Prehistoric archaeology. The site of Garba IV

The lithic industry of Level D.

Tools on pebble and percussion material

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Tools on pebble

Choppers

Of the 886 choppers identified in the general catalogue, 175 (19.75%) have been studied in detail. The data on the typology and typometry are drawn exclusively from the inventory of the analyzed pieces. The data from the general catalogue have been considered only for the general distribution of raw materials.

Raw material

It is interesting to note that, with very rare exceptions, there are no choppers made on obsidian pebbles. The functional destination of the choppers may have required, in most cases, the utilization of basalt because of the greater resistance of this raw material compared to obsidian. Also the other volcanic rocks, less resistant than basalt, appear to be usually neglected in this tool category.

Furthermore, although agreeing with the hypothesis that many choppers may be considered to be really cores, such selection of raw materials indicates a real intentionality in the production of tools on pebble with a specific function, such as particular cutting activities.

In the case of the choppers, this required a tool characterized by a great robustness, in addition to the resistance of the cutting edge or edges.

The definition of chopper/core often attributed to this kind of tool should therefore be limited only to the cases for which it is possible to exclude a different functional destination. Tab. 1 reports the frequencies of the different raw materials employed in the production of choppers.

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Morpho-technical and typometrical aspects

Obsidian

The three obsidian choppers analyzed comprise two distal and one transversal choppers.

They are all characterized by a limited number of removals on both faces. Two of them present two removals on face A and one removal on face B, the other has three removals on face A and one removal on face B. The vertical profile of the cutting edge is always straight, while the lateral profile is in one case rectilinear, in two cases convex.

Raw material	**Catalogue**		**Studied material**	
	N	%	N	%
Obsidian	19	2.14	3	1.71
Basalt	801	90.41	166	94.86
Trachyte	19	2.14		
Trachybasalt	35	3.95	3	1.71
Rhyolite	2	0.23	2	1.14
Tuff	9	1.02	1	0.57
Others	1	0.11		
Total	**886**		**175**	

Tab. 1. Frequency of the different raw materials utilized for choppers.

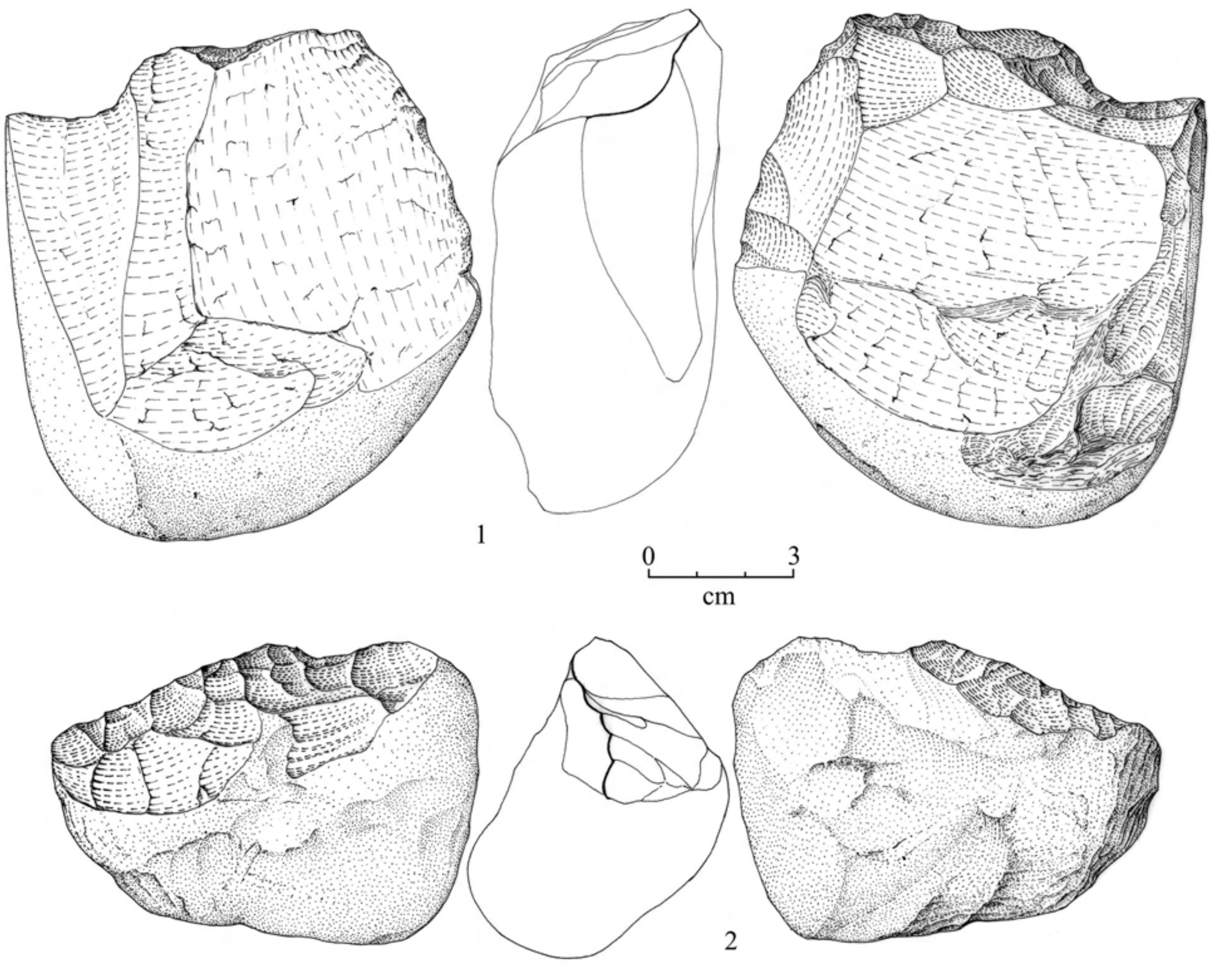


Fig. 1. Garba IV D. 1: lateral-distal bifacial chopper (MK 2784); 2: lateral bifacial chopper (MK 9866). Basalt.
Drawings by M. Pennacchioni

Cortex is present over the entire dorsal surface.

The dimensions, the weight, the angle, and the length of the cutting edge are indicated in Tab. 2.

Length	Width	Thickness	Weight	Angle of the cutting edge	Length of the cutting edge
76	58	46	230	74	33
55	55	42	133	80	40
68	56	39	177	82	40

Tab. 2. Dimensions and weight of obsidian choppers.

Other volcanic rocks

As indicated in Tab. 3, there is a fairly good typological variability among the choppers, although, most of them are lateral (41.28%) and distal (33.72%) choppers.

Choppers	N	%
Lateral	71	41.28
Distal	58	33.72
Transversal	9	5.23
Double	5	2.91
Pointed	3	1.74
Lateral-distal	9	5.23
Peripheral	4	2.33
Roughly shaped	13	7.56
Total	**172**	

Tab. 3. Typological variability of choppers.

There are more bifacial choppers (77.16%) than unifacial ones, while choppers with alternate removals are very rare (Tab. 4).

Choppers	Unifacial		Bifacial		Alternate	
	N	%	N	%	N	%
Lateral	14	35.00	56	44.09	1	20.00
Distal	14	35.00	42	33.07	2	40.00
Transversal			8	6.30	1	20.00
Double	2	5.00	3	2.36		
Pointed	2	5.00	1	0.79		
Lateral-distal	1	2.50	8	6.30		
Peripheral	1	2.50	3	2.36		
Roughly shaped	6	15.00	6	4.72	1	20.00
Total	**40**		**127**		**5**	

Tab. 4. Frequency of different types of unifacial, bifacial and alternate choppers.

Lateral choppers

The lateral choppers are the most common type with 71 specimens out of 172 choppers analyzed (Fig. 1, *2*). Fifty-six lateral choppers are bifacial, 14 are unifacial, and only one is alternate.

Number of removals on face A and on face B

Of the 14 unifacial choppers, five present three removals, nine present four or more removals. Of these, only two are characterized by two series of removals.

On face A of the 56 bifacial lateral choppers, ten present two removals, 15 present three removals and 31 choppers four or more removals. On face B 11 present only one removal, 16 present two removals, 18 present three removals, the remaining 11 present four or more removals. Two are characterized by two series of removals, one by three or more series.

The ratio between the number of removals on face A and those on face B in the bifacial choppers is indicated in Tab. 5 and suggests a higher frequency of choppers whose cutting edge has been obtained with relatively numerous removals on both faces (>3/3: 25%; >3/>3: 17.86%). The only alternate lateral chopper presents three removals on face A and only one removal on face B.

Removals A/B	**N**	**%**
2/1	5	8.93
2/2	3	5.36
2/3	1	1.79
2/>3	1	1.79
3/1	3	5.36
3/2	9	16.07
3/3	3	5.36
>3/1	3	5.36
>3/2	4	7.14
>3/3	14	25.00
>3/>3	10	17.86
Total	**56**	

Tab. 5. Number of removals on both faces (A/B) of bifacial choppers.

Vertical profile of the cutting edge

The unifacial lateral choppers present in five cases a sinuous profile of the cutting edge, in nine cases it is straight. The bifacial lateral choppers are characterized in most cases (48) by a sinuous cutting edge, in the other eight cases by a straight cutting edge. The alternate lateral chopper presents a sinuous profile of the cutting edge.

Lateral profile of the cutting edge

Among the unifacial lateral choppers one presents a rectilinear lateral profile of the cutting edge, for six it is convex, for three sinuous, for three others roof-shaped, one is irregular.

The bifacial lateral choppers are characterized in two cases by a rectilinear outline, in one case by a concave one, in 27 cases convex, in five cases sinuous, in six cases roof-shaped, and in 15 cases by an irregular outline. The only alternate lateral chopper has a convex lateral profile of the cutting edge.

Extension and localization of the cortex

In most cases (49) the cortex is total; in 15 cases the lateral choppers present the base with cortex, in two cases the cortex is localized laterally, in one case it is interrupted by isolated removals, in four cases by several removals.

Typometry

With the exclusion of a bifacial lateral chopper and of the alternate one (length: 76 mm; width: 85 mm; thickness: 63 mm; weight: 330 g) the metrical data refer to the choppers in the studied sample.

