TALL ZAR'A IN WĀDĪ AL-'ARAB: THE "GADARA REGION PROJECT"

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With contributions by Jens Eichner and Patrick Leiverkus

Introduction

The ruins of the Decapolis city of Gadara (Umm Qays أم قيس) are fascinating by their archaeological relevance as well as their extraordinary scenic location. The city is majestically sited on the northeasternmost mountain spur of the Jordanian Plateau, high above the Sea of Galilee (بحيرة طبريا), jutting out into the Jordan Valley. If one looks to the north, the hot springs of "Hammat Gader" (al-Ḥammah as-Sūriyya الحمّة السورية) in the Yarmūk Valley (وادي اليرموك) can be spotted. To the west lies the arable land of the nearby village, extending as far as Jabal aṭ-Ṭūr (جبل الطور, Mount Tabor) in the Galilee (al-Jalīl الجليل). Looking to the south, one discovers an unusually fertile valley: Wādī al-'Arab (وادي العرب). Nevertheless, its relevance for the antique city of Gadara and its pre- and post-classical development has hardly been paid any attention to until now (Hoffmann 1999). The wadi and the trade route running through it are dominated by a remarkable settlement — Tall Zar'a (تل زرعة) (**Fig. 1**).

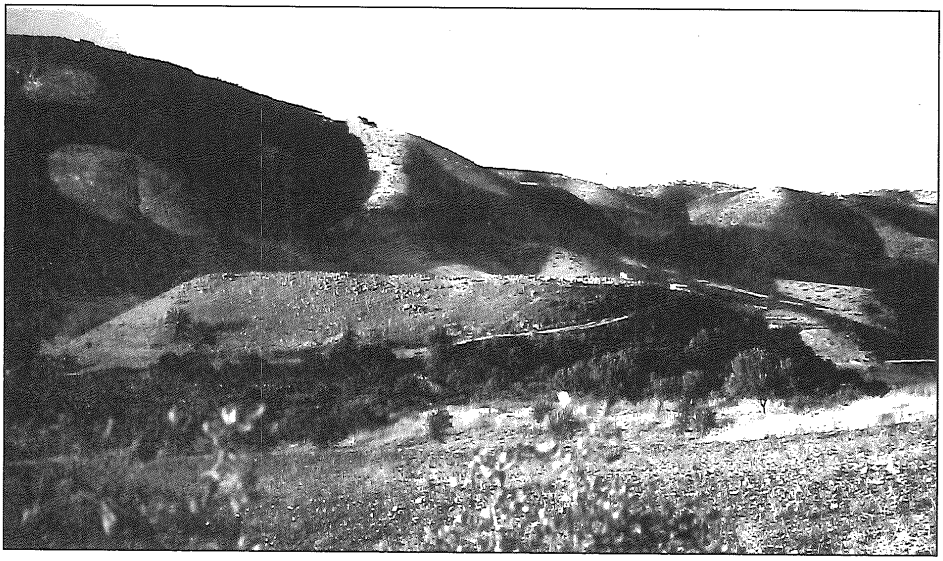
For the next ten years, an integrated study of the Wādī al-'Arab and the urban centers (Tall Zar'a, Gadara) will be the main research work of the Biblical-Archaeological Institute Wuppertal. The regionally oriented formulation of questions, taking into account the interplay of various factors within a region — and thereby questions relevant to the cultural development of that region covering several millennia — leads to an archaeology of a landscape.

The exploration, excavation, and conservation of the antiquities found in Tall Zar'a will be focal points of the archaeological project. The excavation of Tall Zar'a will be realized in a close and trusting cooperation with Dr. Karel J.H. Vriezen (University of Utrecht/Netherlands).

The Area

Wādī al-'Arab (32°35'N, 35°40'E) connects the Jordan Valley — and via Marj Banī 'Āmir (مرج بني عامر) also the Mediterranean coast — with the East Jordanian uplands. Following the wadi course, the tremendous ascent from the trough of the Jordan Valley (about 290m below sea level) up to the modern industrial city of Irbid (إربد, at about 560m above sea level; the surrounding chain of hills to the west near Bayt Rās بيت راس reaches about 612m above sea level) can be overcome without any inconveniently steep and narrow passages. Since nothing similar can be said about the Yarmūk Valley lying to the north, the outstanding geopolitical significance of the wadi can be understood, the more so as one can continue one's journey from the Irbid-Ramthā (الرمثا) basin directly to Damascus (northward), Baghdad (eastward) or 'Ammān (southward).

Together with its tributaries, Wādī al-'Arab has



1. South view of Tall Zar'a, on the mountain spur is ancient Gadara (all photos: Dieter Vieweger).

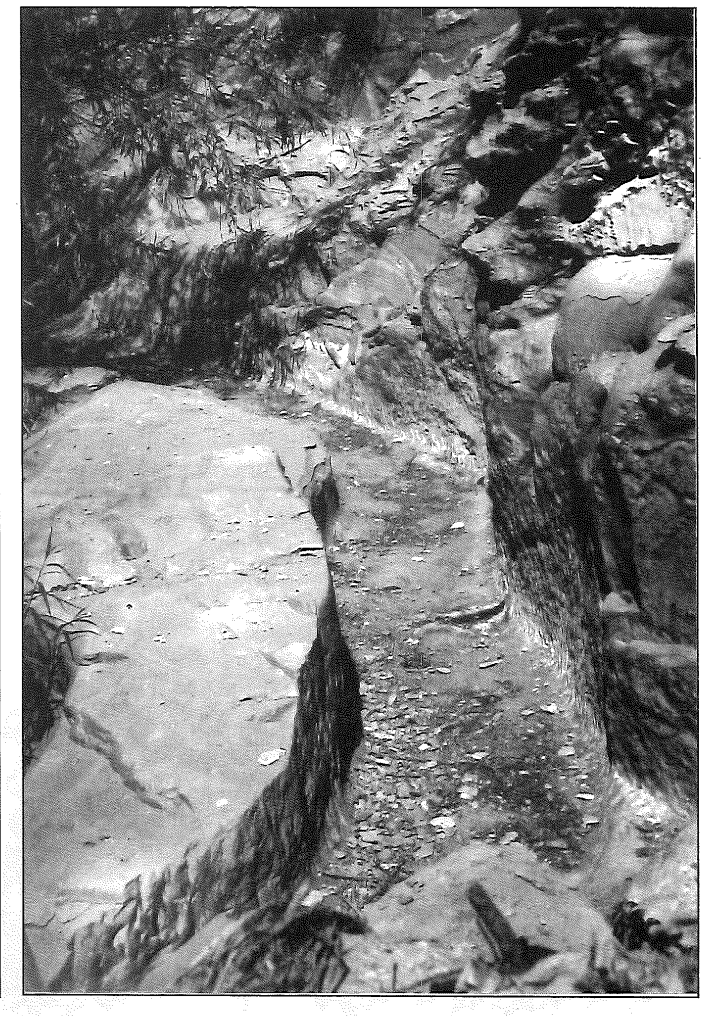
its source in the highland west of Irbid and drains into the Jordan. In the wadi itself, there are numerous springs, some of them thermal, in the western lowlands (**Fig. 2**). Annually about 28.8mm^3 of water flow/flowed through the wadi (Ahmad 1989: 273ff.). The ruins of former water mills (Steuernagel 1926: A 459.466f.; McQuitty and Gardiner, in prep.), channels hacked into the rock (**Fig. 3**) and some short watercourses overgrown with reeds still give an impression of the erstwhile abundance of water in this region. Today modern pump plants have drained the wadi almost completely. The peasants in the vicinity are taking what remains of the water, using power pumps, in order to irrigate their newly laid-out vegetable gardens and olive orchards.

The modern dam in the lower part of the wadi was constructed in 1987. It has a capacity of up to 17.1 million cubic meters of water, serving the irrigation of agricultural ground in the lower Wādī al-'Arab, as well as fishing. Since it was put into operation, not only does the rainwater of the wadi-basin run into the reservoir, but during the rainy season additional water is pumped into it from the King Abdullah Channel.

In the wadi there is extensive grain agriculture. Due to the subtropical conditions (under plastic sheeting) green vegetables can be grown here even during the winter months, allowing for several harvests a year. In the lower wadi tropical and subtropical fruits can also be grown. The upper wadi, however, is quite rocky and therefore suited mainly for pasture.

Plants encountered in Wādī al-'Arab are the common reed *(Phragmites communis)*, oleander *(Nerium oleander)*, and tamarisks *(Tamarix aphylla)*. Many species of water birds visit the area in autumn and spring: the cattle egret *(Bubulcus ibis)*, the little egret *(Egretta garzetta)*, the great white egret *(Casmerodius albus)*, and the heron *(Ardea cinerea)*, as well as the teal *(Anas crecca)*, the coot *(Fulica atra)*, the redshank *(Tringa totanus)*, the marsh sandpiper *(Tringa stagnatilis)*, the greenshank *(Tringa nebularia)*, the pied kingfisher *(Ceryle rudis)*, the Smyrna kingfisher *(Halcyon smyrnensis)*, and the kingfisher *(Alcedo atthis)*. Besides, the water frog *(Rana ridibunda)* and various spe-

2. A spring in Wādī al-'Arab.



3. Channel in Wādī al-'Arab.

cies of perch (sp. *Tilapia zilli*) also live here.[1]

This idyllic view gives an impression, which will probably not last much longer though, of how fertile and green the whole lower wadi once used to be before modern power pumps started to supply water to the nearby industrial city of Irbid.

With 45-75% humidity, the average temperature in the wadi varies from 15°C in winter to 33°C in summer (Hanbury-Tenison 1984a: 386). Annual precipitation is about 380mm and occurs mainly in the period from the end of December until mid-February.

