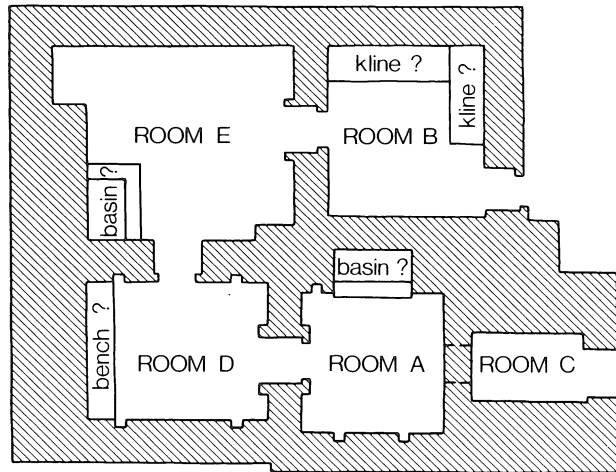
Room C of the Bath was built entirely within the foyer of this Nabataean structure. The south wall of the earlier structure lies outside the periphery of the Bath Building, but the east wall of Room B, the north wall of Rooms B and E, and the south wall of Room B were built on top of the earlier walls. The west walls of Rooms D and E were, curiously, built tightly up against the inside face of the west wall of the Nabataean structure rather than on top of it (see Fig. 5).

The Nabataean building underwent

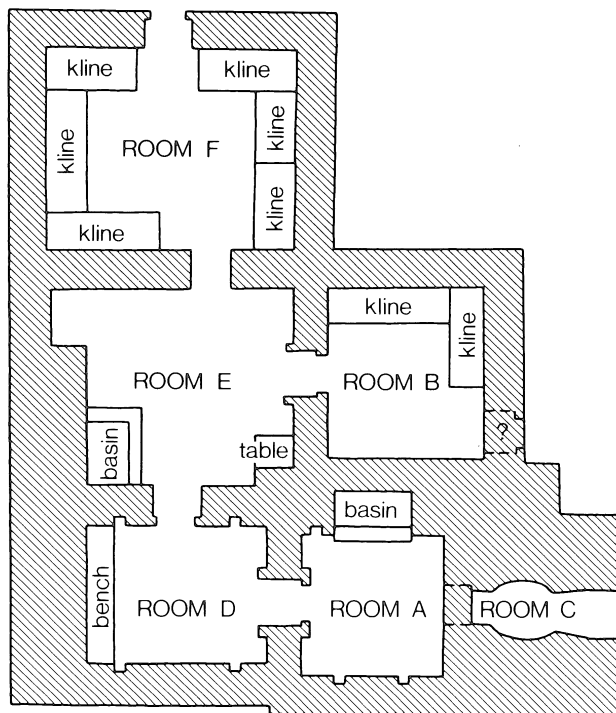
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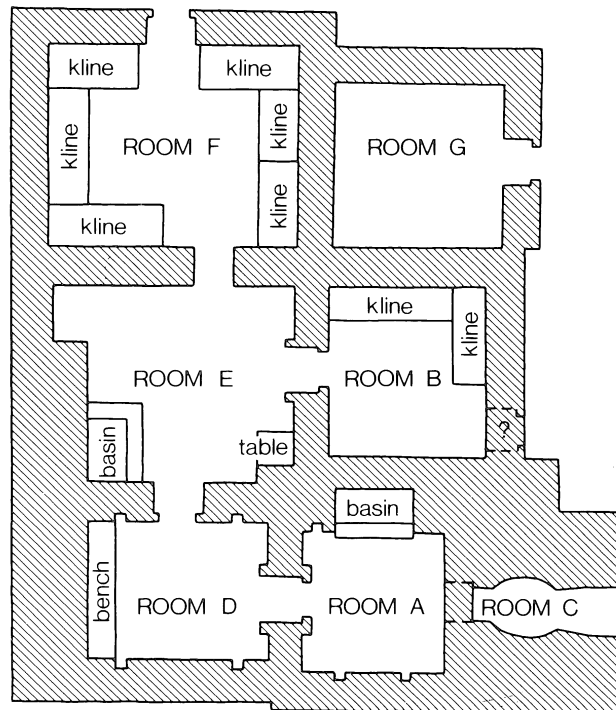
1. NABATAEAN STRUCTURE



2. BATH: STAGE I



3. BATH: STAGE II



4. BATH: STAGE III

Fig. 7. Bath Building: Sequence of development.

significant changes before and/or in the course of its transformation into the Bath seen today, but no evidence was found of a violent destruction. At least some of the walls had been partially dismantled before construction of the Bath commenced, and the more roughly built later walls often rest on top of Nabataean masonry. These later walls are constructed with a mixed facing of re-used Nabataean blocks, rectangular blocks of various dimensions, and small pieces of rubble. The interior of the walls, between the facings, was filled with irregular pieces of rubble set in a crumbly, grey mortar containing numerous flecks of ash. In the upper reaches of these walls the mortar has often totally disappeared as a result of weathering.