Length, width, thickness and weight

Regardless of the uni- or bifacial character, the length of most of the lateral choppers (82.61%) is between

61 mm and 110 mm with very few artefacts outside this range of variability and with a mean of 91.5 mm for the unifacial lateral choppers and of 83.47 mm for the bifacial ones.

Some 85.71% of the unifacial lateral choppers (mean 108.36 mm) and 76.37% of the bifacial ones (mean 92.91 mm) have a width between 81 mm and 110 mm.

The thickness of 81.16% of the uni- and bifacial choppers is between 41 mm and 70 mm with a mean of 63.5 mm.

The weight of the blanks is not uniformly distributed between the minimum (101 g) and maximum (3000 g) values with a mean of 707.5 g for the unifacial choppers and of 596.54 g for the bifacial ones. More than 50% of the unifacial lateral choppers are between 601 g and 800 g (Tab. 6).

These values are very close to those reported for the unmodified pebbles at Garba IV.

Weight (g)	**Unifacial**		**Bifacial**		**Total**	
	N	%	N	%	N	%
101\200			4	7.27	4	5.80
201\300	1	7.14	8	14.55	9	13.04
301\400	2	14.29	11	20.00	13	18.84
401\500			8	14.55	8	11.59
501\600			3	5.45	3	4.35
601\700	6	42.86	4	7.27	10	14.49
701\800	2	14.29	2	3.64	4	5.80
801\900	1	7.14	6	10.91	7	10.14
901\1000	1	7.14	2	3.64	3	4.35
1001\2000	1	7.14	6	10.91	7	10.14
2001\3000			1	1.82	1	1.45
Total	**14**		**55**		**69**	

Tab. 6. Distribution of weight of lateral choppers.

Length and angle of the cutting edge

The length of the cutting edge is greater for the unifacial lateral choppers than for the bifacial ones. Thus 35.71% of the former have a cutting edge between 141 mm and 150 mm (mean: 126.43 mm) compared to 61.83% of the bifacial ones with the length of the cutting edge between 81 mm and 130 mm (mean: 108.24 mm).

The value of the angle of the cutting edge has been measured on all the unifacial lateral choppers and on 39 of the bifacial ones. In 45.28% of the cases the value is between 81° and 90° with a mean of 83.14° for the unifacial choppers and of 85.38° for the bifacial ones (Tab. 7).

Angle	**Unifacial**		**Bifacial**		**Total**	
	N	%	N	%	N	%
61\70	1	7.14	1	2.56	2	3.77
71\80	6	42.86	12	30.77	18	33.96
81\90	6	42.86	18	46.15	24	45.28
91\100	1	7.14	7	17.95	8	15.09
101\110			1	2.56	1	1.89
Total	**14**		**39**		**53**	

Tab. 7. Value of the angle of the cutting edge of lateral choppers.

Distal choppers

There are 58 distal choppers; 14 of these are unifacial, 42 bifacial and two alternate (Figs. 2; 3, *1*, *3*; 4, *2*).

Number of removals on face A and on face B

Of the 14 unifacial distal choppers three present one removal, six present two removals, four present three removals, one presents more than three removals. In one case it is possible to observe two series of removals.

On face A, of the 42 bifacial distal choppers, six present one removal, 19 present two removals, nine present three removals, eight present more than three removals. On face B 23 present one removal, 11 present two removals, seven present three removals, one presents more than three removals. Two present two series of removals.

The ratio between number of removals on face A and on face B is indicated in Tab. 8 and, in contrast to the lateral choppers, it shows a prevalence of distal choppers with few removals (more than 59% with removals between 1/1 and 2/2).

The two alternate distal choppers present one removal both on face A and on face B.

Removals A/B	N	%
1/1	6	14.29
2/1	11	26.19
2/2	8	19.05
3/1	3	7.14
3/2	2	4.76
3/3	4	9.52
>3/1	3	7.14
>3/2	1	2.38
>3/3	3	7.14
>3/>3	1	2.38
Total	**42**	

Tab. 8. Number of removals on both faces (A/B) of distal choppers.

Vertical profile of the cutting edge

The unifacial distal choppers present a sinuous profile of the cutting edge in eight cases, while in six cases it is straight.

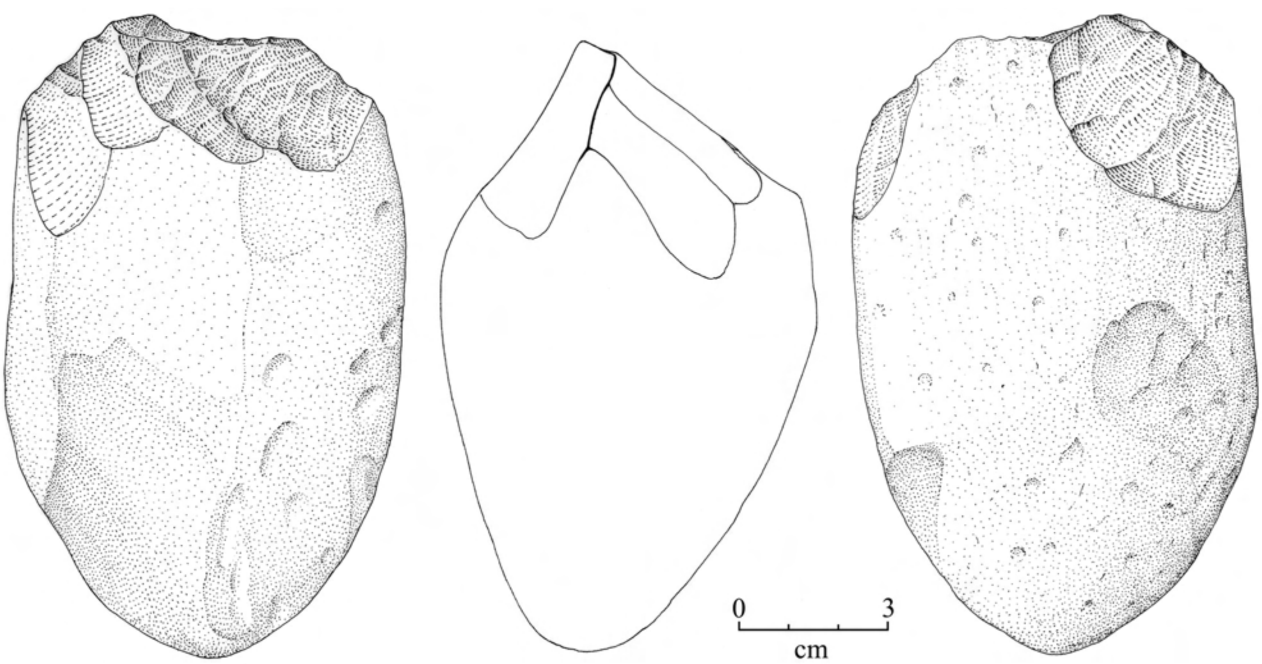


Fig. 2. Garba IV D. Bifacial distal chopper with utilization marks (MK 9266). Basalt. *Drawings by M. Pennacchioni*

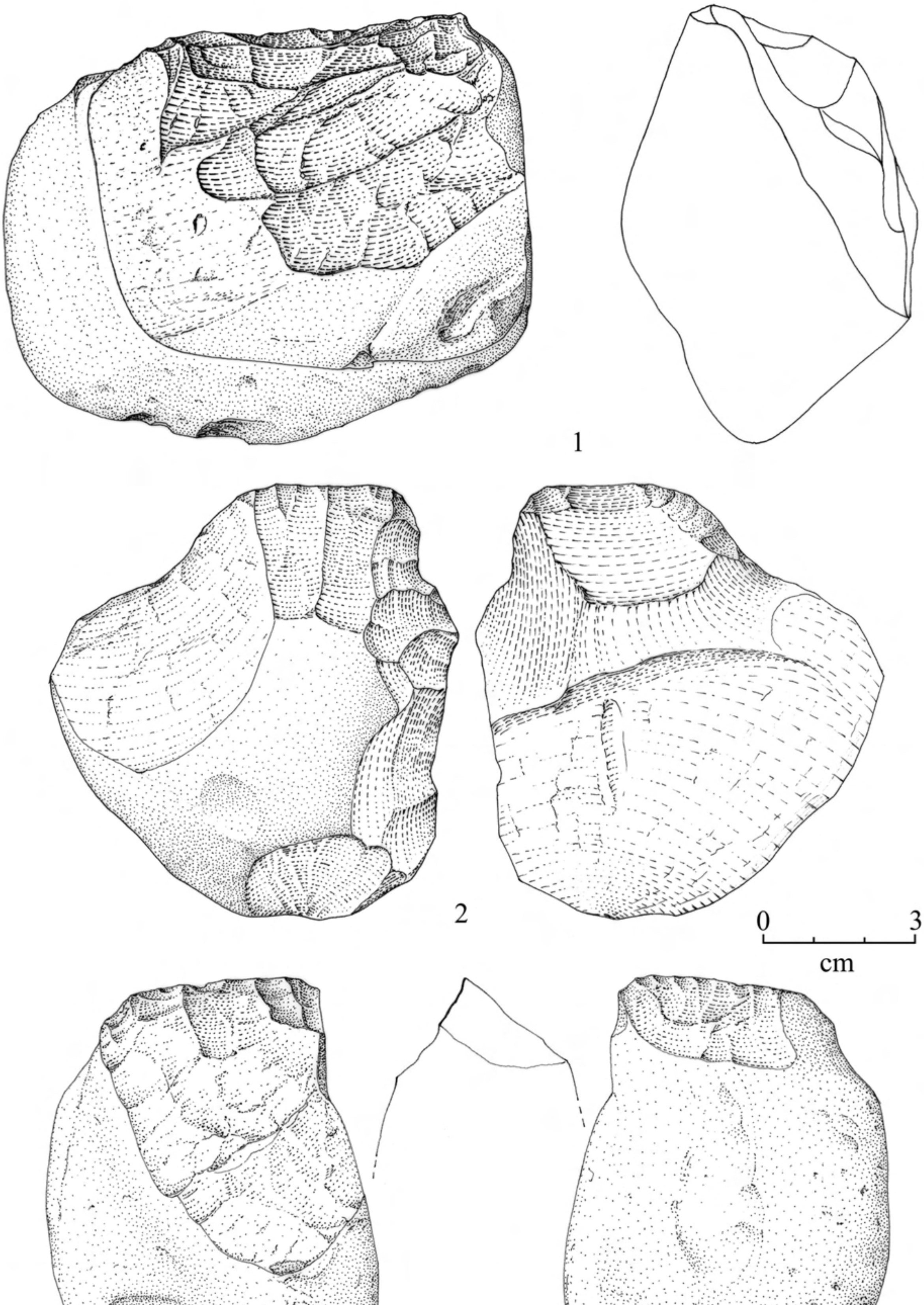


Fig. 3. Garba IV D. 1: distal unifacial chopper (MK 5125); 2: lateral-distal bifacial chopper (MK 2163); 3: distal bifacial chopper (MK 2639). Basalt. *Drawings by M. Pennacchioni*