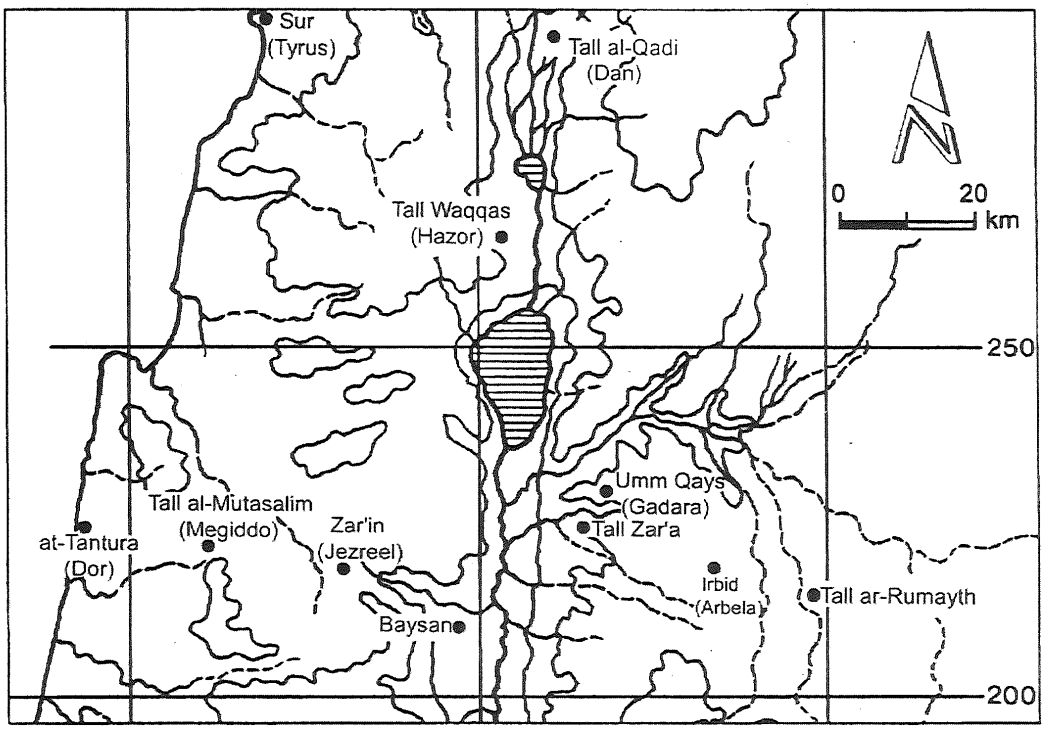
Tall Zar'a تل زرعة (Fig. 4)

Following the main modern Jordanian traffic route that runs south of the town of North Shūna (الشونة الشمالية) and ascends from 190m below sea level to the East-Jordanian uplands, branching off from the Jordan Valley into Wādī al-'Arab and leading up to the plateau via Wādī Abū Ṣāfī (وادي ابو صافي), Wādī Zaḥar (وادي زحر) and Wādī al-'Amūd (وادي العمود), one reaches a small settlement (at about sea level) after only a few kilometers. After driving about another 2km further northeast across some rough terrain, one reaches Tall Zar'a (2119.2252; plateau 160x160m; **Fig. 5**). After leaving the village and turning off from the main traffic route, the *tall* can be seen towering majestically over the reservoir (**Fig. 6**).

As the only notable elevation in the lower Wādī al-'Arab, Tall Zar'a dominates the latter. Not only are Gadara/Umm Qays and its sanctuary *extra muros* within eyesight, but to the west the narrow entrance to the wadi can also be overlooked, as well as the potential crop fields in its western and central parts. Likewise, the terraced slopes on the mountain spur (tillable during the rainy season) are within view toward the east as well as the hillside of the wadi forming a wide semicircle from the east to the south and west (suitable for breeding small livestock).

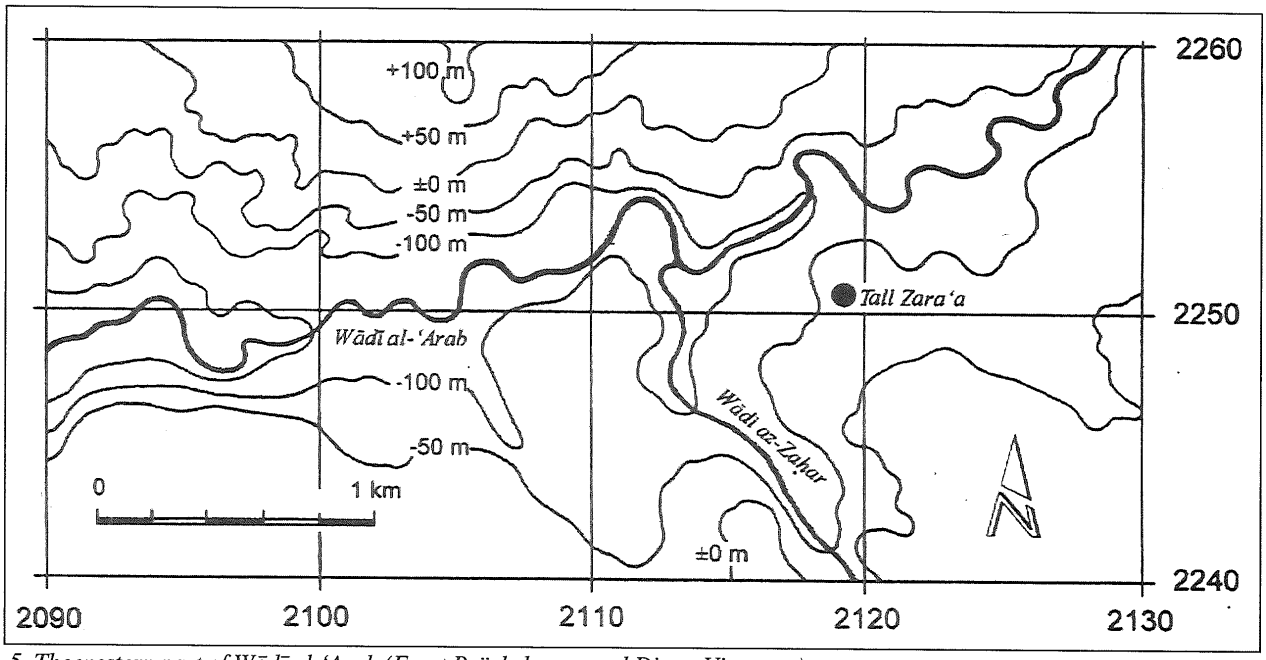
Therefore it is not surprising that in the Early Bronze Age the *tall* was already used for a hilltop settlement and served this purpose repeatedly well into the Middle Ages. Its geological, agricultural and geostrategic advantages (to the north and east the hill is protected by sheer rock faces, to the east and south it obviously overtops the surrounding area by about 22-25m; see **Figs. 1 and 7**) are not to be overlooked.

On the south side there is a modern approach to the plateau (**Fig. 8**). Because of the fact that this path was dug deeply into the *tall* by a bulldozer, it cuts through a recent water reservoir with a plastered interior and, on the inclined lower stretch of the path, through a building constructed with *spolia*, as well as through old wall courses halfway up and on the upper stretch. This approach does thus

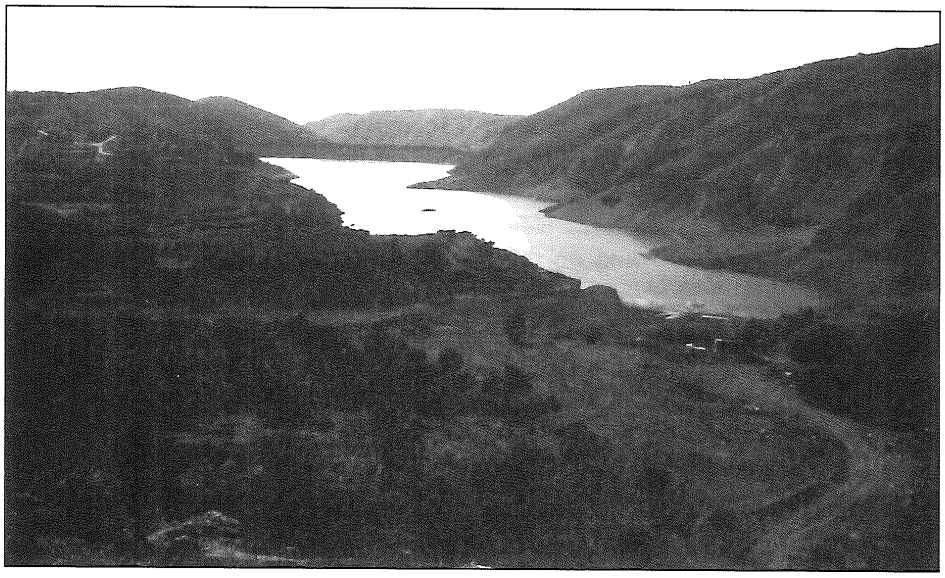


4. The geographic location of Tall Zar'a (by Ernst Brückelmann/Jens Eichner/Dieter Vieweger).

1. Source: MMRAE (Ministry of Municipal and Rural Affairs and the Environment), National Environment Strategy for Jordan. A Resource Book of Information and Guidelines for Action. IUCN-The World Conservation Union. Gland (Switzerland) 1991, Pp. 226ff.; Ahmad 1989: 273ff. and http:www.wetlands.agro.nlWetland_Inventory/MiddleEast Dir/Doc_chapters/JORDAN.doc.



5. The western part of Wādī al-'Arab (Ernst Brückelmann and Dieter Vieweger).



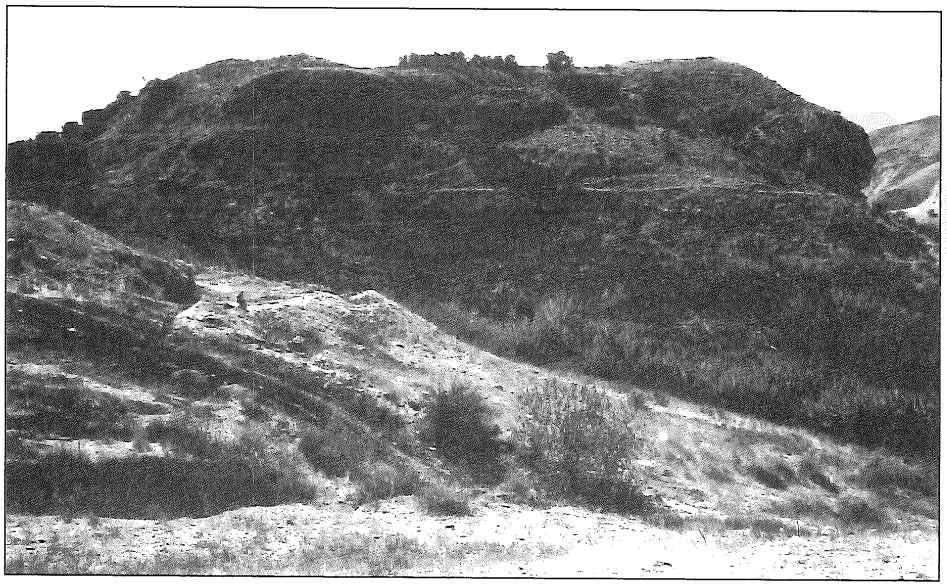
6. Looking westward from Tall Zar'a into Wādī al-'Arab.

not correspond to the topographical conditions of the *tall*.

The south flank of Tall Zar'a offers the best opportunity to comfortably overcome the 25m difference in height, via a 150m long track. The terrace-like edge, which gradually leads from the southwest bottom of the *tall* up to the more spacious plateau in the northeast and now carries irrigation pipes, obviously worked to the advantage of the previously existing old track. Unfortunately, in recent times this track was dug to a depth of more than 50cm for almost its entire length, when irrigation pipes were laid from the well to the nearby olive orchards. As a result, it was badly churned up.

The prominent rocky ledge in the southeast, where the old track reaches the plateau, offers plenty of space for an unproblematic hairpin turn to the west, opening the way to the center of the *tall*. On the *tall*-oriented bank of the upper stretch of the track there is a huge pile of cultural deposits, into which a hole of 4.5m depth was dug by robbers (though it reached neither the natural rock nor any undisturbed layers). The lower layers yielded Iron and Bronze Age sherds. The former building at this place may have served for the protection of the gate construction.