The Bath as seen today went through two stages of development that can be dated tentatively to the Late Roman (Stage I) and the Late Byzantine (Stage II) periods (Fig. 7.2-3). In Stage I, the Bath consisted of five rooms: a reception and undressing room or *apodyterium* that probably contained flat, low benches for sitting, or two (or possibly three) *klíne* benches for sitting or reclining (Room B),⁵ a bathing room with a basin for cold water — *frigidarium* — but with a heated floor (*hypocaustus*, Room E), a sweat room or *laconicum*, with a bench for sitting, and heated floor and walls (Room D), and a hot bath room or *calidarium*, with a heated floor and walls and a basin for heated water. As usual with Roman baths, the furnace room (*praefurnium*, Room C) adjoined the *calidarium*. In Stage II, a second, larger *apodyterium* with six *klíne* benches was added (Room F), the hypocaust floor in the *frigidarium* was filled in, and the heating system in Rooms C, A, and D was rebuilt. The relationship of Room G to this complex is unclear. The walls are less well built than those elsewhere in the Bath, they do not bond with them, and the only door opens outside the

building. The interior of this room had been cleared out to the foundation level sometime in the post-classical period, and no interior features remain to provide a clue to its original function. It is at least possible that it housed a latrine, a facility typically associated with Roman public baths. For the moment, it has been attributed to a separate, final stage of the structure's development. The stub of a poorly built spur wall projects 1.0 m south of the south wall of the structure, on line with the wall separating Rooms A and D. Although the context is badly disturbed, this wall seems to be a later addition to the building.

Room B, most likely the original reception room in Stage I, is a roughly square chamber (3.09 x 2.74 m) entered from the east by means of a door (W 0.75 m) opening inward at the south end of its east wall (Fig. 5). This door is built into the Nabataean masonry and appears to belong to the original construction period. Two *klínai* benches built of flat stones and fired bricks set in a hard white mortar occupy the east (L 1.75; W 0.80; H 0.50 m) and north (L 2.19; W 0.79; H 0.50 m) walls. The benches were finished with the same hard, sandy white plaster that was used for the floor and walls. The plaster of the floor was laid on a bedding of irregular rubble set in a crumbly grey mortar containing numerous flecks of ash. Most of this pavement was torn up at some point (probably during the recent clearing and re-use of the structure), and was replaced with a series of beaten mud floors. At this same time a hearth was constructed in the southwest corner of the room with several re-used blocks set roughly on top of one another on the mud floor. The plaster of the walls was laid on a scored bedding of a very sandy, crumbly mortar. The damage to the south side of the room has made it impossible to discern whether or not a third bench was located at this point, but

5. The term *klíne* is used for a bench with a built-in pillow at one end for use as a support when reclining on one's side or lying flat on one's back. The Latin terminology for the rooms and

features of a Roman bath building is well documented in contemporary authors: see Vitruvius 5.10.1-5, 11.2; Pliny *Ep.* 5.6.25-27; Celsus 2.17.1; Seneca *Ep. Mor.* 90.25.

there is space for it. A door approximately in the middle of the west wall (W 0.635 m) opened outward toward Room E. The *klínai* seen at present probably belong to Stage II, but there must have been some arrangement for seating in this room in Stage I as well.

Rom E, the hypothetical *frigidarium*, is a roughly square room slightly larger than its neighbour to the east (3.55 x 3.15 m). In Stage I the floor had a heating space beneath (Pl. III,1). The original floor was destroyed during the renovations in Stage II, but it was probably constructed of tile and stone in the same manner as the floors in Rooms A and D. The floor slab (*suspensura*) was carried on pillars (*pilae*) built of round fired bricks (*laterculi*, D 0.23 m) set in a dark brown clay. The pillars now survive only to a height of 0.45 to 0.60 m in the fill laid down over them during the Stage II renovations to support the new floor. At present, the floor and walls are covered with a harder, more finely polished plaster than that used in Room B, containing a rich admixture of a coarse red sand. In place of *klínai*, the fittings in the room consisted of square tables built into the northeast and southeast corners, and a basin built into the southwest corner. The table in the northeast corner has been torn out, leaving only the outline of its intersection with the plaster floor (1.02 m N/S, 0.83 m E/W), but the southeast table survives. It was built of fired bricks and flat stones set in a crumbly grey mortar like that used for the *klínai* of Room B and was plastered neatly on its outside faces (0.64-0.61 m E/W, 0.61-0.55 m N/S, H 0.69 m). The vertical surfaces of the table and wall were finished before the floor, but the joint has been smoothed over carefully, and the whole room seems to have been plastered at one time. The small portion of the upper surface that has been preserved does not show any signs of fittings or recesses, and it seems likely that the table was simply intended as an elevated support for a water jar or some other equipment required for bathing. The south wall of the room jogs 0.80 m to the south at the west end of the table, so its north face at this point is

approximately on line with the south face of the party wall to the east — between Rooms A and B.

The focus of the room was undoubtedly the basin built into the southwest corner, constructed of fired brick and flat stones in the same manner as the table opposite (outside L 1.32 m, W 0.93 m; preserved height 0.60 m). The plaster inside the basin (inside dimensions: 1.04 x 0.67 x 0.44 m) is the same type as that used for the floors and walls of the room. As preserved, the basin has a capacity of 307 litres. There is a drain hole approximately in the middle of the north basin wall (D 0.025 m) at the level of the basin floor. The waste water apparently was simply allowed to drain off across the floor toward the west door, which has a drain built into its doorsill. The floor of the room slopes markedly from the southeast to the northwest to facilitate evacuation of the water from this basin and from the basin in Room A — which entered through a similar drain in the doorsill of the door in the south wall of Room E, after passing through Room D. The red plaster used for the floor and walls of this room and of Rooms A and D probably was designed to resist the effect of this water and of the resulting humidity. Both this basin and the basin in Room A are too small and too inconveniently placed to have allowed bathing by immersion. Instead, the bathers would have leaned over the basins, and splashed themselves, leaving great puddles that ran off across the floor through strategically placed drains.

