THE QAL'EH'IYAZDIGIRD POTTERY: A STATISTICAL APPROACH

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THE NATURE OF THE PROBLEM, *by Edward J. Keall*

The illustration of a glazed jar (Pl. Vb and Fig. 6) summarizes in a single object many of the tantalizing challenges that the site of Qal'eh-i Yazdigird has had to offer since the inception of the project in 1965.[1] The jar (QY78.51) has a funnel neck, high-shouldered ovoid body, ring base, green glaze, and a combed and barbitone design. In date, it could range from third century A.D. in the vocabulary of Dura Europos, to seventh century Umayyad. While such a vague date would seem deplorable after so much archaeological activity, it is a reality that the one topic about which we know the least is the very subject which precipitated work at the site in the first place. A stratified sequence of Sasanian pottery was what the excavator sought in 1965; after three subsequent major seasons of work, no adequate stratified deposits of Sasanian or Parthian pottery have been found. Massive amounts of monumental masonry have been exposed, but in most instances the over-burden of collapsed building debris, up to four metres in height, has limited the extent to which floors have been able to be cleared.

Much headway has been made with the identification of what can conveniently be called the Yazdigird corpus of pottery. It appears that the majority of sherds found so far come from vessels that were produced locally. Certain characteristics of the pottery tend to transcend divisions of date set down by dynastic change. Much of the local pottery of early Islamic times retains characteristics of late Parthian. This is true up to around the eleventh century, when more distinctive, externally derived characteristics began to permeate the pottery, so that it carries a specifically Seljuq imprint rather than simply being a modification of what had gone before. This characteristic of the pottery retaining a close identity with that outside the Yazdigird area remained in force until at least the end of the thirteenth century.

Two surprises were presented in the 1978-79 season[2] which had far-reaching consequences for the interpretation of the site. The first was a cache of Parthian green-glazed vessel fragments found at the bottom of a pile of building debris that had been deliberately dumped in one of the rooms in Gach Gumbad West (Fig. 4, area 234; general view, Pl. IIIa; section, Pl. IIIb). The dump, whose eroded top stood exposed above the remains of the walls, also included large numbers of fresco fragments. The sherds were well sealed at the bottom, albeit mixed up with the dumped plaster debris. The discovery of this pottery represented the first time that anything but the smallest concentration of Parthian glazed pottery had been recovered from the site; previous finds of this ware had amounted to less than one per cent of all sherds found. Some identifiable rim sherds were included in the cache. The green glaze and the yellow fabric of the clay spoke clearly of a Mesopotamian origin for the vessels.

The second significant discovery of the 1978-79 season was the glazed jar described above. It was found in room 2 of the Kala Dawar[3] sub-site, located in field 29 of the Ban Gumbeh survey area (Figs. 3b and 5; Pl. VIIa). Kala Dawar experienced a complex history from Sasanian to Seljuq times. Originally it was a *chahar taq* of classic Sasanian type with an ambulatory corridor running around a central core with four L-shaped piers ("aerial" view in Pl. IVa is from north; pier, Pl. IVc). On the west side, a series of roughly square rooms (areas 2, 11 and 12) were appended to the exterior wall of the west corridor. When they were appended has yet to be determined. The reason for this appalling

*Apart from satisfying the need to publish some of the Qal'eh-i Yazdigird pottery as soon as possible, the aim of this article is to suggest ways in which material of this kind can be manipulated to the best advantage. It is a tentative methodological approach and is in no way intended as the definitive catalogue of the site's pottery. Details of rim diameter and body wares have not been included in standard catalogue form partly because of considerations of space. It is also felt by the authors that without great elaboration concerning surface treatment, body texture, firing colour etc., a brief listing is virtually useless, since in many cases the differences are so minor. Full details will be given in the final publication.

ignorance is that the bonding of a wall of rubble masonry in its upper parts does not automatically mean that it is bonded at the base; destructive probes remain to be carried out to test the corners for bonding evidence, and as long as plaster is still intact upon the wall face, evidence of additions having been made is hidden. The acute slope of the terrain and the uneven nature of the underlying bedrock make simple observations about the relative heights of foundations meaningless in terms of saying that lowest is oldest. Evidently these flanking rooms had a history of occupation long after the *chahar taq* structure had ceased to be used. But whether the rooms were a part of the original design of the *chahar taq* remains to be seen.

As far as the preliminary investigation has shown, a significant collapse of masonry occurred in the central part of the *chahar taq*. After the collapse, a small wall was erected to block off the entrance between the corridor and the central core (Pl. IVc). The inner side of the blocking wall had no evidence of a face, as though the wall had been built in direct response to the collapse. Once the wall was in place, the flanking rooms provided the main focus for activity. Such activity involved the accumulation of considerable deposits of ashy debris, which also included many fragments of glass. The corridors of the old *chahar taq* also had a considerable accumulation of the same type of ash (Pl. IVb). Hence, the suggestion that these rooms were used as workshops may not be out of place. Outside the building, the presence of a small hearth (Pl. VIb) also speaks of specialized workshop use. The roofs of the rooms were clearly flat, for a stone roller was found outside the building, indicating a traditional roof of beams covered by wattle and thick mud. At some time later than the construction of these flanking rooms, another room was appended to the extreme west corner of the complex. Other minor modifications continued to be made after that.

All this occurred before Seljuq times, or at least before the introduction of the clearly identifiable pottery with its black paint under transparent blue glaze, so typical of the eleventh and twelfth centuries. Such pottery *is* known in the immediately adjacent area. The fields around the nearby R.O.M. dig house in Ban Gumbeh, less than half a kilometre away (Figs. 1 and 3b, fields 1-16), are relatively abundantly bestrewn with fragments of that type of underglaze painted pottery. Ban Gumbeh has the standard Sultanabad wares as well, which can be dated to the thirteenth and fourteenth centuries. The oven site excavated in the alleyway west of the dig house contained fragments of these wares. Kala Dawar had no such material. The latest activity at the site is attested by the presence of large pits dug into the flanking rooms. From the evidence of a bronze lamp (Pl. VIa; QY78.11) and a bird finial from an ewer (QY78.29), recovered from the pits in area 9, a tenth century date can be ascribed to the pitting activity. The rooms, then, had ceased to be used before the Seljuq period.

The digging of one of these pits in mediaeval times had exposed the previously buried glazed jar QY78.51. The R.O.M. expedition's excavations revealed that this jar had been interred in a very deliberate way (Fig. 6), though the purpose of its interment is unknown. The jar was encased in wet plaster and set in a hole dug in the earth fill of the room. Over the top of the jar and its plaster casing was poured the concrete floor of the room. Whether by design in the search for materials of this kind, or by accident in the digging of a pit for other purposes, the jar was exposed at the edge when the pit was dug. The jar was broken into by this action and its contents, if any, were presumably removed at the time. Part of the concrete floor subsequently fell down into the pit, along with some of the ashy deposits that had accumulated above the concrete.

The date of the jar, then, is limited by a *terminus ante quem* which must be derived from the Abbasid date of the ashy deposits postdating its interment, and by a *terminus post quem* derived from the absence of Parthian pottery at the site. But since the conditions of the jar's interment are so unusual, as well as its type being an anomaly at Qal'eh-i Yazdigird, the possibility of its being an heirloom piece cannot be ruled out. The unsatisfactory label of late Sasanian-Umayyad is the only one which can be derived from its provenance; a similarly vague date, which might even be extended back to include late Parthian, would have to be acknowledged from an examination of its form and style. Although, in general, the Kala Dawar sherds have provided a particularly useful series of fossil indicators for the early Islamic period, the unique glazed jar remains enigmatic. The project has been brought face to face with the stumbling block for which the original expedition was supposed to have supplied the way round.

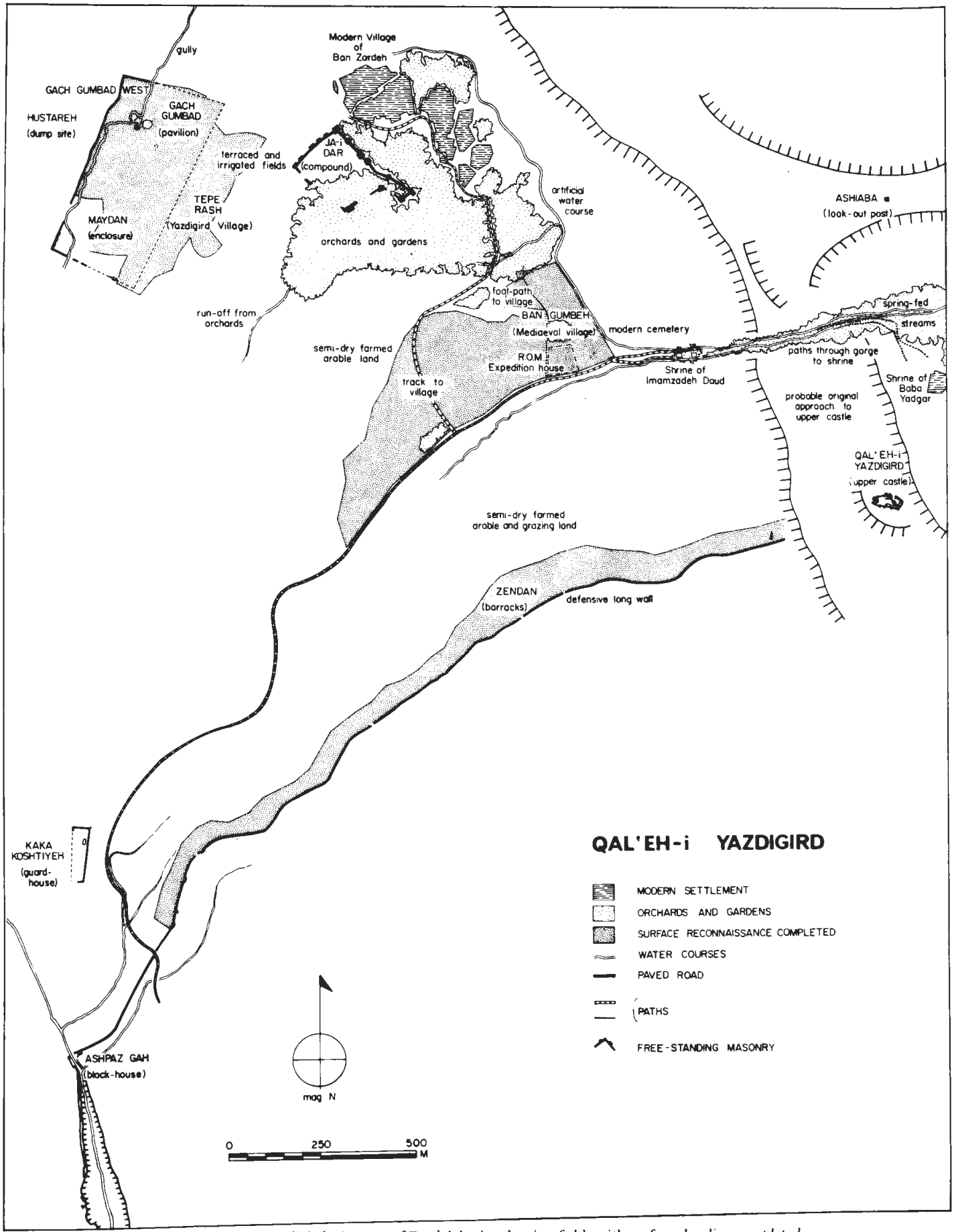


Fig. 1. Qal'eh-i Yazdigird: site map of Zardeh basin, showing fields with surface sherding completed.

Such is the nature of the problem. The second half of this article records an exploratory statistical study, undertaken to probe means of gaining clues to the solution without having to resort to the approach of simply digging more. As background to the study, it will be useful to recapitulate what is generally known or has been deduced about the Yazdigird pottery assemblages. Much of this information has come from the field surveys, for which one of the original purposes was to identify where the heaviest concentrations of pottery (and therefore traces of settlement) existed in the approximately twenty-five square kilometres of the Zardeh basin. The sherd count was a relatively successful venture, as can be seen from the density charts in Figs. 2, 3a and 3b. Without adjustment for actual field size,

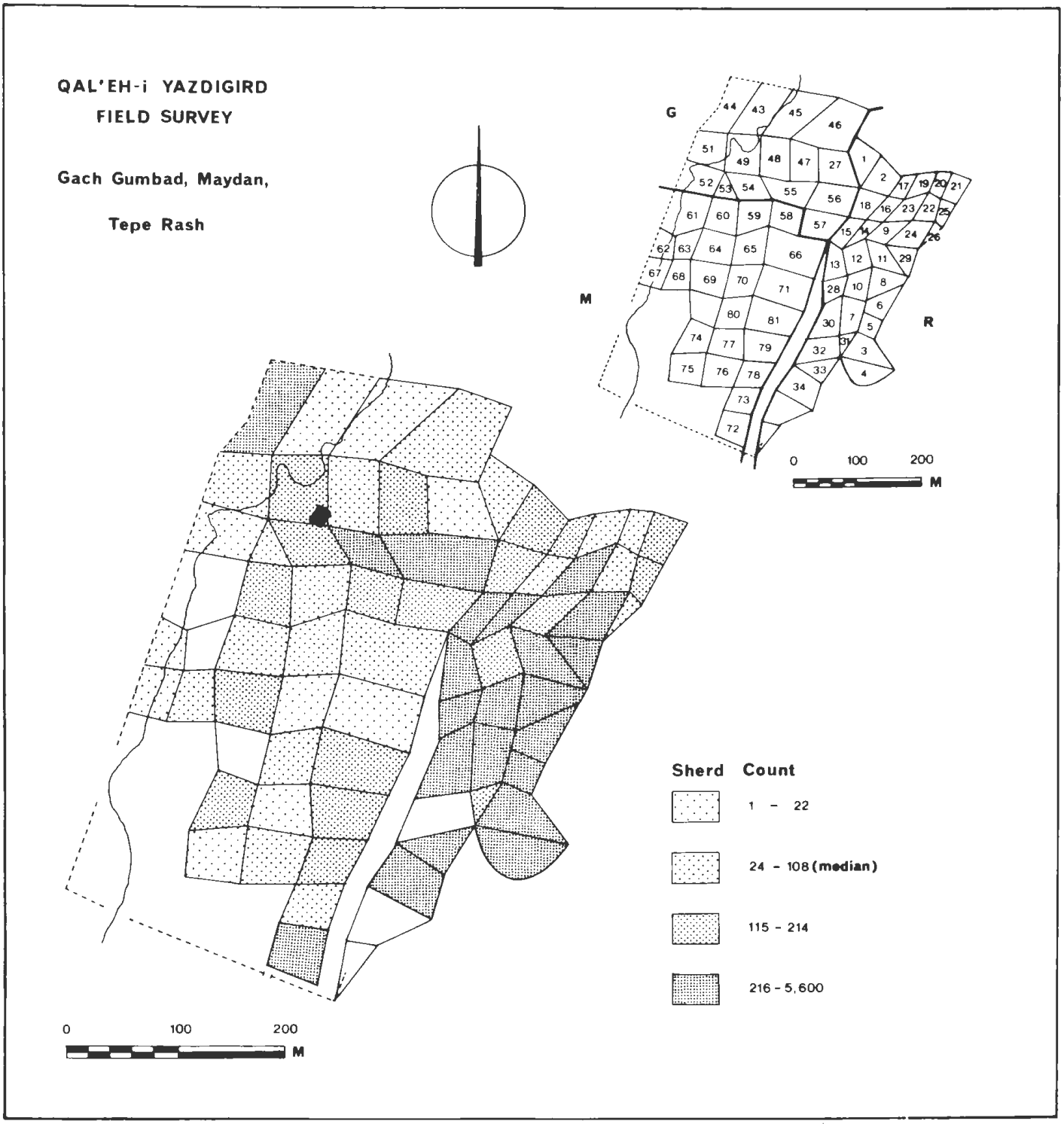


Fig. 2. Sherd count for field survey of Gach Gumbad, Maydan, and Tepe Rash.

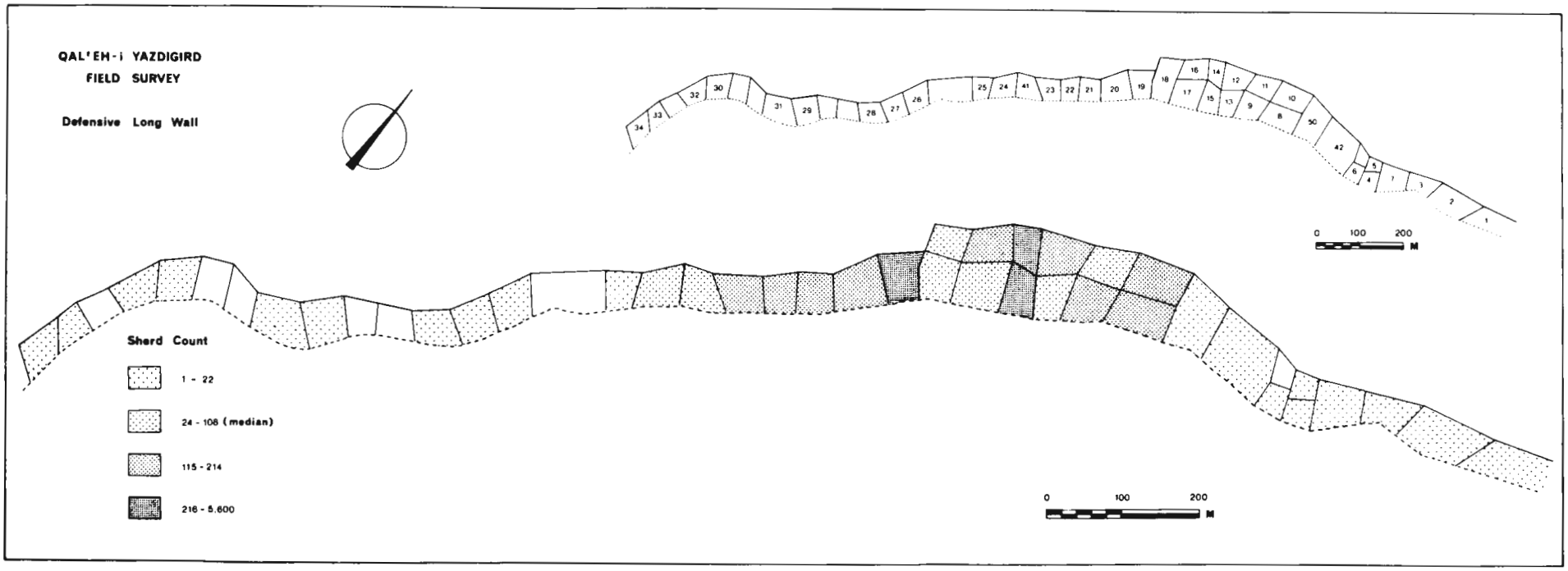


Fig. 3a. Sherd count for field survey of defensive long wall (Zendan).

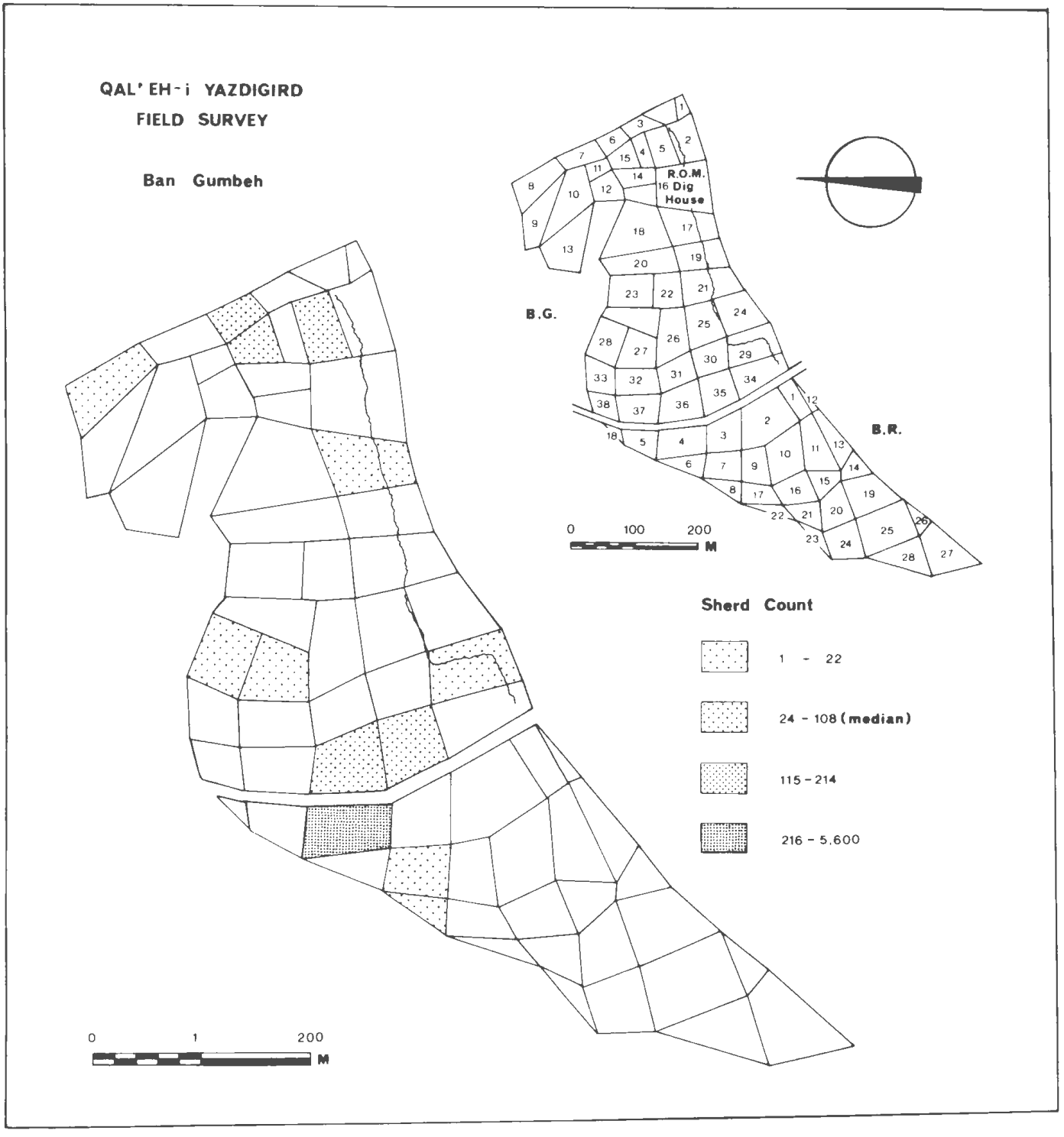


Fig. 3b. Sherd count for field survey of Ban Gumbeh including Kala Dawar.

and with fields ranging anywhere from fifty to one hundred metres on a side, the sherd count had a median figure of one hundred and eight per field, and a maximum figure for any one field of five thousand six hundred collected and recorded.

Unfortunately, terracing of the fields—particularly on the Tepe Rash ridge (Fig. 2, fields 1-34), where the heaviest concentrations occurred (see Pl. II c and d)—appears to have destroyed virtually all trace of the buildings that were once there, leaving only the sherds on the surface of the ground. The problem of identifying these settlements is compounded by the fact that the general building activity

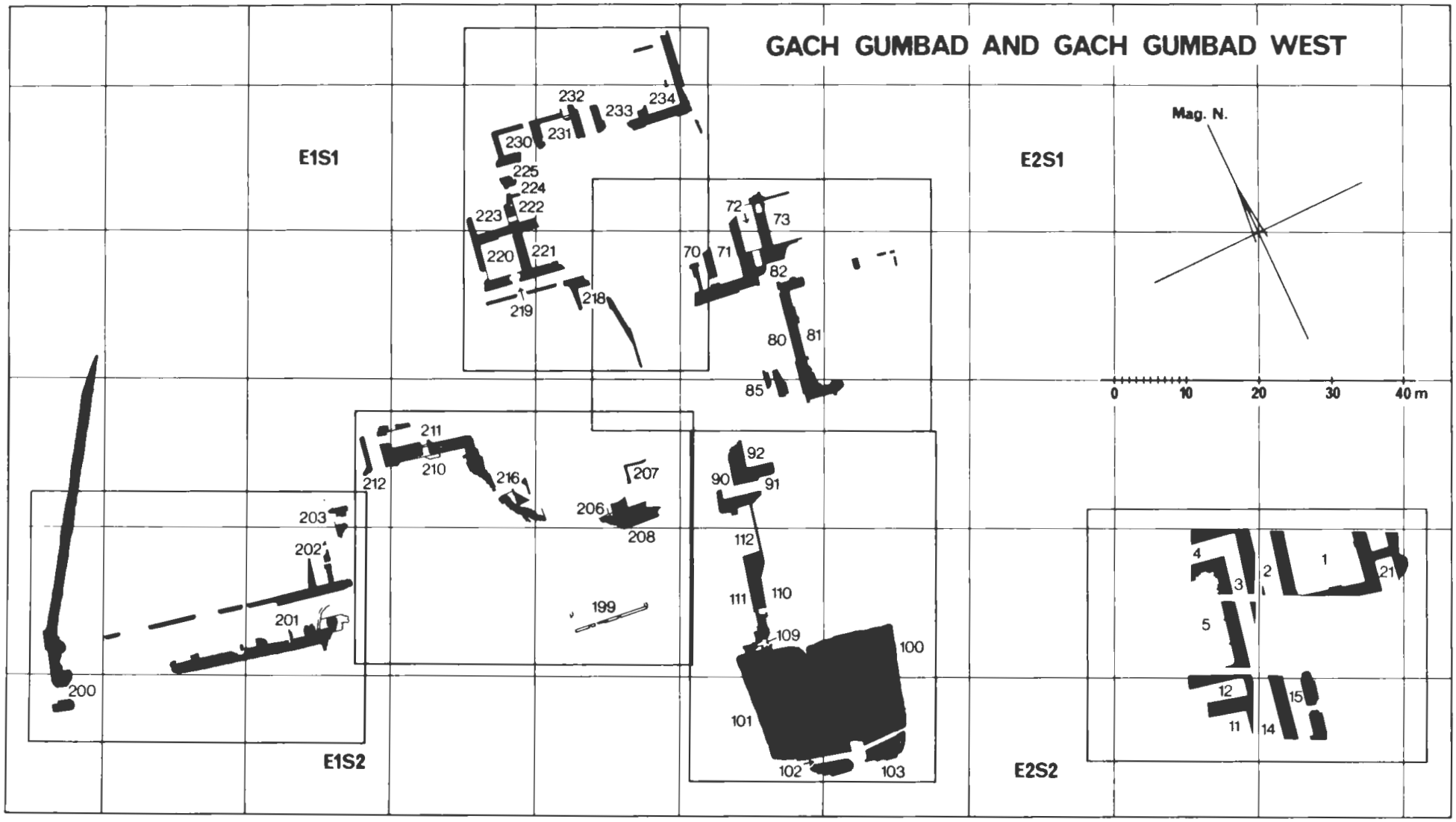


Fig. 4. Plan of walls cleared up to end of 1978–79 season.

which began in the Zardeh basin during the Parthian period appears to have set in motion patterns of erosion which have resulted in the loss of top soil and the down-cutting of gullies through the present fields (see Pl. III c and d). Some material has been lost for good. Nevertheless, in spite of these difficulties, it is clear that the Tepe Rash ridge witnessed occupation of Sasanian date. In the Yazdigird corpus of pottery, Sasanian fossil indicators stand out above all in the Tepe Rash assemblage. The large quantities of sherds from this area and the lack of monumental architecture have led us to identify Tepe Rash as the site of a Sasanian village.

Elsewhere, the Parthian date for the fortified complex of the entire Qal'eh-i Yazdigird site was derived in part from the discovery of Parthian pottery alongside the fortifications of the defensive long wall, particularly in fields 8-23 (Fig. 3a; see also Pl. Ib and c). In these areas associated with the maintenance of the defensive system, the pottery lacks the Sasanian fossil indicators.