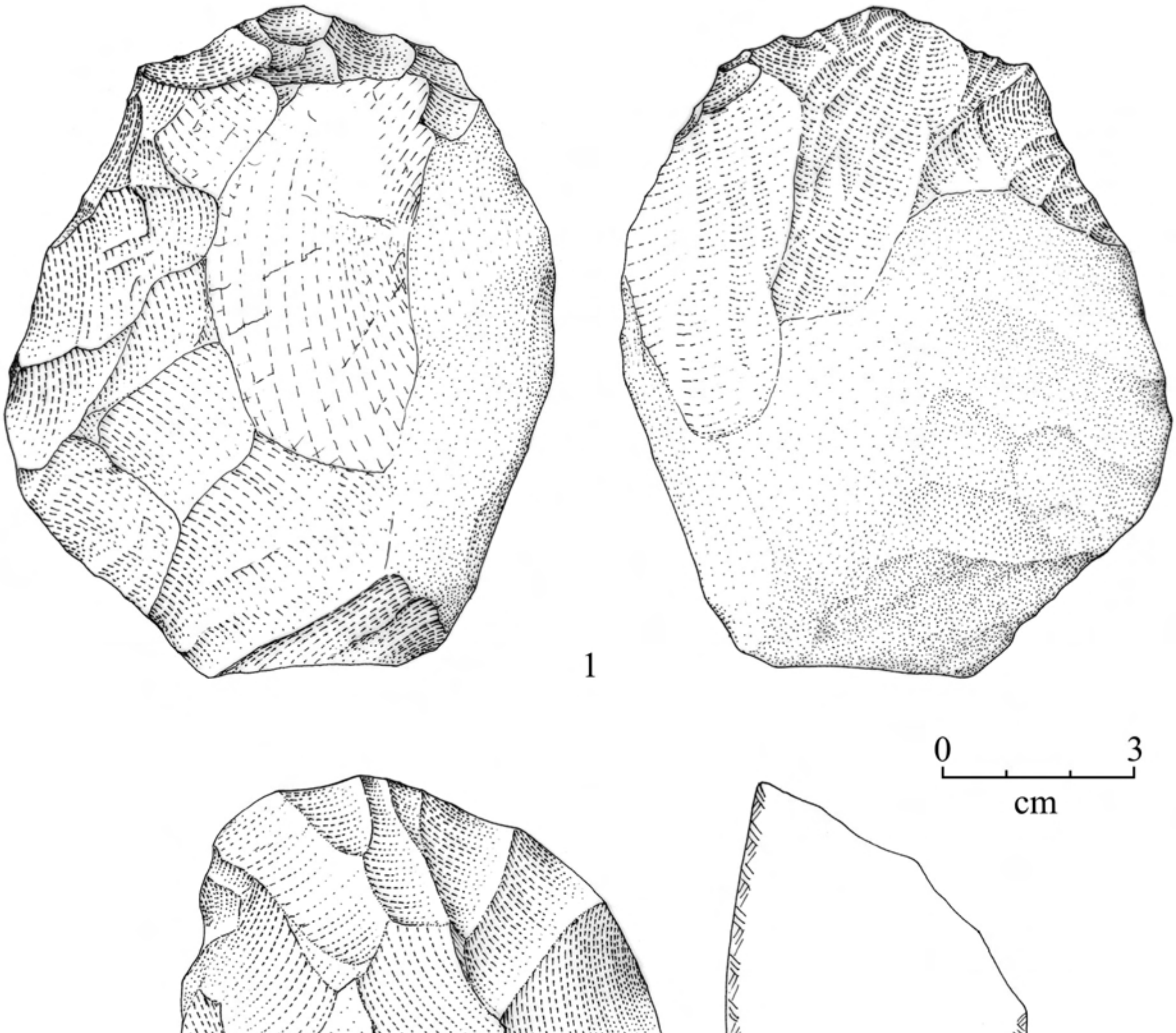


Fig. 4. Garba IV D. 1: lateral-distal bifacial chopper (MK 3989) bilateral-distal unifacial chopper (MK 2138); 2: distal bifacial chopper (MK 2881). Basalt. *Drawings by M. Pennacchioni*

The bifacial distal choppers are characterized in most cases (25) by a sinuous cutting edge, in the other 17 cases by a straight cutting edge. The two alternate distal choppers present a sinuous profile of the cutting edge.

Lateral profile of the cutting edge

Among the unifacial distal choppers three present a rectilinear lateral profile of the cutting edge, in one case it is concave, in two convex, in three sinuous, in one roof-shaped, in one irregular.

The bifacial distal choppers are characterized in 11 cases by a rectilinear profile, in three cases it is concave, in nine cases convex, in eight cases sinuous, in two cases roof-shaped and in nine cases irregular.

The alternate distal choppers have a lateral profile of the cutting edge respectively rectilinear and roof-shaped.

Extension and localization of the cortex

In most cases (49) cortex covers the entire dorsal surface; in two cases only the base has cortex, in five cases the cortex is localized laterally, in one case it is interrupted by isolated removals, in one case by several removals.

Typometry

With the exclusion of one bifacial distal chopper that was not measured and of the two alternate choppers (length: 83-68 mm; width: 87-64 mm; thickness: 63-47 mm; weight: 560-255 g; length of the cutting edge: 70-38 mm; cutting edge angle: 80-78°), the metrical data refer to the sample of analyzed choppers.

Length, width, thickness and weight

The distal choppers are on average slightly longer than the lateral ones. Most of the unifacial ones (78.57%) are between 81 mm and 150 mm long (mean: 90.14 mm). The length of 82.92% of the bifacial ones is between 71 mm and 150 mm (mean: 89.80 mm).

More than half of the unifacial choppers (57.15%) are between 71 mm and 90 mm long (mean: 88.57 mm) while 87.8% of the bifacial ones range between 61 mm and 120 mm (mean: 86.68 mm).

The thickness of most of the pebbles from which uni- and bifacial distal choppers are obtained is between 31 mm and 80 mm with a mean of 53.28 mm for the unifacial ones and of 62.97 mm for the bifacial ones.

The blanks of the distal choppers have a weight ranging between 101 g and more than 1001 g, with a mean of 540 g for the unifacial ones and of 639 g for the bifacial distal choppers (Tab. 9).

Weight (g)	**Unifacial**		**Bifacial**		**Total**	
	N	%	N	%	N	%
101\200	1	7.14	3	7.32	4	7.27
201\300	5	35.71	2	4.88	7	12.73
301\400	1	7.14	6	14.63	7	12.73
401\500	1	7.14	5	12.20	6	10.91
501\600	2	14.29	9	21.95	11	20.00
601\700	1	7.14	5	12.20	6	10.91
701\800	1	7.14	5	12.20	6	10.91
801\900	1	7.14	1	2.44	2	3.64
901\1000	1	7.14	2	4.88	3	5.45
1001\3000			3	7.32	3	5.45
Total	**14**		**41**		**55**	

Tab. 9. Weight of distal choppers.

Length and angle of the cutting edge

The length of the cutting edge, measured on ten unifacial distal choppers and on 40 bifacial ones, is between 31 mm and 80 mm, with a mean of 68.47 mm and with a fairly good number of artefacts presenting an extended cutting edge between 101 mm and 130 mm.

As far as the angle of the cutting edge is concerned, for the 11 unifacial lateral choppers and the 39 bifacial choppers measured, in 90% of the cases, it is between 71° and 100° with a mean of 84,41°.

Transversal choppers

Transversal choppers correspond to the "Chisel choppers" of the Chavaillon classification (see Methodology in this volume). Eight are bifacial transversal choppers, one is alternate.

Number of removals on face A and on face B

One bifacial transversal chopper presents on face A one removal, five present two removals and two present three removals. On face B, two present one removal, six present two removals.

The alternate transversal chopper presents two removals on face A and one on face B.

The ratio between the number of removals on face A and B is indicated in Tab. 10.

Removals A/B	N	%
1/1	1	12.5
2/1	1	12.5
2/2	4	50
3/2	2	25

Tab. 10. Number of removals on both faces (A/B) of transversal choppers.

Vertical profile of the cutting edge

The bifacial transversal choppers present in three cases a sinuous profile of the cutting edge, in five cases it is straight. The alternate transversal chopper has a sinuous profile.

Lateral profile of the cutting edge

Among the bifacial transversal choppers three present a rectilinear lateral profile of the cutting edge, three convex, one sinuous, one irregular. The profile of the alternate transversal chopper is sinuous.

Extension and localization of the cortex

The extension of the cortex is total in all cases.

Typometry

Length, width, thickness and weight

The dimensions and the weight of the alternate transversal chopper are (length: 125 mm; width: 137 mm; thickness: 79 mm; weight: 1760 g; length of the cutting edge: 65 mm; angle of the cutting edge: 87°).

The length of the bifacial transversal choppers ranges from 61 mm to 120 mm, with a mean of 94 mm; the width of 75% of the pieces is between 81 mm and 160 mm with a mean of 96.62 mm.

The thickness of the blanks measures on the average 65.75 mm. The weight is distributed between 301 g and 2000 g, with more than 62.5% between 501 g and 2000 g and with a mean of 780 g.