The ledge also used to contain the natural drain of the artesian well of the *tall*. Traces of sinter can be observed here following the erstwhile flow of the water. There are even combinations of stalactites and stalagmites which can be admired in a



7. Tall Zar'a from the east.

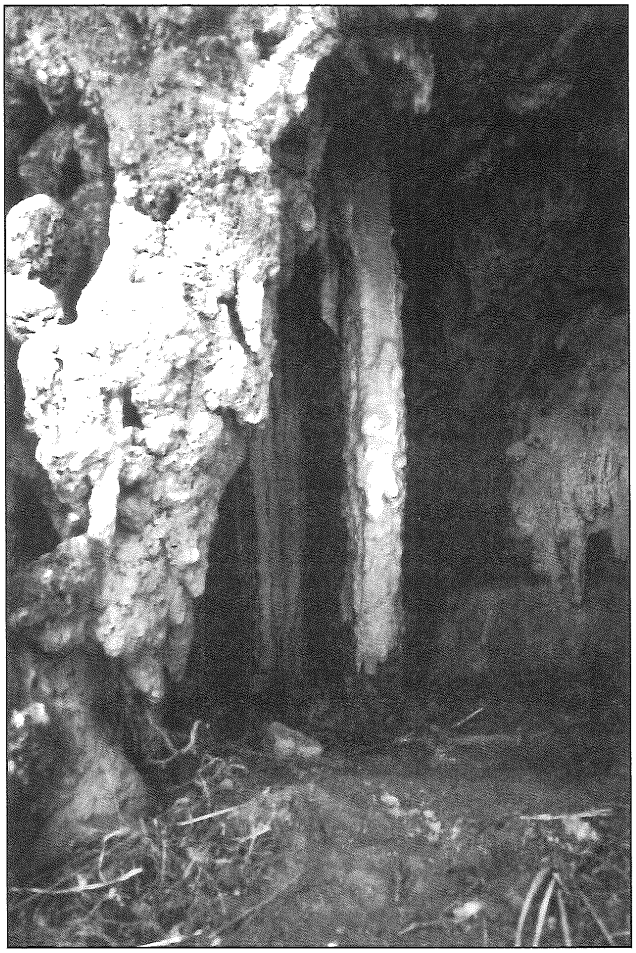
8. The bulldozer-made approach on the southern side of Tall Zar'a.

small stalactite cave halfway up the rock face (**Fig. 9**). They are witness to a substantial flow of water over long periods.

The plateau of Tall Zar'a is characteristically determined by a hollow in the central section (i.e., a well) and by the aforementioned slightly sloping access route in the southeast (formerly serving the natural drainage of spring water, **Fig. 10**). Cultural deposits 4 to 6m deep have formed a broad, slightly undulating band that seems to encircle the center of the plateau. Obviously these deposits — produced by human settlement activity — could accumulate much faster and more unchecked here than in the vicinity of the well where the continuous movement of water, including flooding, has to be considered.

About one third of the plateau surface is used for agriculture. In classical times the southwestern part of the plateau had no doubt a distinctive function. Littered with ashlars that had been worked and reworked many times and Roman-Byzantine potsherds, it repeatedly became an objective for unsuccessful treasure seekers. The discovery of a pedestal (**Fig. 11**) as well as some basalt pillar fragments apparently heightened their frenzy. Noteworthy is a square aperture carefully framed with four trimmed stones which leads into a big cistern with a domed vault of trimmed ashlars (**Fig. 12**). The cistern, measuring 6x10.5m in width and maximally 5.75m in depth, was originally covered with a double layer of plaster about 8cm thick. From the start it was laid out to contain construction elements allowing for future extensions by corbeling. The floor of the cistern shows a secon-

dary partitioning by walls and evidently served temporarily as a shelter or storage facility.



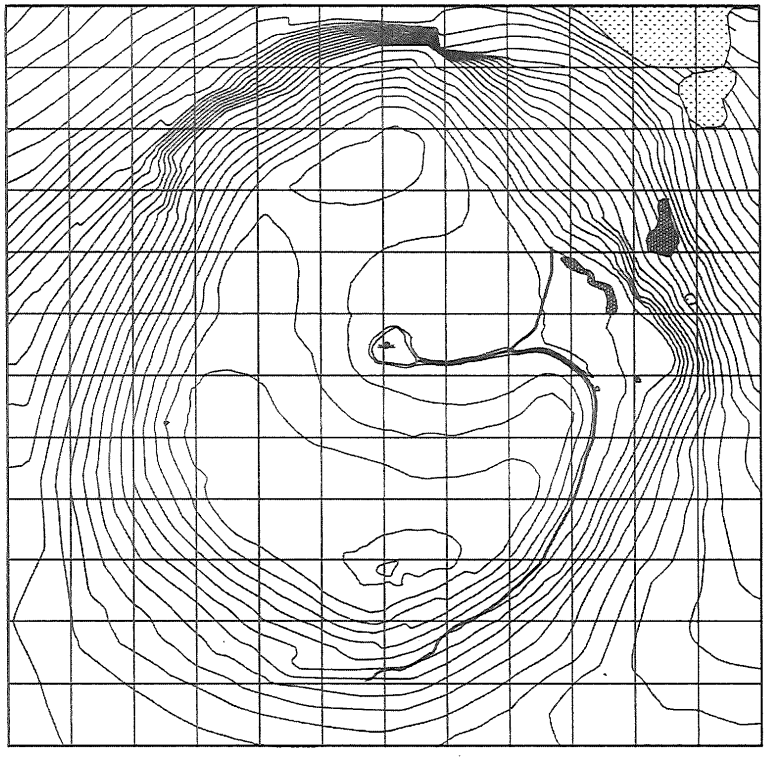
9. Stalactite cavern on the eastern side.

The northern terrace of the *tall*, which is surrounded by Wādī al-'Arab forming a wide curve, may have once served as a kind of lower city or accommodated a settlement, connected, in whatever way, to Tall Zar'a. A house built with *spolia*, ruins of a house in the center of the terrace and additional outlines of (probably recent) houses in the south suggest this possibility. But not too long ago the terrace was extensively leveled by bulldozers to create space for a new olive orchard. As a result the cultural layers were thoroughly disturbed and mostly destroyed to piles of displaced stones and earth covered with predominantly Roman-Byzantine sherds.

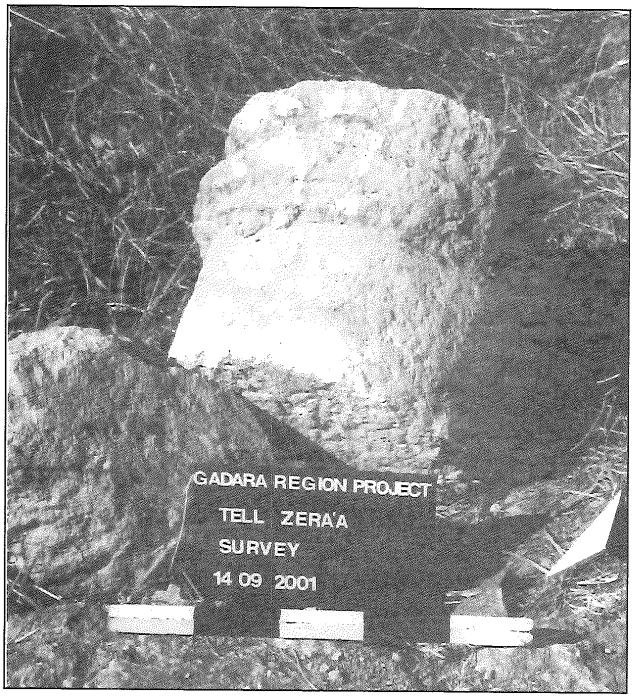
Previous Research

The first archaeologist to recognize the archaeological importance of Wādī al-'Arab was Gottlieb Schumacher (1890: 142f.). Carl Steuernagel (1926: A 464-467) comprehensively wrote about it in the *Zeitschrift des Deutschen Palästina-Vereins*. Subsequently, this information was taken up by Felix Abél (1967: 35f.). Nelson Glueck (1951: 182) visited the wadi in 1942. On that occasion he also reported on the "singularly imposing and completely isolated hill of Tall Zera'ah ...".

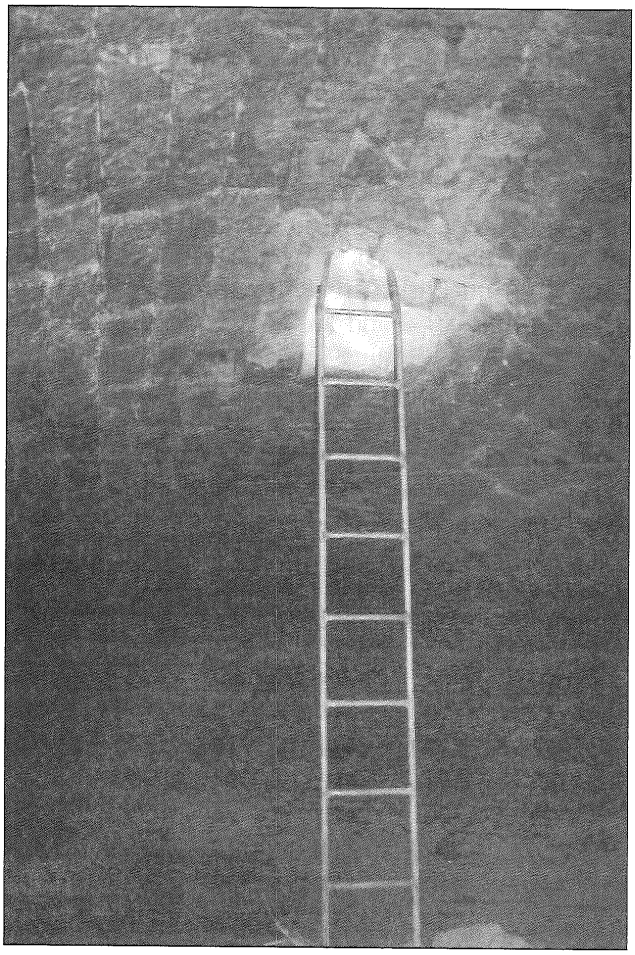
To the north, Wādī al-'Arab adjoins the survey area explored by the Deutsches Archäologisches Institut Berlin ("Gadara/Umm Qais-Survey"; Nadine Riedl). The Jordan Valley to the west (e.g., de Contenson 1960: 12-98; Mellaart 1962: 126-158; Ibrahim *et al.* 1975: 41-66) and the area around Irbid facing east ("Beit Ras Survey") have also been



10. Map of Tall Zar'a (each square is 20 x 20m).



11. Pedestal.



12. Cistern.

investigated (e.g., Lenzen and McQuitty 1988: 270).

In the wadi itself two archaeological explorations have been undertaken until now: The surface inspection, which took place on the 14th and 15th of March 1978, was an archaeological rescue investigation considering the then planning phase of the Wādī al-'Arab dam construction. The project was initiated by the Jordan Valley Authority and the Department of Antiquities of Jordan. The team consisted of John M. Lundquist, Terrence M. Kerestes (University of Michigan), Bryant G. Wood (University of Toronto) and Khair Yassine (University of Jordan). The results were published as a joint project: "An Archaeological Analysis of Three Reservoir Areas in Northern Jordan" (Kerestes *et al.* 1977/78: esp. 129).