A probable Sasanian date, however, can be attributed to two small assemblages of pottery. The first group of sherds was found in fill which pre-dated the emplacement of a squatter wall across the corridor of Gach Gumbad, area 12. At this time the walls of the corridor were showing signs of considerable erosion through exposure to damp (cf. *Iran* XVIII, Fig. 5, no 3—fill, stratum 4; wall, stratum 3). This modest selection of sherds was matched by another group that was discovered in a pit at the southeast corner of Gach Gumbad, area 1. The pit was close to the surface, but nevertheless sealed in an ancient context. In the case of the latter finds, a late Sasanian date may be more appropriate because of the height of the fill.

So, once again, the vital clues to the date of the facets of the site's history are derived mainly from circumstantial evidence. In addition, familiarity with the wares and the decorations began to make it possible to suggest possible seriations of the various types. The basis for the decisions made stemmed in part from experience gained while sherding sites in central and southwestern Iran, as well as in southern Iraq.[4]

Between 1963 and 1967, various sites were sherded as indicated on the map in Fig. 7. The sherding was not a " random " collection of material in the statistical sense, nor under the circumstances could a thorough sampling of the areas have been carried out. One important consistency lies in the fact that the sherds were collected by the same person, so that the same bias was present throughout. A fair range of types of sites were examined, from small mound to large castle. Often the sites had distinguished names, such as Tepe Mil (Chal Tarkhan), Bishapur and Hatra. By contrast, small mounds were represented by sites such as Tepe Hajiabad near the village of that name, on the road from Tehran to Qom; by numerous mounds in the plain of Farrashband; and by an unidentified site north of Kerbela. Most of the sites were within reach of roads, albeit these might be minor ones, either gravel or paved; occasionally access to sites had to be gained on mule-back, as at Qal'eh-i Yazdigird in 1964. Sherds were saved only when something " interesting " could be found in them. They were recorded and drawn in either Tehran or Baghdad and the collections were left in the respective British Institutes there. The same kind of methodological approach was applied in Iraq, under very much the same kind of circumstances as in Iran. This writer's sojourn with the 1966-67 Nippur Expedition of the Oriental Institute of the University of Chicago provided invaluable insight into the make-up of the Parthian pottery of Mesopotamia. In all, between the two countries, thirty-eight sites were sherded, apart from Qal'eh-i Yazdigird and Nippur. One thousand four hundred and thirty-four sherds were collected and drawn from the thirty-eight sites. A selection of these, together with a variety from the Qal'eh-i Yazdigird field surveys, are illustrated in Figs. 8-28.

It must be borne in mind that there are two ways to approach the subject of comparing the available data. The first is an in-site comparison in which all the various minor differences within the same vessel type are noted. This technique may be useful in isolating subtle changes over time, or even the hand of different workmen or groups of workers. As an example, the variants of a heavy-rimmed jar type from Qal'eh-i Yazdigird are illustrated in Fig. 8; in this figure, an attempt has been made also to show texture and to give some idea of inclusions and firing colour. The second approach is the more traditional kind, in which sherds from one site are compared against those from another. This approach, used in the statistical study which follows, necessitates a grosser scale of comparison among sherd characteristics; without the reduction of fine distinctions of form, fabric and decorative

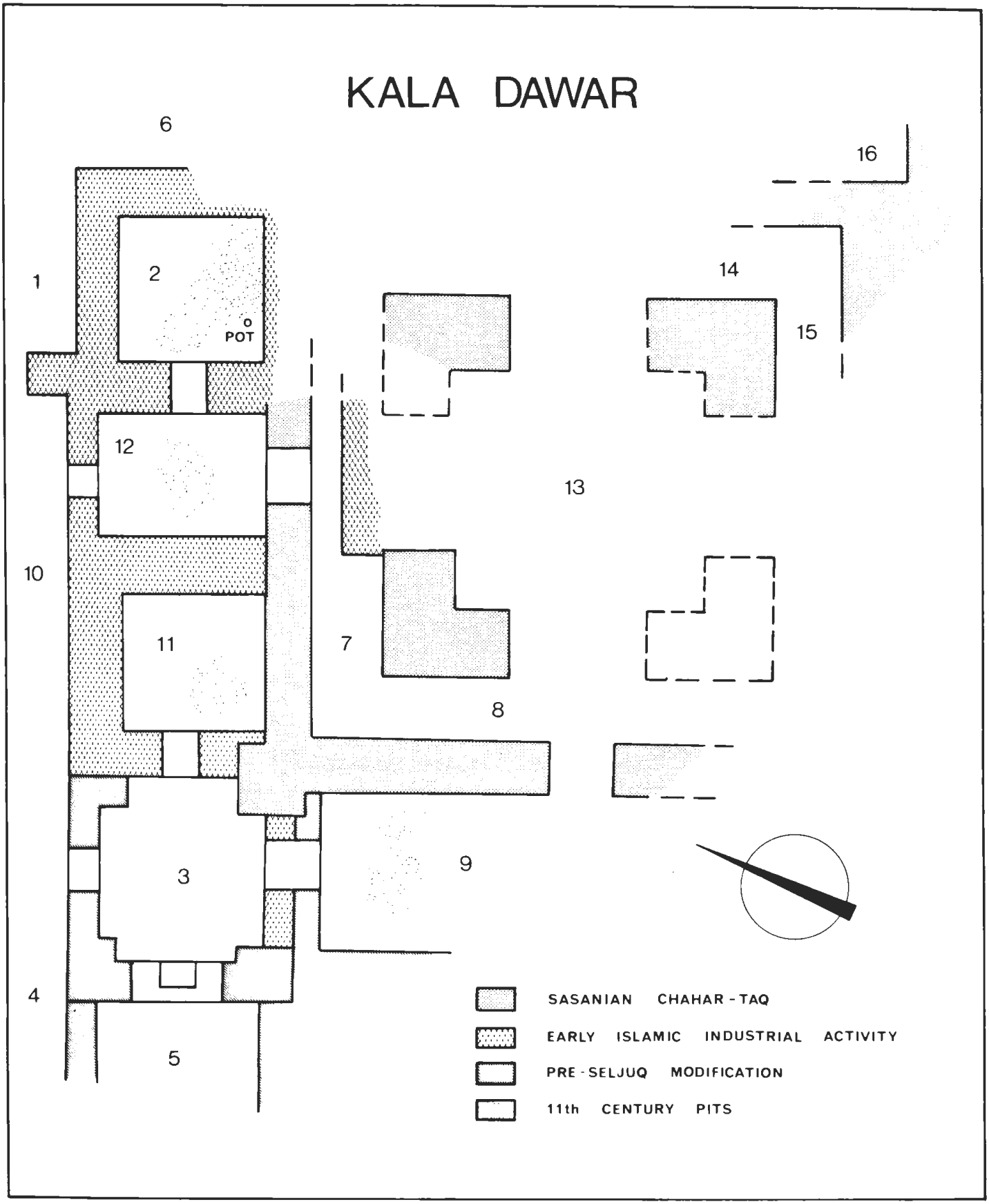


Fig. 5. Kala Dawar: chahar taq *site plan.*

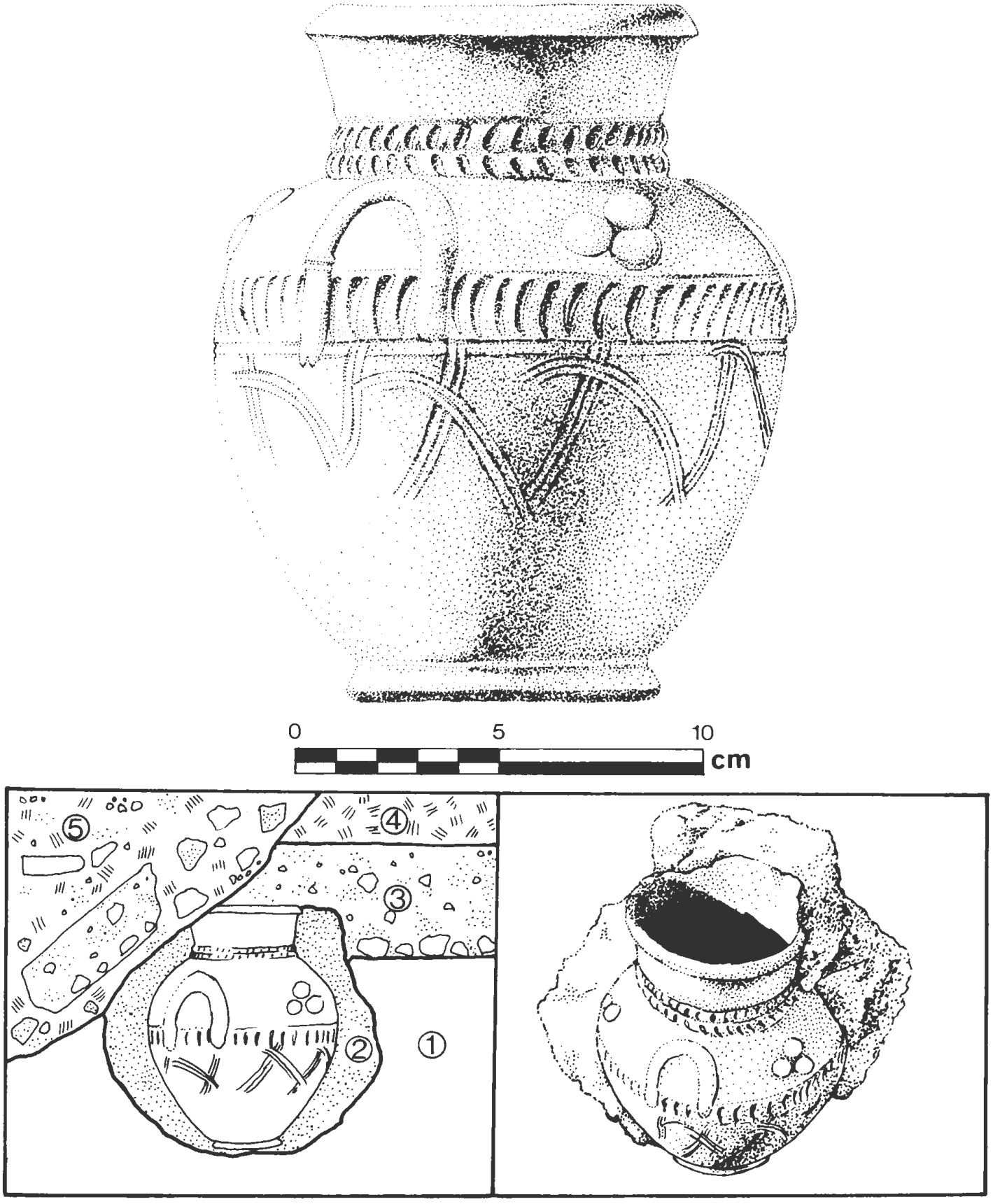


Fig. 6. Glazed jar (Kala Dawar, QY78.51) shown embedded below floor (stratum 3) at side of pit (stratum 5).

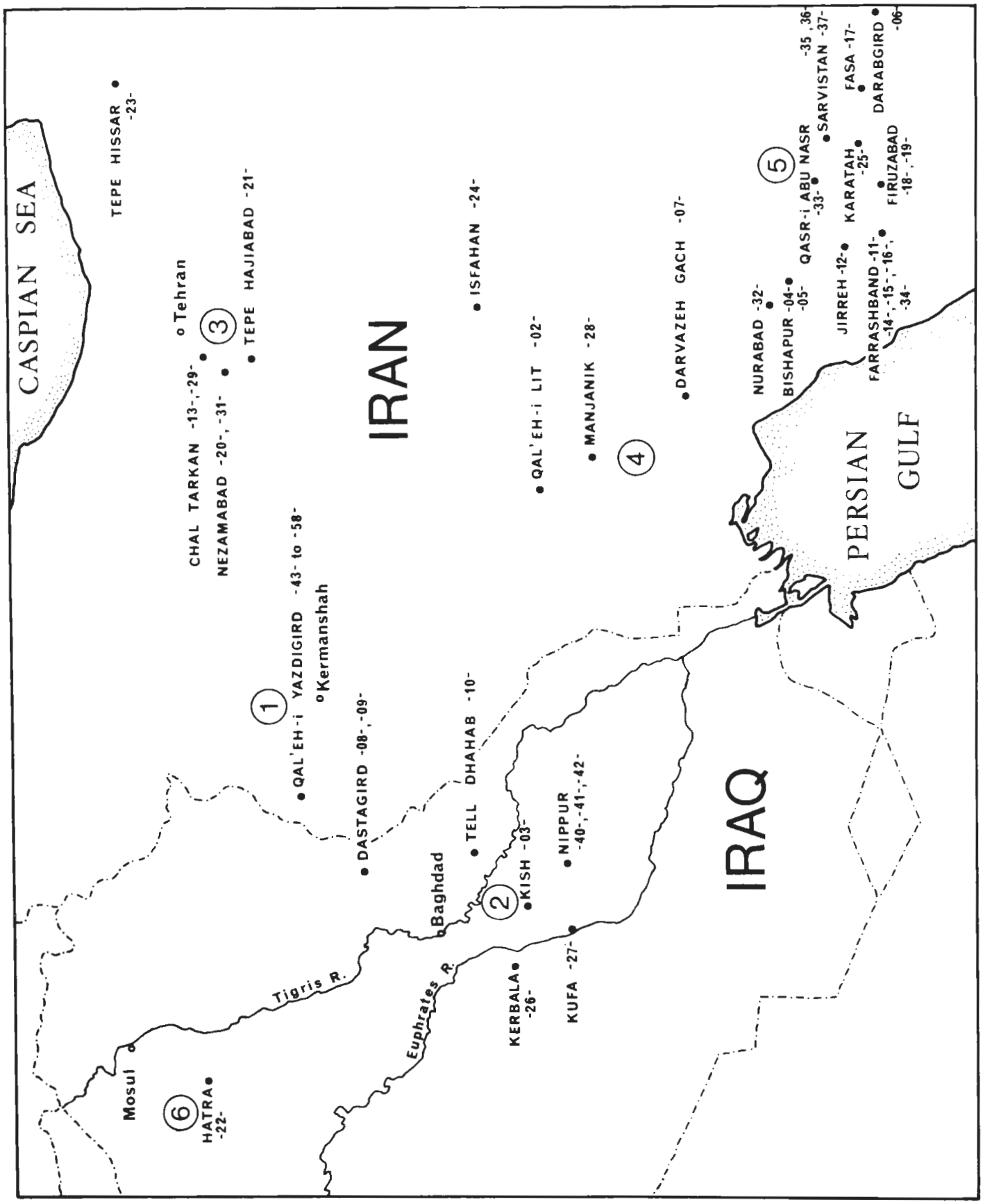


Fig. 7. Map of sites surveyed (by region and site).

treatment to larger sub-groups of categories, there are too many unweighted judgements for a computer programme to suggest meaningful patterns.

For practical purposes, to permit the data from the surveys to be applied on a comparative basis to the Yazdigird corpus, the sites were assigned to six regions (cf. map, Fig. 7), as follows. The names by which, for ease of reference, the regions are designated throughout the text were selected for fairly obvious physical geographical reasons, and in part, of course, they actually reflect the old Abbasid administrative districts.

Hatra (site no. 22) stands on its own in northern Iraq, giving its name to region 6.

Fars, region 5, provided sherds from seventeen sites, including the city (no. 4) and the Qal'eh-i Dukhtar (no. 5) at Bishapur,[5] and the " Ateshgah " palace (no. 18) and Qal'eh-i Dukhtar (no. 19) at Firuzabad.[6] In the plain of Farrashband,[7] sherding was carried out at Tell-i Jangi (no. 11); Jirreh (no. 12), a *chahar taq* site; Qal'eh-i Naqsh-i Bahram (no. 14), a fortress adjacent to the Sasanian rock relief; Tepe Pahn o Pahn (no. 15); Tepe Shahid (no. 16); and Sar Meshad (no. 34). Other sites included in the Fars region are Darabgird (no. 6), the Parthian round city;[8] Qal'eh-i Gabri (no. 17), a mountaintop fortress near Fasa;[9] Karatah (no. 25), a *chahar taq* site east of Maimand;[10] Qasr-i Abu Nasr (no. 33), the pre-Islamic settlement of Shiraz;[11] and two sites at Sarvistan, Tell-i Puk (no. 36) and Tell-i Sang-i Siah (no. 37), as well as the palace itself (no. 35), once thought to be Sasanian and now presumed Islamic.[12]

Region 4 consists of four sites in Khuzistan which, because they are all in the foothills of the Zagros, may more meaningfully be described as *Elymais*. The sites are Tell-i Badr (no. 2), a Parthian terrace platform adjacent to Qal'eh-i Lit, east of the Karun;[13] Gach Darwazeh (no. 7), recorded by Stein;[14] Tepe Manjanik (no. 28) near Izeh/Malamir; and Nurabad (no. 32) with its famous stone tower, west of Kazerun.[15]

Jibal, region 3, covers the area from Isfahan to Damghan. It includes Tepe Alvijan (no. 1); Tepe Eshqabad (no. 13)[16] and Tepe Mil (no. 29),[17] both near Chal Tarkhan south of Rayy; two mounds in the vicinity of Veramin—Gorg Tepe (no. 20) and Tepe Nezamabad (no. 31) near the village of the same name; Tepe Hajiabad (no. 21), forty-five kilometres south of Tehran on the road to Qom; Tepe Hissar (no. 23), site of the Sasanian palace;[18] the " Ateshgah " of Isfahan (no. 24);[19] and Tepe Muval (no. 30) and Tepe Yussefabad (no. 38), both of no outstanding fame.

Numerical ordering of sites with potsherds illustrated in Figs. 8-28

Site no.	*Name*	*Region*		*Site no.*	*Name*	*Region*	
01	Tepe Alvijan	Jibal	(3)	24	Isfahan: Ateshgah	Jibal	(3)
02	Qal'eh-i Lit: Tell-i Badr	Elymais	(4)	25	Karatah	Fars	(5)
03	Kish: Tell Barghuthiat	Diyala	(2)	26	Kerbala: unnamed site	Diyala	(2)
04	Bishapur	Fars	(5)	27	Kufa: Dar al-Imara	Diyala	(2)
05	Bishapur: Qal'eh-i Dukhtar	Fars	(5)	28	Manjanik (Izeh)	Elymais	(4)
06	Darabgird	Fars	(5)	29	Chal Tarkhan: Tepe Mil	Jibal	(3)
07	Gach Darvazeh	Elymais	(4)	30	Tepe Muval	Jibal	(3)
08	Dastagird	Diyala	(2)	31	Tepe Nezamabad	Jibal	(3)
09	Dastagird: Tell Dhuab	Diyala	(2)	32	Nurabad	Elymais	(4)
10	Tell Dhahab	Diyala	(2)	33	Qasr-i Abu Nasr	Fars	(5)
11	Farrashband: Tell-i Jangi	Fars	(5)	34	Farrashband: Sar Meshad	Fars	(5)
12	Farrashband: Jirreh	Fars	(5)	35	Sarvistan	Fars	(5)
13	Chal Tarkhan: Tepe Eshqabad	Jibal	(3)	36	Sarvistan: Tell-i Puk	Fars	(5)
14	Farrashband: Qal'eh-i Naqsh-i Bahram	Fars	(5)	37	Sarvistan: Tell-i Sang-i Siah	Fars	(5)
15	Farrashband: Tepe Pahn o Pahn	Fars	(5)	38	Tepe Yussefabad	Jibal	(3)
16	Farrashband: Tepe Shahid	Fars	(5)	43	Qal'eh-i Yazdigird: Zendan		(1)
17	Fars: Qal'eh-i Gabri	Fars	(5)	44	Qal'eh-i Yazdigird: Ashpaz Gah		(1)
18	Firuzabad: Ateshgah	Fars	(5)	46	Qal'eh-i Yazdigird: Gach Gumbad		(1)
19	Firuzabad: Qal'eh-i Dukhtar	Fars	(5)	48	Qal'eh-i Yazdigird: Maydan		(1)
20	Nezamabad: Gorg Tepe	Jibal	(3)	49	Qal'eh-i Yazdigird: Tepe Rash		(1)
21	Tepe Hajiabad	Jibal	(3)	50	Qal'eh-i Yazdigird: Qoli Darras		(1)
22	Hatra		(6)	55	Qal'eh-i Yazdigird: Upper Castle		(1)
23	Tepe Hissar	Jibal	(3)	58	Qal'eh-i Yazdigird: Kala Dawar		(1)

* *All sherd drawings have site numbers listed in small print*

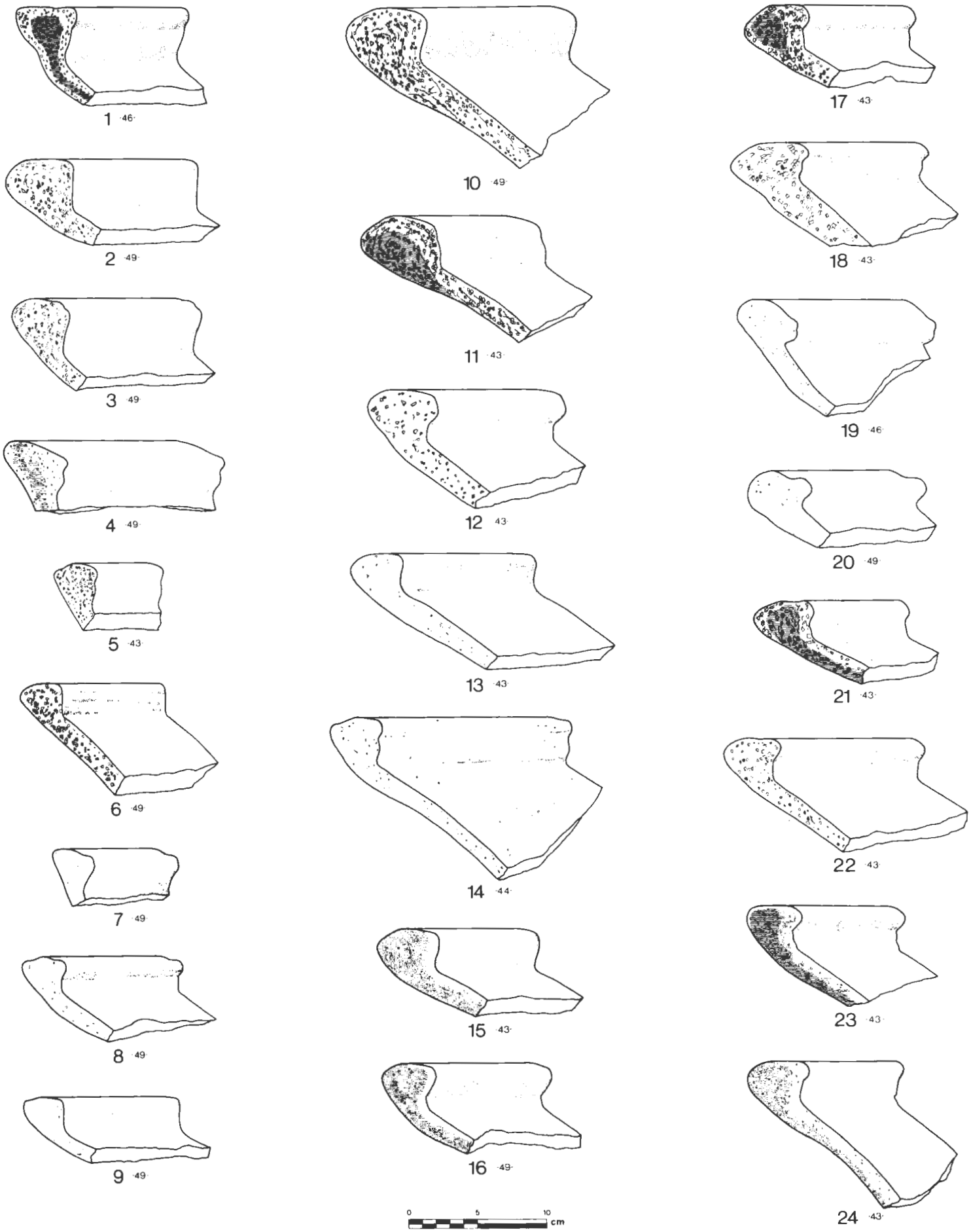


Fig. 8. Rims of storage vessels (heavy rimmed jars) to show minor profile variations of same type of vessel from Qal'eh-i Yazdigird.

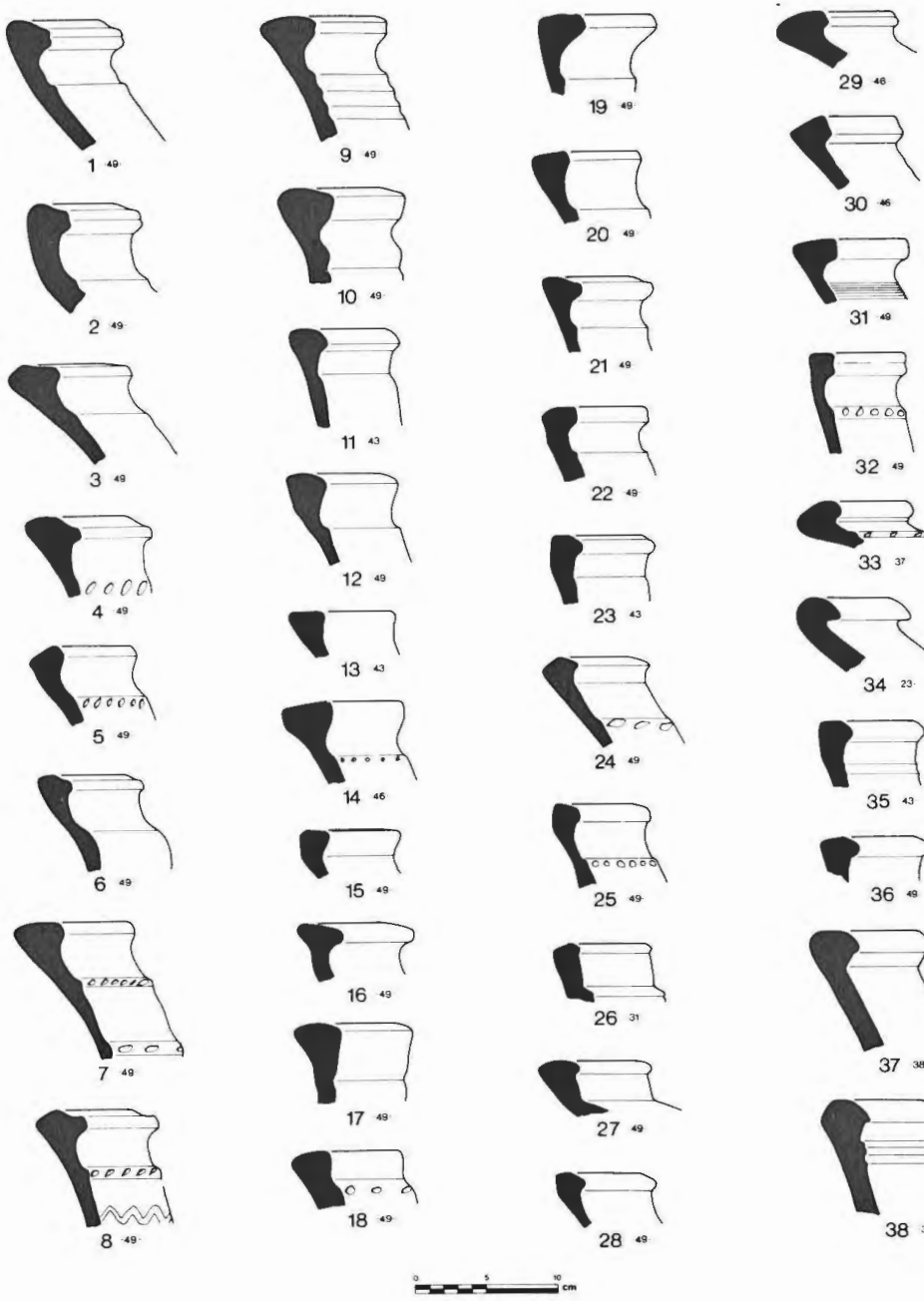


Fig. 9. Heavy rimmed jars.