Length and angle of the cutting edge

The length of the cutting edge has been measured on seven bifacial transversal choppers and it is between 21 mm and 100 mm, with a mean of 48.71 mm. The values obtained for the angle of the cutting edge on four choppers are 85°, 88°, 92°, and 115° respectively.

Double choppers

Two are unifacial, three bifacial.

Number of removals on face A and on face B

The two unifacial double choppers each present three removals on face A and one removal on face B.

Of the three bifacial double choppers, one presents two removals on face A and one on face B, two present three removals on face A and two on face B.

Vertical profile of the cutting edge

The unifacial double choppers present in one case a sinuous profile of the cutting edge, in one case a rectilinear profile. The bifacial double choppers present a sinuous profile.

Lateral profile of the cutting edge

The unifacial double choppers present a convex or sinuous profile. The bifacial choppers present in two cases a convex profile, in one case it is irregular.

Extension and localization of the cortex

The extension of the cortex is total in two cases, in the other cases it is lateral.

Typometry

The values of the length, width, thickness and weight, as well as those of the angle and of the length of the cutting edge are reported in Tab. 11.

	Length	Width	Thickness	Weight	Angle of the cutting edge	Length of the cutting edge
Unifacial	83	70	51	400	95	60 - 50
	81	68	38	280	70	55 - 110
Bifacial	65	51	31	140	90	55 - 60
	85	63	43	270	85	35 - 40
	78	70	48	300	90	60 - 70

Tab. 11. Length, width, thickness, weight, angle and length of the cutting edge of double choppers.

Pointed choppers

Two are unifacial, one bifacial.

Vertical profile of the cutting edge

The unifacial pointed choppers present a sinuous outline of the cutting edge. The bifacial pointed chopper presents a straight outline.

Lateral profile of the cutting edge

The unifacial pointed choppers present a roof-shaped or irregular profile. The bifacial pointed chopper presents a roof-shaped profile.

Extension and localization of the cortex

The extension of the cortex is total.

Typometry

The values of length, width, thickness and weight, as well as those of the angle and the length of the cutting edge are reported in Tab. 12.

	Length	Width	Thickness	Weight	Angle of the cutting edge	Length of the cutting edge
Unifacial	89	104	78	730	80	140
	64	73	48	175	78	120
Bifacial	81	79	76	430	90	105

Tab. 12. Length, width, thickness, weight, angle and length of the cutting edge of pointed choppers.

Lateral-distal choppers

One is unifacial, eight bifacial (Figs. 1, *1*; 3, *2*; 4, *1*).

Number of removals on face A and on face B

The unifacial lateral-distal chopper presents four or more removals on face A. The bifacial lateral-distal choppers present on face A in one case two removals, in three cases three removals, in the other cases four or more removals. On face B there are in two cases one removal, in three cases two removals, in two cases three removals, in one case four or more removals. One presents three or more series of removals.

The ratio between the removals on face A and face B of the bifacial lateral-distal choppers is indicated in Tab. 13.

Removals A/B	N	%
2/1	1	12.5
3/2	3	37.5
>3/1	1	12.5
>3/3	2	25.0
>3/>3	1	12.5

Tab. 13. Number of removals on both faces (A/B) of lateral-distal choppers.

Vertical profile of the cutting edge

The unifacial lateral-distal chopper presents a sinuous profile of the cutting edge. The bifacial lateral-distal choppers present a sinuous profile and only in one case a straight profile.

Lateral profile of the cutting edge

The unifacial lateral-distal chopper presents an irregular profile of the cutting edge. The bifacial lateral-distal choppers present in one case a rectilinear profile, in one case convex, in the other cases irregular.

Extension and localization of the cortex

Cortex extends over the entire dorsal surface except in one case where it occurs laterally.

Typometry

Length, width, thickness and weight

The dimensions and the weight of the unifacial lateral-distal chopper are: length: 125 mm; width: 85 mm; thickness: 71 mm; weight: 840 g. The length of the bifacial lateral-distal chopper varies between 41 mm and 130 mm with a mean of 89.12 mm; the width is between 61 mm and 120 mm with a mean of 86.87 mm. The thickness varies between 31 mm and 90 mm, with a mean of 58.12 mm. The weight of the bifacial lateral-distal chopper varies between 101 g and 1001 g (mean 606.25 g). 50% of them has a weight between 301 and 500 g.

Length and angle of the cutting edge

The values of the length and the angle of the cutting edge of the unifacial lateral-distal chopper are: length of the cutting edge: 130 mm; angle of the cutting edge: 70°. The lengths of the cutting edge of the bifacial lateral-distal chopper are respectively: 47-115 mm, 85-120 mm, 110-55 mm, 100-80 mm, 87 mm, 40-75 mm, 78-55 mm, 40-60 mm. The values of the angle of the cutting edge vary from 71° to 100° with a mean of 87.5°.

Peripheral choppers

One is unifacial, three are bifacial.

Number of removals on face A and on face B

The unifacial peripheral chopper presents four or more removals. All the bifacial peripheral choppers present four or more removals on both face A and on face B.

Vertical profile of the cutting edge

The unifacial peripheral chopper presents a straight profile, while all the bifacial ones present a sinuous profile.

Lateral profile of the cutting edge

The unifacial peripheral chopper presents a sinuous profile. One bifacial peripheral chopper presents a convex profile, the other two an irregular one.

Extension and localization of the cortex

The extension of the cortex is in three cases lateral in one case localized at the base.

Typometry

The values of the length, width, thickness and weight, and those of the angle and the length of the cutting edge are reported in Tab. 14.

	Length	Width	Thickness	Weight	Angle of the cutting edge	Length of the cutting edge
Unifacial	83	61	48	290		140
Bifacial	89	75	49	320	65	270
	89	97	52	450		220
	107	68	47	380	85	260

Tab. 14. Length, width, thickness, weight, angle and length of the cutting edge of peripheral choppers.

Roughly shaped choppers

Six are unifacial, six bifacial, and one alternate.

Number of removals on face A and on face B

Four unifacial roughly shaped choppers present one removal, two present two removals.

Three bifacial roughly shaped choppers present on face A one removal, three present two removals. On face B five present one removal, one presents two removals. The ratio between removals on face A and on face B of bifacial roughly shaped choppers is indicated in Tab. 15. The alternate roughly shaped chopper presents one removal both on face A and on face B.

Removals A/B	N	%
1/1	2	12.5
1/2	1	37.5
2/1	3	12.5

Tab. 15. Number of removals on both faces (A/B) of bifacial roughly shaped choppers.

Vertical profile of the cutting edge

Five unifacial roughly shaped choppers are characterized by a sinuous vertical profile of the cutting edge, one by a straight profile. Four bifacial roughly shaped choppers are characterized by a sinuous vertical profile of the cutting edge, two by a straight profile. The vertical profile of the cutting edge of the alternate roughly shaped chopper is sinuous.

Lateral profile of the cutting edge

Three unifacial roughly shaped choppers are characterized by a rectilinear lateral profile of the cutting edge, two by a concave profile, one by a roof-shaped profile. Two bifacial roughly shaped choppers are characterized by a rectilinear lateral profile of the cutting edge, two by a sinuous profile, two by a roof-shaped profile. The lateral profile of the cutting edge of the alternate roughly shaped chopper is roof-shaped.

Extension and localization of the cortex

The extension of the cortex is total, only in one case it is lateral.

Typometry

Only one unifacial chopper was not measured. The values of the length, width, thickness and weight, as well as those of the angle and the length of the cutting edge are reported in Tab. 16.

	Length	Width	Thickness	Weight	Angle of the cutting edge	Length of the cutting edge
Unifacial	101	95	70	660	87	35
	87	75	62	510	85	47
	118	98	83	1170	88	55
	91	76	57	430	87	45
	58	94	37	240		75
Bifacial	114	83	65	700		
	96	79	75	620	93	40
	77	81	56	370	85	80
	70	110	68	600	90	50
	97	67	63	480	75	70
	80	75	64	370	105	35
Alternate	83	97	61	650		90

Tab. 16. Length, width, thickness, weight, angle and length of the cutting edge of roughly shaped choppers.

Spatial distribution

The spatial distribution of choppers was analysed without regard for their material, since the number of obsidian choppers is meaningless. Many more were found in WS (659, 74.38%) than in ES (227, 25.62%). The highest density in WS lies in the west-central part of its lower half, especially in square 2W/3N (37), while the highest frequency is observable in square 1W/4N (52). In the rest of this sector, as in the upper half of ES, are small areas with higher concentrations, but not significant frequencies. Dispersal increases noticeably in the northernmost part of WS, along its southeastern margin, and especially in the lower half of ES (Plate 1).

Polyhedrons

These artefacts are preferentially made on medium and large sized pebbles. Their multidirectional shaping is often regular producing one or more preferential cutting edges. This would indicate their particular use, without excluding the possibility that some of them may have been real cores before or after their primary use.

All the categories of polyhedrons that are known also at Gombore I have been recognized (prismatic, with preferential cutting edge, with several cutting edges, spherical and pointed), although a precise quantification of the different types was not done.

Raw material

Most of the 51 polyhedrons identified in the general catalogue have been made from basalt pebbles (90.20%), while those of other volcanic rocks are quite rare (Tab. 17). It is also interesting to note that the obsidian polyhedrons are practically absent, with the exception of two that should probably be considered as polyhedral cores. As in the case of the rabots, the avoidance of this raw material seems to suggest some considerations regarding the functional destination of the polyhedrons or at least of most of them.

Raw material	N	%
Obsidian	2	3.92
Basalt	46	90.20
Trachybasalt	2	3.92
Tuff	1	1.96
Total	**51**	

Tab. 17. Frequency of different raw materials utilized for polyhedrons.

Typometry

Of the 51 polyhedrons, 27 have been measured, and none of them is of obsidian. As already mentioned, the dimensions of the polyhedrons tend to be around medium/high values, suggesting a precise selection of pebbles with particular sizes and weight for the preparation of this kind of tool.