Stone-robbing has made it impossible to determine whether or not there was a door in the northwest corner of the room. The present opening (W 0.78 m) is only loosely framed by the blocks of the wall, and the stone doorjambs with offsets seen elsewhere in the building where doors open through the masonry of the early Nabataean structure are absent. There may not have been any opening above the drain for passage, but rather a simple recess in the room. The fill around the drain was constructed of small rubble set in crumbly grey mortar, and the eastern

surface — flush with the wall of the room at this point, was plastered with the typical pink plaster. The drain opening (0.10 m sq.) is formed by stone blocks at its east end, but to the west was built of two circular flue tiles (L 0.45, D 0.11 m) set end to end. This is the type of flue tile (*tubus* or *tubulus* according to Seneca, *Epistulae Morales* 90.25) set into the wall recesses in Rooms A and D. At the drain's exit there was a flat area of small pieces of rubble set in brown, sandy surface soil, concreted by the presence of water.

A third door opened inward in the south wall of Room E (W 0.83 m), in the middle of a low, plastered step (L 1.98; W 0.325; H 0.18 m) that runs along the base of this wall between the southeast table and the basin. An open drain channel across the threshold, plastered with the same hard plaster used for the floor and walls (L 1.10; depth 0.12; W 0.07-0.11 m), allowed water originating in Rooms A or D to pass through and flow across the floor of Room E to the northwest drain.

There is yet a fourth door in Room E (W 0.68 m), opening in the middle of the north wall and allowing entrance to Room F. The plaster around the door jambs has fallen away, revealing that this door, like the west one, is less well finished than the east and south doors and may have been cut through the wall in Stage II. Such a sequence would make sense, for the north door allows access to a Room F, which served as an enlarged *apodyterium* (see below).

A probe was cut through a small section (1.3 x 0.75 m) of the floor in Room E, adjacent to the south step and 0.12 m west of the southeast table, in an attempt to find cultural material to help date the construction and development of the Bath Building (Fig. 8, Pl. III,1). The plaster floor (Th 0.02 m) was bedded on a layer 0.10 m thick of flat stones set in a crumbly grey mortar (Locus 1) 0.07 m thick. Immediately below this bedding there was a thick layer of loose, light grey sandy soil mixed with a large amount of ash, including some pebbles in the upper 0.10 m (Locus 3). This layer was 0.27 m thick, and

in its lower 0.15 m contained 53 large fragments of broken flue tiles, of the rounded rectangular form seen elsewhere in the fill in and around the Bath Building (Bag 153). Three small, worn body sherds were also recovered in this locus, and the fragment of a lid or saucepan: the shapes and wares are not distinctive and may date anywhere from the first to third century A.D. Beneath, there was a surface of a yellow sandy soil sloping slightly toward the north (Locus 4), which surrounded the remains of hypocaust pillars built of bricks mentioned above. The fill among the six pillars exposed included lenses of ash and silt, and contained 51 fragments of the ubiquitous broken flue tiles (Bag 154). The pillars were laid on a layer of small pieces of rubble set in a brown soil.

Although the ceramics from this probe did not make any real contribution to dating the phases of the Bath, the association of broken flue tiles with round hypocaust supports does provide some assistance in determining the relative sequence of development. This probe revealed that at the first stage of its development, Room E had a hypocaust floor, and that this floor went out of use at the same time that a hot room with flue tiles in the walls (Room A?) was remodelled. Since it is so far from the furnace, and since there should be at least one cool room in the Bath, it is unlikely that Room E itself ever had heating elements in its walls. Since round hypocaust bricks occur elsewhere in the Bath only as paving in Room A, it is probable that the hypocaust beneath Room E was filled in at the same time that the heating system of Room A (and of Room D?) was remodelled. Perhaps it was found that the presence of a hypocaust beneath three rooms, and the inclusion of a complete wall-heating system in two (Rooms A and D) required too much fuel, and the system was scaled down.

Room F is the largest room in the Bath (4.34 x 3.47 m). Two *klíne* benches built of bricks, stones, and mortar as in Room B occupy the entire east wall (L 1.64, 1.85; W 0.68; H 0.51 m). Marks in the hard, sandy white plaster that covers