In September 1983 the first campaign of the archaeological survey, supervised by Jack Hanbury-Tenison (1984a: 385-424, 494-496), was carried out in Wādī al-'Arab. His team included Alison McQuitty, Mark Hardiner and Nasser Khasawneh. Within 18 days of fieldwork, 25 square kilometers were examined, and 102 archaeologically relevant sites were documented (Hanbury-Tenison 1984a: 389, 398, 403).

Survey

1. Methods and Procedures

For the *tall* survey conducted in autumn 2001, Tall Zar'a was parceled out into 5x5m squares, oriented to the Palestine Grid. The north-south axis was labeled with letters, the east-west axis with numbers. For the purpose of the survey, 16 squares made up *one* survey square of 20x20m. To simplify matters, survey squares were labeled with the name of the southwesternmost 5x5m square. Thus, survey square V 117, for example, identifies all squares on the coordinates V-Y/117-120 **(Fig. 13).**

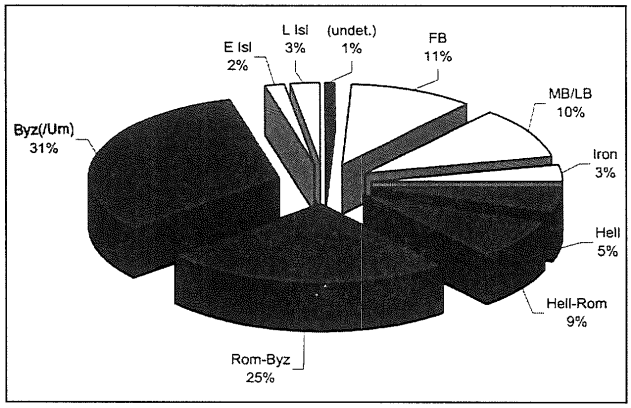
The survey area covered the whole *tall* and all its slopes. In all, 127 survey squares of 20x20m size were searched, i.e., 5.08ha.

To obtain truly comparable survey results measures were taken which ensured a uniform standard for the gathering of sherds: the teams were instructed jointly and formed according to the same criteria (composed in the same way concerning personnel), and a time standard was fixed allowing enough time for the treatment of single survey squares; teams were supposed neither to fall below nor exceed the standard.

For exemplary purposes several survey methods were applied: in addition to the complete gathering of all visible artifacts on the surface, a surface exploration was performed according to the guidelines described by Portugali 1981 (which implied the examination of the *tall* surface to a depth of about one shovel). The focus here was on the ques-

Y 117	Y 116	Y 119	Y 120
X 117	X 116	X 119	X 120
W 117	W 116	W 119	W 120
V 117	V 116	V 119	V 120

13. Survey squares and their denotations.



14. Chronological classification of all pottery found on Tall Zar'a (excluding the Portugali Survey).

tion of whether the Portugali method, apart from a quantitative increase in the amount of artifacts, also allowed an essentially different qualitative prediction. Finally, we tested whether the results of the complete *tall* survey could have been achieved without the substantial amount of energy spent, that is, by using random or directed sampling methods.

2. The Tall Survey

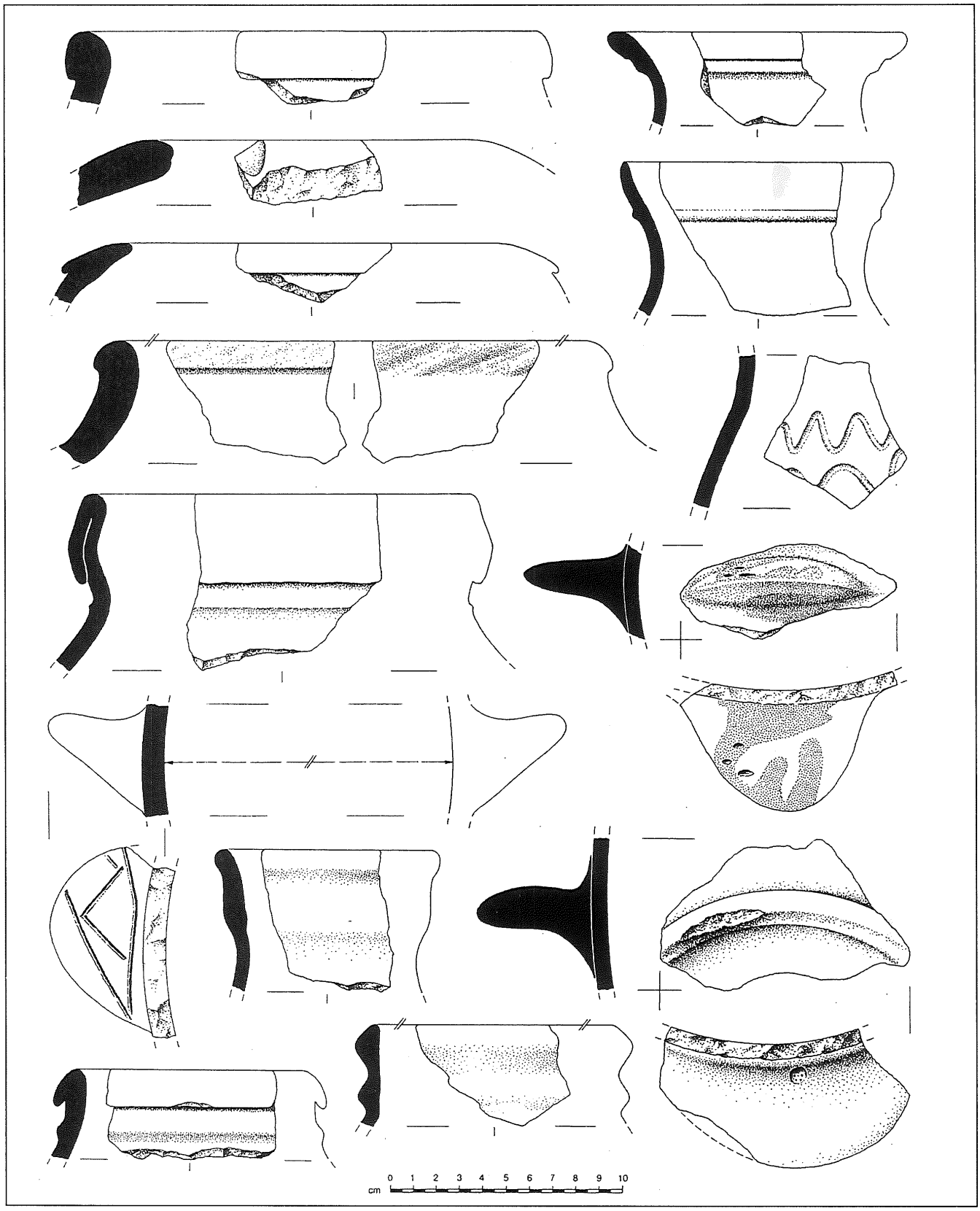
Altogether 24,059 sherds (plus many vestiges of Roman-Byzantine roof tiles) were found and catalogued (**Fig. 14**), 22,318 of these in the course of the surface inspection of Tall Zar'a and another 1,741 during the survey based on the Portugali method (15 squares of 5x5m each). Out of the total number of sherds 2,847 were diagnostics. All sherds were evaluated both qualitatively and quantitatively. We examined and described 48 different wares and classified them into 9 chronological groups (**Figs. 15-21**).

First of all the chronological classification of the pottery gathered substantiates a long period of settlement activity on Tall Zar'a, which reaches from the Early Bronze Age well into the Ottoman period (**Table 1**). However, the sherds were not distributed evenly over the *tall*. The different quantities of sherds found in the various zones of the *tall* (to begin with, a distinction was made between the plateau and the slopes) demanded thorough evaluation.

In order to enable a comparison of the above listed quantities of sherds found in zones of different sizes, the following diagram (**Fig. 22**) shows the percentage distribution of the chronologically classified pottery in every single zone. The obvious difference between the finds from the plateau and those from the slopes is conspicuous. On the plateau finds of later periods dominate. Particularly Hellenistic to Byzantine (79%) and, at a lower level, Islamic (7%) pottery was found here in considerable numbers. Yet within the latter group of wares only Middle and Late Islamic pottery differentiate significantly (5% on the plateau against 1-2% on the slopes). On the plateau the prehistoric periods (from Early Bronze to Iron Age) reach a quota of only 14% and are thus underrepresented. This appears to be quite plausible considering the huge amount of cultural deposits measuring 5-6m in depth, as will be shown below. These quantitative differences do not necessarily reflect the intensity of settlement activities during the epochs they represent.

***Table 1:** Chronological classification of pottery found on Tall Zar'a (excluding the Portugali survey).*

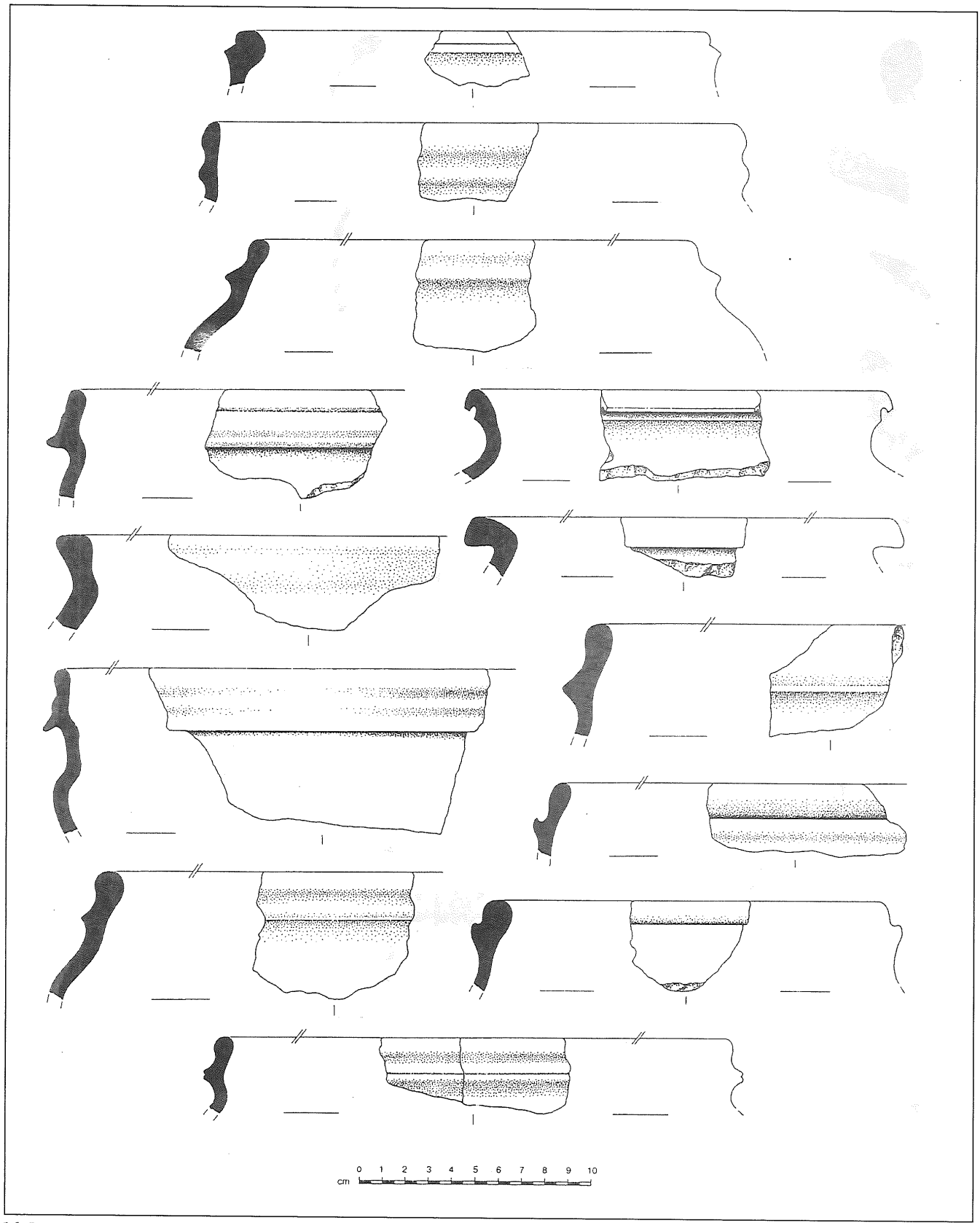
	East	South	West	North	Plateau	Σ
Undetermined (undet.)	68	17	26	48	32	191
Early Bronze Age (EB)	394	671	675	405	214	2359
Middle/Late Bronze Age (MB/LB)	308	197	355	717	695	2272
Iron Age (Iron)	198	124	152	210	74	758
Hellenistic Period (Hell)	147	124	191	311	419	1192
Hellenistic-Roman Period (Hell-Rom)	298	342	429	351	508	1928
Roman-Byzantine Period (Rom-Byz)	524	656	990	1327	2044	5541
Byzantine(-Umayyad) Period (Byz[/Um])	621	1507	1167	1529	2301	7125
Early Islamic (E Isl)	59	64	61	83	107	374
Late Islamic (L Isl)	38	94	94	41	311	578
Total result	2655	3796	4140	5022	6705	22318