Length, width, thickness and weight

Most of the polyhedrons (85.19%) are obtained from pebbles between 81 mm and 120 mm long, with a mean of 97.3 mm (Fig. 5A). Regarding the width, 92.58% of the pieces are between 81 mm and 120 mm with a mean of 90.74 mm (Fig. 5B). The thickness of 88.89% of the polyhedrons is between 61 mm and 100 mm, with a mean of 82.67 mm. The values of the weight appear more uniformly distributed (Fig. 5C) with artefacts between 251 g and 1500 g with a mean of 912.3 g (Fig. 5D).

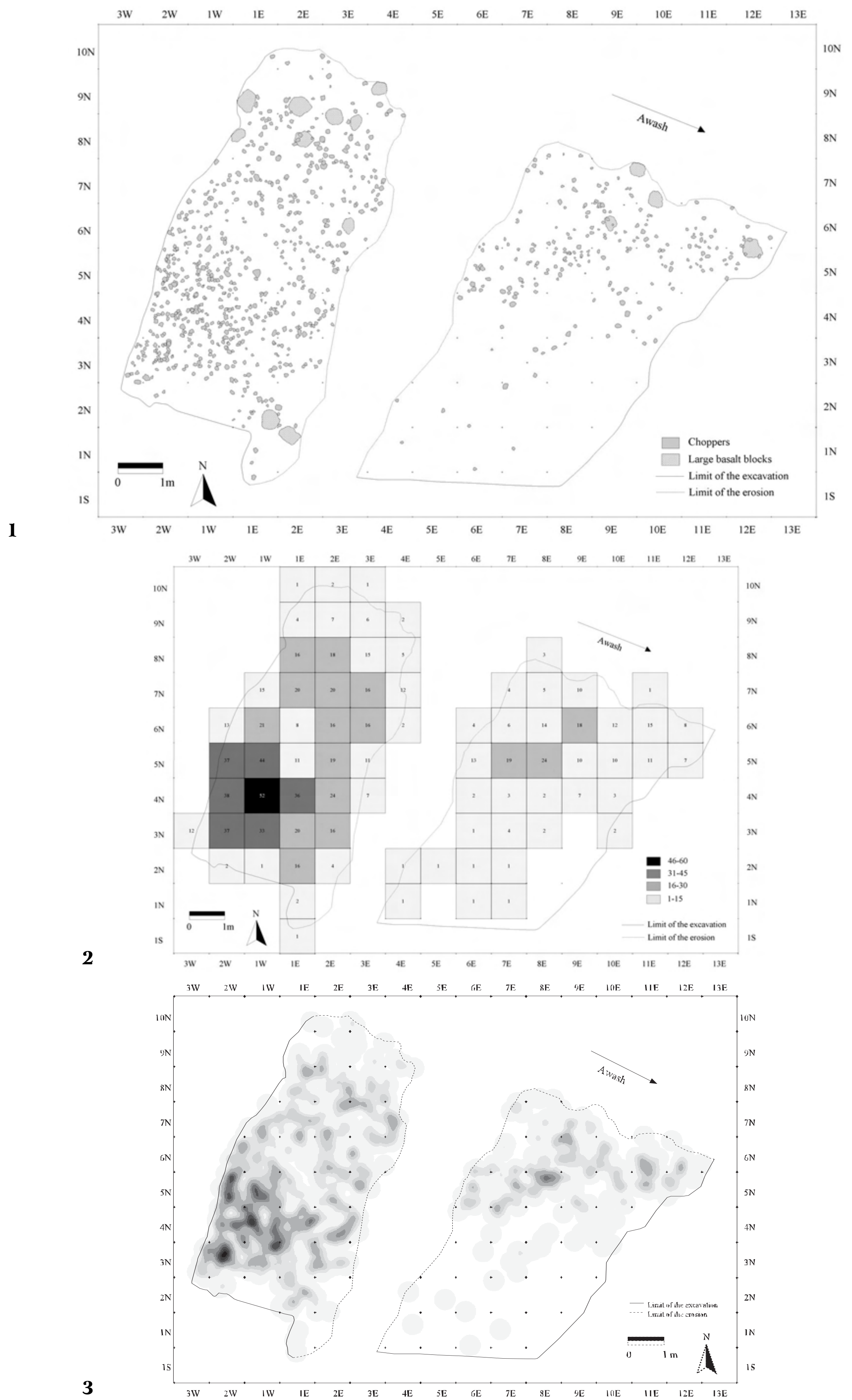


Plate 1. Garba IV D. 1. Plan of choppers. (*Original plan by G. M. Bulgarelli and M. Piperno, digital map by R. Gallotti*) 2. Frequency of choppers. 3. Density areas of choppers.

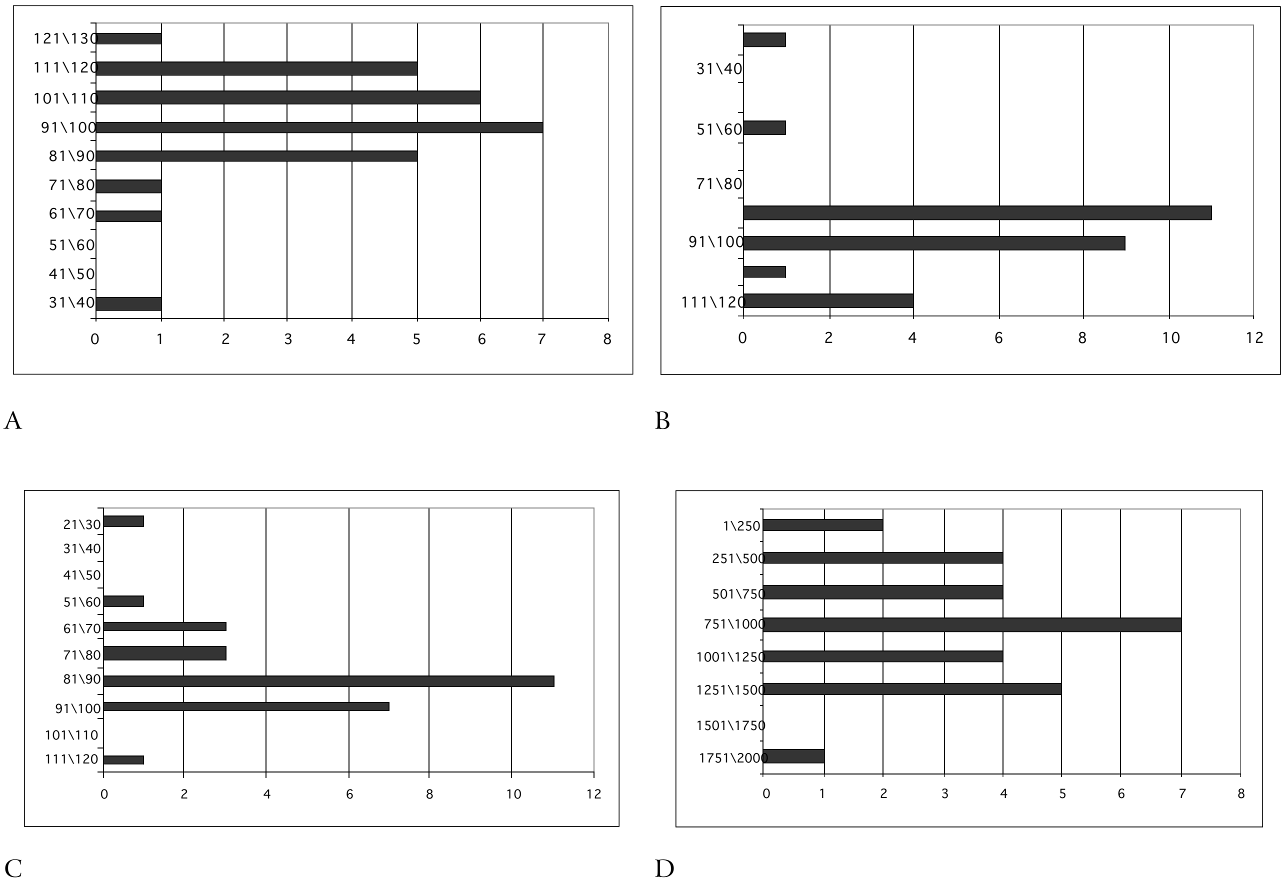


Fig.5. Length (A), width (B), thickness (C) and weight (D) of polyhedrons.

Rabots

This is a relatively frequent tool, and among the most typical ones in the pebble industry of Level D (Figs. 6; 7, *1*, *3*). The differentiation from thick end-scrapers is not always evident (Fig. 7, *2*). Only four of these latter tools have been identified in Level D.

Of the 101 rabots identified, 41 have been studied in detail (40.59%).

All the rabots analyzed are of basalt. Of the 101 rabots reported in the general catalogue 96 are of basalt, three of obsidian, one of trachyte, and one is in the “diverse” category. The almost total absence of obsidian rabots may be easily explained considering the probable functional destination of this tool.

In its general characterization, this artefact on pebble is obtained with a series of two or generally more removals, often of elongated flakes, forming with the striking platform, usually obtained with a previous removal or less frequently completely covered with cortex, an angle close to 90°.

Character of the horizontal plane of the rabot

In most cases (25) the horizontal plane is obtained with a concave removal; in six cases it is a flat removal, in one case a convex removal, in five cases the plane is obtained with a convex removal, in four cases it is a horizontal plane with cortex.

Number of vertical removals on the front of the rabot

Only one rabot presents two removals, four present three removals, nine present four removals and most of them (27) present five or more vertical removals.

Character of the removals

Most of the rabots (30) are characterized by scaled removals, seven by elongated removals and four present removals with various typology.

Position of the front

In 31 cases the position is frontal, in seven lateral-frontal, in three bilatero-frontal.

Outline of the front

In 31 cases the front is arched, in one case it is rectilinear, in nine irregular.

Aspect of the front

In 15 cases the front is continuous, in 26 it is denticulate.

Extension of the cortex

In 20 cases the cortex is total, in 21 cases partial. Seventeen rabots present isolated removals on the surface of the pebble.

Composite tool

In eight cases the rabots are associated to cores, in three cases they are double rabots.

Typometry

Length, width, thickness and weight

The values of the length of the rabots are distributed quite homogeneously in the different classes (Tab. 18) between 71 mm and 150 mm, with a mean of 103.29 mm; artefacts longer than 130 mm should however be considered as exceptional.