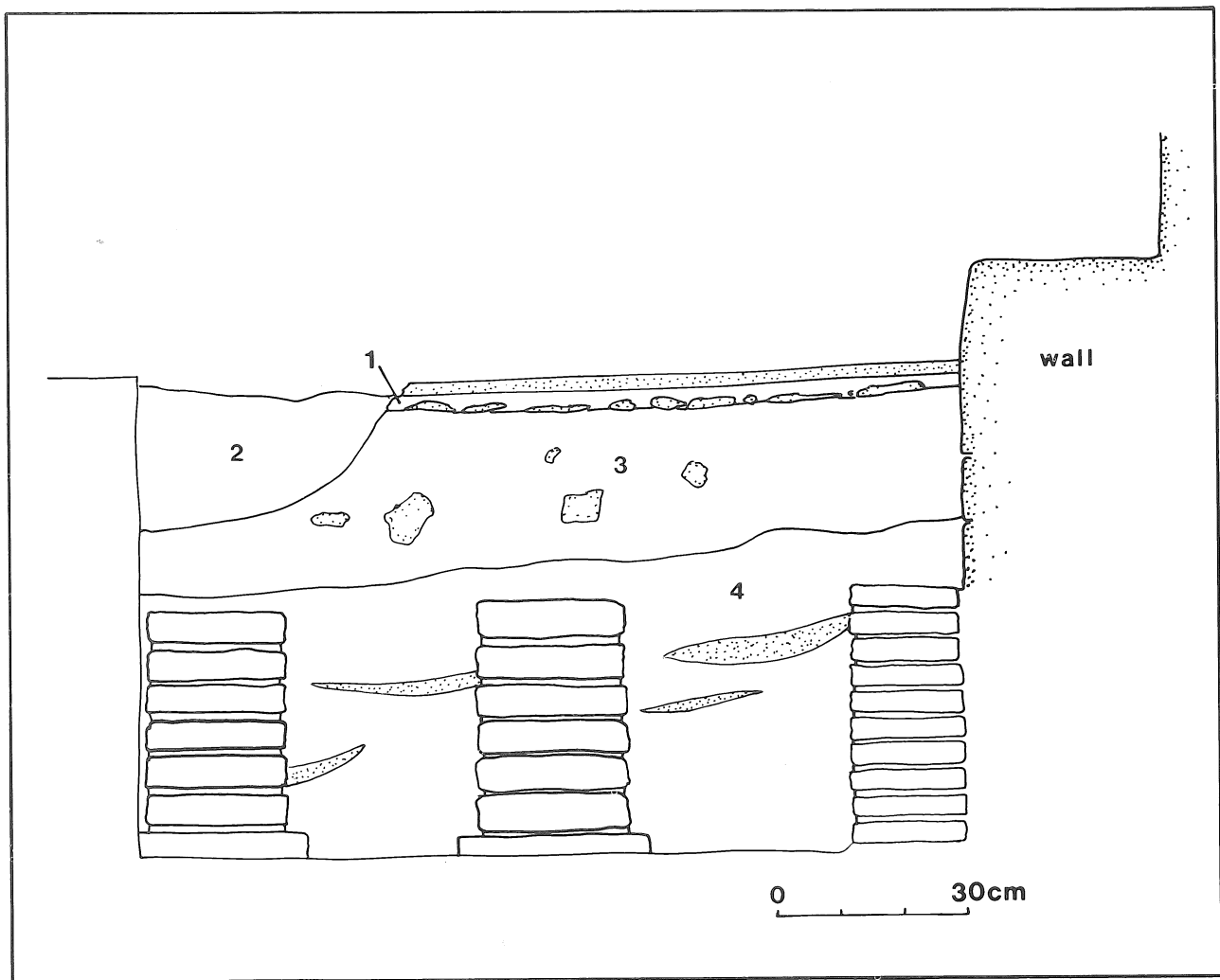


Fig. 8. Bath Building: Probe in Room E, east face.

the floor and the benches reveal that there were originally two more *klínai* along the north wall, two along the west wall, and one at the west end of the south wall — all cut away to floor level. The patterns left in the floor by this later remodelling (probably during the recent reoccupation of the site) reveal that the two *klínai* along the north wall framed a step (H 0.29) leading to a door (W 0.83 m) that opened inward through the north wall. The framing of the north door by two *klínai* indicates that this door is contemporary with these fixtures, and it seems likely that it was the primary entrance to the room.

Room F seems to have been a later addition to the Bath complex, probably built as part of the Stage II renovation: the east and west walls of the room do not bond at their south ends with the north

wall of Rooms B and E, and the south door appears to be cut through an existing wall — in contrast to the north door. The west wall of the room was built on top of the west Nabataean facade wall, whereas the west wall of Room E was built behind it.

It seems likely that the Stage I reception facilities in Room B were found to be inadequate for the needs of the bath, so a larger *apodyterium* was added (Fig. 7.2-3). It is possible that at this same time the door in the east wall of Room B fell out of use or was blocked up. In any case, the north door in Room F must have become the principal entrance to the Bath in Stage II. Patrons could enter through this door, undress here or in Room B, then begin the process of bathing with a cold splash from the basin in Room E. From this point onward, the process of bathing was fixed

by the plan of the structure, which follows the typical Roman bathing liturgy of progressively warmer rooms, followed by a return along the same route.

The door in the south wall of Room E led to Room D, a rectangular chamber (3.10 x 2.39 m) with a bench along the west wall (L 3.10; W 0.46; H 0.39 m). This was probably the *laconicum*, or sweat room: there are benches and a heated floor, but no basins. It is possible that portable basins were used here, and that the room served as a *tepidarium* or warm bath room, but this seems unlikely in view of the presence of built basins in Rooms A and E. Evaporation of water from the basin in Room A that flowed across the heated floor would have provided a moist atmosphere. The bench is built in the same manner as the tables and *klíne* benches in Rooms B, E, and F. The floor is composed of the same hard red plaster seen in Room E, laid on top of a layer of small pieces of rubble set in a crumbly grey mortar. This pavement is supported on sixteen brick hypocaust pillars in the same manner as the floor of Room A (see below). The heat from the furnace in Room C passed below the floor of Room A and into the sub-floor level of Room D by means of an opening corresponding to the east door. There is a similar opening beneath the north door in Room D that — in Stage I of the Bath — allowed hot air to enter the hypocaust of Room E. Heat and smoke could also escape from the Room D hypocaust by means of four vents in the walls. These are vertical recesses (0.15 m sq.) built into the north and south walls near their east and west ends. They served to hold and protect vertical flue tiles: well-fired pipes of a fine, hard reddish brown fabric, with a circular cross-section (outside D 0.11; L 0.45 m), inset at one end to fit one inside another. The space around the tiles was filled with a very crumbly sandy brown mortar with specks of lime and ash. This mortar, and the interior surfaces of the tiles, is discoloured by smoke. The walls of the entire room were then covered with a bedding of hard, sandy grey plaster (Th 0.01 m) scored to hold the same type of pink

plaster found on the floor. The east door (W 0.79 m), had offset doorjambs that projected 0.10 m into the room. The impression of a wooden doorpost (0.14 x 0.16 m) in the plaster of the floor at the south side of the door opening shows that the door opened into the room and was hung at its south side.