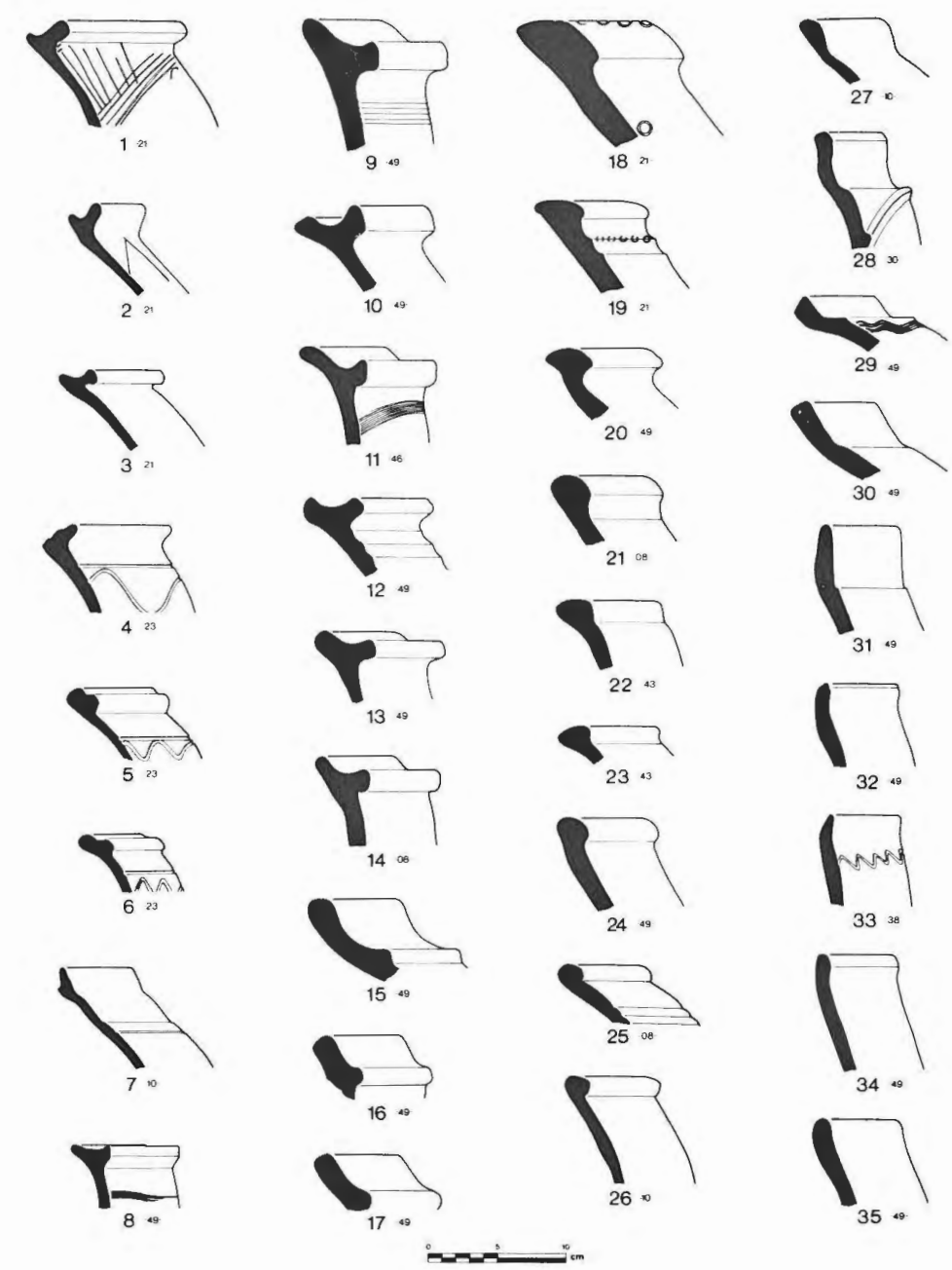


Fig. 10. Closed mouth jars.

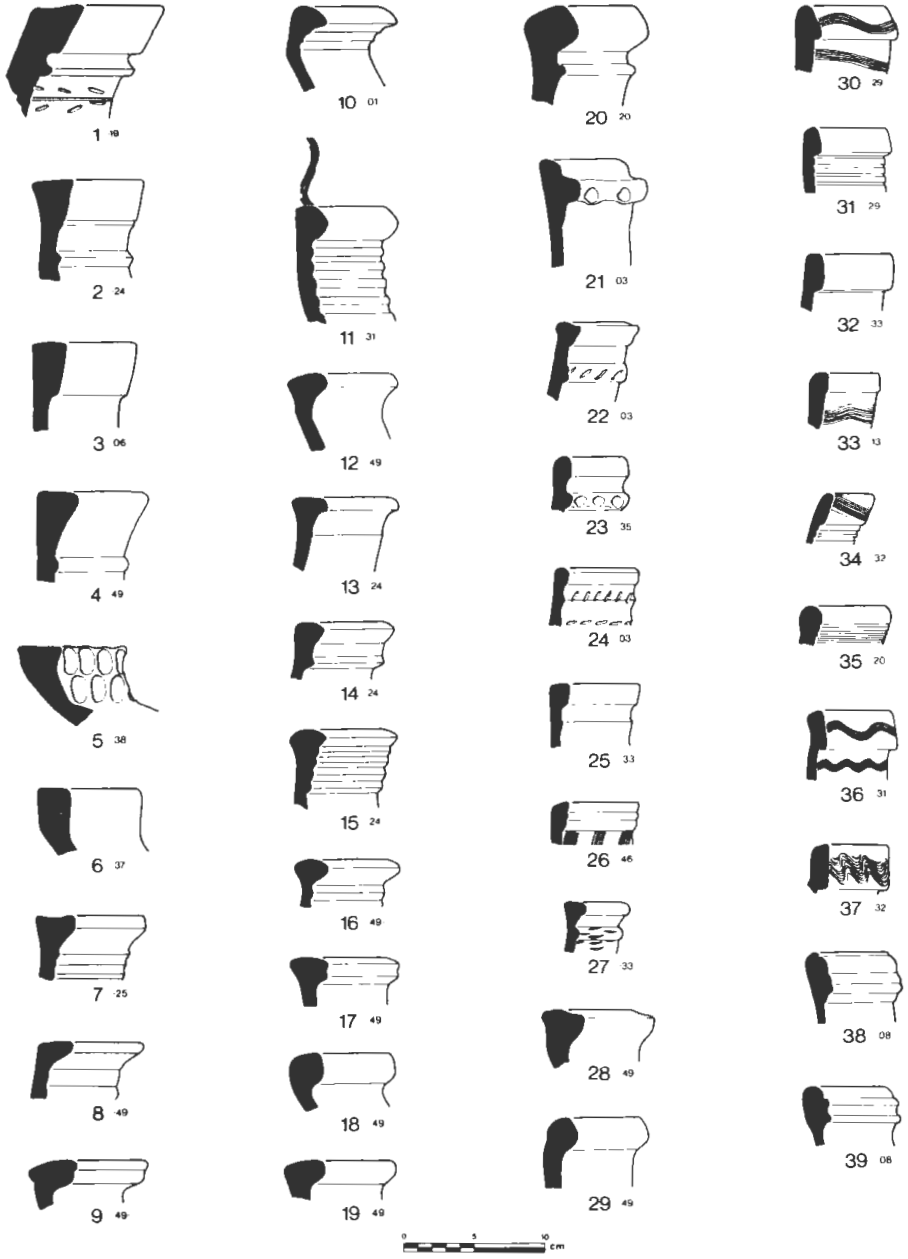


Fig. 11. Heavy rimmed jars.

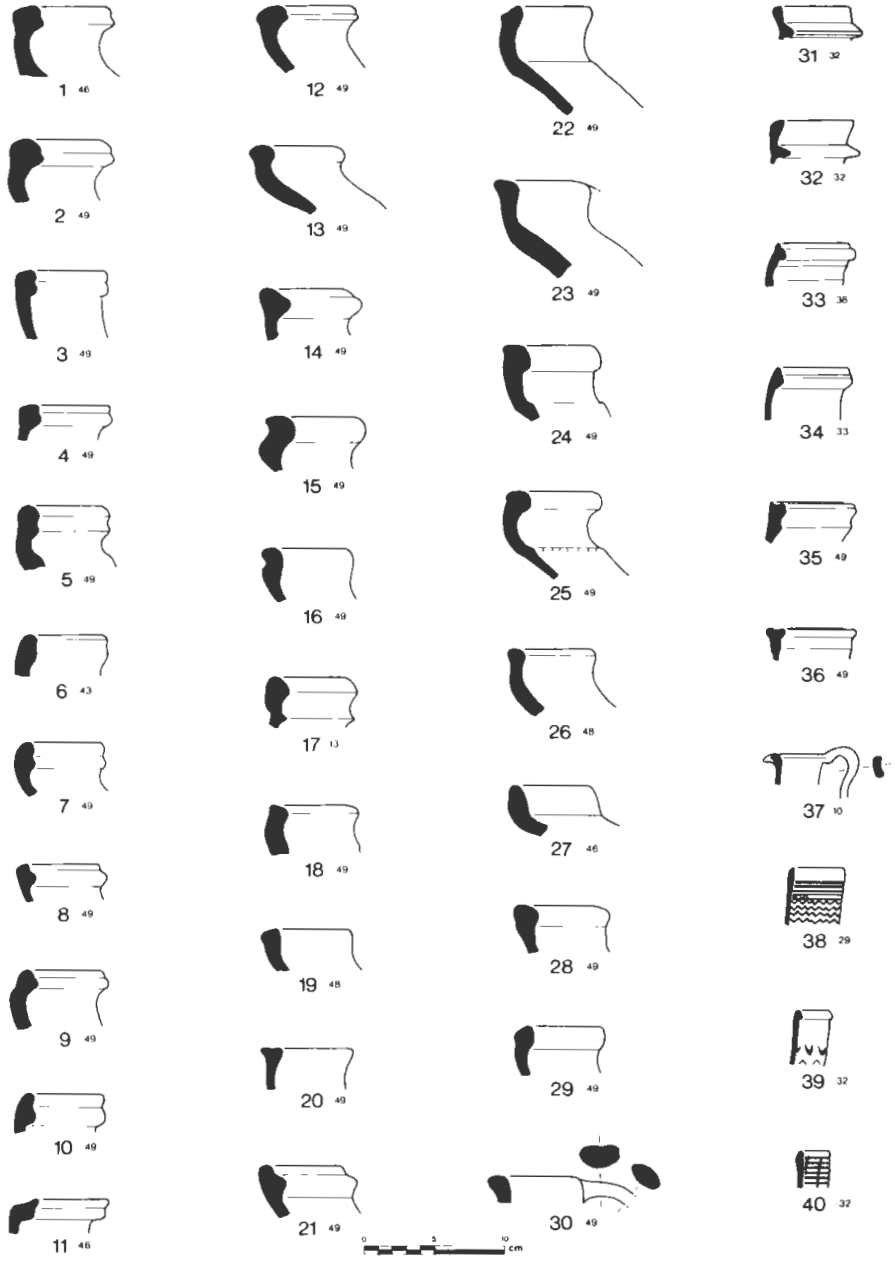


Fig. 12. Squat jars; pitchers and jugs.

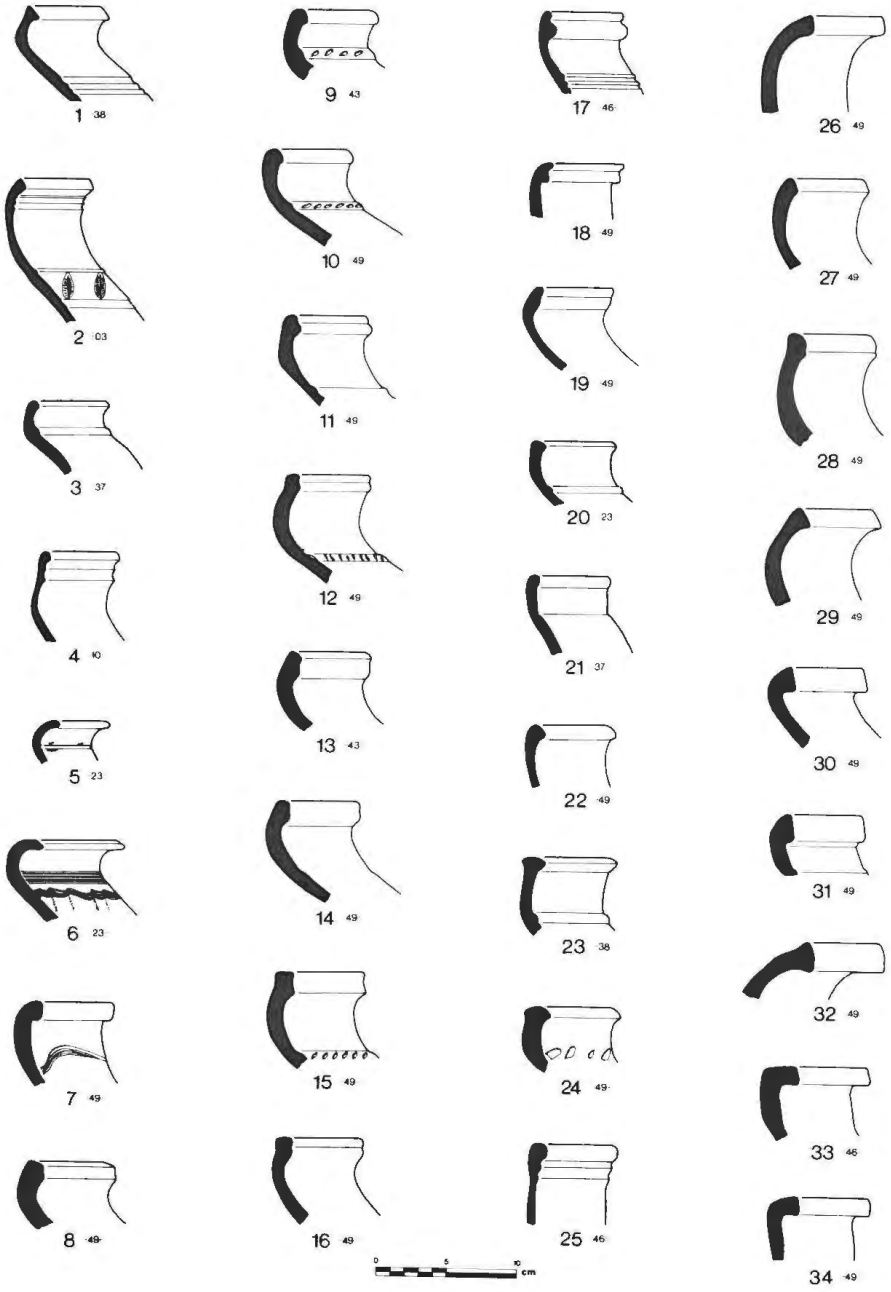


Fig. 13. Squat jars.

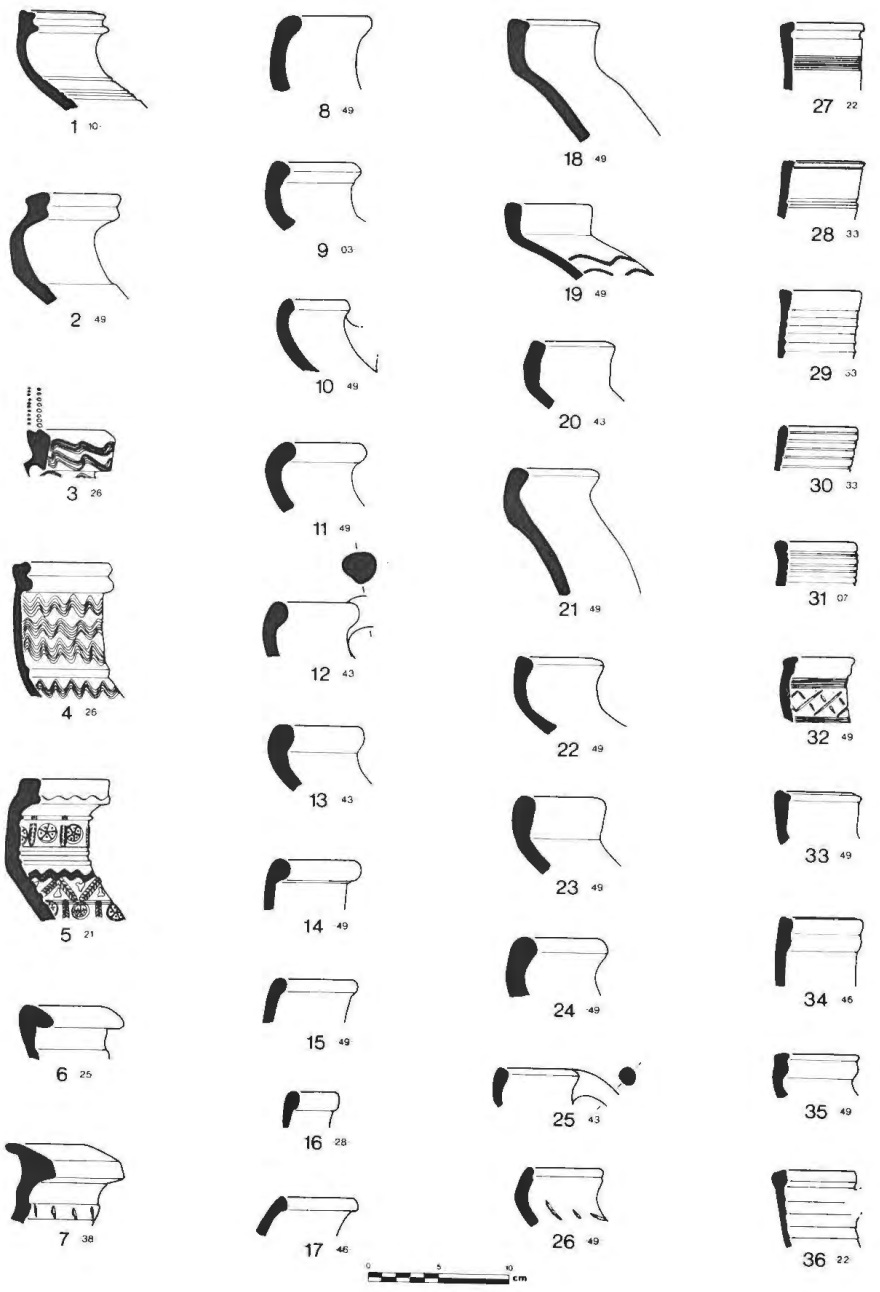


Fig. 14. Funnel necked jars.

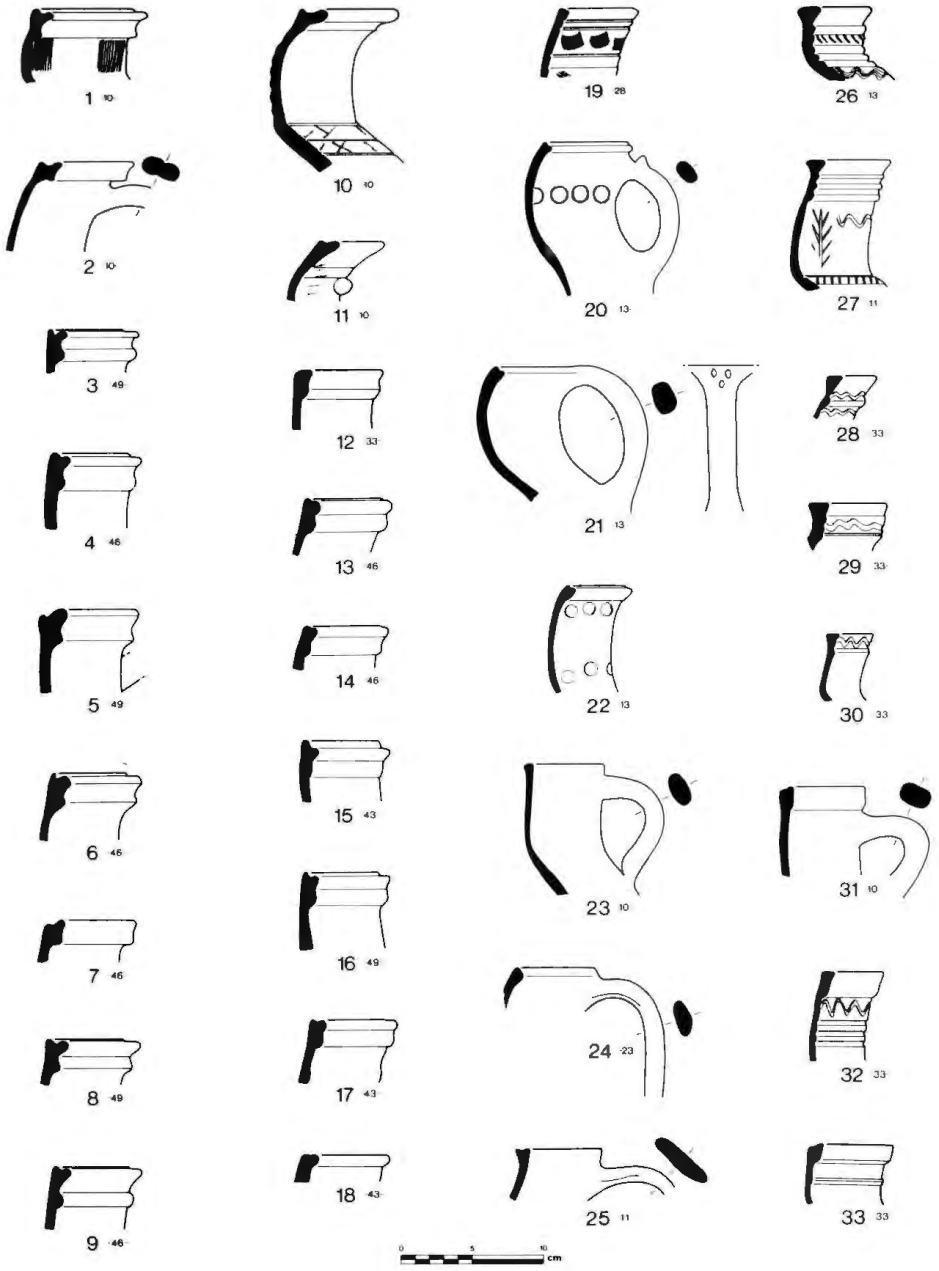


Fig. 15. Funnel necked jars.

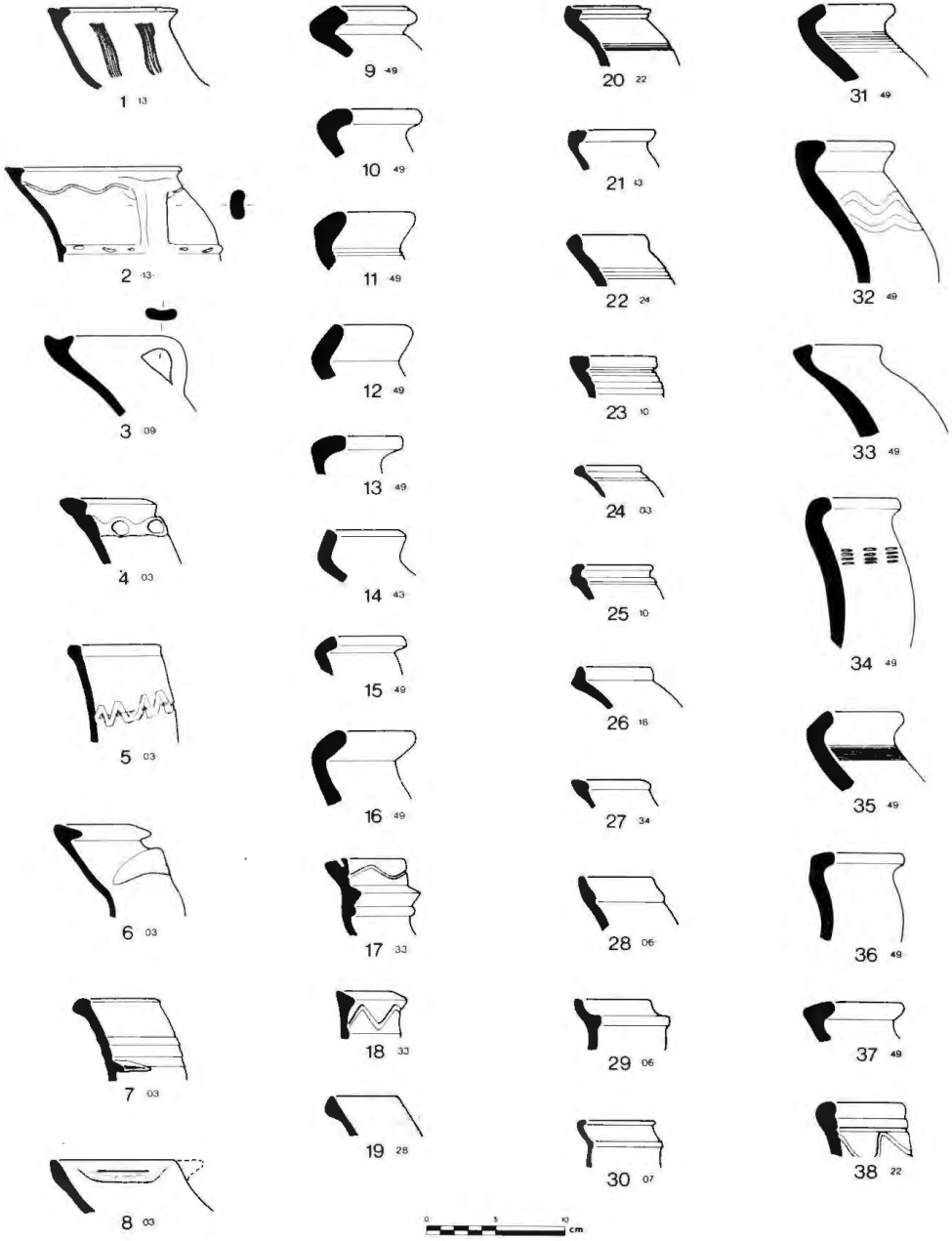


Fig. 16. Funnel necked jars; squat jars; closed mouth jars.