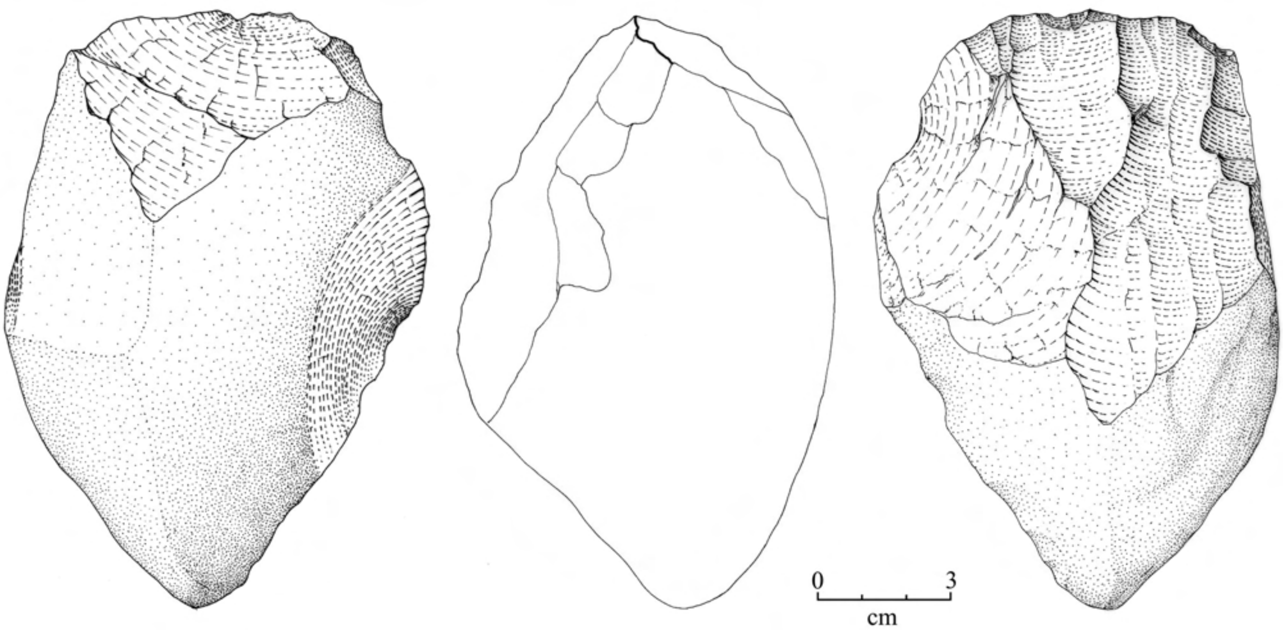


Fig. 6. Garba IV D. Rabot. (MK 8960). Basalt. *Drawings by M. Pennacchioni*

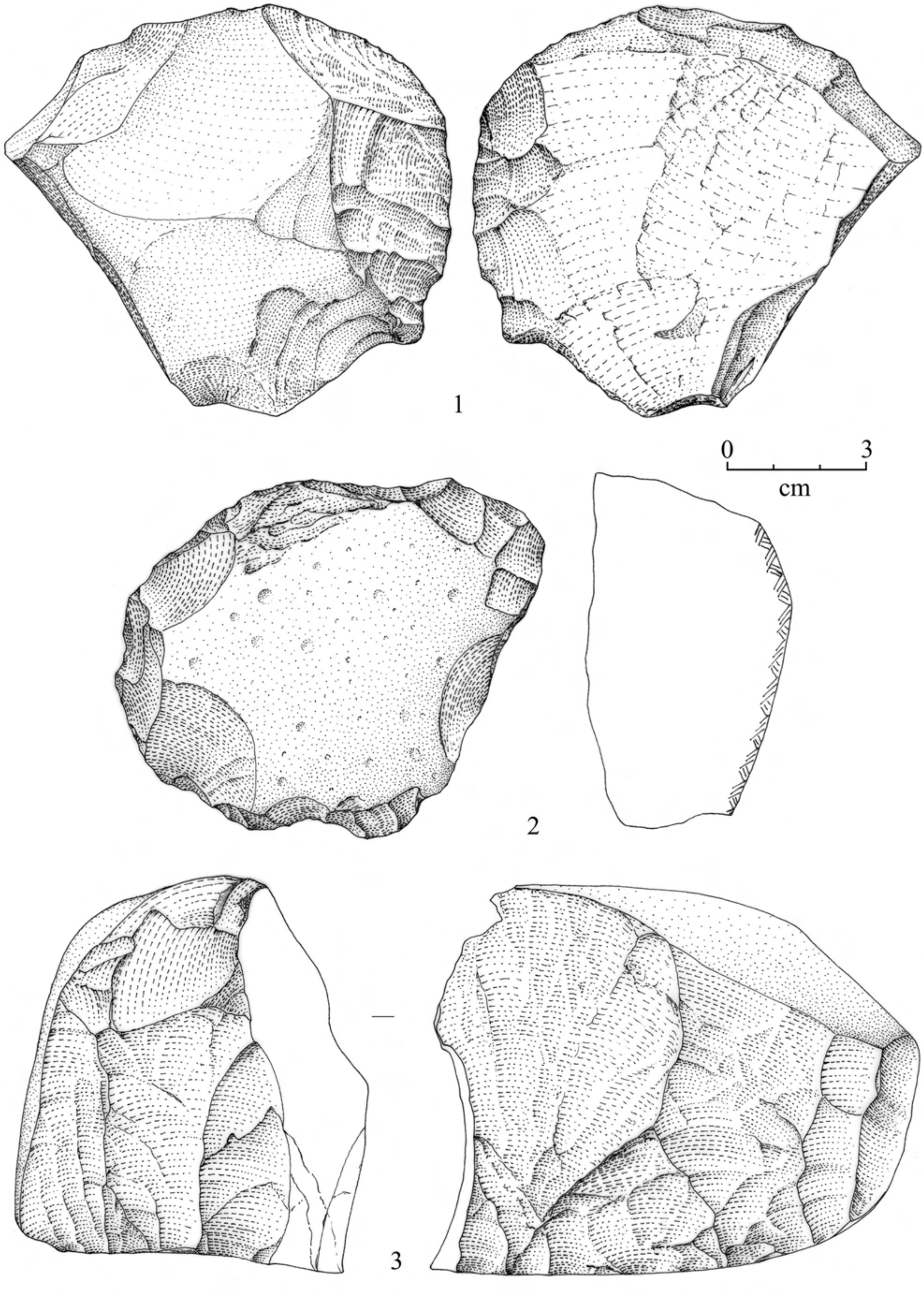


Fig. 7. Garba IV D. 1, 3: rabots (MK 9069, 9765); 2: Heavy end-scraper (MK 5945). Basalt. *Drawings by M. Pennacchioni*

Length (mm)	N	%
71\80	4	9.76
81\90	10	24.39
91\100	4	9.76
101\110	7	17.07
111\120	9	21.95
121\130	5	12.20
131\140	1	2.44
141\150	1	2.44
Total	**41**	

Tab. 18. Length of rabots.

More than 92% of the blanks of the rabots are between 61 mm and 110 mm wide with a mean of 88.63 mm. The thickness of the rabots appears uniformly distributed between values of 41 mm and 100 mm, with a mean of 70.19 mm.

Also the data on the weight of the rabots indicate a range between 200 g and 2000 g, with a mean of 850.36 g. In consideration of their probable functional destination, it is interesting to observe however that the pebbles with greater weight (between 801 g and 2000 g) are slightly more frequent, with more than 46.34% of the rabots between 901 g and 2000 g (Tab. 19).

Weight (g)	N	%
201\300	1	2.44
301\400	6	14.63
401\500	3	7.32
501\600	3	7.32
601\700	4	9.76
701\800	1	2.44
801\900	4	9.76
901\1000	8	19.51
1001\2000	11	26.83
Total	**41**	

Tab. 19. Weight of rabots.

Angle of the cutting edge

It has been measured on 34 rabots and shows a higher frequency (61.76%) of angles between 81° and 90°. The mean of the angle of the cutting edge is 88.47°.

Length of the cutting edge

The lengths of the cutting edge measured on eight rabots, range from a maximum of 230 mm to a minimum of 36 mm (230, 170, 165, 160, 95, 60, 50, 36 mm).

Spheroids

Only one basalt spheroid is present in Level D at Garba IV (Fig. 8).

The shape is perfectly spherical and it was obtained by means of numerous small multidirectional removals; these have been then resumed by an intense chipping activity affecting almost the whole surface of the piece, excluding a portion with cortex, limited to a little bit less than one third of its surface (Texier and Roche 1995). The dimensions and the weight are: length: 115 mm; width: 99 mm; thickness: 95 mm; weight: 1230 g.