Room A is a slightly smaller, approximately square (2.47 x 2.45 m) room with a basin built into its north wall (Figs. 5-6, Pl. III,2). This room and Room C (the furnace or *praefurnium*) were built into a larger room within the original Nabataean structure, making use of its north and east walls, but inserting a new wall on the west to separate Rooms A and D, and an enormous amount of rubble and mortar packing to isolate the furnace structure (Pl. III,2). The lower section of the north wall, between Rooms A/C and Room B, corresponds to the outlines of the Nabataean structure and is built in the same careful manner, while the south wall is built in the more slipshod technique used for the walls in Rooms D and E. The south wall of Room A is set slightly south of the line of the south wall of Room D, and not quite parallel to it. A basin (1.35 x 0.67 x >0.47 m), was built into the north wall of the room. The basin floor is 0.12 m above the pavement, but the original upper edge of its wall has been lost. The capacity at present is 425 litres. Water drained out through a thin pipe set into the western end of its south wall and was allowed to run across the floor, through Rooms D and E, and out the drain in the west wall of Room E. The basin is waterproofed with the same light red plaster used for the floor and walls of this room and Room D.

Four vertical recesses for flue tiles were built into the east and west ends of the north and south walls of the room in the same manner as those of Room D, but arranged less symmetrically. The two north recesses had to be moved closer to either end of this wall in order to avoid the basin. As in Room D, these vents were designed to heat the walls of the room, provide a draft for the furnace, and carry off smoke. The south wall of this room, however, was

provided with a further heating facility, preserved at the time of excavation only at the southeast corner. The entire south wall was covered with a layer of medium-hard white plaster 0.135 m thick, which encased a layer of upright flue tiles set side by side to carry heat up through the wall. These tiles, in contrast to the circular tiles set into the walls of this room and of Room D, had a slightly rounded rectangular section: outside dimensions 0.085 x 0.15 m. No complete example was preserved, but the impressions left in the plaster indicate that they were at least 0.235 m long. They were manufactured of a fine, very hard light pink fabric, but are usually found heavily discoloured by smoke and heat. Preservation of a portion of the floor at the northeast corner of the room reveals that no such layer of pipes was installed there, probably because of the presence of the basin.

The fill in the in-filled hypocaust below the floor of Room E consisted for the most part of rounded rectangular flue tiles of this same type, indicating that this arrangement was used in Stage I of the Bath as well as Stage II. Several of these tiles from Stage I, however, have slightly different proportions than those of Stage II, suggesting that some modifications may have been made. Fragments of the Stage II tiles were found by the thousands throughout the fill within the rooms of the Bath Building, and in the upper strata excavated outside. Since these tiles were mounted high in the wall, they were very susceptible to damage and to deposit high in the fill around the structure after its abandonment and destruction.

The heating system in Room A was exposed and made accessible through the destruction of the floor by clandestine diggers (Fig. 6, Pl. III, 2). The pillars, built of square bricks (0.21 m sq.; Th 0.03 m) rest on a pavement composed for the most part of the circular bricks used for the hypocaust pillars of Stage I, chinked with fragments of rectangular bricks. There were 16 pillars in the room, set approximately 0.35 m apart, rising to an original height of 0.80 m, carrying a complex

paving 0.32 m thick. The pillars were capped by two courses of three rectangular bricks (0.095 x 0.22 m) each, set sideways, which carried a paving of very large, heavy bricks 0.51 m square (Th 0.04 m). A paving composed of bricks, flat stones, and mortar 0.10 m thick was laid on these bricks, and above it a bedding layer of crumbly grey mortar 0.04 m thick. The final paving of a carefully polished layer of hard, sandy pink plaster 0.02 m thick was laid on this. The interior stone faces of the walls of the room were enclosed by brick walls built up to the level of the paving. Insets were built into this brick lining corresponding to the vertical flues built into the walls above, and an opening 0.57 m wide extending back as far as the party wall between Rooms A and B allowed heated air to circulate beneath the water basin. The floor of the basin was supported at this point on large slabs of red sandstone. Another gap in the west wall allowed heated air to enter the space below Room D (and — in Stage I — continue on to the hypocaust below Room E). Along the south wall, a gap was left between the floor pavement and the wall to allow hot air to enter the vents in the plaster heating layer.

At the time of excavation, the space between the pillars of Rooms A and D was filled to a depth of 0.40 m with a fill composed of a fine, compact, light brown loess, with occasional layers of fine ash 0.01-0.02 m thick, up to a level 0.25 m above the floor. The layer of ash resting directly on the floor probably represents the deposit from the last firing of the furnace. Since it is unlikely that the heating system could have functioned effectively if the loessal fill had been allowed to accumulate much above 0.10 m, the higher ash layers should represent the by-product of post-abandonment disturbance of the enormous amounts of ash that were deposited elsewhere around the structure during the period of use. Cultural material recovered from this fill (Loci 30 and 32; Bag nos. 112, 113, 123) included Nabataean, Roman, Early Byzantine and Late Byzantine or Umayyad ceramics, numerous pieces of glass vessels, and numerous

charred ovicaprid and bird bones. There were also several dozen sherds of flat panels of a slightly greenish but virtually transparent glass that may have formed window panels. Although no trace of windows has survived, the heated rooms are on the south side of the Bath Building, and glazed openings would have helped heat these spaces.⁶