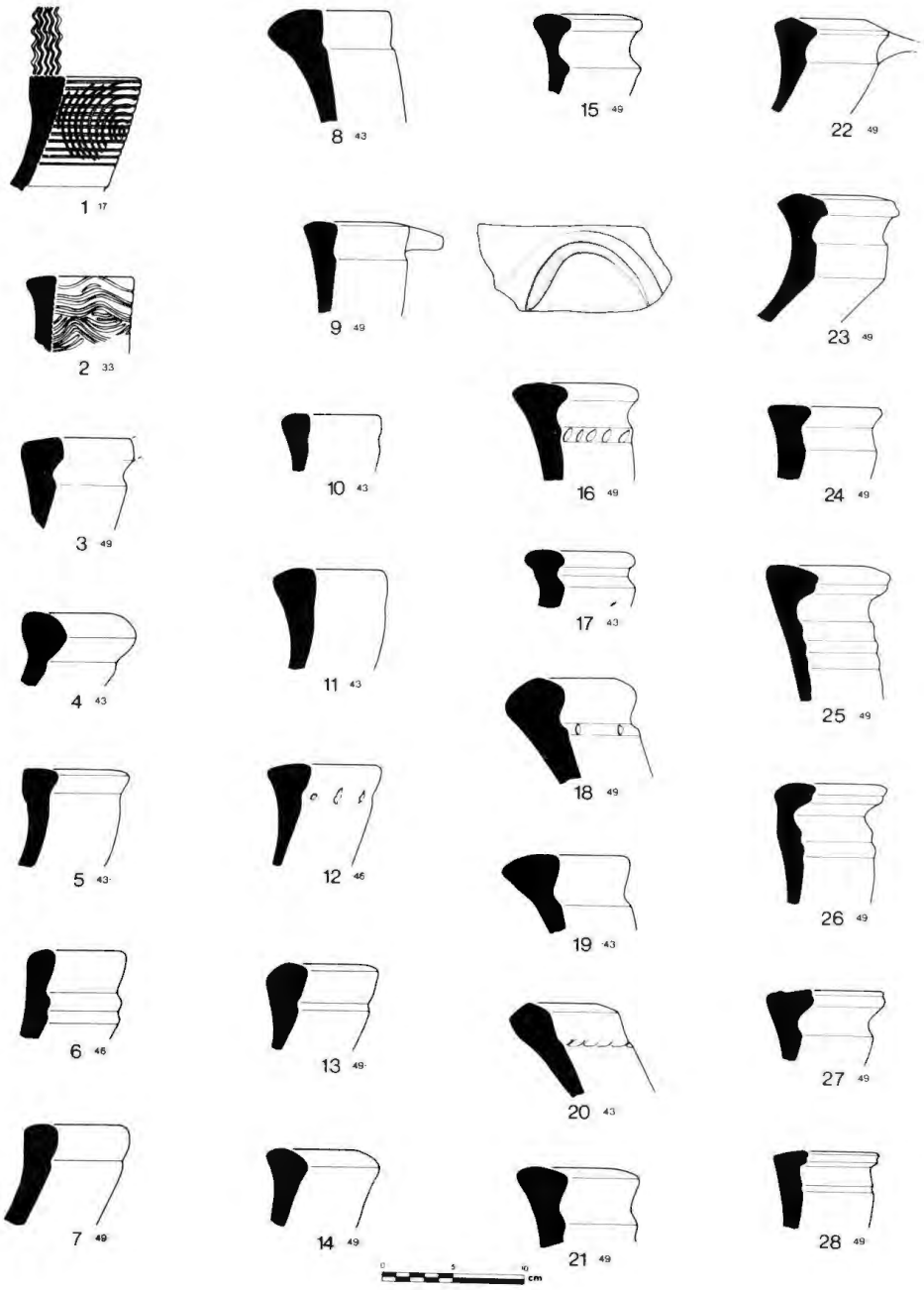


Fig. 17. Thick rimmed basins.

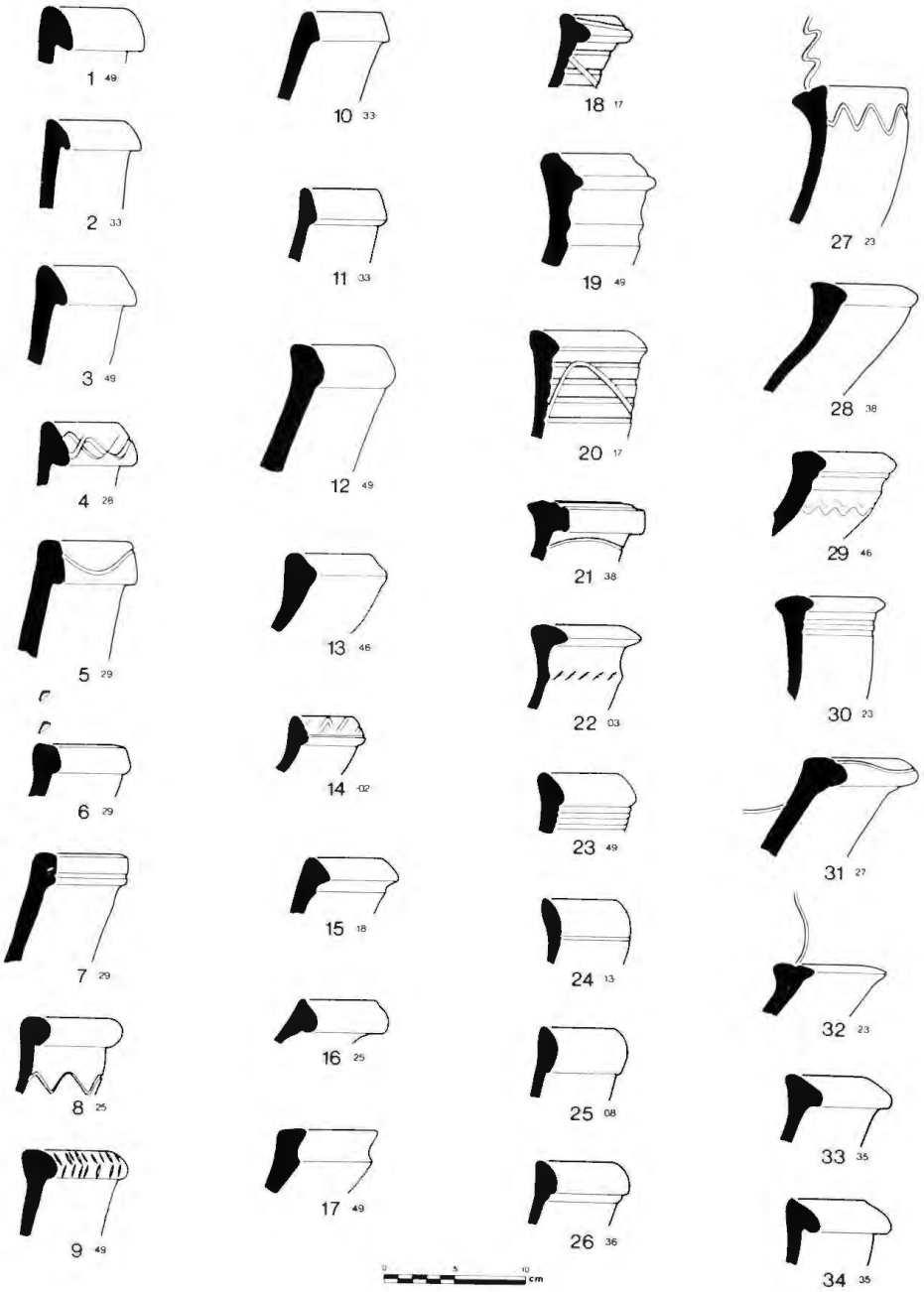


Fig. 18. Thick rimmed basins.

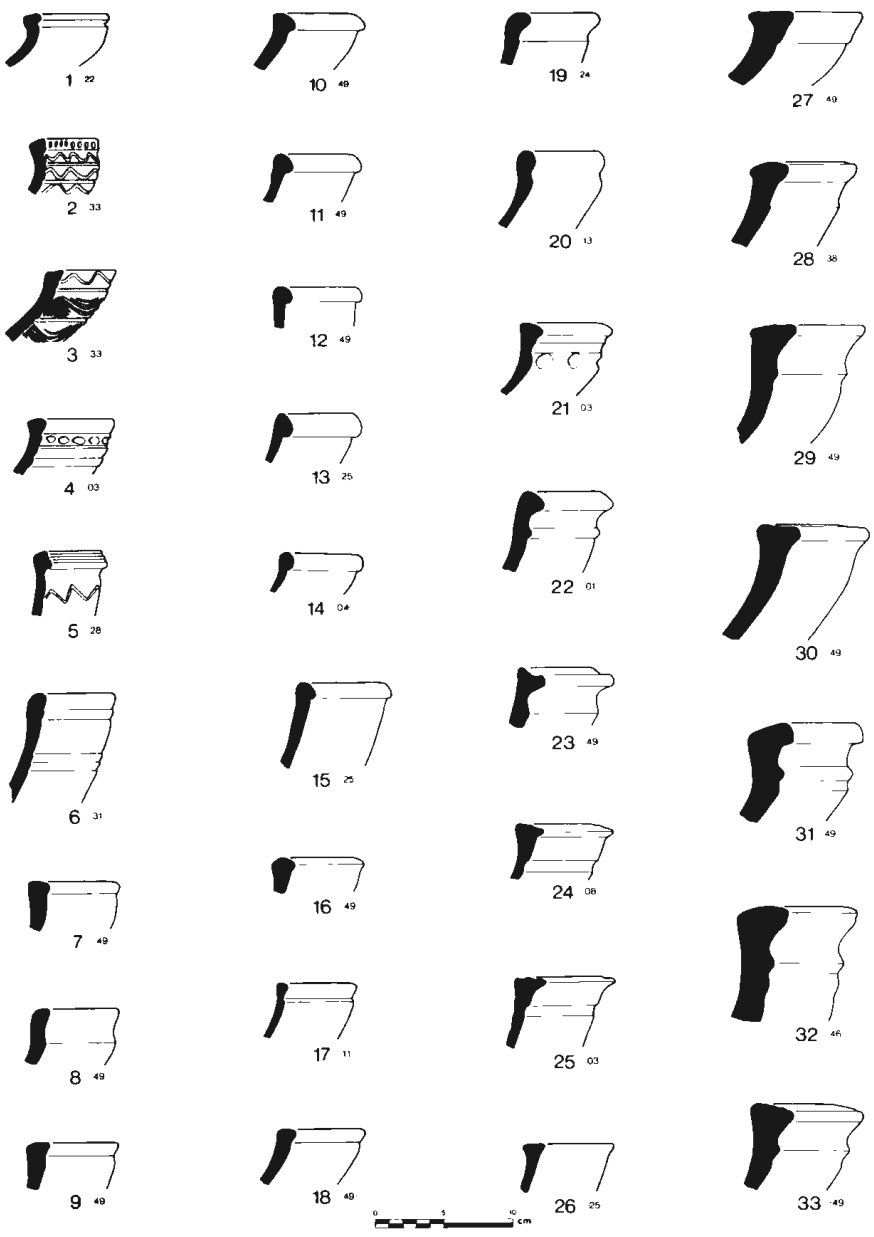


Fig. 19. Bowls.

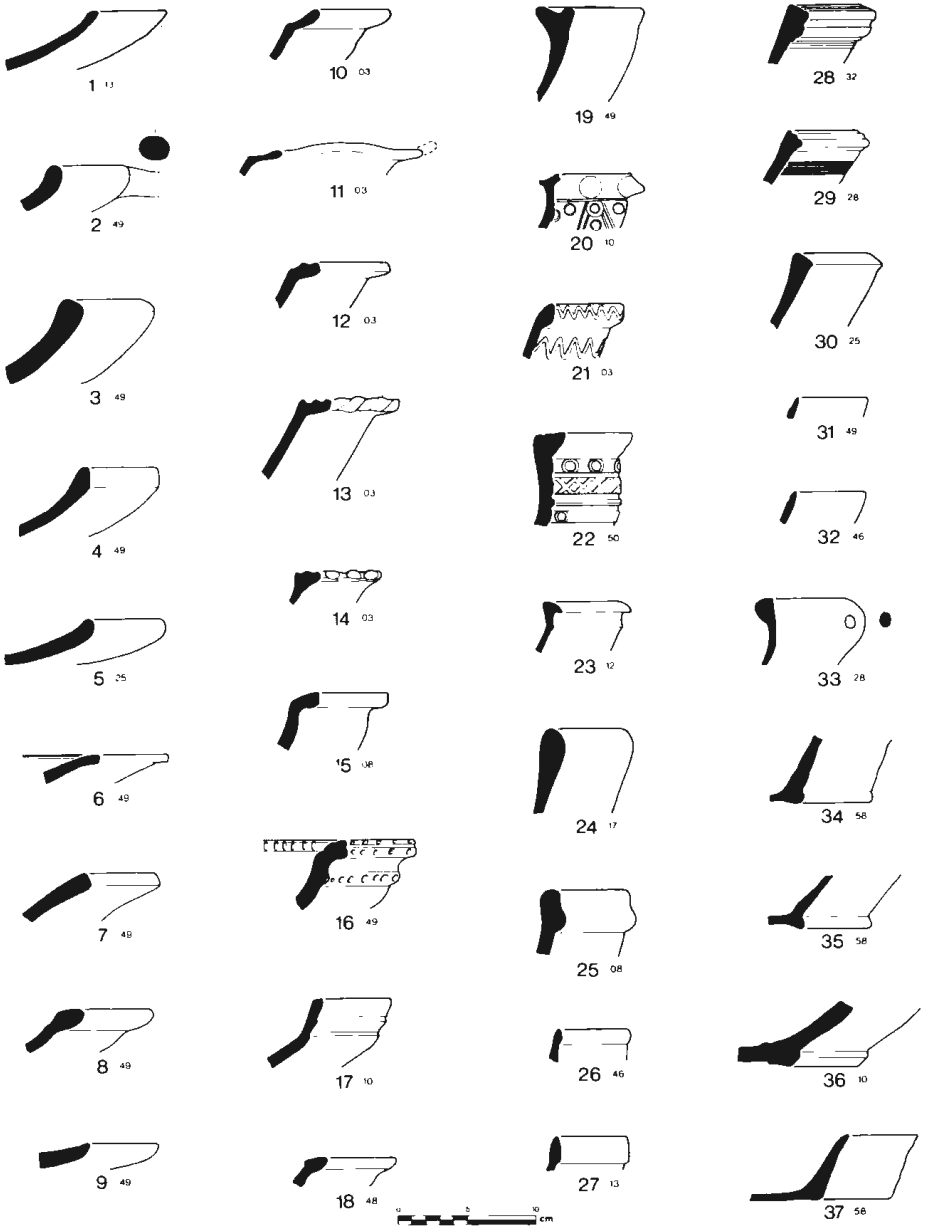


Fig. 20. Bowls; cups; bases.

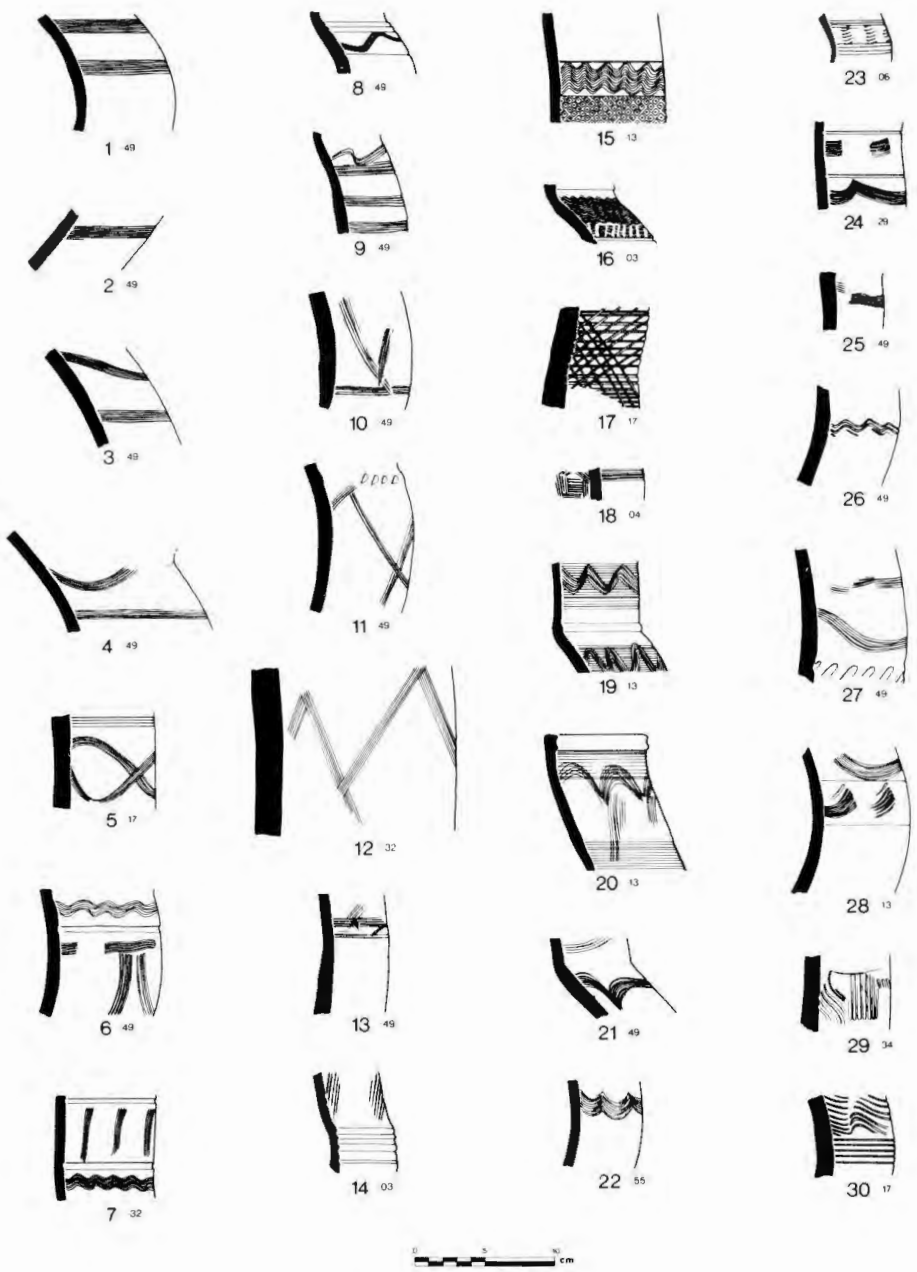


Fig. 21. Combed decoration.

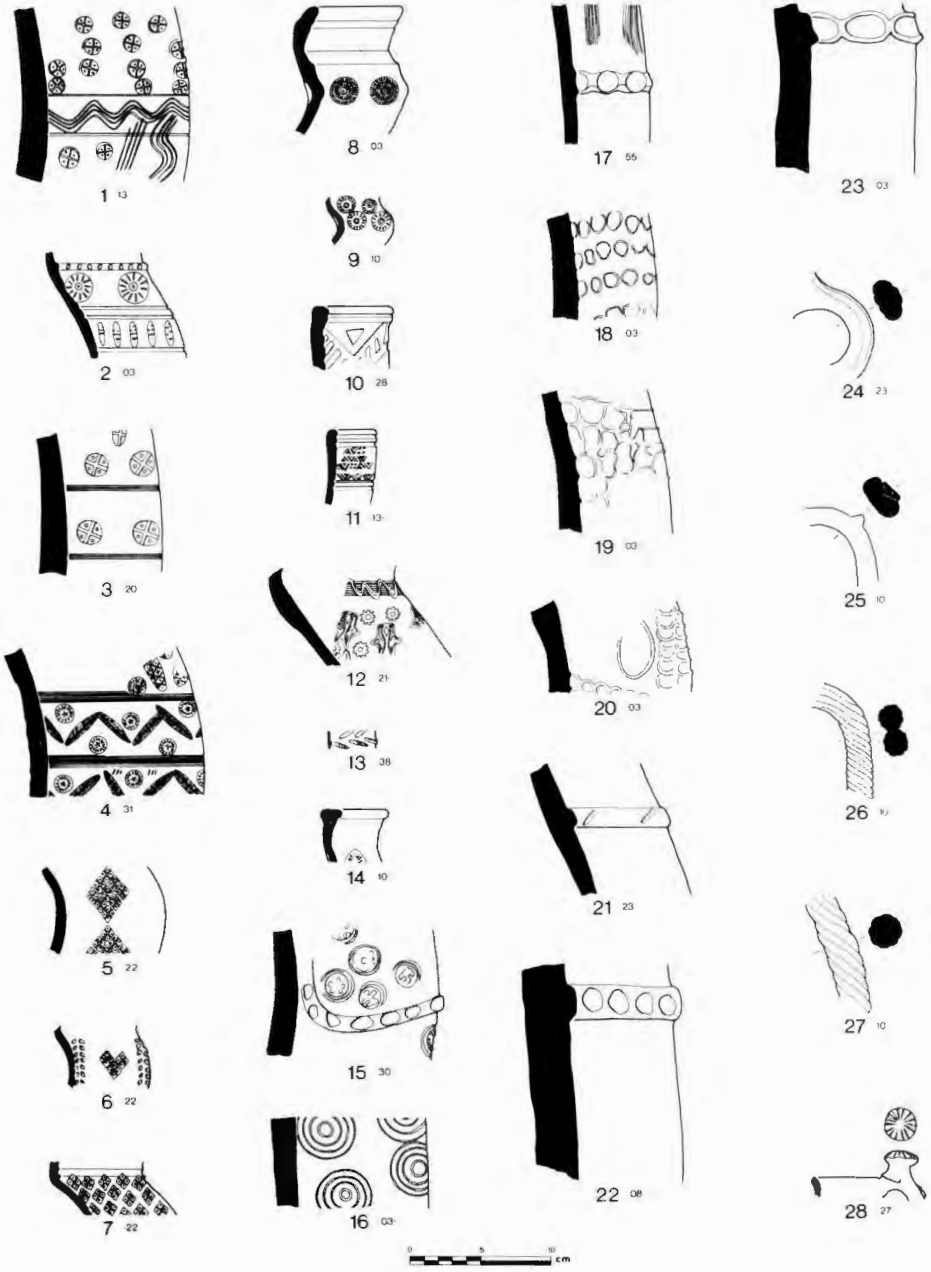


Fig. 22. Stamped, appliquéd and ribbed decoration; handles.

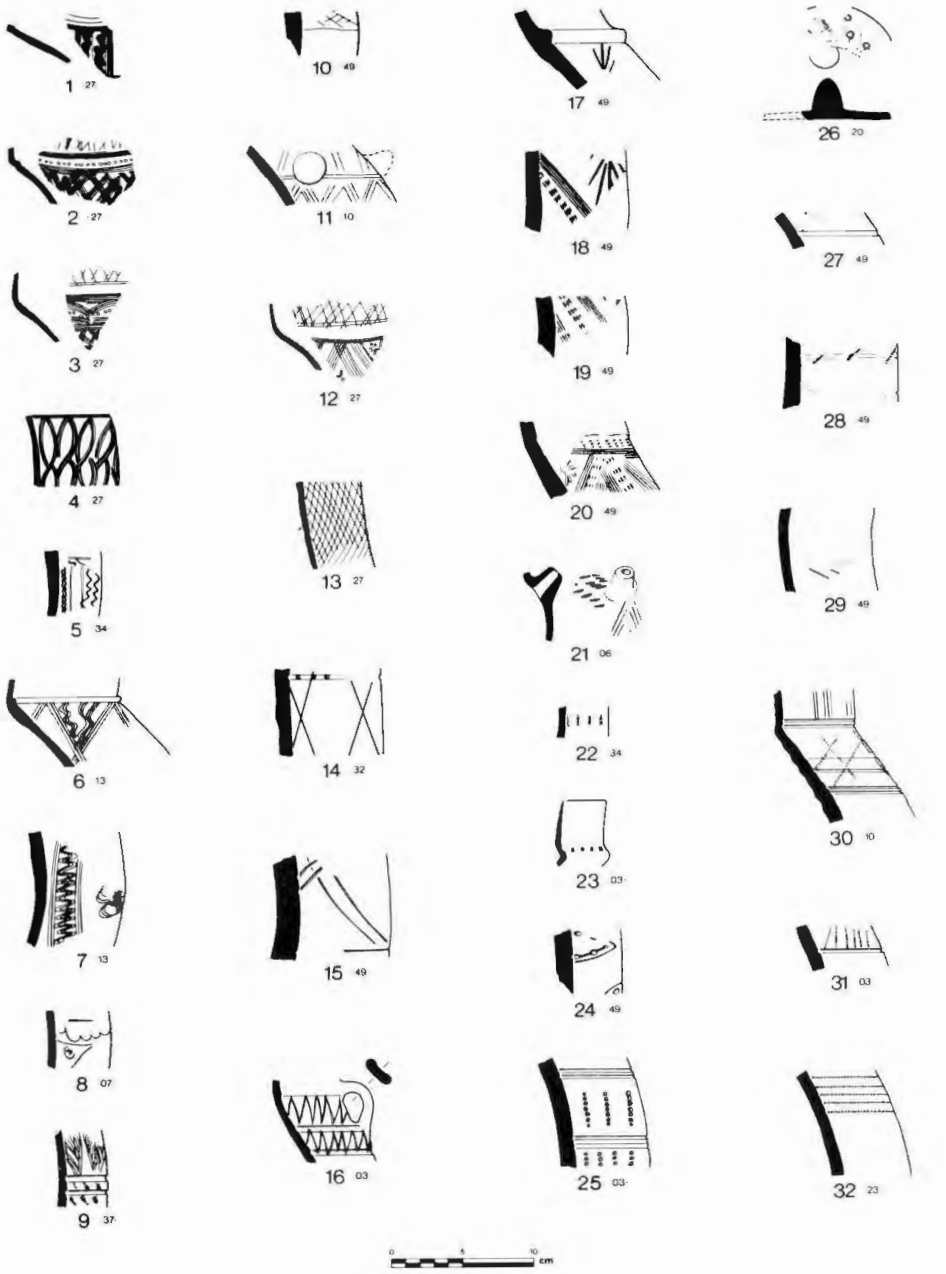


Fig. 23. Forked and scratched decoration.

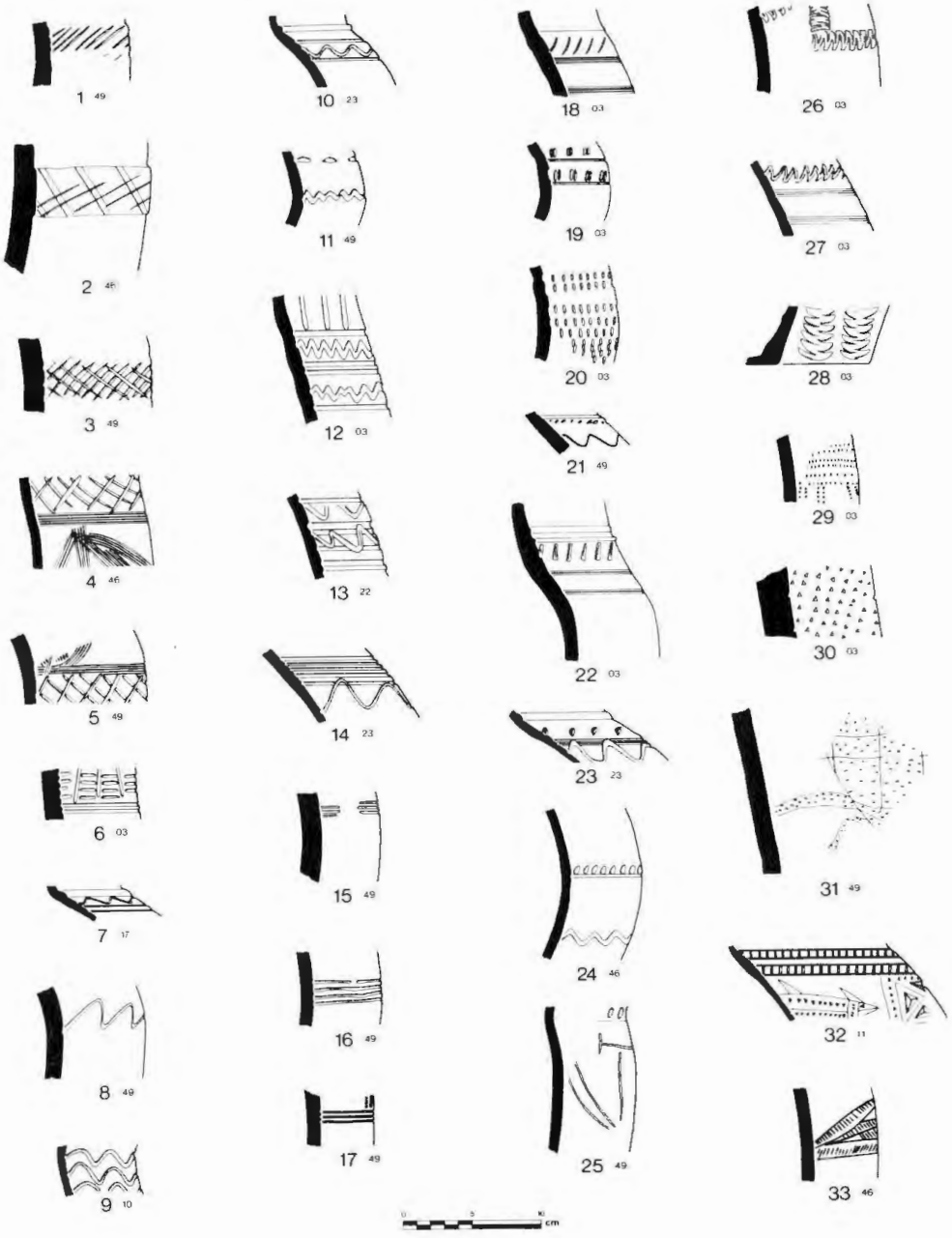


Fig. 24. Impressed decoration.