15. Early Bronze Age wares.

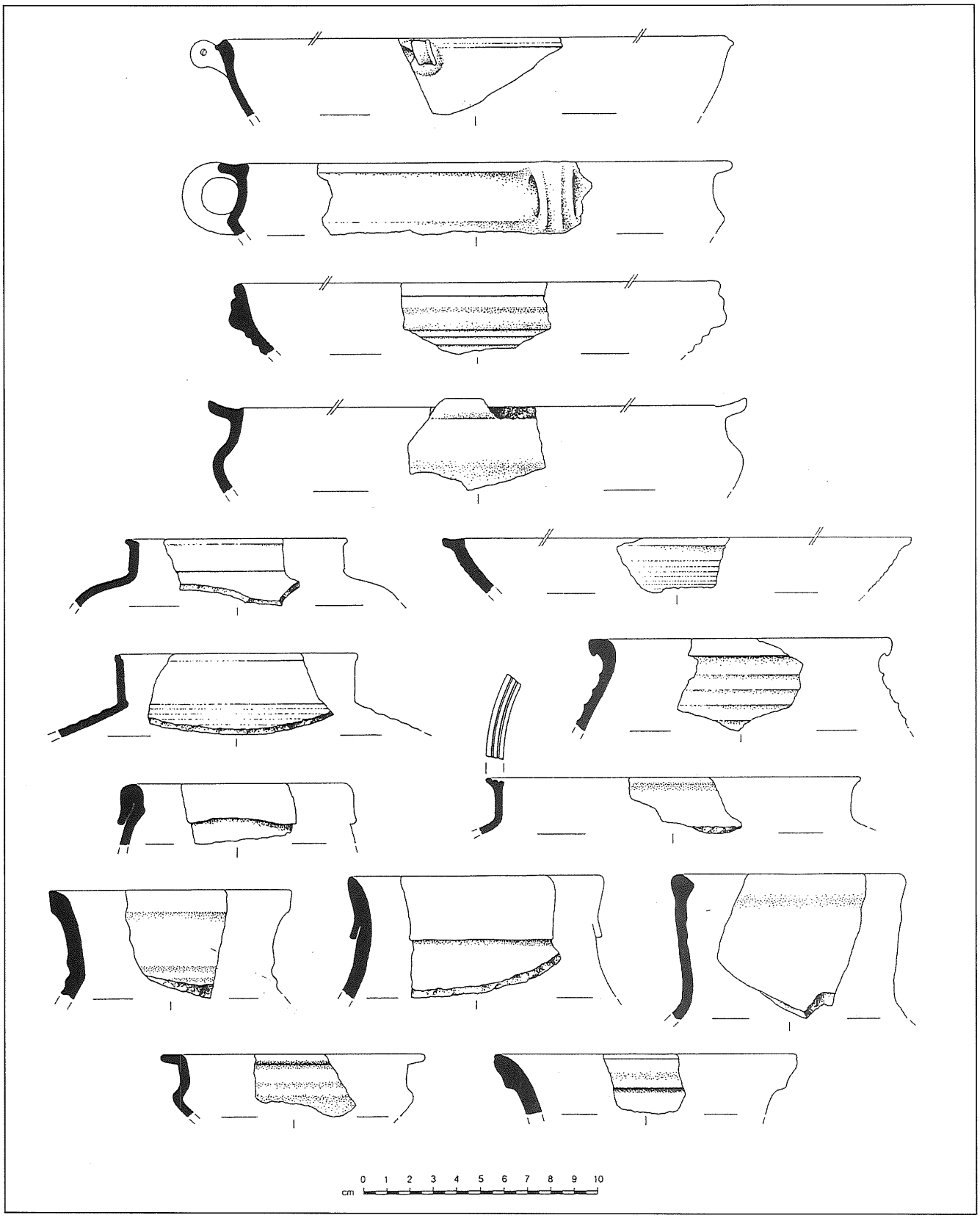
The vast majority[2] of the prehistoric sherds (Early Bronze till Iron Age) were found on the slopes of the *tall* (from 28% on the north up to 34% on the east side) where, along its extensive

2. On the slopes of Tall Zar'a, we found ten times as many Early Bronze Age sherds and nine times as many Iron Age sherds as on the plateau. Concerning the finds from other periods, this proportion averages about 2:1 (slopes:plateau).



16. Iron Age wares.

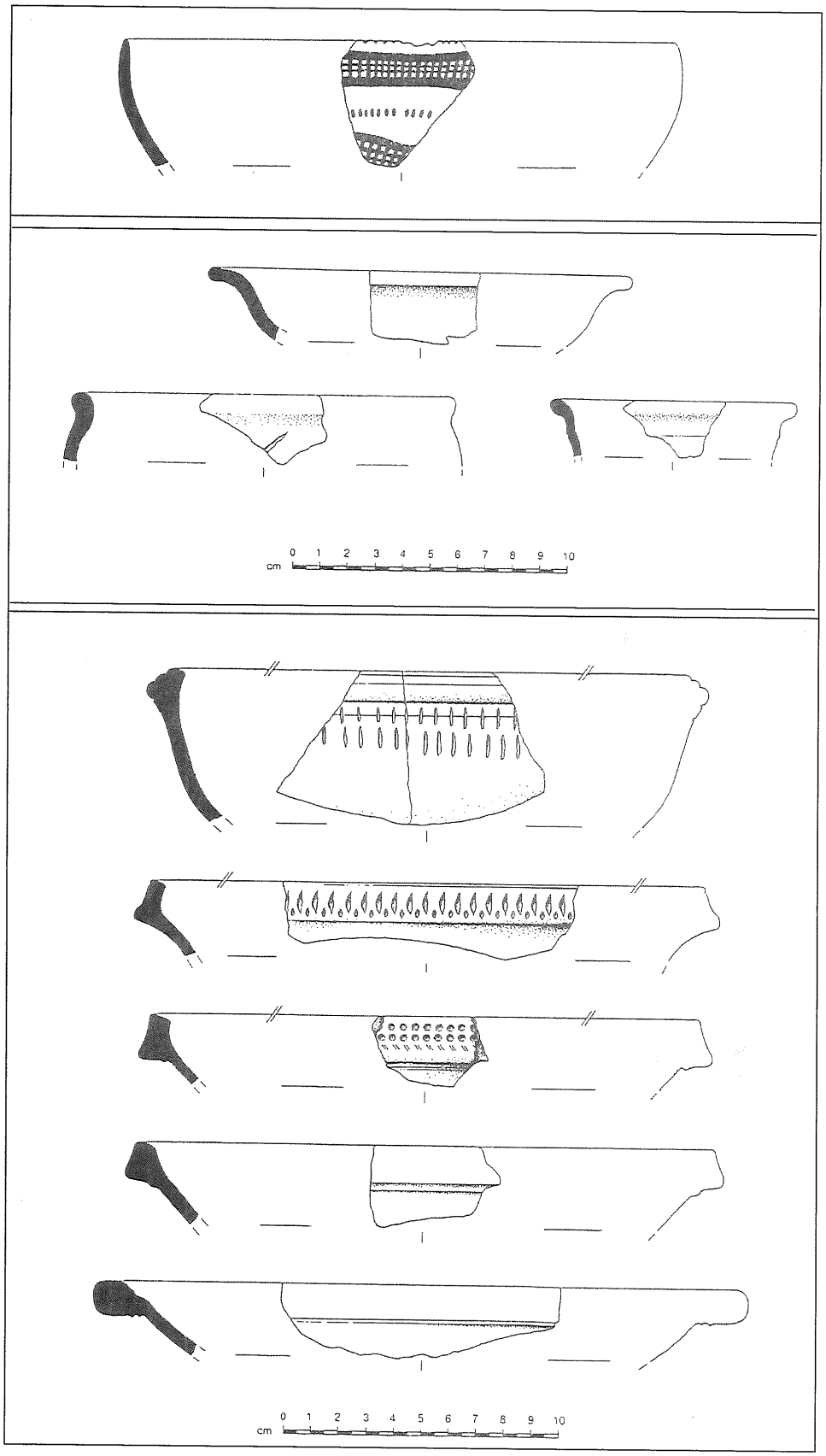
edges, the prehistoric layers were not covered by later strata as much as on the plateau. Whereas Iron Age sherds were collected in almost comparable quantities on all slopes of the *tall*, Early Bronze sherds were concentrated on the east, south and west slopes (15-18% against only 8% on the north