A small probe (0.40 x 0.50 m) was made through the floor near the southeast corner of the room in an effort to obtain ceramic material for dating Construction Stages I and II. Excavation revealed that the brick paving was set in a layer of hard, dark brown soil 0.07 m thick (Locus 1), resting directly above a 0.01 m thick layer of very fine, dark grey ash (Locus 2) (Fig. 9). One possibly Early Byzantine body sherd was recovered from Locus 1 (Bag 162), but Locus 2 was sterile. The ash layer ran up against the brick pillars, which rested on large, irregular pieces of sandstone rubble set in a sandy, light brown soil (Locus 3). Smaller pieces of rubble were scattered in the fill between the pillars, along with some small, worn fragments of pottery (Bag 163). Only one of the potsherds recovered has been identified so far: it is a Nabataean cooking pot rim of the second century A.D. This foundation layer (Th 0.12 m) overlay a bedding of coarse, light red sand (Locus 4) that had a very smooth and regular upper surface, slightly compacted in the upper 0.05 m, but loose deeper down. The restricted size of the probe allowed excavation only 0.11 m into this layer, but one Early Nabataean cup rim dating to the early first century B.C. was recovered (Bag 166). This layer of light red soil is very similar to the fill around the foundation at the southeast corner of the Nabataean structure into which the Bath was built (Loci 30, 32), and it occurs at nearly the same level (955.25 m a.s.l., as opposed to 955.40 m for the foundation offset of the building). The ceramics from Locus 3 in the probe in

Room A suggest that Stage I of the Bath should be dated no earlier than the second century A.D. — while those of Locus 1 show that the Stage II renovation probably did not take place earlier than the Early Byzantine period. This chronology does not contradict the loose chronology provided by the pottery from the probe in Room E.

Room C, the furnace area, is totally different in design, but it reflects much the same building history and makes use of the same materials as the rest of the Bath (Pl. III,2). The furnace was built into a slightly projecting foyer of the Nabataean structure (approximately 2.23 m N/S, 1.99 m E/W) — possibly the main entrance to that building. There is a well-built door (W 0.86 m) in the middle of the east wall, constructed of carefully coursed blocks with diagonal trimming on their outer surfaces. The west door, leading to Room A, was originally arched: the lowest voussoir course survives on either side and the inside, upper surface of the block on the south carries an inset for a clamp.

The room was drastically remodelled in Stage I during its transformation into a furnace. The arch, which would have risen 0.70-0.80 m above the level of the floor in Room A, was either blocked up or dismantled, to demarcate the east wall of the room. Two east/west walls 1.10 m apart were then built across Room C to delineate the furnace area, and the spaces behind them to the north and south were filled with earth covered by an enormous volume of rubble set in a crumbly, light grey mortar. These blocking walls, and the paving on the floor of the room, were built of red sandstone blocks. Several courses of bricks (0.22 m sq.) were built up along either side of this paving, against the side walls, to a height of 0.10 m. The original floor — now visible only at the east and west ends of the room, below the Stage II furnace floor, extends out at least 0.50 m east of the east door of the building. The

6. Fragments of window glass were found in Room C of the Late Roman/Umayyad bath building at

Hammat Gader (Hirschfeld & Solar 1981:212, 217).

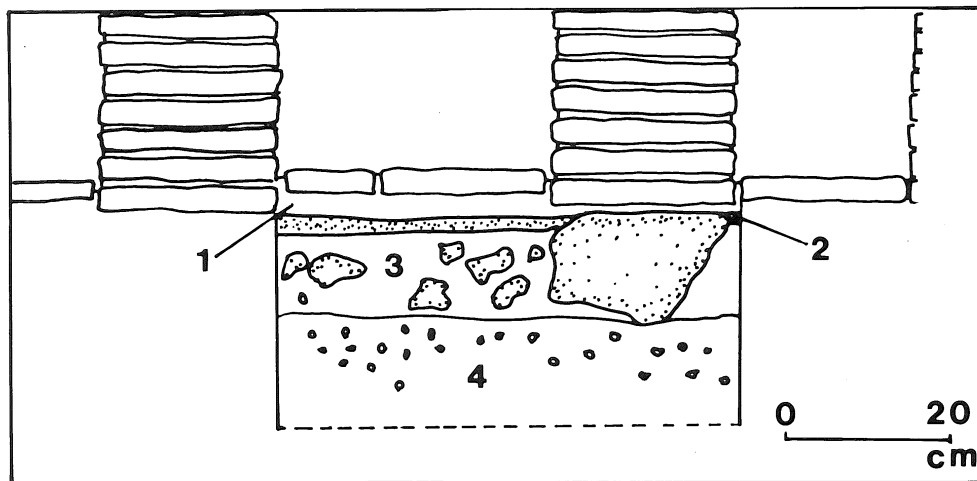


Fig. 9. Bath Building: Probe in Room A, east face.

extension of the pavement probably was intended to facilitate introduction of fuel into the building and the scraping out of the ashes. It is no longer possible to determine how this first furnace was roofed.

After a period of use evidenced by the marks of burning on the sandstone walls and floor and several thin lenses of ash, the furnace was completely rebuilt, probably at the time of the Stage II renovation. Well cut but re-used sandstone blocks were set against the side walls of the furnace and across the east entrance, and the space inside above the original floor was filled with a packing of sandstone and limestone rubble 0.24 m thick (Loci 37, 39) set in a hard orange clay and capped with a smooth layer of clay 0.05 m thick. The ceramics found in this packing (Bag nos. 142, 145, 149) date from the Nabataean to the Late Byzantine periods. The furnace box was built of fired bricks above this new floor. Just inside the east entrance, a pitched brick vault 0.81 m long and originally approximately 0.85 m high, was built of coarse, dark red bricks set in a crumbly grey mortar possibly mixed with clay. West of this vaulted entrance there was an oval, domed fire box 0.85 m long, built of the same type of bricks, but laid flat rather than on their edges. A shorter pitched brick vault (L 0.25 m) abutted two brick piers (0.55 x 0.23 m) that framed the opening (W 0.52 m) into the hypocaust below Room A. A large amount of ash was

recovered from the floor of this later furnace, including some large pieces of charcoal. Several large pieces of stem reveal that at least one of the fuels used was Jointed Saltwood (*Haloxylon articulatum*) still the prevalent brush around Humeima today, and one which the Bedouins now use for cooking. It produces a very hot flame, but for only a short time, so enormous quantities must have been needed to heat the Bath Building.