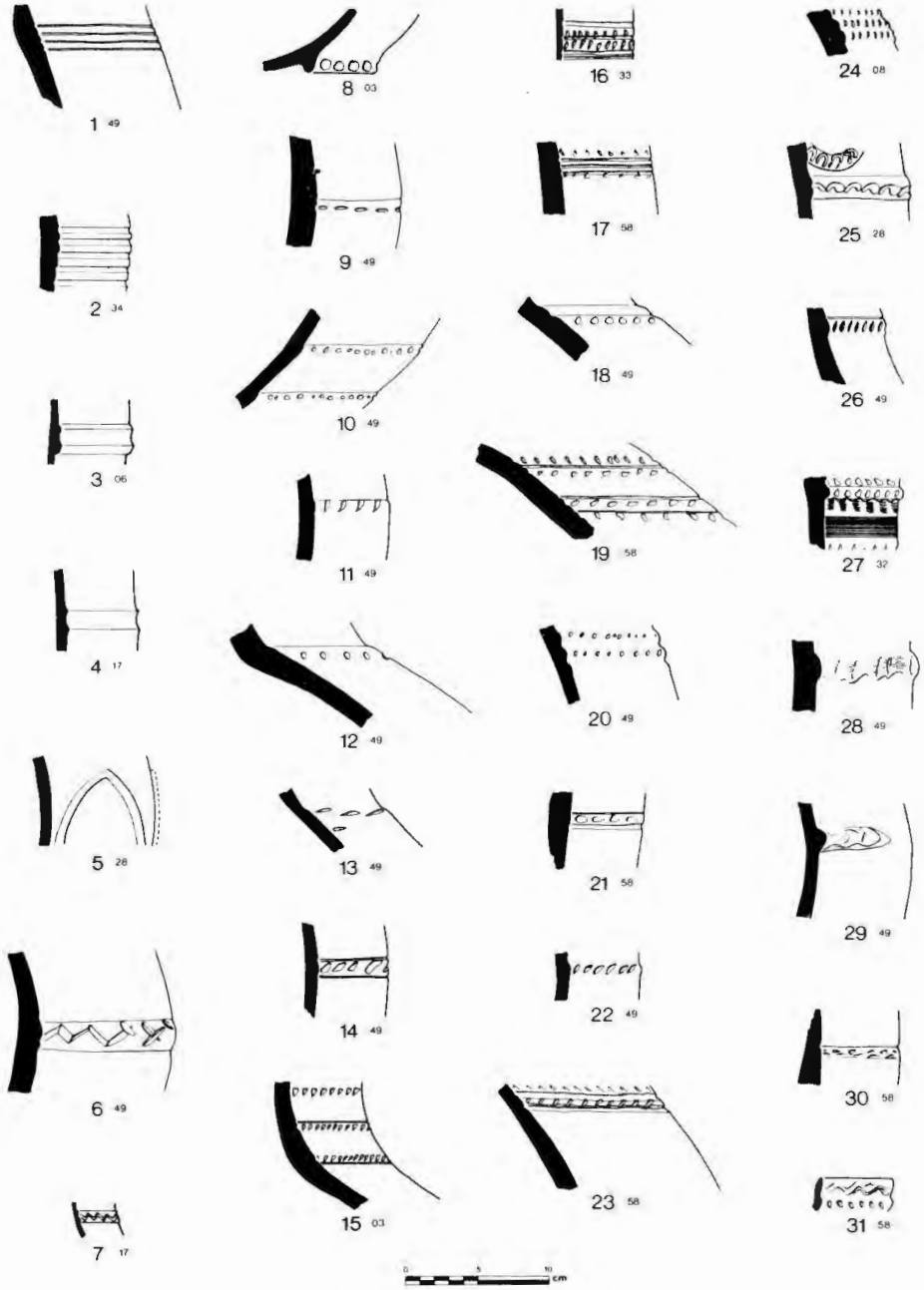


Fig. 25. Grooved and impressed decoration.

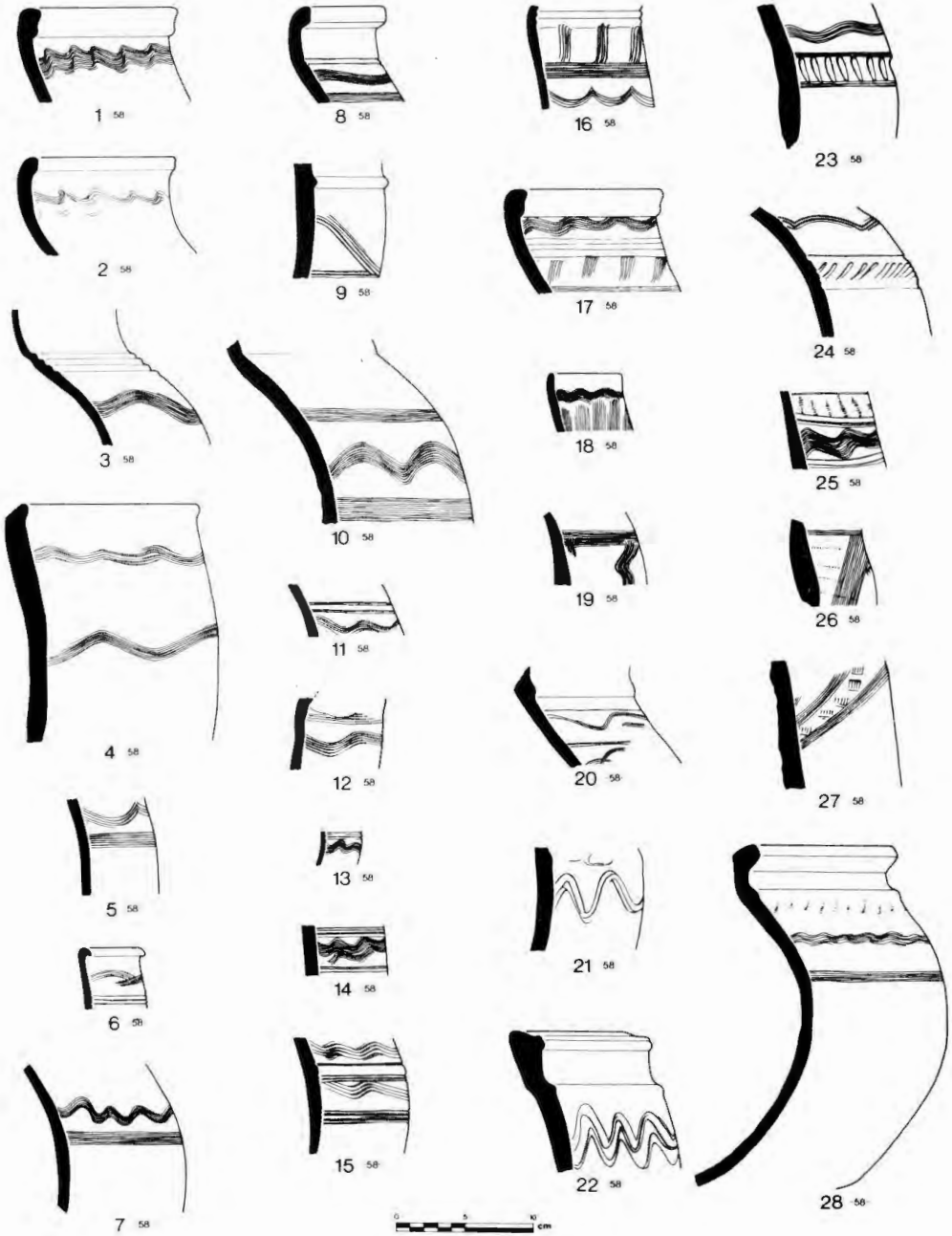


Fig. 26. Combed decoration (Kala Dawar).

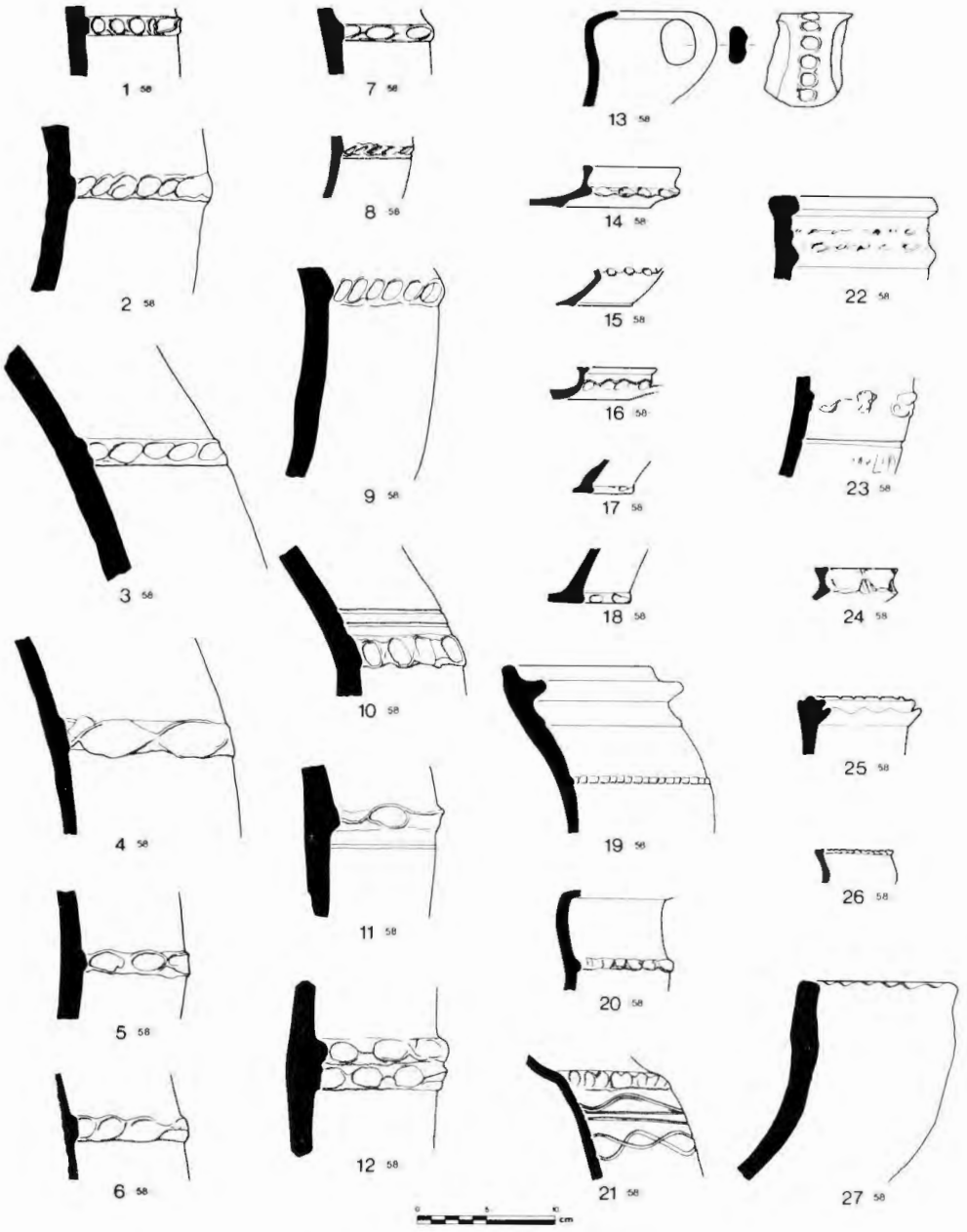


Fig. 27. Ribbed decoration (Kala Dawar).

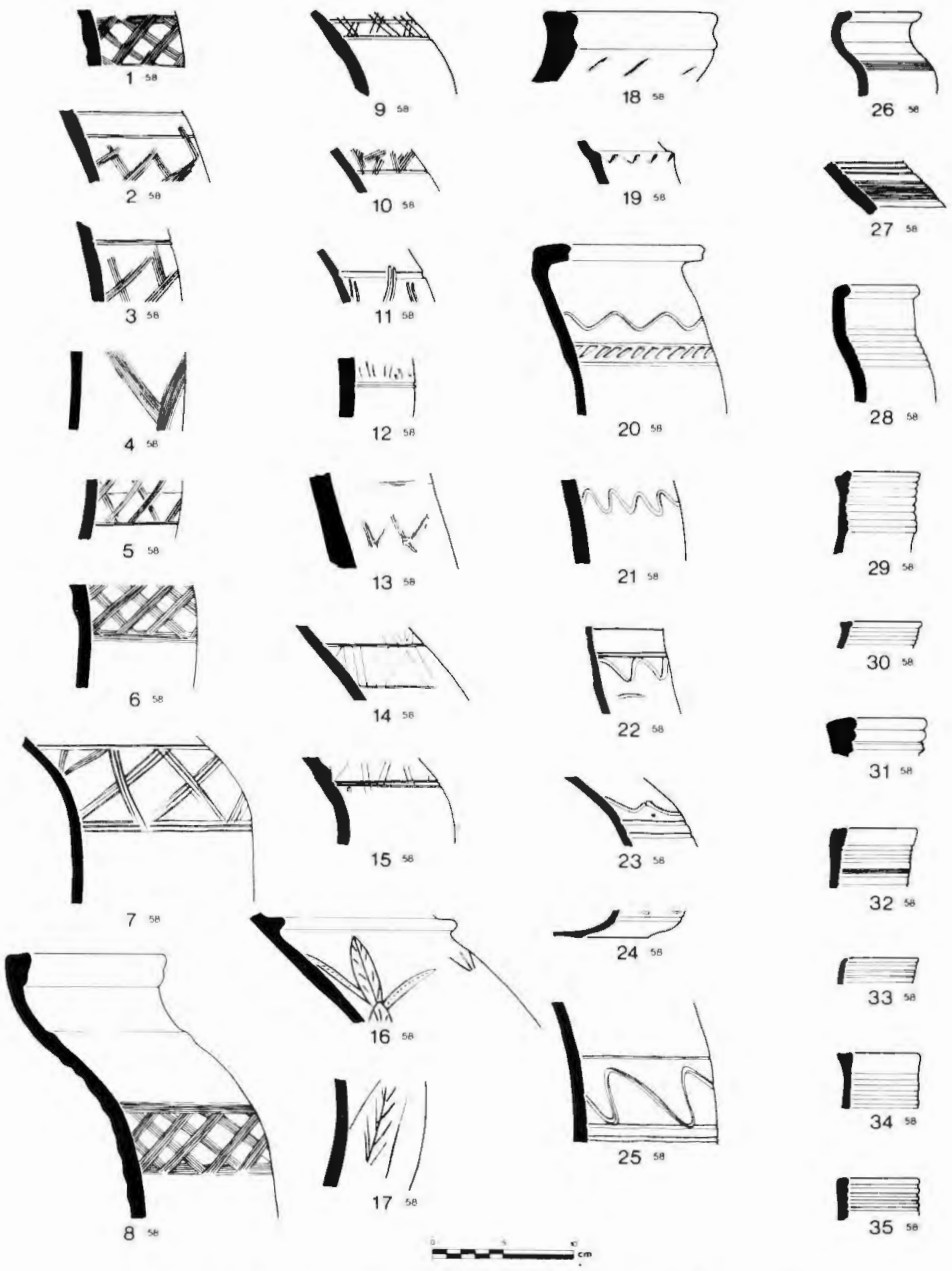


Fig. 28. Combed, scratched and grooved decoration (Kala Dawar).

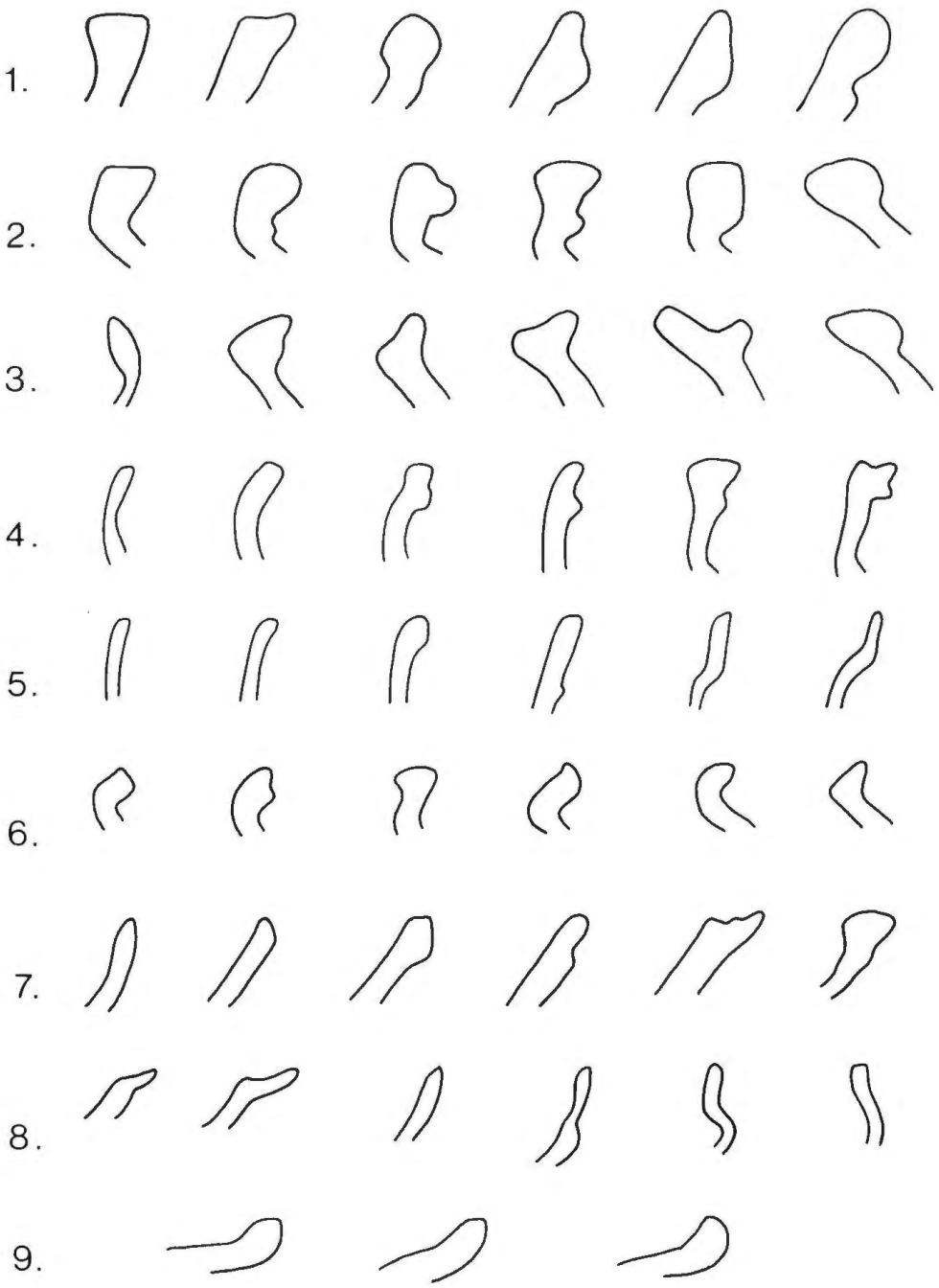


Fig. 29. Rim types (simplified):
(1) thick-rimmed basins; (2) heavy-rimmed jars; (3) closed-mouth jars; (4) funnel-necked jars; (5) pitchers and jugs; (6) squat jars; (7) bowls; (8) cups; (9) plates.

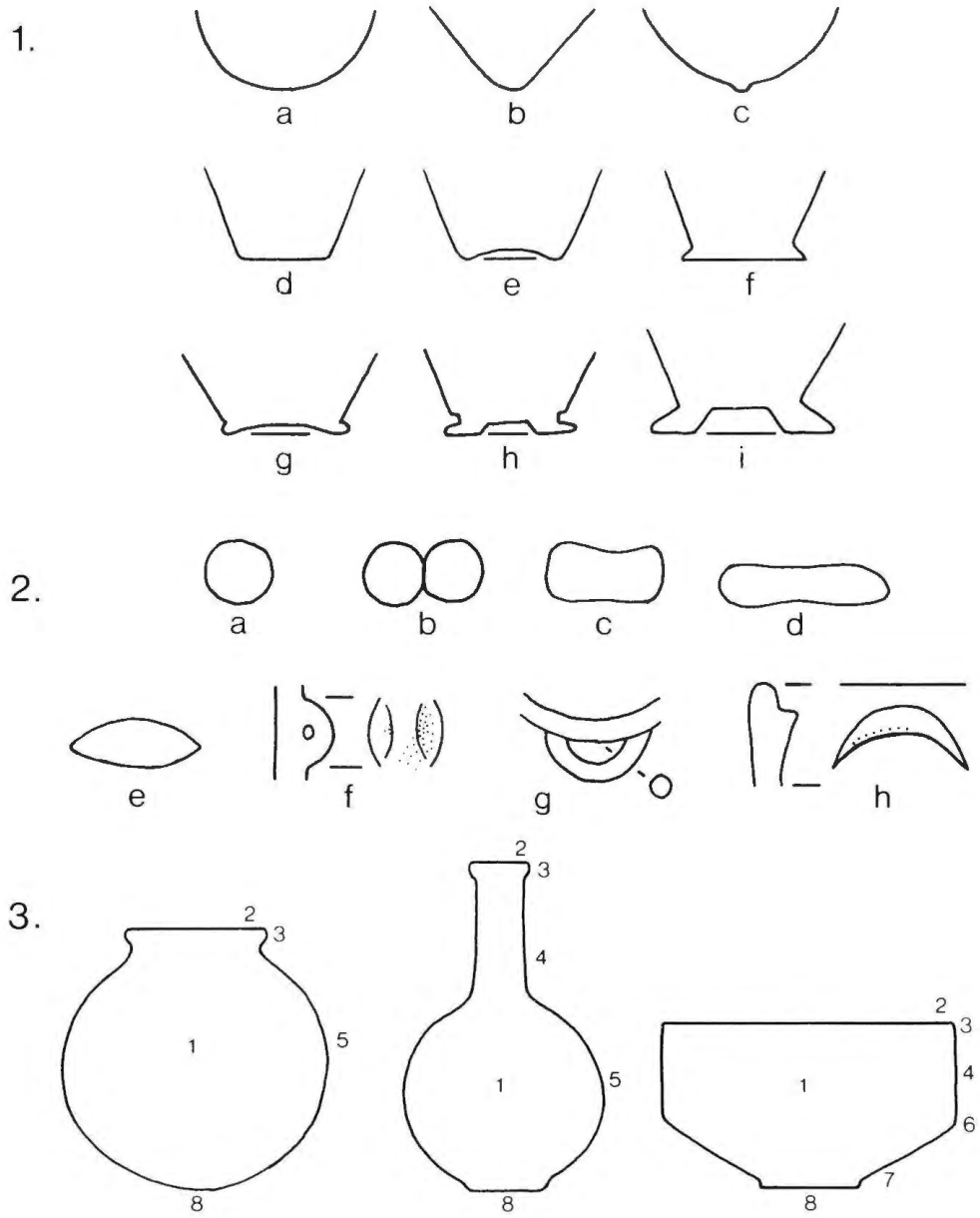


Fig. 30. Base and handle types:
(1a) round; (b) pointed; (c) nipple; (d) flat; (e) concave flat; (f) disk; (g) concave disk; (h) ring foot; (i) high foot. (2a) single strand; (b) double strand; (c) square strap; (d) wide strap; (e) oval; (f) lug; (g) ring; (h) blind loop.

Body profile:
(1) inside; (2) rim top; (3) outside rim; (4) neck; (5) body; (6) carination; (7) belly; (8) base.

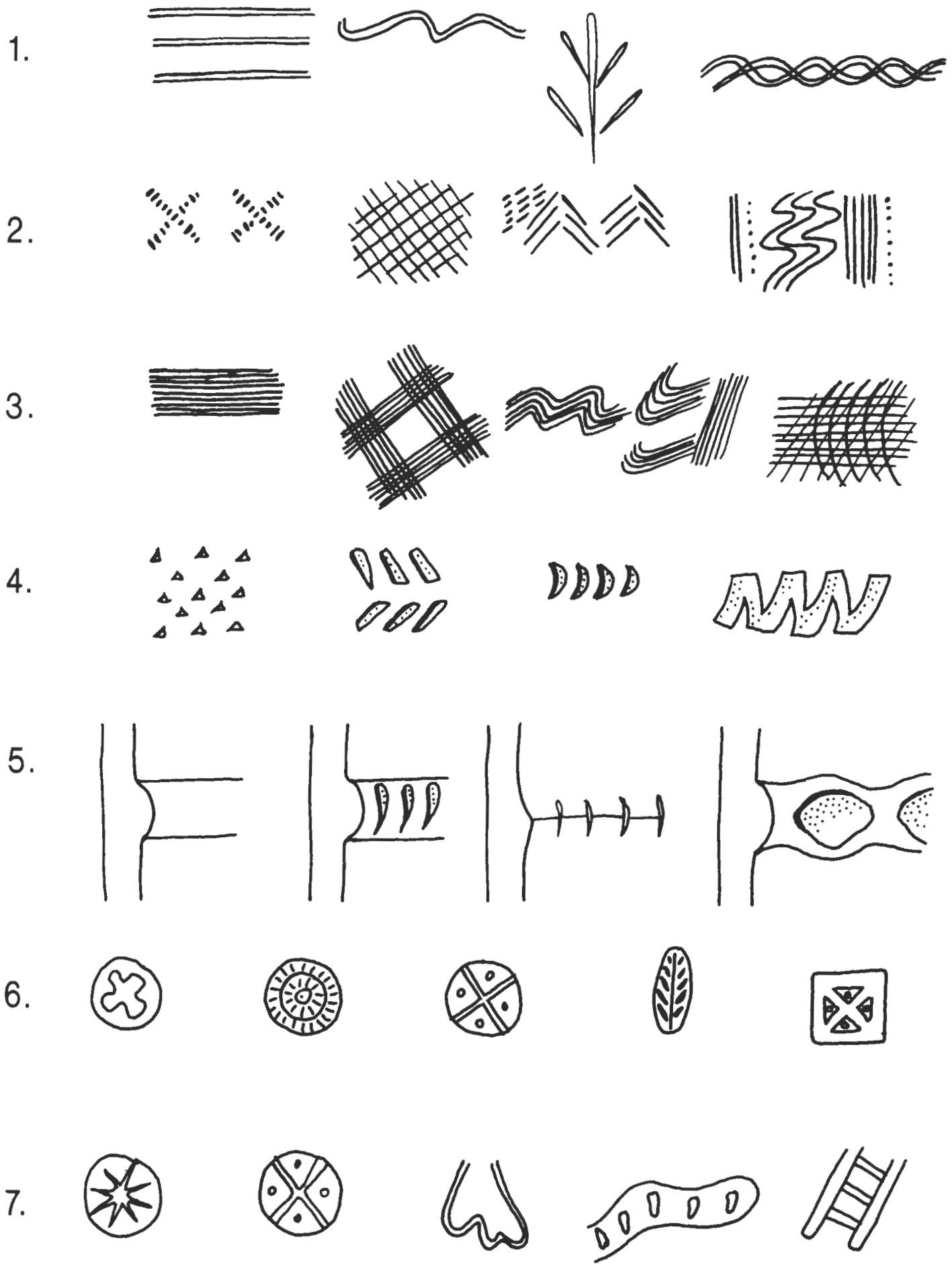


Fig. 31. Decoration types (simplified):
(1) grooved; (2) forked and scratched; (3) combed; (4) pinched and impressed; (5) ribbed; (6) stamped; (7) appliquéd.