17. Fine red wares.

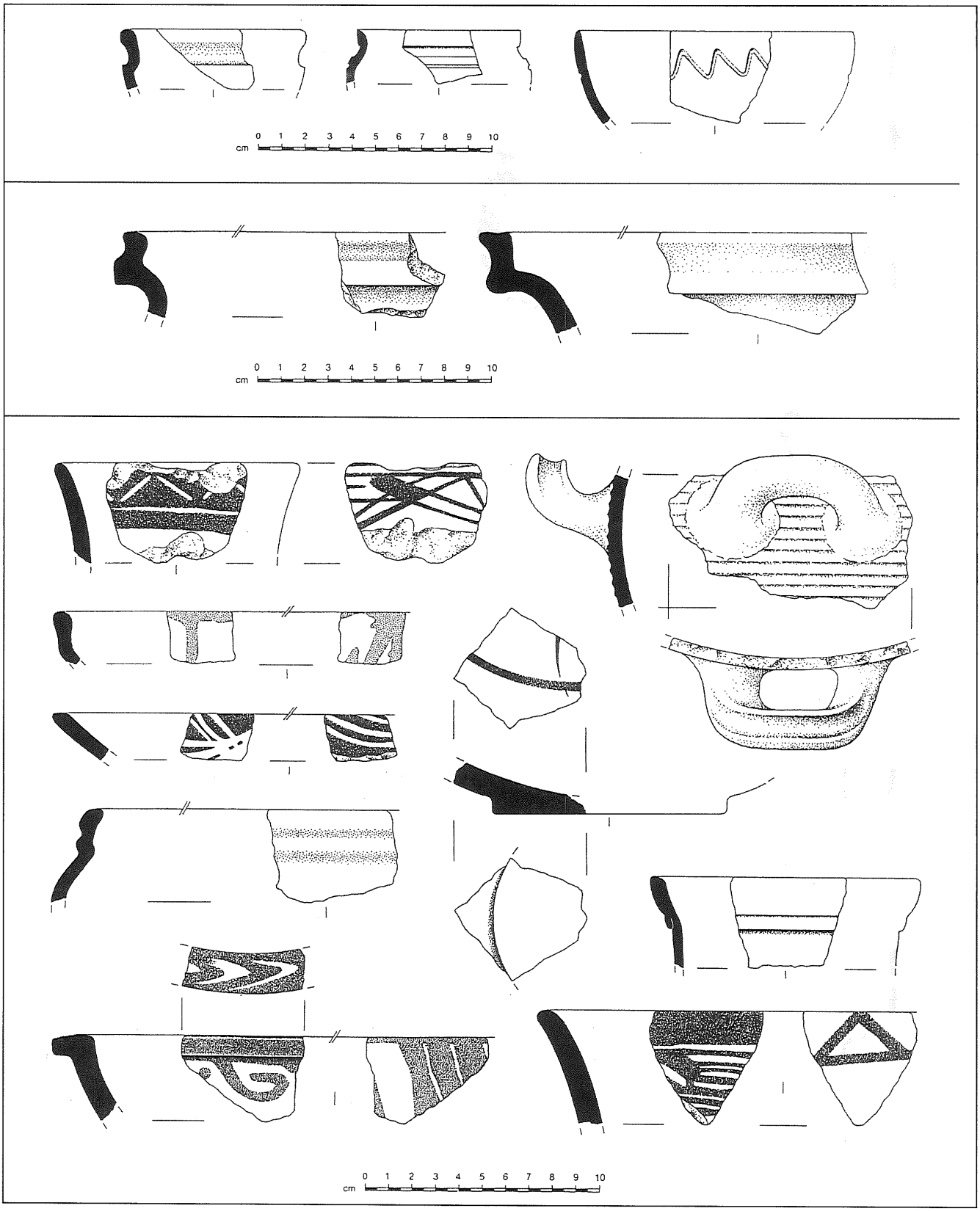
slope). Middle and Late Bronze finds occurred most frequently on the east and north slopes (12 and 14%, respectively).

As expected, the average amount of finds per survey square on the plateau was high, namely 203 sherds per survey square; yet this amount was also found on the rocky northern slope that descends steeply to Wādī al-'Arab. Along its edges and at



18. White Slip Ware (Cyprus/import) (top); fine wares (centre); Late Roman C/African Red Slip (bottom).

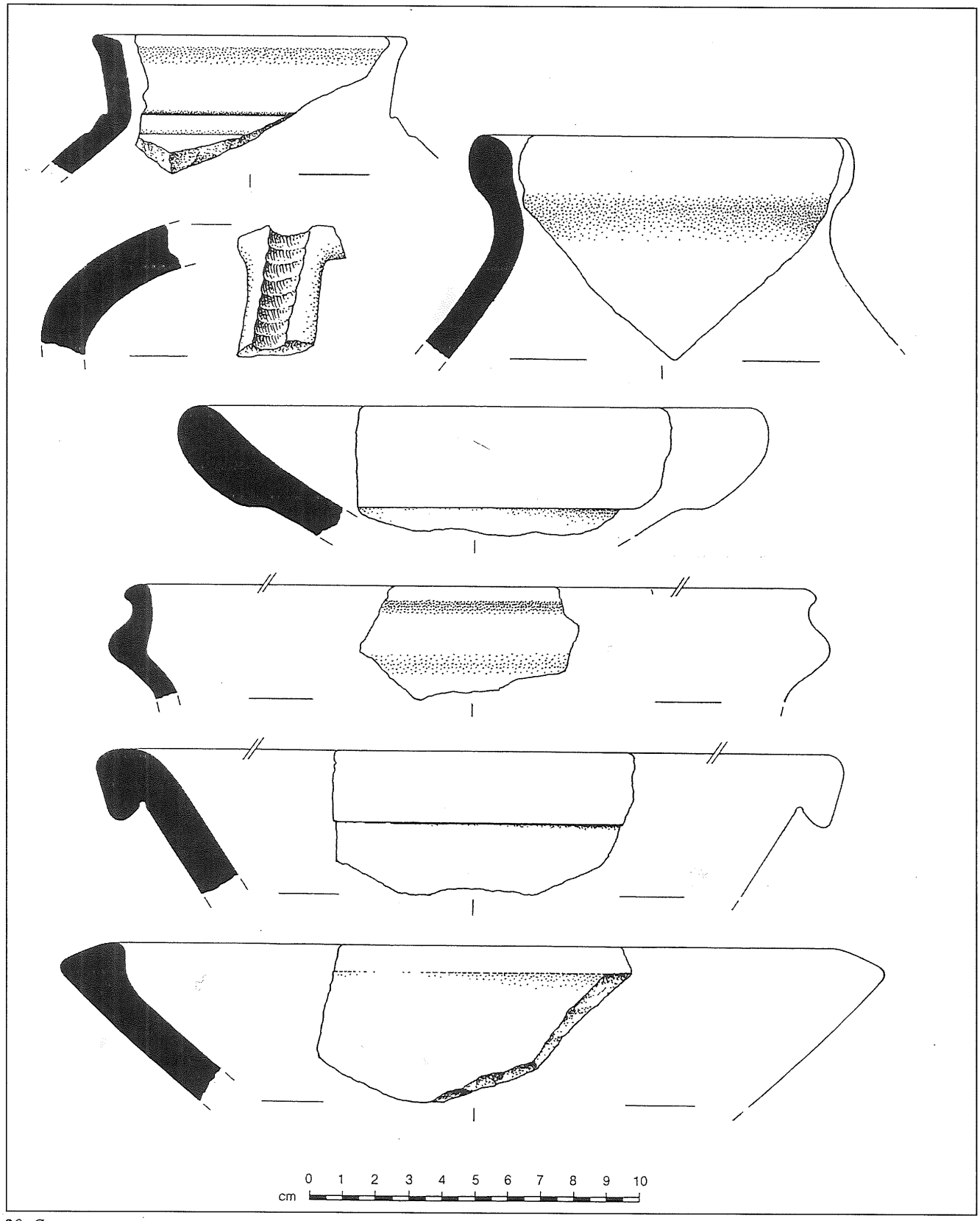
the bottom artifacts were found in large amounts (201 per square). Even more pottery was found on the west slope (207 per square). The many terrace-like edges of the slope with its height of 25m and covered with cultural remains, and some of the animal burrows practically guaranteed good finds. By



19. Terracotta wares (top); Gadara Ware (centre); Islamic wares (bottom).

contrast, the south slope (127 per square), because it is better protected against cracks by antique walls, and the east slope (140 per square), because it is dominated by boulders, produced a lower average result.

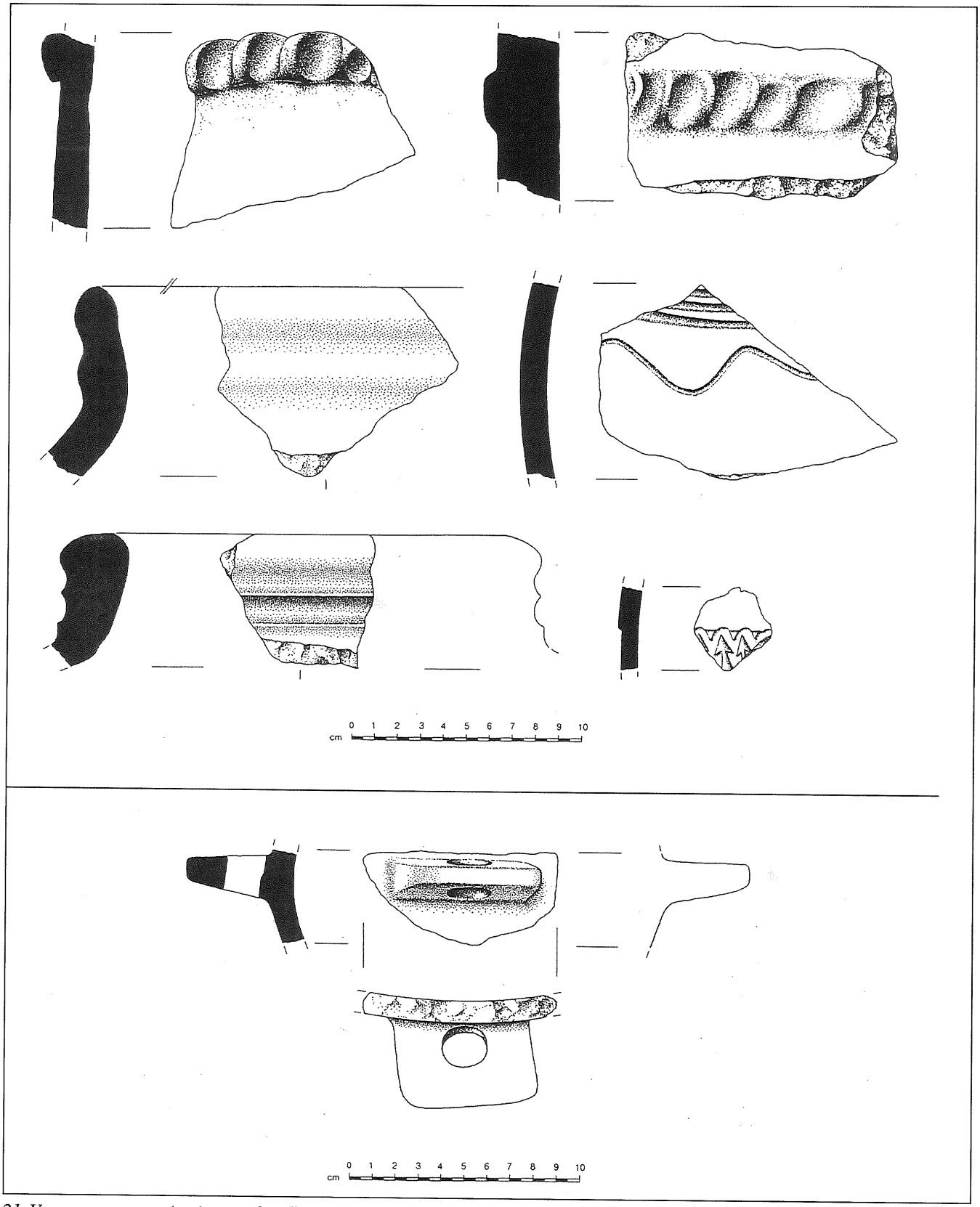
The following beam diagrams (**Fig. 23**) illustrate the quantitative data in a more detailed way. The x-values of the diagrams represent the average