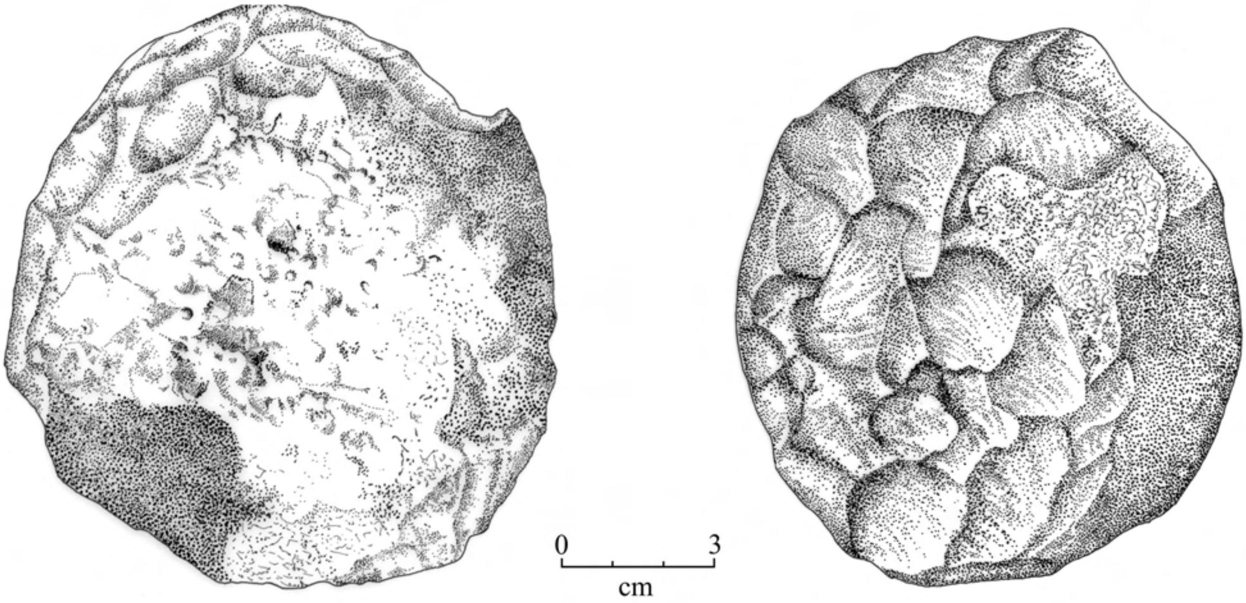


Fig. 8. Garba IV D. Spheroid (MK 9273). Basalt. *Drawings by J.-L. Boisaubert*

Casually trimmed pebbles

The data on the casually trimmed pebbles are drawn from the study and the measurements made during different field seasons. This category includes pebbles presenting an isolated removal or usually two non-adjacent removals.

These artefacts are typologically very close to the roughly shaped choppers, from which they are often almost undistinguishable. Their typological interest is very limited.

Raw material

Most of the 98 casually trimmed pebbles identified in Level D at Garba IV (75.51%) are obtained from basalt pebbles, although a fairly good percentage (21.43%) is on obsidian pebbles, a raw material that is rarely employed in the manufacturing of tools on pebble (Tab. 20).

Raw material	**N**	**%**
Obsidian	21	21.43
Basalt	74	75.51
Trachyte	2	2.04
Tuff	1	1.02
Total	**98**	

Tab. 20. Frequency of different raw materials utilized for casually trimmed pebbles.

Typometry

The data reported refer to 86 measured casually trimmed pebbles (CTP). The obsidian CTP are usually on smaller pebbles compared to those of other volcanic rocks.

Length, width, thickness and weight

The length of 81.25% of the obsidian CTP is between 51 mm and 80 mm; the length of 74.29% of the CTP of other volcanic rocks is between 71 mm and 110 mm, with a mean respectively of 71.69 mm and 89.69 mm. 87.5% of the obsidian CTP are between 31 mm and 70 mm wide (mean 54.25 mm), compared to 88.58% of the basalt CTP for which the width is between 51 mm and 100 mm (mean: 73.23 mm). Regardless of the raw material, 68.6% of the CTP are between 31 mm and 60 mm thick with a mean of 43.81 mm for the CTP on obsidian pebbles and 50.94 mm for those of basalt respectively.

Most of the CTP weigh between 101 g and 500 g, with a mean of 216.75 g for the obsidian CTP and of 437.2 g for those of basalt.

Handaxes and bifacial tools

Handaxes and bifacial tools

In Level D at Garba IV there are some artefacts with bifacial removals, obtained from large sized flakes or from obsidian or basalt pebbles. In some cases these can be considered real handaxes, in other cases they are large flakes with bifacial removals wider on one face and limited to a minimal portion of the edge on the opposite face. The described specimens are the most characteristic.

Handaxe (MK 2931)

Asymmetric handaxe on probable obsidian flake with invasive removals on one of the faces and less invasive ones on the other face (Fig. 9). The profile of the edges is strongly sinuous near the base and more rectilinear towards the distal extremity, slightly rounded (length: 140 mm; width: 82 mm; thickness: 42 mm).

Handaxe (MK 4516)

Handaxe on basalt flake, quite symmetric, obtained with large removals on both faces (Fig. 10). The distal extremity is slightly rounded. The profile of the edges is moderately sinuous (length: 134 mm; width: 85 mm; thickness: 59 mm).

Handaxe (MK 5229)

Handaxe on basalt flake obtained with large invasive removals on one faces and more marginal removals on the other face. Some of them are made in order to thin the butt (Fig. 11). The profile of the edges is quite sinuous (length: 139 mm; width: 90 mm; thickness: 35 mm; weight: 510 g).

Handaxe (MK 3398)

Asymmetric handaxe on basalt flake obtained with large removals on both faces (Fig. 12). Both extremities are slightly rounded. The profile of the edges is quite sinuous (length: 155 mm; width: 85 mm; thickness: 49 mm).

Bifacial tool (MK 4482)

Large obsidian flake obtained with bifacial removals completely invasive on both faces (Fig. 13). Secondary retouch and utilization traces are present on the distal extremity and on one of the edges. Both extremities are very rounded. The profile of the edge is moderately sinuous (length: 150 mm; width: 80 mm; thickness: 60 mm).

Bifacial tool (MK 7731)

Small handaxe on flake obtained with invasive removals and partially resumed by secondary retouch on the dorsal face. The ventral face is affected by a few large peripheral removals, not resumed by retouch. The profile of the edges is quite sinuous (Fig. 14, *1*).