Two important questions that were not settled by the excavation of the Bath are the arrangement of the water supply and the type of roofing. Since the upper portion of the building has been lost, both these problems can be answered only hypothetically. The overflow channel from the Nabataean Reservoir (no. 63) can last be traced approximately 20 m north of the Bath, but it follows a consistent bearing up to this point, one which would have carried it approximately 10 m east of the east facade of the Bath. In the original, first century B.C. arrangement, this runoff channel probably conducted the overflow water to the cisterns in the settlement centre or to small gardens below the settlement. At some time in the Roman period, however, the free overflow was replaced by a lead pipe system laid in the conduit, and the flow of water was controlled by a bronze stopcock installed behind a grating or door outside the south wall of the reservoir (see Oleson 1988a, 1988b). This lead pipe system may well be contem-

porary with Stage I of the Bath, since the pipe could have left the aqueduct channel at the point of its closest passage by the building and entered it below ground level. It may have carried the water directly to all the basins in the building (one in each of Rooms A and E, as in Stage II?) by means of pipes in the walls, for the slope is sufficient to provide the necessary pressure. Alternatively, the pipeline may have filled a holding reservoir for both tanks, perhaps built into the masonry packing over Room C, from which the cold water tank could have filled by means of a separate pipe or by jars. There may also have been a metal reservoir over the furnace in Room C, from which a pipe could have conducted heated water to the basin in Room A. The water in this basin was also heated from below, by the air in the hypocaust.

It is interesting, in view of the fact that the Bath Building went through two stages of development, to note that two separate, successive pipelines drew water from the Nabataean Reservoir. The lead pipe beginning at the stopcock has already been noted, but there was also a conduit of terracotta pipes that bypassed the reservoir altogether (Oleson 1988a, 1988b). This pipeline drew the water from the aqueduct at a point 5 m north of its intersection with the reservoir, carried it around the west side, and can last be traced 20 m south of its south wall on a bearing slightly east of that of the aqueduct. It is possible that the lead pipeline should be associated with Stage I of the Bath, and the terracotta pipeline with Stage II. Unfortunately, only one possible pipe fragment (as distinct from the circular flue tiles) was recovered from the Bath Building, and it has different proportions than those used near the reservoir.

Restoration of the roof is also a difficult problem. The walls do not seem

sturdy enough to have supported barrel vaults of mortared rubble or of blocks, and the large masses of masonry one would expect as the result of the ruin of either type of roof are absent. Transverse arches could have been built in the rooms to support slab roofs, as in the cisterns and houses of the Nabataean to Byzantine periods found throughout this region, but no traces of the impost survive on the plaster floors or walls, and no voussoir blocks were identified. As a result, it seems more likely that wooden beams were imported from some forested region to the north and used as the major rafters for flat roofs of brush, reeds and stucco. The absence of roof tiles suggests that the roofs were flat, and that they were certainly stuccoed.

Summary of the 1989 Campaign

The 1989 campaign of the Humeima Hydraulic Survey has produced significant results. We now know that the re-working of the water-supply system in the Roman and Byzantine periods had as part of its rationale the provision of a bathing facility — something that constitutes an integral part of the Roman cultural matrix. This Bath Building was in use until the Late Byzantine and possibly into the Umayyad period, and it constitutes evidence for the sort of structure that influenced the design of later Islamic bath buildings.⁷ In addition, there is now at least tentative ceramic evidence that the public cisterns in the habitation centre were built in the first century B.C., at the time of Auara's foundation by Aretas III. Further analysis of the ceramic material from Cistern no. 68, however, is necessary before this hypothesis can be completely accepted. This campaign also showed that construction of the circular cisterns within houses may have begun quite early in the history

7. The enormous corpus of comparative material for the design of the Humeima bath cannot be cited in this context, but it should be noted that a related installation was found at el-Lejjun in 1989, and a similar Byzantine bath at Mamphis

has recently been published (Negev 1988: 167-181). Recent research on Roman baths throughout the empire is summarized by DeLaine (1988). For a discussion of the heating systems in Roman baths see Rook 1978.

of Auara. Finally, a start has been made in defining the settlement plan and settlement development through a preliminary analysis of the remains visible on the surface (see the article by Blétry-Sébé in this volume, p. 313-317).

The time is now ripe for the second stage of investigations at Ḥumeima: excavation of the military and domestic architecture and of some of the presumed public structures in the settlement centre, around Cisterns nos. 67 and 68. The principal investigator of the Ḥumeima Hydraulic Survey is now planning a cam-

paign of excavation in the settlement area of ancient Auara by an enlarged Canadian team, in collaboration with Jordanian and American scholars, in consultation with the Director of the Department of Antiquities of the Hashemite Kingdom of Jordan. The first field season of such a joint expedition is tentatively planned to take place in 1991.