20. Coarse wares.

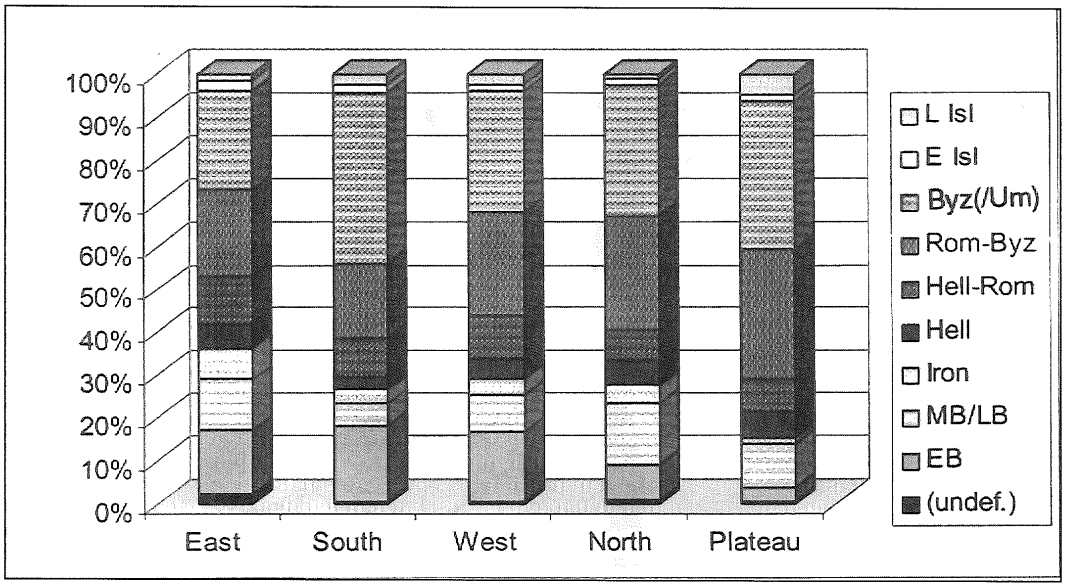
number of finds per square (20x20m). When comparing the figures, the abundance of Rom-Byz (on average 62 finds per survey square) and Byz[/Um] pottery (70 per square) on the plateau is conspicuous.

As regards the finds on the east, south and west slopes, the distribution graphs of the chronological classification are quite similar, whereas the flat pla-

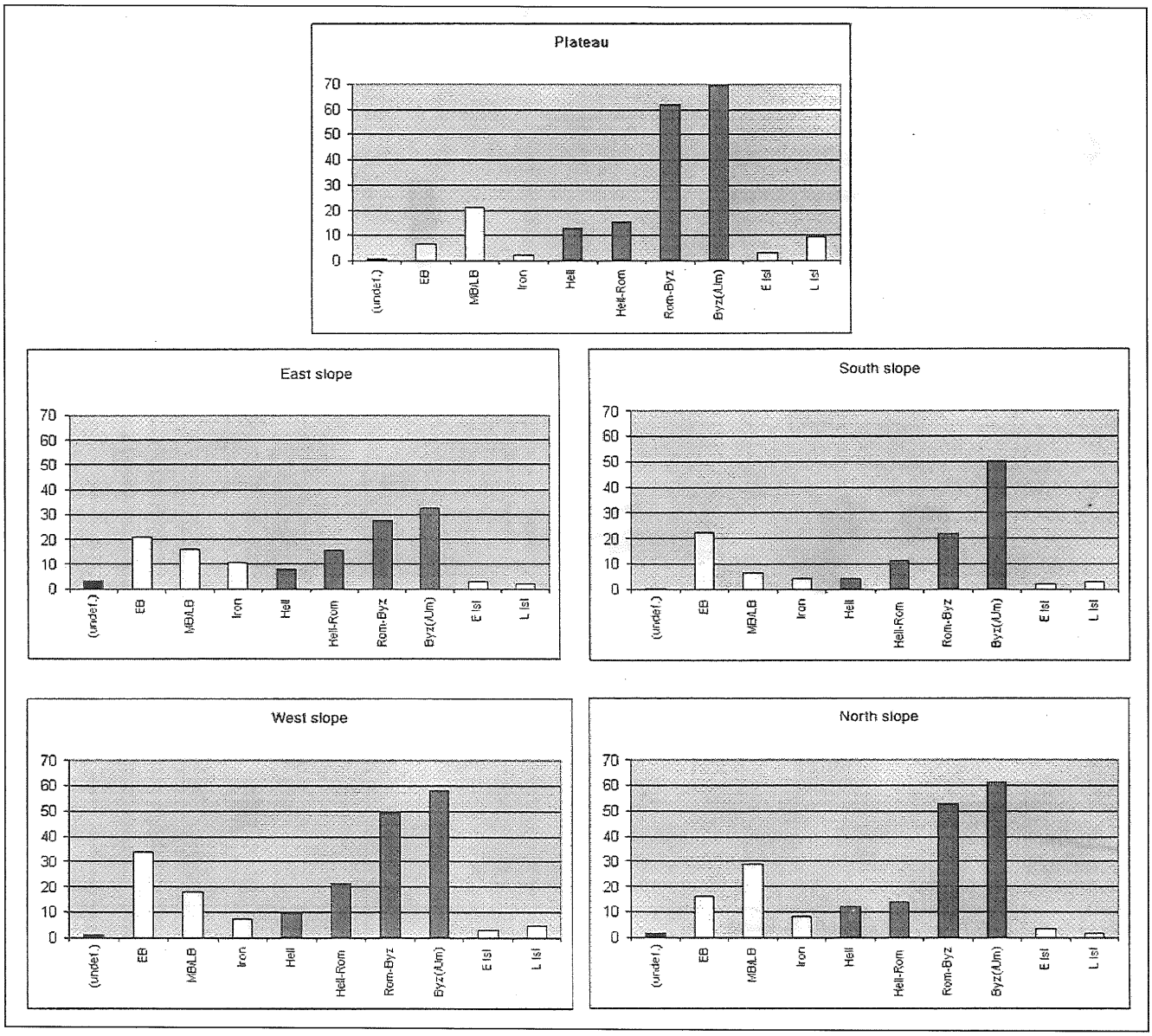


21. Very coarse wares (top); stone handle (bottom).

teau and the steeply descending slope to the north show similarities in spite of their differences. It is difficult to interpret this aspect, but perhaps it can be related to the fact that there was a settlement in the northern part of the plateau in Roman-Byzantine times (directly below the north slope and above the bend of Wādī al-'Arab which proceeds north of this place).



22. Percentile distribution of the chronologically classified pottery on Tall Zar'a (excluding the Portugali survey).



23.a-e. Average amount of finds per survey square on Tall Zar'a (excluding the Portugali survey).

It has already been mentioned above and could be confirmed that prehistoric artifacts were found, and above the bend of Wādī al-'Arab which proceeds north of this place).

It has already been mentioned above and could be confirmed that prehistoric artifacts were found, especially on the east, west and north slopes. Nevertheless, the even distribution of Early Bronze pottery over the whole west half and the northeastern slope of the *tall* is remarkable. Compared to an average of 20 sherds per survey square, 35-94 were found here. Two survey squares (Z113 and R109) turned up 80, survey square AM109 even 94 Early Bronze Age sherds. Only few, though especially remarkable ceramic concentrations were located between the north plateau and the north slope; in all, 38 sherds in survey square AQ133, 68 in AU137 and, surprisingly, 158 in AM141 — by far the highest density of Early Bronze (and thus prehistoric) pottery — could be identified. The topographical shape of the *tall* does not clearly explain this peculiarity.

The Iron Age ceramics, which were less well attested in terms of quantity (on average 6.56 finds per square), were found to be concentrated mostly on the northwest slopes (15-29 finds per square) and, to a lesser extent, in the northeast (up to 25 finds per square) and southeast (up to 19 finds per square). With 59 sherds, the robbed grave in survey square AM145 obviously yielded the highest density of Iron Age pottery.

In contrast to what we expected, Roman-Byzantine sherds, which were found in great numbers throughout, did not show a quantitative concentration in the southwestern and southern areas of the plateau where, characteristically, the corresponding architecture dominates (see above; just two survey squares, Z121 and R125, yielded 210 sherds each). Instead, the ceramic finds of the Roman-Byzantine era were concentrated in the central west (nearly constantly more than 200, even up to 550 finds per square), northwest (up to 460 finds per square) and northeast areas of the plateau (up to 320 finds per square) and the upper slopes of the *tall* adjoining these areas.

The Islamic sherds showed a high concentration on the plateau, in particular in the vicinity of the well, though in different ways. Whereas the Early Islamic finds occurred mainly near the well and especially in the northeastern corner of the plateau, the Middle and Late Islamic ceramic finds covered the area extending from the well and its immediate surroundings to the south. However, in spite of the especially on the east, west and north slopes. Nevertheless, the even distribution of Early Bronze pottery over the whole west half and the northeastern slope of the *tall* is remarkable. Compared to an conspicuity of the mostly painted or glazed artifacts, the quantity of the sherds found is quite limited. Hence one could infer that in Islamic times only certain sections of the plateau were used for settlement purposes. Only excavations can prove or disprove the validity of such conclusions, though. At any rate, early in the 20th century, Steuernagel (1926: A 465) reported that the hill was "now at least partially inhabited again".

3. Comparison of Various Survey Methods

The general arrangement was that surveys should always be conducted by persons who were thoroughly instructed in advance and who would always operate as a two-person team. They had to accomplish the search of 400 square meters (one survey square) in one hour, completing 7 survey squares a day. The geographic achievement profile (i.e., the proportion of steep slopes – inclined surfaces – level surfaces) was planned in advance in such a way that it was comparable from day to day. Extra work per day and premature changing from one survey square to another were considered undesirable as were delays. These measures were intended to maintain the same standard of collecting from the first to the last square and to prevent an increase in the error rate by different subjective "concepts" of gathering methods, speed, topographically caused problems or other, personal aspects.