The *Diyala*, region 2, is comprised of Tell Barghuthiat (no. 3), the Parthian/Sasanian mound at Kish;[20] Dastigird (no. 8), normally associated with being the capital of Chosroes II Parvez;[21] Tell Dhuab (no. 9), a small mound near Dastigird; Tell Dhahab (no. 10) near Humainiyeh; a nameless site (no. 26) fourteen kilometres north of Kerbela; and the Dar al-Imara at Kufa (no. 27), the site of an Ummayad governor's residence.[22]

Finally, *Yazdigird*, region 1, comprises the material collected on survey in the Zardeh basin of Qal'eh-i Yazdigird. For the purposes of this article, attention need only be drawn to the Zendan (no. 43), by the long defensive wall; Gach Gumbad (no. 46); the Maydan enclosure (no. 48); Tepe Rash (no. 49); the Upper Castle (no. 55); and Kala Dawar (no. 58). The pottery excavated from stratified contexts from both Qal'eh-i Yazdigird and Nippur[23] has yet to be included in the study due to time limits imposed by the deadline for publication.

THE STATISTICAL APPROACH,* *by Marguerite J. Keall*

The Qal'eh-i Yazdigird sherds have not been dated reliably. In order to find the place of these sherds both in space and time—that is, how they can be dated and how they relate to sherds from both Mesopotamia and the Iranian plateau—several types of analysis were attempted. It should be understood that these attempts were just that, preliminary trials to find an optimum approach for further, more exhaustive work.

Two basic questions were the take-off points for research: (1) are there any regional similarities among the sherds, such that sherds grouped by regions constitute a "best" grouping? and (2) are there individual similarities among the sherds from all regions that present a better grouping?

To answer the first question, the complete body of sherds was divided into six geographical regions, and these regions compared on the full range of the available data. In many instances, there were moderate levels of similarity among sherds from the same region. At the same time, there were regional differences. For a number of characteristics, these region-to-region differences were statistically significant.

The analysis of the second question was more difficult. Two approaches were taken. First, we attempted to collapse the data by using a type of factor analysis known as principal components analysis. The information supplied by that analysis was then partially graphed to see if clusters of sherds would appear. For several reasons detailed below, we also tried a second method, by which an hierarchical grouping procedure known as H-group was applied to a subset of the body of sherds. This procedure starts with each sherd as an individual group and then step-by-step combines two groups to reach a solution which has one group less than the previous step. Step one, in our case, consisted of 380 groups, each with one sherd. Step two resulted in 379 groups, 378 groups with one sherd and one group with two sherds. We followed the analysis and noted the way in which it combined sherds. The analysis was stopped at the point when there were only 50 groups, 42 groups with several members and 8 groups each with one sherd only.

Both of these analyses are discussed in detail below. First, however, it is useful to see what the sample was like. After this description, the two research questions will be dealt with in turn.

The Data

A sample of 1,434 sherds was used in most of the analyses that follow. All the sherds were from surface collections, with the entire sample representing a total of 44 sites. Each sherd was coded for a number of different variables. The code book for the variables is provided in Appendix A. (The complete codes are occasionally omitted; however, their range is noted.)

*As much as possible, statistical jargon has been deliberately omitted from this section. For those of the readers with statistical expertise, we apologize for some of the simplifications in the text. They were deemed necessary for the larger portion of the reading audience.

Within each variable, there are several different possibilities for the sherds. For example, one of the variables, " rim shape ", had nine categories, each of which was assigned a number. Thus each sherd was coded according to its category of " rim shape ". Those sherds without a rim were also assigned a number, corresponding to the category *no rim*. Of the group of 1,434 sherds, 461 of them were classified as having no rim, with the remaining 973 falling into various other categories. Stated as a percentage, then, 67.9 per cent of the original sample were rim sherds. If we go on to take this group of 67.9 per cent of the sample as the relevant subset, 17.6 per cent fall into the category of *funnel-necked jars*, 15.8 per cent are *heavy-rimmed jars*, 13.2 per cent are *bowls*, 12.9 per cent are *thick-rimmed basins*, 12.5 per cent are *squat jars*, 11.9 per cent are *closed-mouth jars*, 10.8 per cent are *pitchers and jugs*, 4 per cent are *cups*, and 1.3 per cent are *plates*. In the same manner, each sherd was categorized for each variable. Interesting features of the sample are described in the following paragraphs. The complete set of frequency distributions is provided in Appendix B.

As distinct from " rim shape ", an attempt was made to classify the sherds by " vessel type ". Close to two-fifths of the sherds were *pots*, just under one-third were *jugs*, and a similar number were *craters*. There were only 7 *flasks*, 5 *platters*, and 2 each of *lids* and *lamps*. Obviously one would not like to make many predictions about the nature of any of these latter vessel types. There were only 30 "bases"; more than one-third of these were *concave disks*, one-quarter were *flat disks*. Only 78 " handles " were present; they tended to be in the catch-all category of *handle of unknown type*.

Categories for the variables " rim diameter ", " thickness " and " ware " were also assigned. More than one-third of the rim sherds were found to have a diameter between 15 and 25 cm.; neither extreme of the diameter scale was heavily represented. In like manner, the majority of the sherds have a thickness ranging between 0.5 and 1.0 cm. At the extremes of the thickness scale, more sherds were thinner than 0.5 cm. than were thicker than 1.0 cm. The cumulative frequency of all sherds up to 1.0 cm. in thickness was 85.1 per cent. There was very little discrimination among the sherds by the ware of the sherd: nearly two thirds of them were *pink buff*.

" Finish of sherd " was another variable which showed little discrimination among categories: more than 80 per cent of the sherds were of *plain finish*, both inside and out. Of the glazed sherds, nearly all exhibit *monochrome* glazing, whether such glaze is located outside, inside, or on both surfaces. In fact, only *polychrome* and *underglaze paint* exist as other categories containing sherds.

For sherds that were decorated, a code was devised whereby not only the " style of decoration " was recorded, but also the " location of decoration " on the sherd. Thus an individual sherd could have different decorations in eight locations and each would be assigned a decoration-type code for the location of the decoration. Only 3 sherds were decorated on the inside of the rim, 2 of them *grooved* and 1 *combed*. There were 188 decorated neck portions of sherds: over one-third of them were grooved, and a smaller percentage were *ribbed*. The area of the sherd which exhibited decoration most frequently was the body: 314 body sherds were decorated. Nearly one-quarter of them were *combed*, one-fifth *grooved*, and the remainder *scratched, ribbed* or *impressed*, in fairly equal proportions. No bases were decorated and the handles, if decorated, were all *appliquéd*. All decorations, regardless of location on the vessel, were summed. When this was done, *grooved* decoration was seen to be the most prevalent, followed in order of decreasing numbers by *combed, ribbed, impressed, scratched, stamped* and *appliquéd*.

The method of dating sites was to assign both a beginning and an end date to each site. The assumption was that a site was occupied at each time interval between the beginning and the end dates. Using this method meant that some sites were occupied at nearly all the time periods under consideration. Nearly all (99.4 per cent) of the sites were inhabited during the *Sasanian* period. Three-quarters of the sites had *Early Islamic* occupation, and nearly two-thirds had *Late Parthian* levels. *Early Parthian* times were covered by 62.3 per cent of the sites. Periods later than *Early Islamic* were represented by substantially fewer sites.

For the dating of individual sherds, rigid criteria were used. Only those sherds with a nearly positive temporal identification were assigned a date. If there was any question over the date, that sherd was classified as being of unknown date. It was hoped that by this method, the coder would not prejudice the results of any attempts to group the sherds. As a result of this " rule ", only 144 sherds were assigned a date. Of those positively identified, 42 per cent were *Sasanian*, 16 per cent *Partho-Sasanian*,

and 17.3 per cent either *Early* or *Late Parthian.* Thus, over three-quarters of the dated sherds were Parthian or Sasanian.

In order to answer the first research question posed above, the sites had to be aggregated into geographical regions. Six such regions were derived, as described in the first section of this article. Qal'eh-i Yazdigird represented 30 per cent of all sherds in the sample; the Diyala contained 22.6 per cent of the sherds; Fars and Jibal each had just over 20 per cent; and Hatra and Elymais each had a much smaller 3 per cent.

In summary, then, the sample was fairly well distributed by rim characteristics and vessel types. " Sherd ware ", " finish " and " glaze " were not finely divided. Generally, one category of these latter variables contained an overwhelming majority of the group—in this sample, *pink buff* ware, *plain* finish, and *monochrome* glazing. Decorations, where present, were diverse. The sherds and sites were concentrated (also due to the choice of sites) in the Parthian and Sasanian periods. Among the study regions, Elymais was not represented by a large collection of sherds, nor was Hatra, where only the site of Hatra itself was included as a member of the region.

Can the sherds be classified by their regions?

For many of the variables for which the sherds were coded, there were statistically significant[24] differences among the geographical regions. The strength of the relationships between these variables and the geographical region were, however, usually only weak to moderate. The pattern of the relationship was, on the other hand, frequently interesting. There is one specific difficulty in the interpretation of these cross-tabulation results. Because of the nature of the data, which contains many missing pieces and unknown or not applicable responses, it is likely and indeed frequent that cells of the contingency table are either empty, or filled with very small numbers of sherds. This event places the chi-square statistic, the value on which the test of significance is based, in jeopardy. In most cases, we attempted to regroup the data so that the empty cells were eliminated, and then carried out the test of significance.

The two measures of strength of association utilized were Cramer's V and the contingency coefficient. Both measures are applicable to nominal data; that is, to data where number codes have no strictly numerical meaning, but are only stand-ins for the "name" of a category. For example, grooved decorations were assigned number codes ranging from 110 to 199, but these numbers have no meaning, in the sense that 120 is not 10 more than 110; it is merely a different type of grooved decoration. Cramer's V has the additional quality that it can be compared from one table to another table. The contingency coefficient varies according to the size of the table—thus it has a large upper limit for larger tables, and a smaller upper limit for smaller tables. This makes comparisons of its value among tables of differing sizes extremely difficult.

It has often been assumed that regional groups of sherds were very different from one another, and that any attempt to classify sherds would have to recognize the regional variable; in fact, it was assumed likely that sherds from different regions could not really be placed together in groups.[25] Our analysis showed that there are indeed regional variations, but that for the most part these variations are of only moderate strength. Because of the moderate nature of the relationships, it becomes likely that there are other ways to group sherds which would yield " better " groupings—groupings that are more distinct from one another, such that sherds within the group are very much alike, and at the same time, each group of sherds is very dissimilar from every other group of sherds.

Having said that regional differences do exist in the results of the present study, but bearing the above caveat in mind, we shall now discuss the relationships between geographical regions and the sherd variables. A complete set of the contingency tables can be found in Appendix C.

Rim characteristics: All variables dealing with characteristics of rims are significant: " presence of rim top ", " presence of outside rim ", " rim shape ", and " rim diameter ". The first two variables are exactly the same as one another: of the 1320 sherds for which presence or absence of a rim could be noted, precisely the same number (73.9 per cent) had a rim top as had an outside rim. Thus an investigation of one of them is a copy of an investigation of the other. Qal'eh-i Yazdigird stands out

Pl. Ia. The Zardeh basin: cliff-edge view. The right hand of the man on the right points to the Maydan enclosure.

Pl. Ib. The defensive long wall from lower end, with Zendan fields to left.

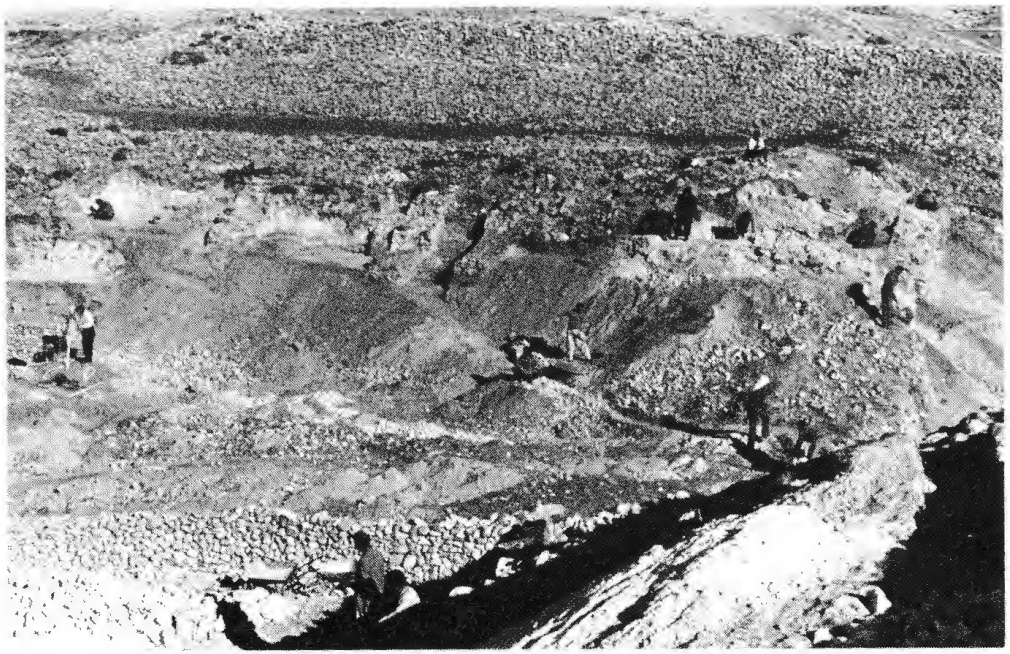
Pl. Ic. The defensive long wall, with Zendan excavations at top of photograph.

Pl. IIa. The Maydan enclosure and Ja-i Dar gardens seen from the cliffs above Zardeh.

Pl. IIb. The Ja-i Dar gardens of Zardeh seen across the flat fields of the Maydan enclosure.

Pl. IIc. The terraced fields of Tepe Rash.

Pl. IId. Tepe Rash with Gach Gumbad far right.



Pl. IIIa. Clearing wall stubs in Gach Gumbad West.

Pl. IIIb. Section through dump of plaster containing Parthian glazed sherds.

Pl. IIIc. Gully down-cut through fields; sherd of Pl. IIId embedded in bank on left.

Pl. IIId. Parthian sherd exposed in bank through down-cutting action.

Pl. IVa. Bird's-eye view of Kala Dawar.

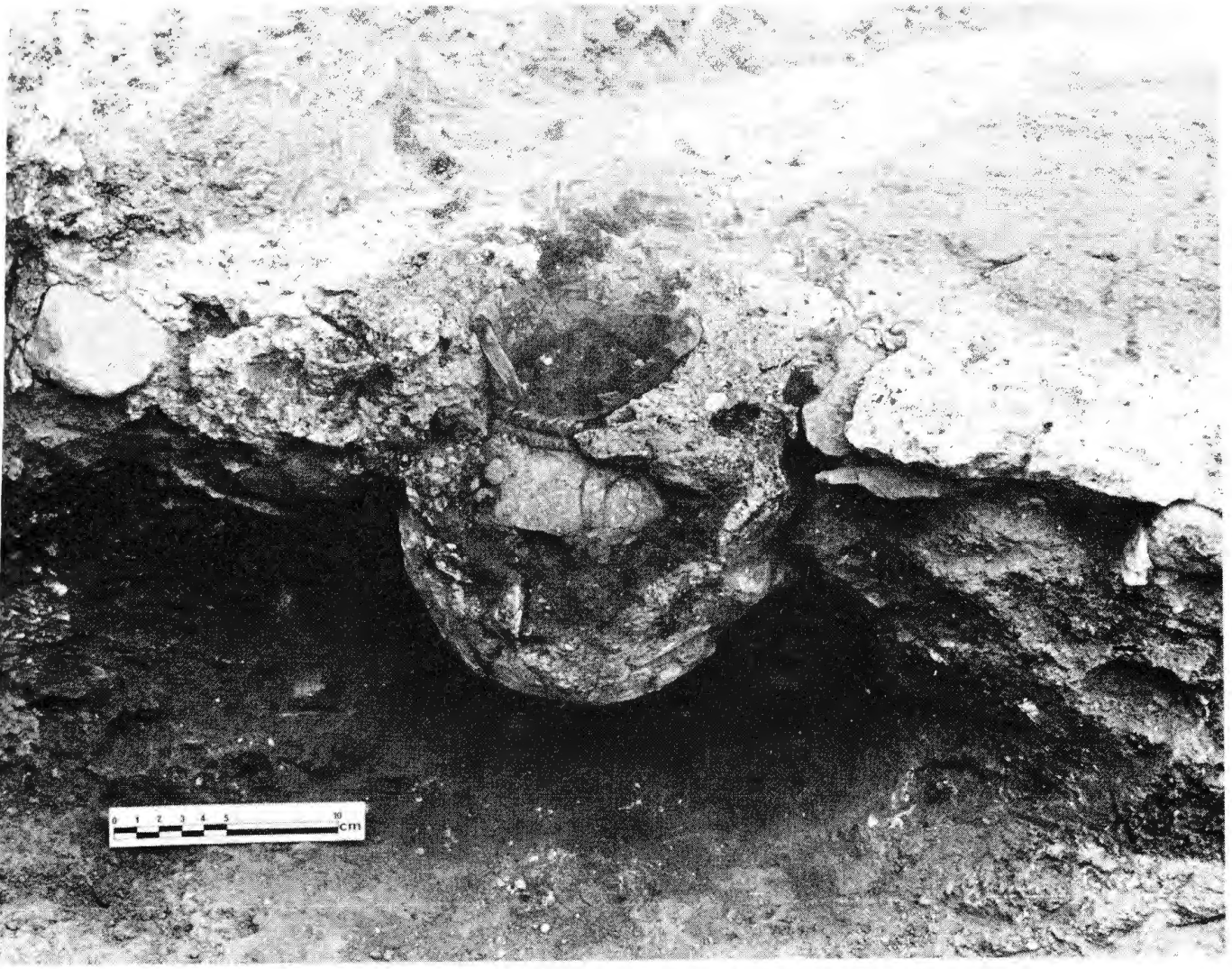
Pl. IVc. L-shaped pier of Kala Dawar chahar taq *and blocking wall in corridor.*

Pl. Va. Plainware jug from Kala Dawar workshop (10th century). H. 12.7cm. (QY78.8)

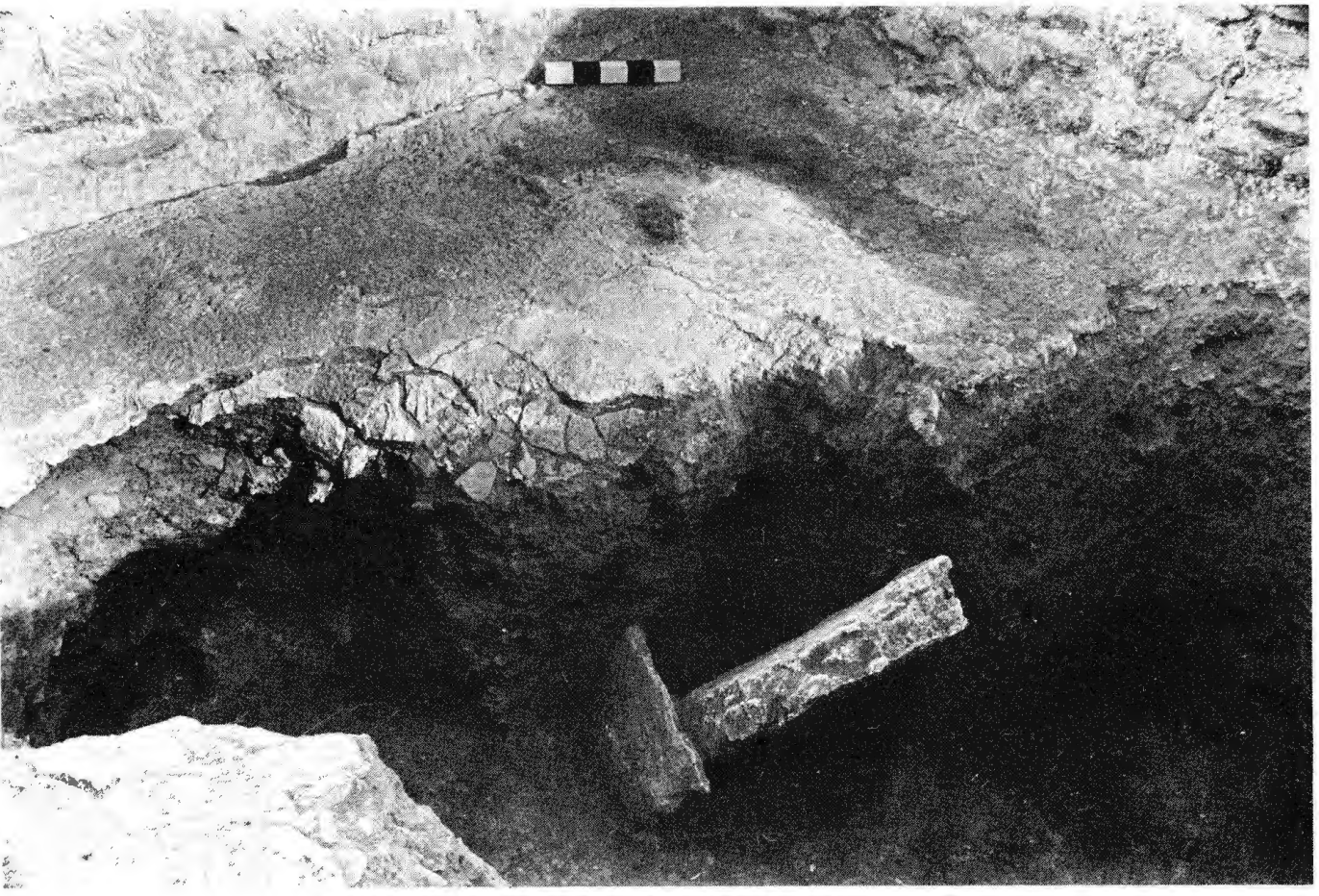
Pl. Vb. Glazed jar from Kala Dawar, once embedded in plaster and set below floor of room 2 (Umayyad?). H. 15.5cm (QY 78.51)

Pl. VIa. Bronze lamp from Kala Dawar: L. 12.2cm., W. 8cm. (QY 78.11)

Pl. VIb. Oven and workshop area outside of Kala Dawar.



Pl. VIIa. Glazed jar embedded in plaster floor of Kala Dawar, room 2.



Pl. VIIb. Pit in Kala Dawar, room 2, with fallen slab of concrete floor.

Pl. VIIIa. Plaster pot stand in guard-chamber of Zendan tower room (Parthian period).

Pl. VIIIb. Oven in Ban Gumbeh "alleyway" site (12th century).

Pl. VIIIc. "Pseudo-clinkyware" juglet from Zendan excavations (Parthian). (QY 75.7)

among the regions as having a higher percentage of rim sherds than the other regions—an additional 10 per cent of the Yazdigird sherds are rim sherds. Elymais is noticeably lacking in rim sherds—a mere 56.8 per cent of its sherds have rims.

An investigation of " rim shape " shows Hatra to have the fewest different types of rims—only five of the possible nine categories are represented in that region. Elymais has no *heavy-rimmed jars* or *plates*. All other regions have at least a few sherds in each category of " rim shape " noted. Yazdigird has a high proportion of *heavy-rimmed jars*, and a low number of *pitchers and jugs* and *bowls*. The Diyala has only half as many *squat jars* as one would expect; on the other hand, it has nearly three times more *cups* than all other regions on average. Jibal has fewer *cups* than one would expect. However, here the numbers are very small, and percentage responses can be misleading. Jibal has one sherd in the category of cups; if this region were average in nature, 4 per cent of its sherds would be in this category—in this case, about 5 sherds. Thus, the sherder picked up only one sherd in the category, whereas we might have expected him to find five such sherds. When the numbers involved are so small, it is misleading to make any judgment on the basis of the figures here; a survey carried out a few years later might have produced the required five cups—a 400 per cent increase, but only four additional sherds. Elymais has only one *funnel-necked jar,* when on average we would expect it to have four such jars. It has more than double the number of *pitchers and jugs* as expected, and triple the number of *cups*. Again, the size of Elymais sub-sample is small (n=21). Fars has more *thick-rimmed basins* than expected and fewer *heavy-rimmed jars*. Nearly half of Hatra's sherds are *closed-mouth jars*—four times the proportion expected. It has only one-third the number of *funnel-necked jars* expected and double the number of *bowls*. Again, these extreme variations occur when the sample size is small (n=19), and care must be taken in interpretation.

The entire sample of rim sherds had a distribution of diameters, such that more than half of the sherds was less than 25 cm. in diameter. Of the larger-diameter sherds, very few of them had extremely large diameters—about three-fifths of them had diameters between 25 and 35 cm. Yazdigird had a higher proportion of the larger diameters. The Diyala had very few large diameters, but had a large number of sherds in the 10-15 cm. size—70 per cent of its sherds had diameters less than 25 cm. Jibal was at the other extreme, with nearly half of its sherds greater than 25 cm. in diameter. The Elymais sherds had no representatives in either the smallest or the largest diameter category; however, two-thirds of its sherds were less than 25 cm. in diameter. Fars also had two-thirds of its members in the less-than-25 cm. categories. Hatra had no sherds larger than 25 cm.; the largest group of the Hatra sherds (38 per cent) was between 5 and 10 cm. in rim diameter.

Size, Ware and Finish Characteristics: Since not all sherds were rims, and not all rims had a diameter noted, a fairly unrigorous variable was created: " sherd size ". This size varied from *tiny* to *very large* and was a qualitative judgment on the part of the coder. Most of the 1434 sherds that were coded on this variable were *small* (61.5 per cent). Nearly all the rest were *medium*. Yazdigird tended to have more *medium* than *small* (compared to the average), as did the Diyala. Jibal very definitely had larger sherds than expected. Elymais, Fars and Hatra, on the other hand, all had high percentages of *small* sherds—from 81 per cent to 87 per cent. The relationship is not very different from the rim diameter analysis described above; however, the strength of association is marginally greater.

The majority of sherds were between 0.5 and 1.0 cm. in thickness. Very few were extremely thick; a slightly larger proportion was very thin. Yazdigird had more sherds in the median category (0.5 to 1.0 cm.) and more than average in the next larger grouping. The Diyala and Jibal were not too dissimilar from the average of all sherds. Elymais had distinctly thinner sherds—three-fifths of its sherds were between 0.3 and 0.5 cm. Fars and Hatra also tended toward thinner sherds, Hatra having absolutely no sherds thicker than 1.0 cm.

As noted above, most of the sherds in the sample were *pink buff* ware. At Hatra, only 2 types of ware were present: *pink buff* and *yellow cream*. None of the sites exhibited sherds in every category of " ware ". There were, however, other striking differences between regions. Yazdigird had nearly 80 per cent of its sherds in the *pink buff* group, while the Diyala had just over one-quarter of its sherds in this category. The Diyala had nearly two-thirds of its sherds in the *yellow cream* group. Jibal and Fars each had a high

number of *pink buff* sherds, while Elymais had a large number of *red brown* sherds—about six times what one would expect on average.

The finish of each sherd, both inside and out, was noted. As a rule, only two or three categories of the " finish " variable were well represented in the sample—*plain, slip-painted* and *glazed*. More than 80 per cent of all sherds was *plain*, either inside, outside, or both. Nearly 100 per cent of the Yazdigird sherds was *plain* inside and out. A slightly smaller proportion of the Jibal sherds was *plain* finished. The Diyala and Hatra had substantially larger numbers of *glazed* sherds. The *slip-painted* sherds were mainly from Fars.