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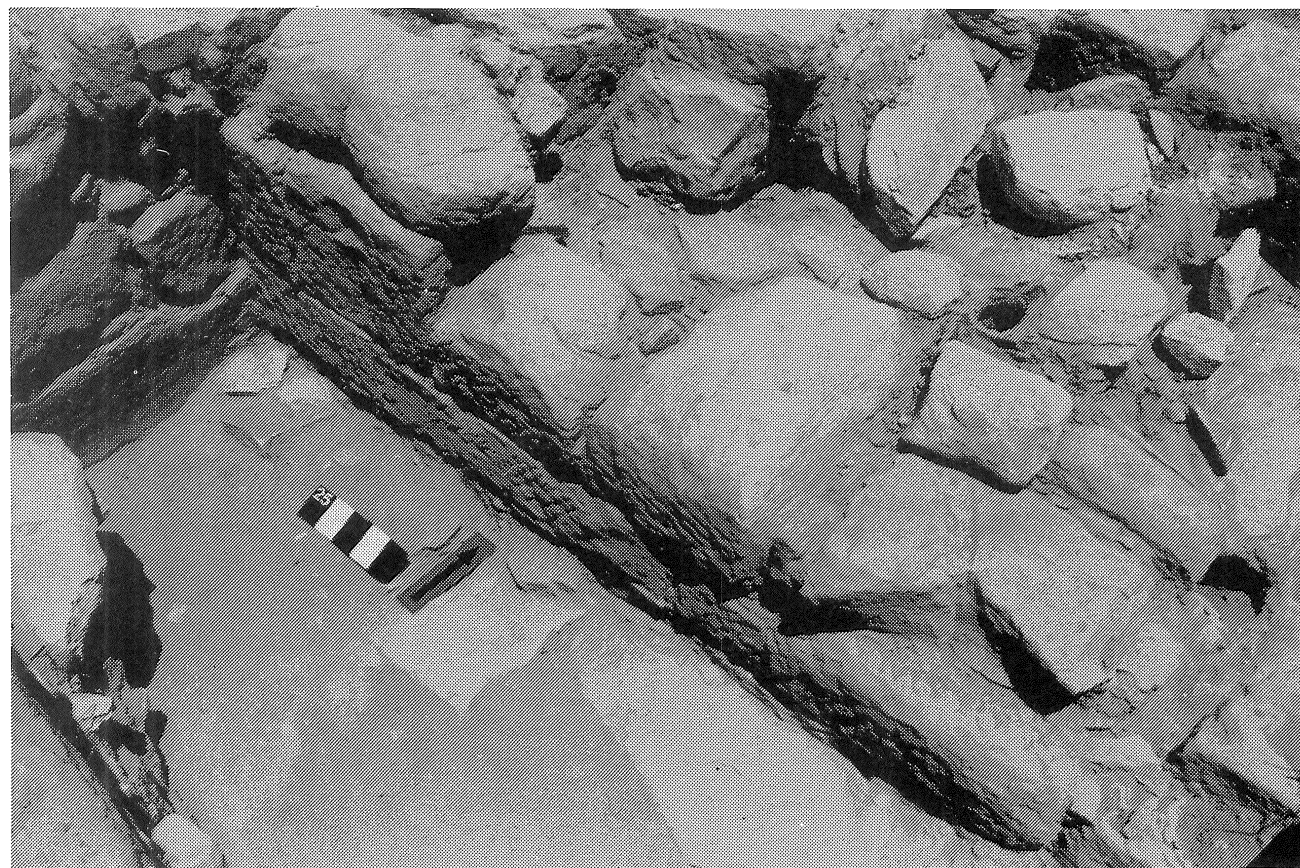
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1. Cisterns nos. 67-68: View from northwest.



2. Probe at Cistern no. 69: View from east.



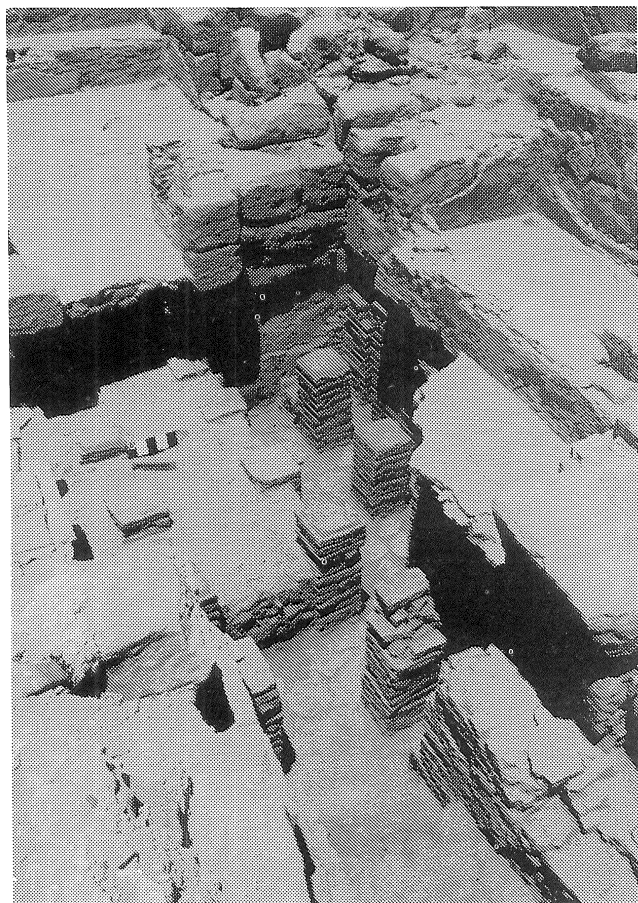
1. Probe at Cistern no. 64: View of drain and outside of cistern wall, from east.



2. Bath Building: General view from northeast.



1. Bath Building: Probe in Room E, from west.



2. Bath Building: Furnace and Room A, from southeast.