The following survey methods were adopted:

a) the complete *tall* survey; area: 127 squares of 20x20m (expenditure of work: 18 workdays for 2 persons);

b1-4) four surveys based on different[3] random samples of survey squares; area: 15 squares of 20x20m per person (expenditure of work: 2 workdays each for 2 persons);

c1-2) c1) a survey based on a directed sample of survey squares I[4] (condition: 3 squares per slope and 3 squares on top of the plateau); c2) a survey based on a directed sample of survey squares II (without any preconditions concerning the location on the *tall*); area: each 15 squares of 20x20m per person (expenditure of

3. Three times we chose a random sample of Tall Zar'a as a whole. Once (b4) we chose a random sample of three squares from each of the five main areas of the *tall.*

4. After a thorough inspection of Tall Zar'a, but before the survey was started, two archaeologists independently selected 15 squares each. They had to select those squares which were representative of the five main areas of the *tall.*

work: 2 workdays each for 2 persons);

d) a survey based on the methodological guidelines of Portugali (1981). Because a complete exploration of the *tall* according to these guidelines appeared to be unworkable, the method described under c1) was chosen as a basis for the selection of the "Portugali squares" (a survey based on a directed sample without any preconditions concerning the location on the *tall*); area: 15 squares of 5x5m (expenditure of work: 4 workdays for 2 persons — estimated expenditure of work for a complete survey: 135.5 workdays for 2 persons).

Leaving the usual subjective distortions aside, the complete gathering of sherds guarantees the most representative view of the facts which can be brought about by a survey. Considering this, the expenditure of 18 workdays appears to be justifiable. It allows not only for an overall evaluation of the complete *tall*, but also of single — even small — areas in a representative way. To work out an excavation strategy, reliable data about smaller and bigger *tall* areas are needed, for example about areas with an extremely, or at least extraordinarily high or low concentration of sherds of a specific ware or period. Therefore, an inclusive *tall* survey seems to be an unalterable precondition for the excavation of a multi-phased *tall* with massive cultural layers.

As will be shown below, the random selection of about 10% of the total survey area has produced a surprisingly rich database for a reliable estimation of the total amount of finds, of their chronological distribution and the proportional relations

Table 2: Sequence of deviations.

Formula (deviation): $\|\chi\text{-}a\|^2=\sum_{i=1}^{n}(\chi_i\text{-}a_i)^2$.

The average deviation with 99% confidence is 2.8%, the maximal deviation is 10%. The average deviation with 95% confidence is 2.4%, the maximal deviation is 8.5%.

%	Tall survey	Random selection				Directed selection	
	a	b_1	b_2	b_3	b_4	c_1	c_2
(undet.)	1	1	0	2	1	1	0
EB	11	13	9	12	11	13	8
MB/LB	10	10	12	8	9	7	8
Iron	3	4	4	4	4	4	3
Hell	5	4	6	6	5	5	6
Hell-Rom	9	10	8	8	9	8	7
Rom-Byz	25	22	26	26	28	26	26
Bys(/Um)	31	32	32	31	29	34	38
E Isl	2	2	1	2	1	1	1
L Isl	3	2	2	2	3	1	3
Difference[i]	0	4.24	4.0	3.16	4.0	5.48	8.37

%	Directed selection	Portugali method
	c_1	d
(undet.)	1	0
EB	13	12
MB/LB	7	3
Iron	4	3
Hell	5	5
Hell-Rom	8	10
Rom-Byz	26	27
Bys(/Um)	34	37
E Isl	1	1
L Isl	1	2
Difference	5.48	9.70

between the represented periods (as far as this can be established in a survey). If, within the scope of extensive geographic explorations, *tulūl* are to be included, this method seems to be recommendable. Especially the expenditure-income ratio (also considering the evaluation of the artifacts) is impressive because of its high efficiency. However, it should be kept in mind that single areas of the *tall* cannot be surveyed comprehensively with this method. The directed selections show only a moderately satisfactory result.

The expenditure of work for conducting a survey according to the Portugali guidelines is enormous. Because of the size of Tall Zar'a, only a sample of squares as a basis of future explorations will undoubtedly be workable. Considering the limited prospects for gaining information in view of the many periods and the long enduring settlement of the *tall*, a survey based on this method appears not to be useful in the present case.

Relating the sample-based surveys to the overall *tall* survey as the point of reference, a clear sequence of several deviations can be established **(Table 2).**

Geoelectric Tomography

Within the scope of the geophysical exploration of the *tall*, geoelectric mapping and two-dimensional as well as three-dimensional tomographic techniques were used in order to:

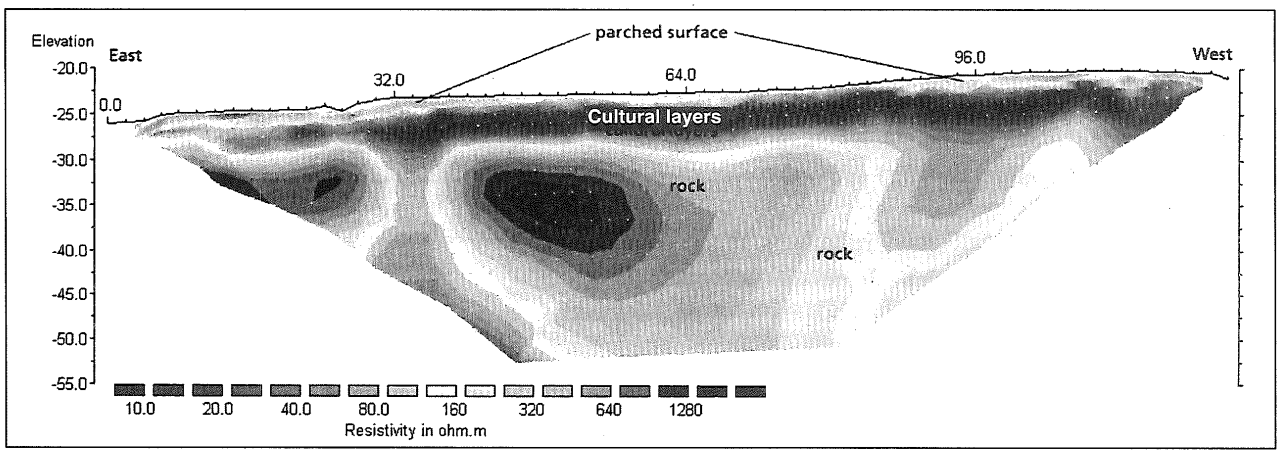
- be able to plan archaeological excavations in advance and to develop exact strategies for the planned excavation;
- acquire knowledge of non-excavated areas; and
- leave undisturbed larger excavation areas for coming generations.

For the purpose of the geophysical exploration a LGM 4-Point Light μC and a Geolog 2000 Geo-Tom were used. On Tall Zar'a more than 50 profiles in various configurations could be measured. Below, two outcomes, which will be published here beforehand, are interpreted:

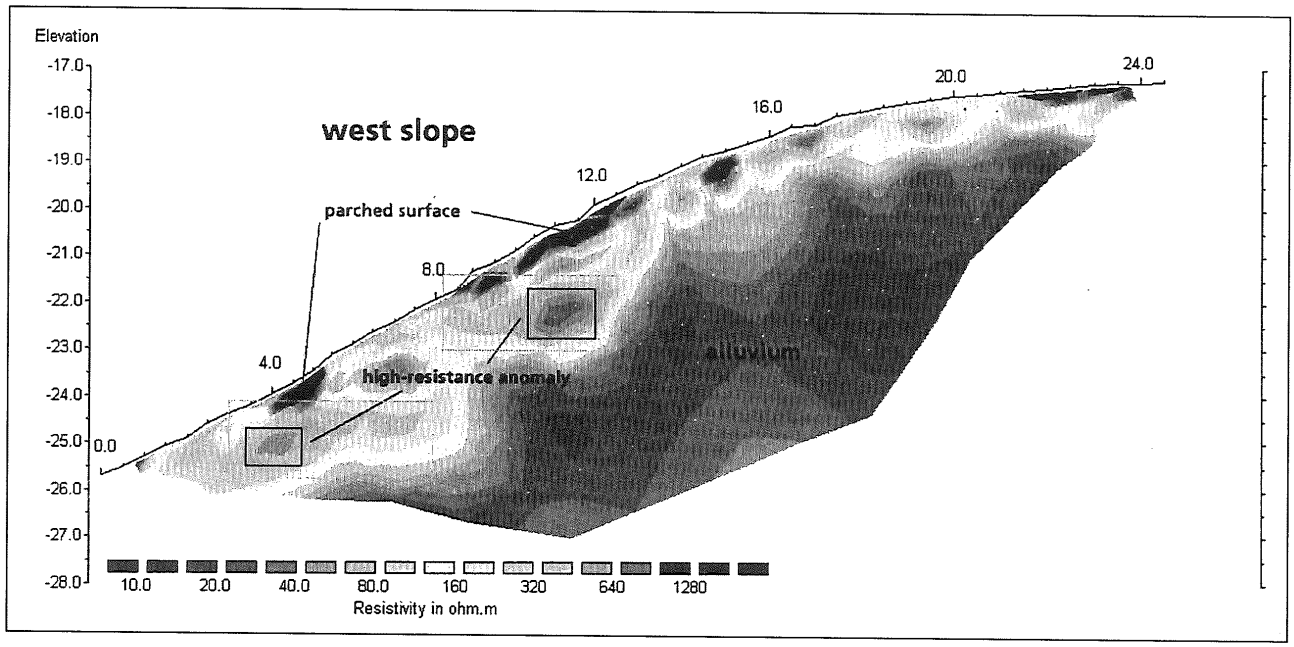
The first measurement **(Fig. 24)** shows a profile (in dipole-dipole configuration) which runs across the *tall* in an east-west direction and yields essentially geological insights. For this 63 electrodes were positioned at a distance of 2m. In the profile shown, a cultural layer of 5-6m in thickness can be recognized, showing a low-ohmic value (up to 100Ω to the max.) below the dried-up surface which, as expected, appears as a high-ohmic anomaly (more than 160Ω). An important observation of our survey confirms the enormous thickness of the cultural layer of Tall Zar'a. The cistern found in the southeast of the *tall*, which has a depth of 5.75m, reaches up to the actual *tall* surface directly above the cistern's round brickwork arch and is built on bedrock.

In the east, bedrock almost reaches up to the surface. Since the *tall* as a whole slopes slightly toward the east, drainage occurred in that direction. Probably the remarkable down-going double-conic (low-ohmic) area at meter 32.0 is connected with the functioning of the artesian well.

On the west slope about 20 parallel placed profiles were plotted and measured with 50 electrodes at 0.5m distance. Here the dipole-dipole configuration was also used in order to ensure a better resolution of the screen process prints. In this way, a location of the walls on the slopes of the *tall* should be possible. On the surface they cannot be localized. In the model illustrated in **Fig. 25,** two high-ohmic anomalies can be traced at meter 4.0 and 11.0, lying up to 2m below the surface. Since these anomalies occur in all 20 parallel profiles, it can be assumed that they are related to the remains of wall structures. Detailed analyses — especially the three-dimensional modeling of measurement values — are currently under way.



24. East-west profile of the Tall Zar'a plateau (Iteration 4, RMS-fault = 24.5).



25. West slope profile (Iteration 4, RMS-fault = 12.9).

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