The investigation of " glaze type " by region was not statistically significant. Here again, nearly all the glazed sherds were of one type—*monochrome* glaze. The number of glazed sherds was also small—90 glazed outside and 92 inside. Obviously, the existence of glaze of any nature is of more importance here than the type of that glaze. If the sample had a considerably higher percentage of glazed sherds, this might not be the case. If the percentages remained the same but the size of the groups were to be multiplied tenfold, the glaze-region relationship might well prove to be significant.[26] The strength of the glaze relationships was very similar to that of the finish relationships. Even though we cannot state with any certainty that another sample of sherds from the same areas would yield the same results for glazes, we see that Yazdigird, Elymais and Hatra had only *monochrome* glazes; that *polychrome* glaze occurred only in the Diyala; and that *underglaze painted* sherds were found only in Jibal and Fars.[27]

Profile and Features: There were only 30 bases in the sample. The relationship between " base type " and geographical region was not statistically significant. However, the association itself was of moderate strength—one of the strongest noted of any of the variables. Notable differences included the following: *no bases* were present from Jibal; all Fars bases were *flat;* only the Diyala had any *nipple* bases; and Yazdigird and Elymais had a higher than average proportion of *concave disk* bases.

Very few sherds—only 78 out of the 1,434—also included a handle. Nearly one-fifth of the handles were *square strapped;* however, this type of handle was present only in the Diyala, Jibal and Hatra. Just over one-tenth of the handles were *blind loop,* and an equal proportion were *double strand*. Again, only three regions were represented in each category: for both *blind loop* and *double strand* handles, only Yazdigird, the Diyala and Fars had examples. The largest category of " handle types " was the one that consisted of *unknown* or *not noted* types—nearly one-quarter of the entire handle sample was thus coded. Although the relationship is significant and of moderate strength, the numbers involved are unfortunately very small, and large percentage differences can consist of only one or two sherds.

For sherds from vessels (as opposed to lids, lamps, etc.) seven possible zones for the " profile " were noted; each sherd was coded as having a portion of the profile or not having that portion. For all zones except the *carination*, the relationships with geographical region were statistically significant. In all cases, the strength was on the weak side. The sample size for each of these variables was 1,320. Nearly three-quarters of the sherds in the sample had *rim-tops, outside rims, necks* and *bodies*. Elymais and the Diyala had substantially lower proportions of *rim* sherds, and somewhat lower proportions of *neck* and *body* sherds. Very few sherds had any *carination,* and only slightly more had *bases* and *bellies*. The Diyala is notable for the larger number of *carinations* present. Both the Diyala and Elymais stand out with higher proportions of *bellies* and *bases*. Hatra had a higher proportion of *bases,* but not a very much higher proportion of *bellies* than average. In no case is the relationship strong enough to be predictive. Thus, if one were to find a sherd with carination, we might suggest that it did not come from Jibal or Elymais, and that it is more likely to have come from Hatra than Fars, but no positive statement could be made on where to place the sherd.

Decorations: The decorations were combined to create a single variable expressing the over-riding " decoration type " on any sherd. This, by necessity, is a smoothing operation, and some of the detail of the sherds is lost in the process. But the loss of information on detail is compensated for by the ability to analyse regionally. More than one-quarter of all sherds were *grooved*; in the Elymais region, over 40 per cent were *grooved*; Yazdigird had few *scratched* or *appliquéd,* and no *stamped* sherds. On the other hand, it had somewhat higher than average numbers of *impressed* and *ribbed* sherds. The Diyala

had double the average number of *stamped* sherds. The other categories varied slightly from the averages for the whole sample, but not enough to be outstanding: Jibal had fewer *impressed* and more *stamped* sherds than expected; Elymais, as already noted, had many *grooved* sherds, and five times as many *appliquéd* sherds as the average; Fars had more *combed* sherds, and fewer *impressed, stamped* and *appliquéd;* Hatra had no *scratched* or *ribbed* sherds, five times as many *stamped* sherds as expected, and substantially more *grooved* sherds than average. Here again, although the relationship is fairly moderate, the predictability allowed by the nature of the relationship is small.

In summary, one could say that the strongest associations are found in statistically insignificant relationships, or with variables dealing with only a tiny subset of the sample, as in the case of "base type" and "handle type". Those variables which one would expect to be useful—"rim shape", "vessel type"—although significant, are fairly weak in association; thus the pattern of results, while perhaps yielding insights into the corpus of sherds, does little to help us in our search for the best analytical framework.

As for the question of regional differences among the body of sherds, the answer is: yes, there are regional differences. These differences are significant, and in a few cases of moderate strength. However, in very few instances is there good predictability. Most sherds do not fit only at one site, on the basis of any of their variables; it may be that they occur more frequently at some sites, but not exclusively at those sites. Thus, for the purposes of placing the group of Yazdigird sherds into the Iranian-Mesopotamian context, the notion of regionality has little to offer.

Just because regional differences are insufficient for predictability, it does not follow that another method will accomplish this better. It might, but equally as often it might not. But the question is raised whether there is a better method for grouping sherds: a method by which the differences between groups are maximized, while at the same time differences between the sherds within each group are minimized. In order to proceed towards this goal, we must resort to some more sophisticated types of analysis.

Are there other grouping mechanisms that yield more explanatory or predictable clusters of sherds?

There are several different methods of cluster analysis and data reduction techniques available. The general difficulty is one of the nature of archaeological, particularly potsherd, data. In the present study, the data is of a type known as nominal. As explained above, this refers to data where the numbers assigned to individual categories for each variable have no intrinsic meaning, but are merely a stand-in for a descriptive label. Most of the available techniques require that the data be interval level in nature. In some cases, ordinal data can be substituted without any loss of power of the test procedures.

Interval level data is a type where the numbers assigned to categories of variables not only have meaning as numbers, but the differences between intervals is equal. A frequently used example of the nature of interval data is the thermometer—the degrees have meaning, and the difference between 9° and 10° is the same-sized interval change as that between 24° and 25°, indeed between any two consecutive numbers on the scale. Most, if not all, the data we have is not interval in nature. Some of our data is, however, ordinal. This means that the data is ordered, that there is a ranking involved. Our examples include "rim diameter", sherd "thickness", and sherd "size".

Because of the restrictions imposed by the nature of data, and since we have chosen to ignore the "rules", we must be very careful in our interpretation of the results. Otherwise, there is a risk of spurious results—results based on chance assignments of numbers to categories, rather than due to any regularities located in the data.

Factor Analysis: One of the most common, perhaps most overworked, types of analysis used in the search for regularities in large samples of data is factor analysis.[28] We have used a type of factor analysis known as principal components analysis. This analysis attempts to identify factors or components that explain the variability in the sample by reducing the given set of variables to a smaller group of factors. Each one of these factors, in the ideal case, would explain a portion of the sample variability. By using the first few factors, it is hoped that a large proportion of the sample can be

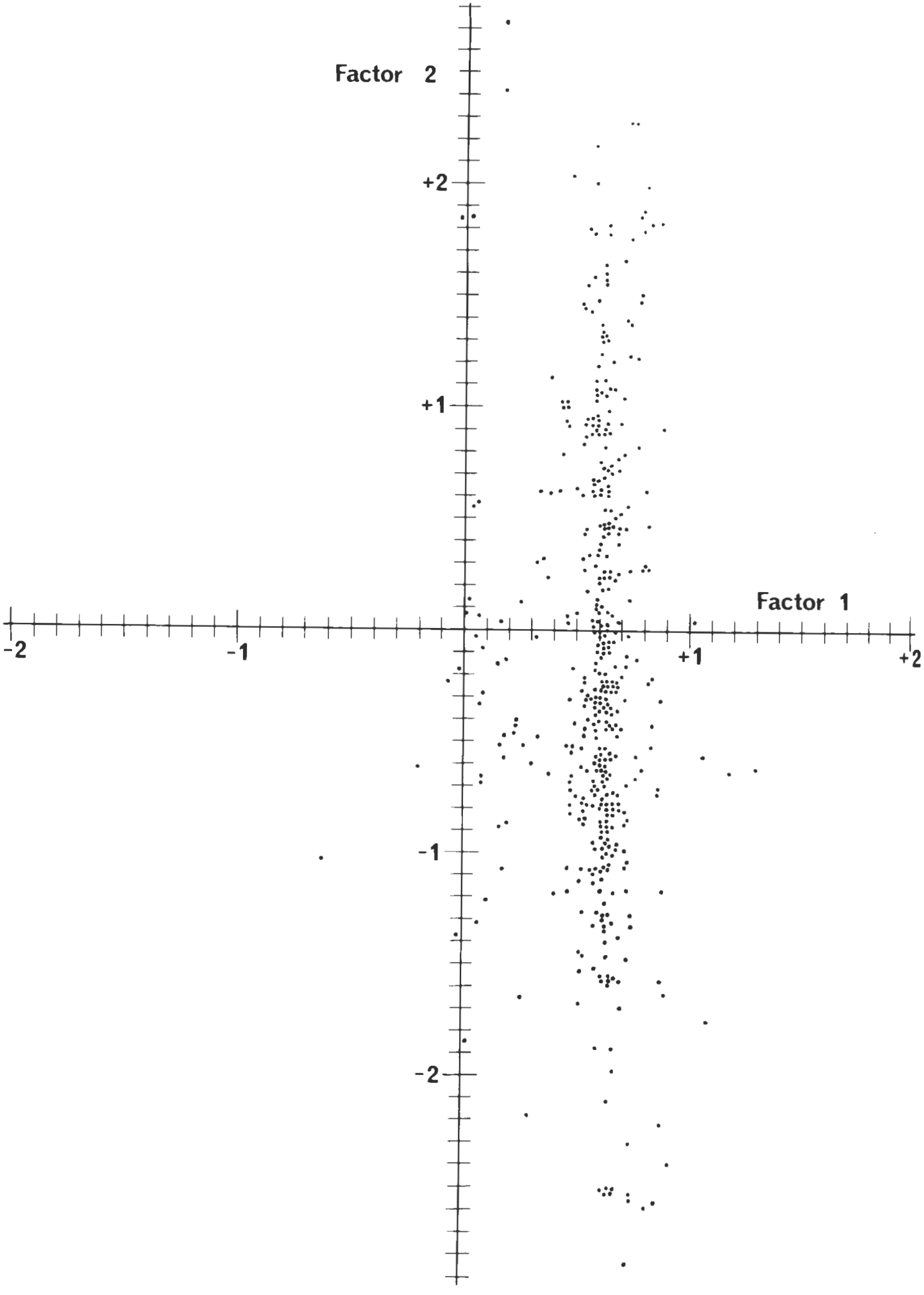


Fig. 32. Principal components analysis: plot of the factor scores.

described. Along with the factors, and a description of how each variable contributes (or loads on) to the factor, the output of a principal components analysis also provides factor scores for each individual data item. Thus for each sherd in the sample, its composite score for each factor is given.

If we plot the scores of each sherd on its first factor (horizontal axis) and second factor (vertical axis), we can locate groupings of sherds from the graph. Usually, some clusters that are fairly distinct emerge from the analysis, but there is frequently a large number of items for which divisions would be arbitrary at best. Where should one draw the divisions between groups? Is that division meaningful? After one has made a decision about how the clusters should be grouped, one can submit these divisions to a discriminant analysis routine, which will respond with a measure of the " discrimination " between the groups. In other words, has one made a very " good " group, or is there still too much variability within the groups? Thus, after using a powerful data reduction technique, one is reduced to guesswork about the nature of the clusters that might emerge.

The sample data in the study was submitted for reduction by principal components analysis. Twenty-six variables were entered originally; eleven factors emerged. The first two factors accounted for some 30 per cent of the variability in the data. Factors are identified by those variables which load heavily onto them. In the case of the first factor in this analysis, it was highly loaded by variables having to do with the portions of the sherd extant, particularly rim to body portions, and the composite variable of decoration type. Factor 2 was concerned with rim shape and diameter, sherd thickness and sherd size; factor 3 was loaded heavily by vessel type and the existence of bases and bellies; factor 4 comprised site and finish characteristics; and factors 5 through 11 were concerned with individual decoration types. Sherd date was also loaded on both factors 5 and 6.

Each sherd was given a " score " for its position on each factor (see Fig. 32). By plotting these factor scores, factor 1 vs. factor 2, we hoped to obtain clusterings of sherds that were self-evident. In fact, although there are sets of outlier sherds, ones that are quite different from other sherds, the main group of sherds appears to differ substantially only on factor 2. For factor 1, this majority of sherds lies in a band of fairly narrow width. There is little way in which to discriminate within the band, and no obvious way to break this band or vertical strip into groups. An arbitrary division into groups may be no more meaningful, for predictive purposes, than the division into regional groupings.

The difficulties with this type of analysis should be evident at this point. First, the data itself is not suitable for the analysis. Secondly, the interpretation of the factors is often difficult under the best of circumstances; in our case, although there seems to be some rationality to the factors, we can by no means be positive about the correctness of our interpretation. Thirdly, the graphic presentation of individual sherds and their scores on the first two factors, and the subsequent division into clusters of like sherds, is of questionable reliability. We will continue in the near future to attempt various ways of classifying the sherds on the basis of the factor scores. Preliminary glances at sherds found close together on the graph indicate that they are of a similar nature, and that a grouping involving them would not be incorrect. However, much more detailed work remains to be done to verify the accuracy of groups derived by this method.

One further problem exists because of the nature of the data. In many cases, individual variables for some sherds are missing: either the information does not exist or the variable does not apply to the sherd in question. In these cases, the computations of correlations, and thus the underpinnings for the factor analysis, are diminished by the unavailable data. In the present study, some 700 sherds for which much of the data was of such a " missing " nature could not be included in the analysis. Their factor scores were ignored in the computations. This means that an arbitrary subset of the data was ignored. It may be that an arbitrary assignment of a code to such missing data will alleviate the problem. Of course, such an assignment presents further difficulties in the interpretation of the results.

Cluster Analysis: There is a group of techniques referred to as cluster analysis, all of which have the ability to group data according to specified variables and by specified algorithms.[29] The techniques have an initial constraint—they can handle relatively little data at reasonable computer costs. Thus, for our preliminary analysis, a subset of the data sample was taken. 380 sherds were selected, and submitted to a hierarchical grouping procedure known as H-group.[30] In this procedure, as briefly

described at the beginning of this discussion, each sherd is given a group number at the outset. In the first step of the grouping procedure, those two sherds which are most alike are put into one group, and the remaining 378 sherds are left in their individual groups. The next step takes the next most like sherds or groups and combines them. Because the procedure is carried out step-by-step in a hierarchical fashion, it is possible to follow along each step of the way and see how sherds are combined. In this way, the combinations are much more "open" than were the factor scores in principal components analysis.

At each step, a measure of the error (or, conversely, its "goodness") is given. This measure is relative rather than absolute, so there is no real way of stating the explanatory or predictive power of the groupings. Again, the groups must be submitted to a discriminant analysis in order to ascertain their "goodness".

For the first attempt with H-group, several variables were utilized, each weighted equally; that is, the presence of *grooved* decoration, the presence of *combed* decoration, the appropriate category of "rim shape", and so on, were each given exactly the same weight in the determination of the similarity between any two sherds or groups of sherds. This resulted in some very unusual groupings—groupings which were not exactly what we had in mind. The second attempt deleted several variables, and gave weights to those remaining, so that together the outside and inside "finish" were weighted the same as the "sherd date". "Rim shape" and "rim diameter" were also weighted, .75 and .25, so that together their weighting was equivalent to other single variables.

Of the 380 sherds in the sample subset that were submitted to H-group clustering, the proportions are not too dissimilar from those existing in the total sample. The Yazdigird sherds are over-represented (36.3 per cent), the Diyala is under-represented (17.1 per cent), and both Jibal and Fars are nearly the same (20.8 per cent and 20 per cent respectively). Similarly, Elymais and Hatra are nearly the same as in the total sample (3.7 per cent and 2.1 per cent respectively). When the analysis was halted at the 50-group level, 8 sherds remained in single-member groups (see Fig. 33). None of these "oddball" sherds was from Yazdigird; however, 3 were from Elymais, a region with only 14 sherds in the sub-sample.

On the basis of sheer numbers alone, the sherds would combine in groups in the following proportions: Yazdigird would be in 21.9 per cent of all groups; Fars in 20.2 per cent; Jibal in 19.5 per cent; the Diyala in 19.2 per cent; Elymais in 11.3 per cent; and Hatra in 7.9 per cent. It turns out that Yazdigird combines more than would be expected with the Diyala, Jibal and Hatra, and less with Elymais and Fars. Yazdigird was involved in more single-region groupings than any other area. Of the 28 groups in which Yazdigird was involved, nine consisted only of sherds from Yazdigird. The Diyala was represented in 14 of the groupings with Yazdigird; Jibal in 16; Fars in 12; Hatra in 7; and Elymais in 6. Hatra is an interesting case. Only 8 sherds from that region were in the analysis. One of these was never grouped with any other sherds; each of the remaining 7 went into a different grouping, and all of these groups included Yazdigird sherds. Elymais followed nearly the same pattern: of the 14 sherds from this region, 3 were never recombined, 8 were included in 6 groupings which also involved Yazdigird, and the remaining 3 were in 3 groups which did not include Yazdigird, but did include Fars.

The most common combination of regions was Yazdigird with itself—9 groups. Three groups were found in three different combinations of regions: Yazdigird, the Diyala, Jibal and Fars; Yazdigird, the Diyala, Jibal, Fars and Elymais; and the Diyala and Fars. These groupings lead one to suspect that, given any sensitivity in the data, Yazdigird, the Diyala, Jibal and Fars are sites with much overlap in sherd types. We have already noted how Yazdigird combines with Elymais and Hatra, although the numbers of sherds from each of those regions is small, and thus limits the possibility of their sherds occurring in many other groupings with Yazdigird sherds. One can only tentatively conclude that parts of the Yazdigird material are similar to sherds from all of the other regions. These tantalizing inferences, and the existence of very reasonable groupings of sherds, are sufficient to give impetus to further attempts at clustering.

Besides the excessive computer time needed by the H-group technique, one of the problems that became apparent was one of the high degree of variability in the sample. The analysis is often used in clustering decoration types among potsherds from North American Indian sites, where there are only

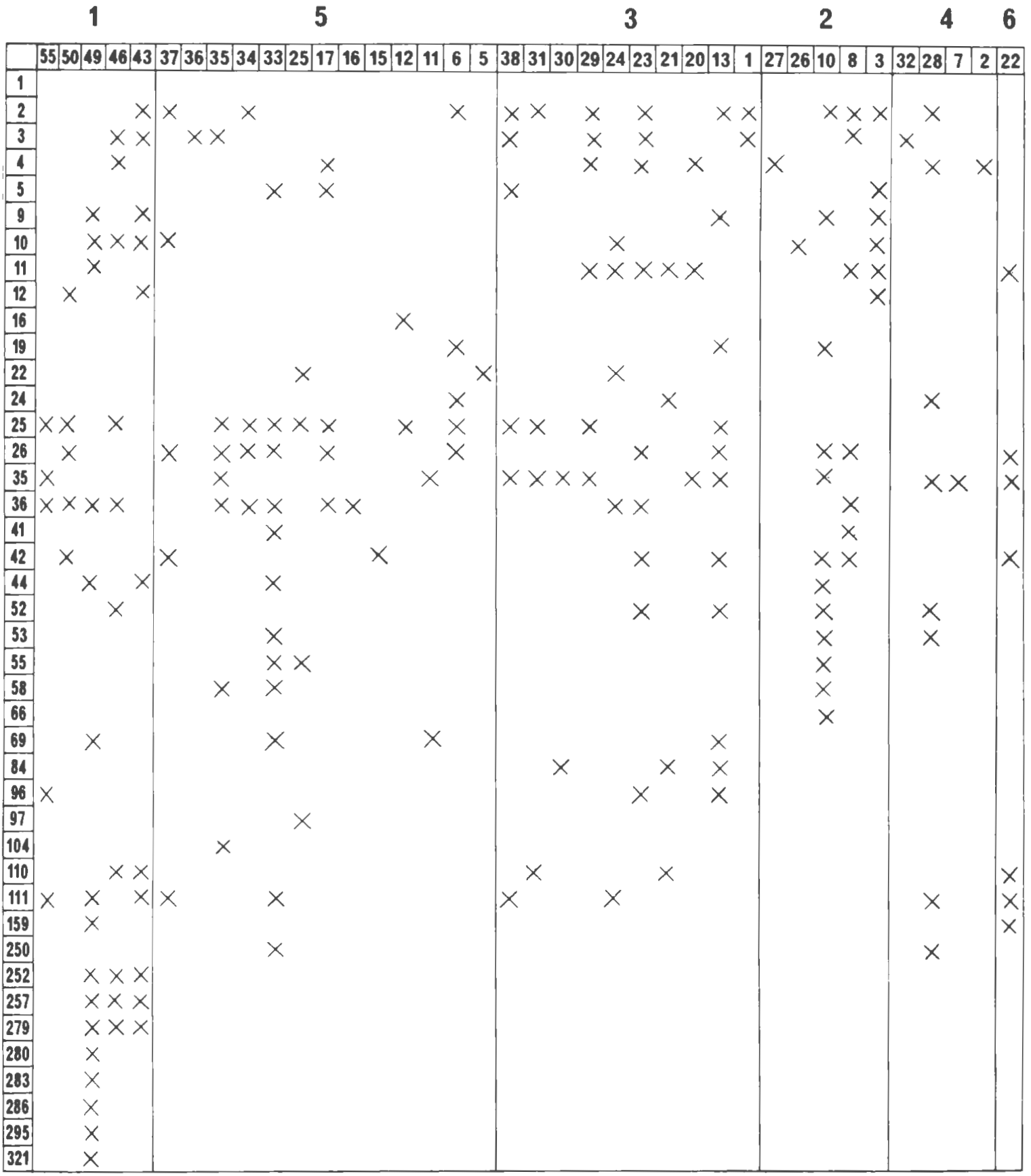


Fig. 33. H-group cluster analysis. Composition of sherd groups by region and site: x-axis, 6 regions and 58 sites; y-axis, 42 sherd groups (8 sherds from sites 8, 10 (twice), 19, 20, 25, and 33 were not grouped, making a total of 50 groups).

a few resultant groups. The sample we used was extremely diverse, and any attempt to end with only a few groups by necessity placed quite different types of sherds together in the same group. Thus, when we halted the analysis at the 50-group level, some of the groupings included quite dissimilar material.

In answer to the question of whether there are groupings which cross regional boundaries, and put

sherds together regardless of their spatial location, the answer is yes. Whether these groupings are more or less explanatory or predictive than the regional groupings remains to be tested by the discriminant analysis. It is hoped that more of the survey and the excavated sherds from Qal'eh-i Yazdigird and sherds from surveys in the Kangavar and Mahidasht valleys, as well as excavated sherds from Nippur, can be incorporated into the sample before future analyses are undertaken.[31] The coding system, particularly the codes for rim type and decorations, will also be refined to correct some of the difficulties evident at this time. It is expected that the combination of a larger sample size and an improved coding system will produce more consistent results. The groupings derived from the application of the techniques discussed—regional groupings, principal components groupings, and H-group clusters—will all be submitted to a discriminant analysis programme to test for the " goodness " of the groups. We hope that this will eventually lead to a more useful sherd typology and thus to the correct placement of the Yazdigird material.

[1] Almost everyone who has participated in the five expeditions has had something to do with the pottery, but those deserving special mention are Linda Ritchie and Kim Maurer-Trinkaus, who did most of the field reconnaissance in 1975 under difficult circumstances. Subsequent surveys included the invaluable help of Rosemary Aicher, Shahin 'Atafi, Mahsumeh Hatemi, Christopher Evans, Peter Morgan, and St. John Smith; William Pratt was expedition photographer, and Linda Ritchie prepared the ink drawings; Carole Richards prepared maps and graphs, as well as acting as co-ordinator of the drawing projects; Nancy Willson has done sterling work in editing this article, though none of its shortcomings should be attributed to her.

[2] This, the last season of work before the Revolution, was sponsored by the Royal Ontario Museum, with a generous supporting grant from the Social Sciences and Humanities Research Council of Canada.

[3] The villagers of Ban Zardeh have their own distinguishing names for various parts of their environment. Often an otherwise undistinguished lump of masonry is simply called Qal'eh (or Qal'a in local dialect). The expedition added the name of Dawar, from the name of our foreman who owned the land, in order to be more specific. But so as not to confuse its abbreviation QD with Qoli Darras (another surveyed area), the site was labelled Kala Dawar. The first report of the *chahar taq* under Qal'eh-i Dawar (*sic*) appeared in *Iran* XVII, 1979, pp. 158-59.

[4] These sites were sherded while the writer was a Wolfson Fellow of the British Institute of Persian Studies, 1963-65, and while enjoying a Wainwright Travel Fellowship at the British School of Archaeology in Iraq in September 1966. Besides the help which the occasional use of a vehicle from these centres gave, grateful mention should be made here of the countless people in Iran and Iraq who welcomed me on their picnic forays into the countryside, as well as the bemused bus and taxi drivers who took me to remote and seemingly insignificant spots on the landscape.

[5] R. Ghirshman, *Bichâpour,* vol. I, Paris, 1971.

[6] D. Huff, " Ausgrabungen auf Qal'a-ye Dukhtar ", *Archäologische Mitteilungen aus Iran*, N.F. 9, 1976, pp. 157-173.

[7] L. Vanden Berghe, " Récentes découvertes de monuments Sassanides dans le Fars ", *Iranica Antiqua*, 1, 1961, pp. 181-187.

[8] A. Stein, "An Archaeological Tour in the Ancient Persis", *Iraq*, 3, 1936, pp. 111-225.

[9] A. Stein, *ibid.*

[10] L. Vanden Berghe, *op. cit.*

[11] W. Hauser and J. M. Upton, " The Persian Expedition at Kasri Abu Nasr ", *Bulletin of the Metropolitan Museum of Art*, Dec. 1934; forthcoming publication for the Metropolitan Museum of Art by D. Whitcomb.

[12] A. Stein, *op. cit.*; important discoveries in unpublished Ph.D. dissertation by L. Bier from Institute of Fine Arts, New York, 1978.

[13] cf. E. Keall, " Partho-Sassanian Archaeology: a new phase ", *Expedition*, 13, 3/4, 1971, p. 58.

[14] A. Stein, *Old Routes of Western Iran*, London, 1940.

[15] D. Huff, " Nurabad ", *Archäologische Mitteilungen aus Iran*, N.F. 8, 1975, pp. 167-210.

[16] D. Thompson, *Stucco from Chal Tarkhan-Eshqabad near Rayy*, London 1976.

[17] R. Naumann, " Tepe Mill, ein Sassanidischer Palast ", *Baghdader Mitteilungen*, 3, 1964, pp. 75-77.

[18] E. Schmidt, *Excavations at Tepe Hissar (Damghan)*, Philadelphia, 1937; Kim Maurer-Trinkaus has been doing pioneer work for a Ph.D. dissertation at the University of Pennsylvania in Philadelphia on the late historical sites in the area of Damghan.

[19] M. Siroux, " Atésh-Gah près d'Ispahan ", *Iranica Antiqua*, 5, 1965, pp. 39-82.

[20] S. H. Langdon, " Excavations at Kish and Barghuthiat 1933 ", *Iraq*, 1, 1934, pp. 113-123.

[21] cf. R. McC. Adams, *Land Behind Baghdad*, University of Chicago, 1965, p. 80.

[22] Mohamed Ali Mustafa, " Dar-al-Imara at Kufa ", *Sumer*, 13, 1957, pp. 207-208.

[23] This author is responsible for the publication of the Parthian fortress and Parthian Inanna Temple for the Oriental Institute of the University of Chicago.

[24] Statistical significance here refers to the results of a chi-square test of association. It can be interpreted to mean that whatever relationship occurs between the two variables under consideration, that relationship is not due to random elements or chance, but rather it would occur again if the test were to be repeated with another sample of sherds from the same areas. The test assumes that the sample is a random one. Thus, it means that one might find a very small, but significant relationship between two variables, or conversely a strong, but statistically insignificant relationship. The best of all possible worlds is, of course, a strong and significant relationship.

In most cases, we are bending the rules for applying the statistical tests and methods. Because the nature of our research is exploratory—we are not making life and death or major investment decisions on the basis of the outcomes of the research—we feel that we can take the risks involved in using these techniques on somewhat unsuitable data. But one must never forget that we are on shaky ground.

Most of the analyses presented are the products of computer programmes from the package of programmes known as SPSS (Statistical Package for the Social Sciences). We used FREQUENCIES (univariate frequency distributions), CROSSTABS (bivariate contingency analysis) and FACTOR (principal components analysis). See Norman H. Nie, et al. *SPSS: Statistical Package for the Social Sciences,* 2nd edition. New York: McGraw Hill, 1975.

[25] A notable contribution to the regional identification of pottery appears in E. Haerinck " Typologie et distribution de la céramique d'époque parthe (ca. 250 av. J.C à ca. 225 après J.C.) en Iran".

E. Haerinck, "Contribution à l'etude de la céramique d'époque parthe en Iran", *Akten des VII. internationalen Kongresses für iranische Kunst und archäologie, München 7.-10. September, 1976*. pp. 286-293.

[26] This is because the value of the chi-square statistic is influenced by the size of the sample. The larger the sample, the more likely it is that any relationship noted between variables will be statistically significant.

[27] It should be noted, however, that as mentioned above (p. 34), underglaze painted pottery is found at Yazdigird; but this material was not included in the present sample.

[28] Besides the discussion of factor analysis contained in the SPSS Manual, the most useful source is H. H. Harman. *Modern Factor Analysis*. Chicago: The University of Chicago Press, 1960.

[29] The most exhaustive treatment of cluster analysis techniques is found in Michael R. Anderberg. *Cluster Analysis for Applications*. New York: Academic Press, 1973.

[30] The programme H-GROUP is originally from D. J. Veldman. *Fortran Programming for the Behavioural Sciences*. New York: Holt, Rinehart and Winston, 1967. The authors are indebted to Charles Matthews of the Department of Geography, York University, Toronto, for his work on the original programme—work that expanded the size of sample acceptable and allowed for the possibility of weighting the input variables. He also provided a large dose of moral support when it was most urgently needed.

[31] T. Cuyler Young and Louis D. Levine have expressed their wish that the late historical data from their respective surveys be included in any future programme of analysis. As previously mentioned, E. J. Keall is responsible for publication of the Nippur material on behalf of the Oriental Institute and thereby has access to the "late" Nippur data. Dr. Levine provided useful advice in establishing the coding manual used for this article.

APPENDIX A

CODING MANUAL

Variable Number	Variable Description	Codes		Columns
1	Site	Sites numbered consecutively from 001 to n		1–3
2	Section Number	Qal'eh-i Yazdigird grid locations		4–9
3	Square Number	Qal'eh-i Yazdigird excavation squares		10–11
4	Plot Number	Qal'eh-i Yazdigird excavation plots		12–14
5	Find Number	Consecutive numbering from each site: 0001–9999		15–18
6	Rim Shape	100–199	Thick rimmed basins	19–21
		200–299	Heavy rimmed jars	
		300–399	Closed mouth jars	
		400–499	Funnel necked jars	
		500–599	Pitchers and jugs	
		600–699	Squat jars	
		700–799	Bowls	
		800–899	Cups	
		900–998	Plates	
		999	Unknown/No Response	
7	Base Type	00–09	Round	22–23
		10–19	Pointed	
		20–29	Nipple	
		30–39	Flat	
		40–49	Plain Concave	
		50–59	Flat Disk	
		60–69	Concave Disk	
		70–79	Ring footed	
		80–89	High footed	
		99	Unknown/No Response	
8	Handle Type	10–19	Round Strand	24–25
		20–29	Double Strand	
		30–39	Triple Strand	
		40–49	Square Strap	
		50–59	Wide Strap	
		60–69	Oval Strap	
		70–79	Lug	
		80–89	Ring	

Variable Number	Variable Description	Codes		Columns
		90–98	Blind Loop	
		00	Type not Noted	
		99	No Response	
9	Profile Portion (from)	1	Inside	26
		2	Rim Top	
		3	Outside Rim	
		4	Neck	
		5	Body	
		6	Carination	
		7	Belly	
		8	Base	
		9	Unknown/No Response	
10	Profile Portion (to)	Same as code for variable 9		
11	Profile Feature	1	Handle	28
		2	2 Handles	
		3	3 Handles	
		4	Multiple Handles	
		5	Spout	
		6	Spout and Handle	
		7	Hole	
		9	No Response	
12	Rim Diameter	1	5 cm. or less	29
		2	6–10 cm.	
		3	11–15 cm.	
		4	16–25 cm.	
		5	26–35 cm.	
		6	36–50 cm.	
		7	More than 50 cm.	
		9	Unknown/No Response	
13	Body Thickness	1	0.3 cm. or less	30
		2	0.4–0.5 cm.	
		3	0.6–1.0 cm.	
		4	1.1–2.0 cm.	
		5	2.1–4.0 cm.	
		6	More than 4.0 cm.	
		9	Unknown/No Response	
14	Sherd Size	1	Tiny	31
		2	Small	
		3	Medium	
		4	Large	
		5	Very Large	
		9	No Response	
15	Sherd Ware	00–09	Pink Buff	32–33
		10–19	Yellow Cream	
		20–29	White Paste	
		30–39	Grey Mica	
		40–49	Heavy Grog	
		50–59	Red Brown	
		60–69	Yellow Biscuit	
		70–79	Composite White	

Variable Number	Variable Description	Codes		Columns
		80–89	Porcelain	
		90–98	Straw Temper	
		99	Unknown/No Response	
16	Sherd Finish (outside)	00–09	Plain	34–35
		10–19	Burnished	
		20–29	Pared	
		30–39	Slopped Slip	
		40–49	Scored	
		50–59	Slip Painted	
		60–69	Bitumen	
		70–79	Glazed	
		80–89	Pierced	
		90–98	Real Slip	
		99	Unknown/No Response	
17	Sherd Finish (inside)	Same as code for variable 16		36–37
18	Sherd Glaze (outside)	00–09	Monochrome	38–39
		10–19	Bichrome	
		20–29	Polychrome	
		30–39	Sgraffiato	
		40–49	Champleve	
		50–59	Slip Paint	
		60–69	Underglaze Paint	
		70–79	Minai-enamel	
		80–89	Porcelain	
		90–98	Other	
		99	Unknown/No Response	
19	Sherd Glaze (inside)	Same as code for variable 18		40–41
20	Decoration-Zone 1	100–199	Grooved	42–44
		200–299	Scratched	
		300–399	Combed	
		400–499	Impressed	
		500–599	Ribbed	
		600–699	Stamped	
		700–799	Appliquéd	
		000	No Response/Not Decorated	
21	Decoration-Zone 2	Same as code for variable 20		45–47
22	Decoration-Zone 3	Same as code for variable 20		48–50
23	Decoration-Zone 4	Same as code for variable 20		51–53
24	Decoration-Zone 5	Same as code for variable 20		54–56
25	Decoration-Zone 6	Same as code for variable 20		57–59
26	Decoration-Zone 7	Same as code for variable 20		60–62
27	Decoration-Zone 8	Same as code for variable 20		63–65
28	Decoration-Zone 9 (handle)	Same as code for variable 20		66–68
29	Site date (from)	00–09	Pre 150 B.C.—Seleucid	69–70
		10–19	150 B.C.–A.D. 50—Early Parthian	
		20–29	A.D. 50–225—Late Parthian	
		30–39	A.D. 225–640—Sasanian	
		40–49	A.D. 640–750—Early Islamic	
		50–59	A.D. 750–833—Abbasid	
		60–69	A.D. 833–1050—Late Abbasid	

Variable Number	Variable Description	Codes		Columns
		70–79	A.D. 1050–1258—Seljuq	
		80–89	A.D. 1258–1492—Mongol	
		90–98	Post 1492—Modern	
		99	Unknown/No Response	
30	Site Date (to)	Same as code for variable 29		71–72
31	Vessel Type	10–19	Crater	73-74
		20–29	Pot	
		30–39	Jug	
		40–49	Platter	
		50–59	Cup	
		60–69	Lid	
		70–79	Lamp	
		80–89	Flask	
		99	Unknown/No Response	
32	Sherd Date (from)	Same as code for variable 29		75–76
33	Sherd Date (to)	Same as code for variable 29		77–78
34	Comments	Numbered comments from 01–99		79–80

APPENDIX B

Table 1

FREQUENCY DISTRIBUTION OF RIM SHAPE

Type of Rim	%
Thick rimmed Basins	12.9
Heavy rimmed Jars	15.8
Closed mouth Jars	11.9
Funnel necked Jars	17.6
Pitchers and Jugs	10.8
Squat Jars	12.5
Bowls	13.2
Cups	4.0
Plates	1.3
(n)	(973)

Table 2

FREQUENCY DISTRIBUTION OF VESSEL TYPES

Vessel Type	%
Craters	28.2
Pots	39.5
Jugs	29.5
Platters	0.5
Cups	1.2
Lids	0.2
Lamps	0.2
Flasks	0.7
(n)	(1,000)

Table 3

FREQUENCY DISTRIBUTION OF BASE TYPES

Base Type	%
Nipple	10.0
Flat	16.7
Flat Disk	23.3
Concave Disk	36.7
Ring Foot	13.3
(n)	(30)

Table 4

FREQUENCY DISTRIBUTION OF HANDLE TYPES

Handle Type	%
Round Strand	9.0
Double Strand	10.3
Square Strap	19.2
Wide Strap	6.4
Oval Strap	9.0
Lug	6.4
Ring	2.6
Blind Loop	11.5
Unspecified	25.6
(n)	(78)

Table 5
FREQUENCY DISTRIBUTION OF RIM DIAMETER

Diameter	%
5 cm. or less	1.2
6–10 cm.	7.9
11–15 cm.	16.5
16–25 cm.	37.6
26–35 cm.	21.3
36–50 cm.	14.6
More than 50 cm.	0.9
(n)	(968)

Table 6
FREQUENCY DISTRIBUTION OF SHERD THICKNESS

Body Thickness	%
0.3 cm. or less	3.9
0.4–0.5 cm.	24.6
0.6–1.0 cm.	56.6
1.1–2.0 cm.	14.2
2.1–4.0 cm.	0.8
More than 4.0 cm.	—
(n)	(1,313)

Table 7
FREQUENCY DISTRIBUTION OF SHERD WARE

Ware	%
Pink Buff	63.9
Yellow Cream	24.3
White Paste	2.6
Grey Mica	2.4
Heavy Grog	4.6
Red Brown	1.8
Yellow Biscuit	0.2
Straw Temper	0.2
(n)	(1,125)

Table 8
FREQUENCY DISTRIBUTION OF SHERD FINISH

Finish Type	Outside	Inside
	%	%
Plain	82.5	85.9
Burnished	1.7	0.7
Pared	0.3	—
Slopped Slip	1.0	—
Slip Painted	6.9	5.1
Bitumen	—	0.2
Glazed	7.3	8.0
Real Slip	0.3	0.1
(n)	(1,150)	(1,150)

Table 9
FREQUENCY DISTRIBUTION OF SHERD GLAZES

Glaze Type	Outside	Inside
	%	%
Monochrome	88.9	93.5
Polychrome	2.2	2.2
Underglaze Paint	6.7	4.3
Other	2.2	—
(n)	(90)	(92)

Table 10
FREQUENCY DISTRIBUTION OF SHERD PROFILE
(% of sherds having profile portions noted)

Profile Portion	%
Rim Top	73.9
Outside Rim	73.9
Neck	75.2
Body	26.7
Carination	0.8
Belly	2.3
Base	2.3
(n = 1,320)	

Table 11

FREQUENCY DISTRIBUTION OF SITE DATES

(% of sherds coming from sites occupied at time noted)

Date	%
Seleucid	18.0
Early Parthian	62.3
Late Parthian	64.8
Sasanian	99.4
Early Islamic	75.0
Abbasid	24.4
Late Abbasid	12.2
Seljuq	10.7
Mongol	8.9
(n = 1,430)	

Table 12

FREQUENCY DISTRIBUTION OF SHERD DATES

Date	%
Early-Late Parthian	9.4
Late Parthian	7.4
Partho-Sasanian	15.4
Sasanian	40.9
Early Islamic	12.1
Other	14.8
(n)	(149)[a]

[a] Note that this figure is only 10% of all the sherds—1,285 sherds are not dated.

Table 13

FREQUENCY DISTRIBUTION OF SHERD DECORATIONS

Decoration	Total %	Zonal Portions of Sherds: Inside	Rim Top	Outside Rim	Neck	Body	Carination	Belly	Base	Handle
Grooved	28.1	66.7	28.6	60.7	36.7	20.4	—	33.3	—	—
Scratched	11.3	—	—	—	5.3	16.6	50.0	—	—	—
Combed	21.3	33.3	21.4	14.3	18.1	24.5	—	—	—	—
Impressed	13.1	—	42.9	10.7	11.2	12.7	50.0	66.7	—	—
Ribbed	17.0	—	7.1	14.3	23.9	14.3	—	—	—	—
Stamped	5.7	—	—	—	3.2	8.3	—	—	—	—
Appliquéd	3.4	—	—	—	1.6	3.2	—	—	—	100.0
(n)	(558)[a]	(3)	(14)	(28)	(188)	(314)	(2)	(3)	(0)	(6)

[a] The n-value of 558 is not 558 individual sherds but 558 portions of sherds with decorations—a single sherd may have decoration in more than one zone and each decoration would be included in the total of 558. There are in fact 513 sherds that are decorated.

Table 14

PERCENTAGE OF SHERDS IN GEOGRAPHICAL REGIONS

Region	% of Sherds
Qal'eh-i Yazdigird	30.2
Diyala	22.6
Fars	20.5
Jibal	20.3
Hatra	3.3
Elymais	3.1
(n)	(1,434)

APPENDIX C

Table 15

RELATIONSHIP BETWEEN SHERD PROFILE PORTIONS PRESENT AND GEOGRAPHICAL REGIONS

Geographical Region	n	Portion Present: Rim Top	Outside Rim	Neck	Body	Carination	Belly	Base
Qal'eh-i Yazdigird	533	84.4	84.4	83.3	82.6	0.6	1.3	0.9
Diyala	258	59.7	59.7	65.5	60.9	1.9	6.6	6.6
Jibal	167	72.5	72.5	74.9	67.1	—	—	—
Elymais	37	56.8	56.8	54.1	64.9	—	5.4	8.1
Fars	295	71.5	71.5	72.5	72.2	0.3	1.0	1.0
Hatra	30	63.3	63.3	70.0	70.0	3.3	3.3	6.7
Total	1,320	73.9	73.9	75.2	73.3	0.8	2.3	2.3
	p[a]	.001	.001	.001	.001	n.s.[d]	.001	.001
	V[b]	.224	.224	.179	.192	.087	.155	.174
	C[c]	.218	.218	.176	.189	.086	.153	.172

[a] The value given here is a measure of the statistical significance of the relationship based on the chi-square statistic. Statistical significance at the .001 level can be interpreted as less than 0.1% possibility of making an error when we say that the relationship noted between the two variables is not due to chance; i.e., that it would recur should another sample be selected.

[b] V refers to Cramer's V, a measure of the strength of association between two variables. The measure varies from 0.0 to 1.0—values closer to 1.0 denote stronger associations.

[c] C refers to the contingency coefficient, another measure of the strength of association. The coefficient is derived directly from the value of the chi-square statistic and is therefore not independent of the size of the table being investigated. This fact makes comparisons of the value of C across differing sized tables much more difficult.

[d] n.s. is an abbreviation for not significant.

Table 16

RELATIONSHIP BETWEEN RIM SHAPE OF SHERDS AND GEOGRAPHICAL REGION

Rim Shape	Total	Qal'eh-i Yazdigird	Diyala	Jibal	Elymais	Fars	Hatra
Thick Rimmed Basin	12.9	10.9	10.5	15.7	14.3	18.6	—
Heavy Rimmed Jar	15.7	22.9	13.7	15.7	—	4.8	—
Closed Mouthed Jar	11.9	11.6	11.1	14.9	14.3	8.1	47.4
Funnel Necked Jar	17.6	19.8	18.3	17.4	4.8	14.8	5.3
Pitchers and Jars	10.8	6.9	9.8	14.0	23.8	16.2	15.8
Squat Jar	12.5	15.6	6.5	10.7	9.5	12.4	5.3
Bowl	13.2	8.9	18.3	9.9	19.0	18.6	26.3
Cups	4.0	1.6	11.1	0.8	14.3	5.2	—
Plate	1.3	1.8	0.7	0.8	—	1.4	—
	(973)	(449)	(153)	(121)	(21)	(210)	(19)
		$p < .001$		$V = .181$		$C = .376$	

Table 17
RELATIONSHIP BETWEEN RIM DIAMETER OF SHERDS AND GEOGRAPHICAL REGIONS

Diameter	Total	Qal'eh-i Yazdigird	Diyala	Jibal	Elymais	Fars	Hatra
5 cm. or less	1.2	0.7	1.9	0.9	—	1.4	9.5
6–10 cm.	7.9	5.0	7.6	8.6	20.8	9.1	38.1
11–15 cm.	16.5	11.8	30.4	11.2	20.8	17.2	28.6
16–25 cm.	37.6	42.3	31.6	31.0	25.0	38.8	23.8
26–35 cm.	21.3	22.5	19.6	24.1	25.0	20.1	—
36–50 cm.	14.6	15.9	8.9	24.1	8.3	12.9	—
51 cm. plus	0.9	1.8	—	—	—	0.5	—
	(968)	(440)	(158)	(116)	(24)	(209)	(21)
		$p < .001$		$V = .153$		$C = .323$	

Table 18
RELATIONSHIP BETWEEN SHERD SIZE AND GEOGRAPHICAL REGION

Size	Total	Qal'eh-i Yazdigird	Diyala	Jibal	Elymais	Fars	Hatra
Tiny	0.2	—	—	—	5.1	0.3	—
Small	61.5	55.5	55.2	45.6	82.1	81.3	87.5
Medium	36.7	43.9	41.8	48.5	12.8	18.3	12.5
Large	1.5	0.6	3.0	5.3	—	—	—
Very Large	0.1	—	—	0.6	—	—	—
	(1,343)	(535)	(268)	(169)	(39)	(300)	(32)
		$p < .001$		$V = .179$		$C = .337$	

Table 19
RELATIONSHIP BETWEEN SHERD THICKNESS AND GEOGRAPHICAL REGION

Thickness	Total	Qal'eh-i Yazdigird	Diyala	Jibal	Elymais	Fars	Hatra
0.3 cm. or less	3.9	0.9	7.1	3.6	7.9	6.5	—
0.4–0.5 cm.	24.6	9.2	24.7	23.6	60.5	44.5	63.3
0.6–1.0 cm.	56.6	67.4	58.4	52.7	28.9	43.2	36.7
1.1–2.0 cm.	14.2	21.6	8.6	19.4	2.6	5.5	—
2.1–4.0 cm.	0.8	0.9	1.2	0.6	—	0.3	—
	(1,313)	(533)	(255)	(165)	(38)	(292)	(30)
		$p < .001$		$V = .216$		$C = .397$	

Table 20
RELATIONSHIP BETWEEN SHERD WARE AND GEOGRAPHICAL REGION

Ware	Total	Qal'eh-i Yazdigird	Diyala	Jibal	Elymais	Fars	Hatra
Pink Buff	63.9	78.6	27.5	80.7	57.1	74.1	64.7
Yellow Cream	24.3	3.8	64.5	9.9	28.6	13.4	35.3
Heavy Grog	4.6	13.7	—	3.5	2.4	2.6	—
White Paste	2.6	2.7	3.7	2.9	—	2.0	—
Grey Mica	2.4	1.1	0.7	0.6	—	6.1	—
Red Brown	1.9	—	2.6	2.3	11.9	1.5	—
Yellow Biscuit	0.2	—	0.7	—	—	—	—
Straw Temper	0.2	—	0.4	—	—	0.3	—
	(1,125)	(262)	(273)	(171)	(42)	(343)	(34)
		$p^a < .001$		V = .290		C = .545	

[a] The relationship remains significant at the .001 level when ware is recoded into four categories: pink buff, yellow cream, heavy grog, and other.

Table 21
RELATIONSHIP BETWEEN SHERD FINISH AND GEOGRAPHICAL REGION

Finish	Total	Qal'eh-i Yazdigird	Diyala	Jibal	Elymais	Fars	Hatra
			Outside of Sherd				
Plain	82.5	98.9	82.2	91.5	58.1	69.5	79.4
Slip Painted	6.9	0.4	0.7	—	11.6	20.1	—
Glazed	7.3	0.8	12.8	4.0	11.6	7.9	17.6
Burnished	1.7	—	0.4	2.3	16.3	2.3	—
Pared	0.3	—	0.4	1.1	—	—	—
Slopped Slip	1.0	—	3.6	0.6	—	—	—
Real Slip	0.3	—	—	0.6	2.3	0.3	2.9
	(1,150)	(261)	(281)	(177)	(43)	(354)	(34)
		$p^a < .001$		V = .229		C = .456	
			Inside of Sherd				
Plain	85.9	98.1	86.1	94.9	76.7	74.3	76.5
Glazed	8.0	1.1	12.8	4.5	9.3	9.9	17.6
Burnished	0.7	—	—	0.6	14.0	0.3	—
Slip Painted	5.1	0.4	0.7	—	—	15.5	2.9
Bitumen	0.2	0.4	0.4	—	—	—	—
Real Slip	0.1	—	—	—	—	—	2.9
	(1,150)	(261)	(281)	(177)	(43)	(354)	(34)
		$p^b < .001$		V = .229		C = .456	

[a] The relationship remains significant at the .001 level when finish is recoded into four categories: plain, painted, glazed, and other.

[b] The relationship remains significant at the .001 level when finish is recoded into three categories: plain, glazed, and other.

Table 22
RELATIONSHIP BETWEEN SHERD GLAZE AND GEOGRAPHICAL REGION

Glaze Type	Total	Qal'eh-i Yazdigird	Diyala	Jibal	Elymais	Fars	Hatra
			Outside of Sherd				
Monochrome	88.9	100.0	89.5	71.4	100.0	87.1	100.0
Polychrome	2.2	—	5.3	—	—	—	—
Underglaze Paint	6.7	—	—	28.6	—	12.9	—
Other	2.2	—	5.3	—	—	—	—
	(90)	(2)	(38)	(7)	(6)	(31)	(6)
		n.s.		V = .245		C = .391	
			Inside of Sherd				
Monochrome	93.5	100.0	94.4	87.5	100.0	91.4	100.0
Polychrome	2.2	—	5.6	—	—	—	—
Underglaze Paint	4.3	—	—	12.5	—	8.6	—
	(92)	(3)	(36)	(8)	(4)	(35)	(6)
		n.s.		V = .209		C = .283	

Table 23
RELATIONSHIP BETWEEN BASE TYPES AND GEOGRAPHICAL REGION

Base Type	Total	Qal'eh-i Yazdigird	Diyala	Elymais	Fars	Hatra
Nipple	10.0	—	17.6	—	—	—
Flat	16.7	—	11.8	—	100.0	—
Flat Disk	23.3	20.0	29.4	—	—	50.0
Concave Disk	36.7	60.0	29.4	66.7	—	50.0
Ring Foot	13.3	20.0	11.8	33.3	—	—
	(30)	(5)	(17)	(3)	(3)	(2)
		n.s.		V = .444		C = .664

Table 24
RELATIONSHIP BETWEEN HANDLE TYPE AND GEOGRAPHICAL REGION

Handle Type	Total	Qal'eh-i Yazdigird	Diyala	Jibal	Elymais	Fars	Hatra
Square Strap	19.2	—	32.3	44.4	—	—	20.0
Double Strand	10.3	11.8	16.1	—	—	—	20.0
Round Strand	9.0	23.5	6.5	—	—	—	20.0
Blind Loop	11.5	17.6	16.1	—	—	7.7	—
Wide Strap	6.4	—	3.2	11.1	—	23.1	—
Oval Strap	9.0	5.9	3.2	22.2	66.7	7.7	—
Lug	6.4	—	—	11.1	33.3	23.1	—
Ring	2.6	5.9	—	—	—	7.7	—
Other/Unknown	25.6	35.3	22.6	11.1	—	30.8	40.0
	(78)	(17)	(31)	(9)	(3)	(13)	(5)
		$p^a < .005$		$V = .418$		$C = .683$	

[a] Statistical significance is lost when handle types are recoded to eliminate the empty cells in the table.

Table 25
RELATIONSHIP BETWEEN VESSEL TYPE AND GEOGRAPHICAL REGION

Vessel Type	Total	Qal'eh-i Yazdigird	Diyala	Jibal	Elymais	Fars	Hatra
Crater	28.2	22.3	29.6	27.0	40.0	39.0	27.8
Pot	39.5	51.9	26.1	36.5	30.0	26.8	55.6
Jug	29.5	23.7	42.2	31.3	25.0	30.2	16.7
Platter	0.5	—	0.5	0.9	—	1.5	—
Cup	1.2	0.7	0.5	3.5	5.0	1.5	—
Lid	0.2	—	0.5	0.9	—	—	—
Lamp	0.2	—	0.5	—	—	0.5	—
Flask	0.7	1.4	—	—	—	0.5	—
	(1,000)	(443)	(199)	(115)	(20)	(205)	(18)
		$p^a < .001$		$V = .140$		$C = .299$	

[a] The relationship remains significant at the .001 level when vessel type is recoded into four categories: crater, pot, jug, and other.

Table 26
RELATIONSHIP BETWEEN SHERD DECORATION AND GEOGRAPHICAL REGION

Decoration Style	Total	Qal'eh-i Yazdigird	Diyala	Jibal	Elymais	Fars	Hatra
Grooved	27.1	26.5	21.6	26.0	43.8	31.4	35.3
Scratched	10.9	6.5	15.5	13.5	12.5	11.4	—
Combed	20.9	21.3	12.9	20.2	18.8	31.4	11.8
Impressed	13.5	18.1	19.0	7.7	—	7.6	17.6
Ribbed	18.1	25.8	14.7	18.3	—	16.2	—
Stamped	5.8	—	11.2	9.6	6.2	1.0	29.4
Appliquéd	3.7	1.9	5.2	4.8	18.8	1.0	5.9
	(513)	(155)	(116)	(104)	(16)	(105)	(17)
		$p < .001$		$V = .196$		$C = .401$	

Table 27
RELATIONSHIP BETWEEN EXISTENCE OF DECORATION AND GEOGRAPHICAL REGION

Is Sherd Decorated?	Total	Qal'eh-i Yazdigird	Diyala	Jibal	Elymais	Fars	Hatra
Yes	35.8	28.5	41.3	58.8	37.2	29.5	50.0
No	64.2	71.5	58.7	41.2	62.8	70.5	50.0
	(1,434)	(543)	(281)	(177)	(43)	(356)	(34)
		$p < .001$		$V = .214$		$C = .210$	

Table 28
RELATIONSHIP BETWEEN SHERD DATE AND GEOGRAPHICAL REGION

Sherd Date	Total	Qal'eh-i Yazdigird	Diyala	Jibal	Fars	Hatra
Early/Late Parthian	9.4	—	22.0	8.3	—	—
Late Parthian	7.4	—	5.1	—	—	88.9
Partho-Sasanian	15.4	74.2	—	—	—	—
Sasanian	40.9	—	27.1	91.7	89.5	—
Early Islamic	12.1	25.8	15.3	—	2.6	—
Other	14.8	—	30.5	—	7.9	11.1
	(149)	(31)	(59)	(12)	(38)	(9)
		$p^a < .001$		$V = .596$		$C = .639$

[a] Values of p, V and C are virtually worthless here because of the large number of empty cells.