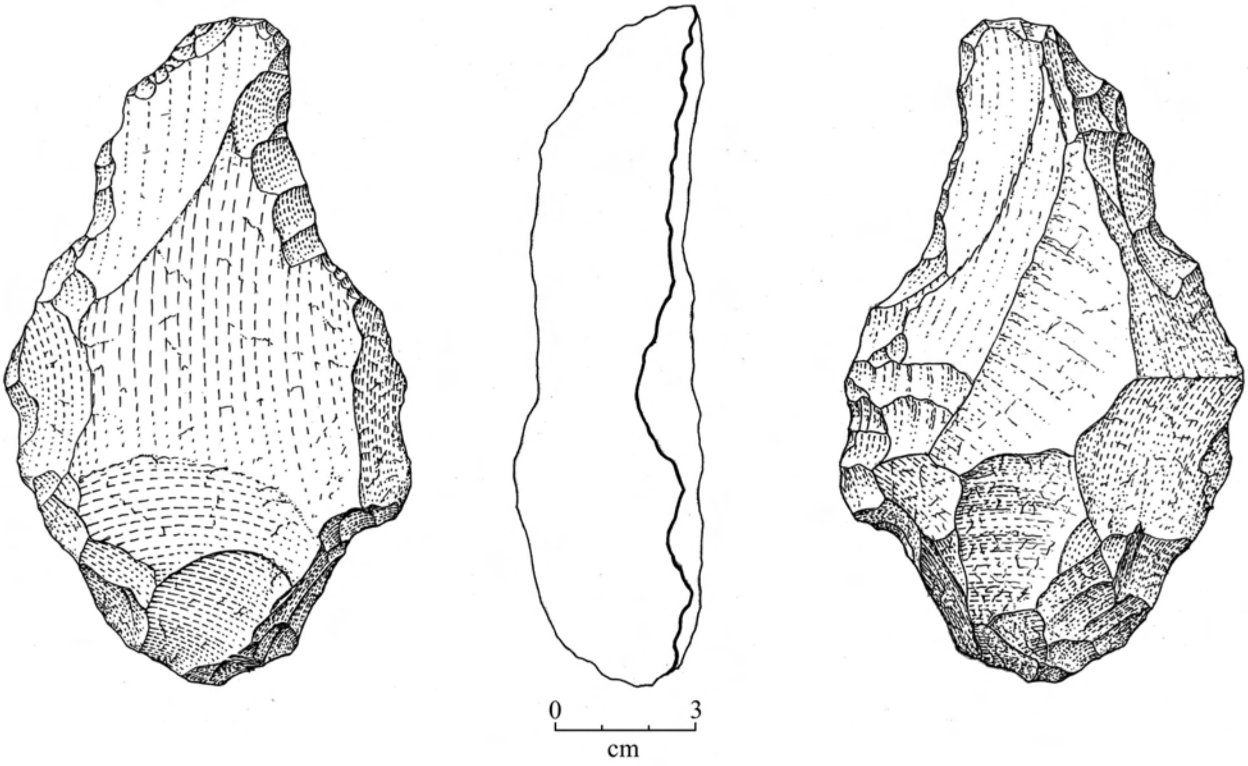


Fig. 9. Garba IV D. Handaxe (MK 2931). Basalt. *Drawings by M. Pennacchioni*

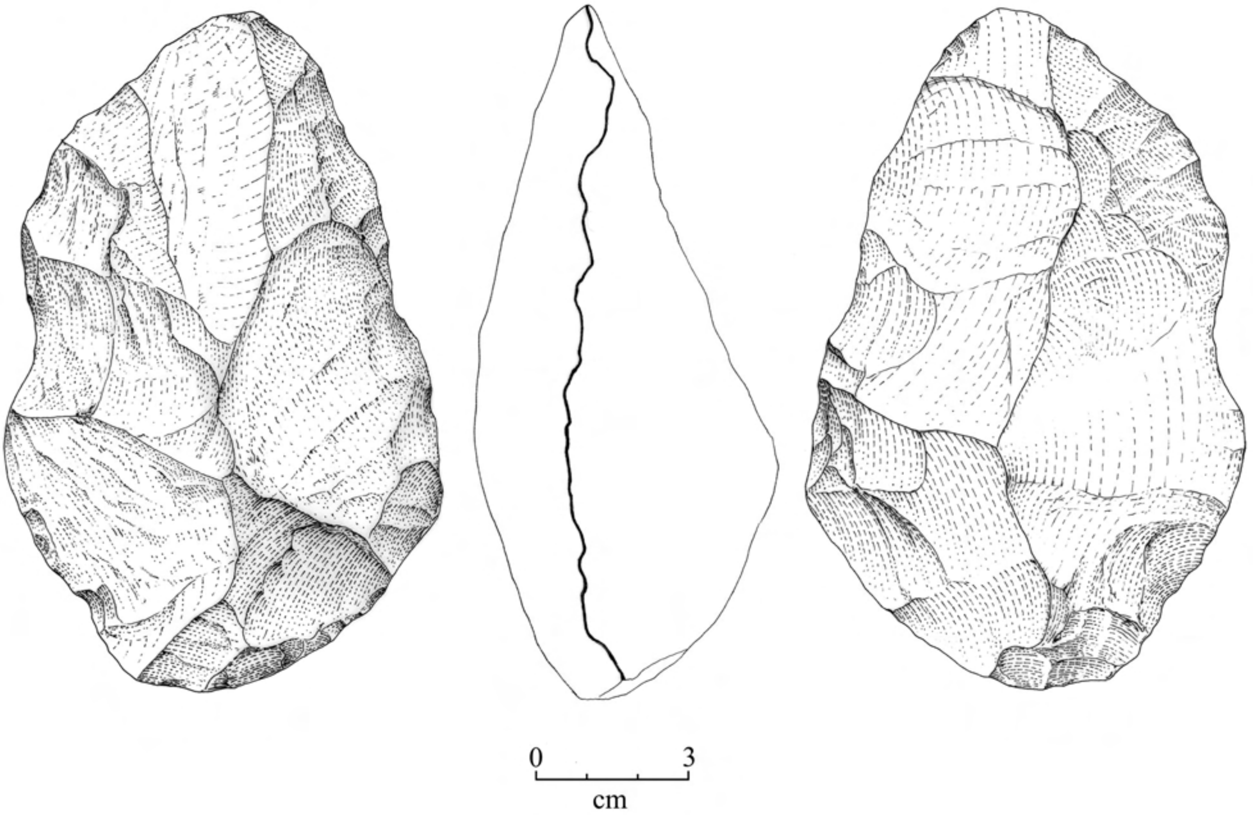


Fig. 10. Garba IV D. Handaxe (MK 4516). Basalt. *Drawings by M. Pennacchioni*

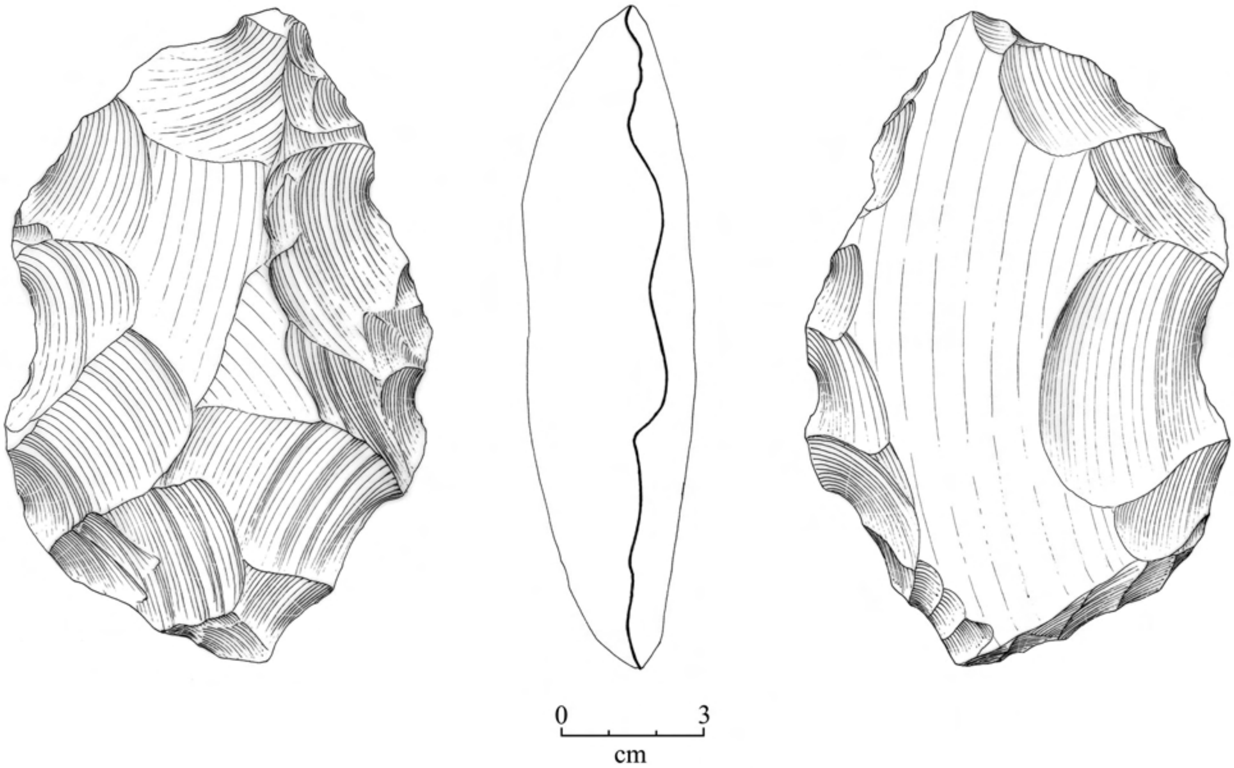


Fig. 11. Garba IV D. Handaxe on flake (MK 5229). Basalt. *Drawings by M. Pennacchioni*

Bifacial tool (MK 5377)

Small artefact on basalt pebble (Fig. 14, *2*) with bifacial removals, pointed distal extremity and very sinuous profile of the edges (length: 62 mm; width: 39 mm; thickness: 35 mm; weight: 70 g).

Bifacial tool (MK 6618)

Small artefact on obsidian pebble with bifacial removals and pointed distal and proximal extremities (Fig. 14, *3*). A limited portion of the cortex is preserved on one of the faces. The profile of the edges is moderately sinuous (lenght: 82 mm; width: 40 mm; thickness: 27 mm).

Percussion material

Battered pebbles

1307 battered pebbles have been reported in the general catalogue. Only 84 (6.43%) have been studied in detail.

Raw material

Most of the battered pebbles are of basalt or other very hard volcanic rocks, while the obsidian ones are present in very low percentages (Tab. 21).

Morpho-technical aspects

The data reported refer to the small sample studied in detail.

Raw material	Catalogue		Studied material	
	N	%	N	%
Obsidian	5	0.38		
Basalt	1058	80.95	53	63.10
Trachyte	191	14.61		
Trachybasalt	7	0.54	3	3.57
Tuff	26	1.99	9	10.71
Rhyolite	19	1.45	19	22.62
Others	1	0.08		
Total	**1307**		**84**	

Tab. 21. Frequency of different raw materials utilized for battered pebbles.

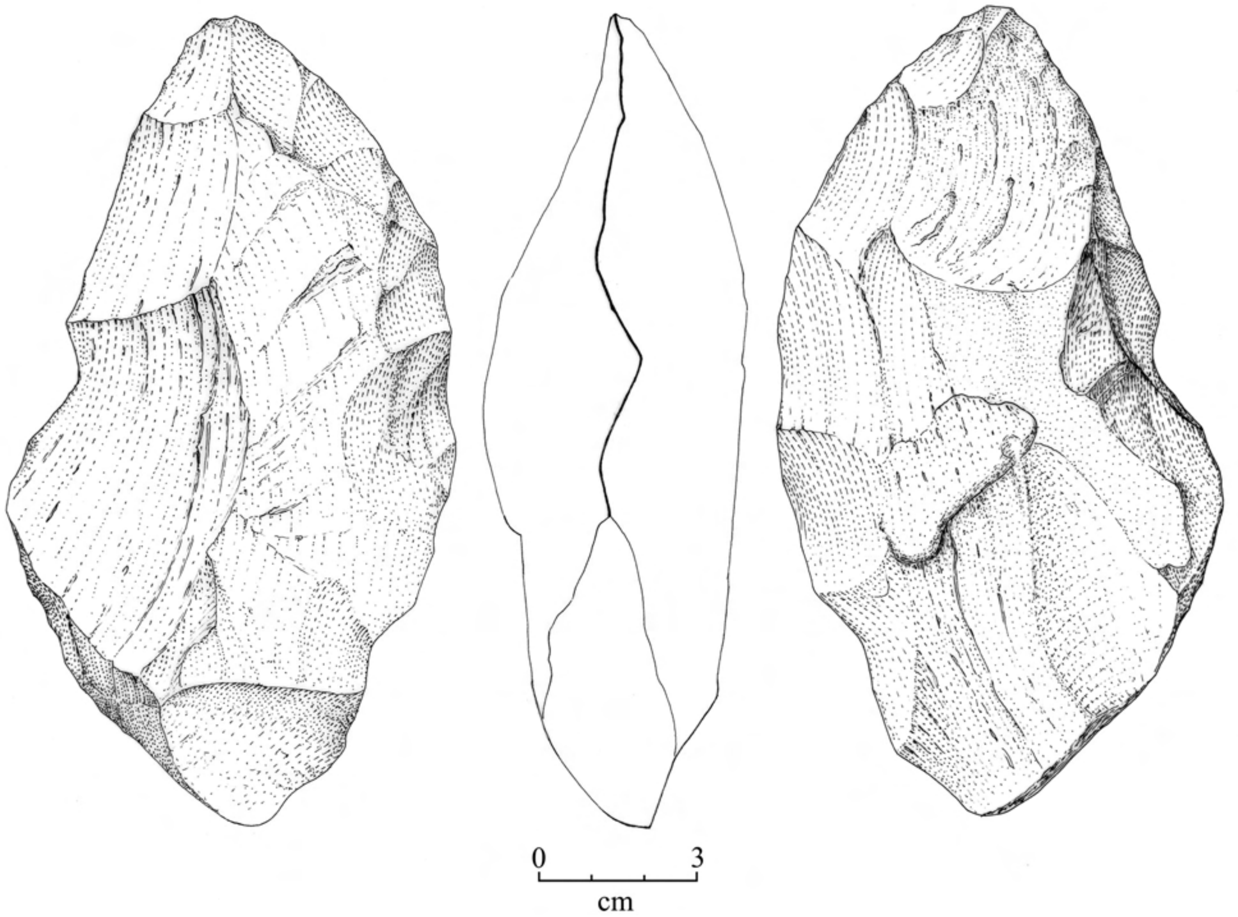


Fig. 12. Garba IV D. Handaxe on flake (MK 3398). Basalt. *Drawings by M. Pennacchioni*

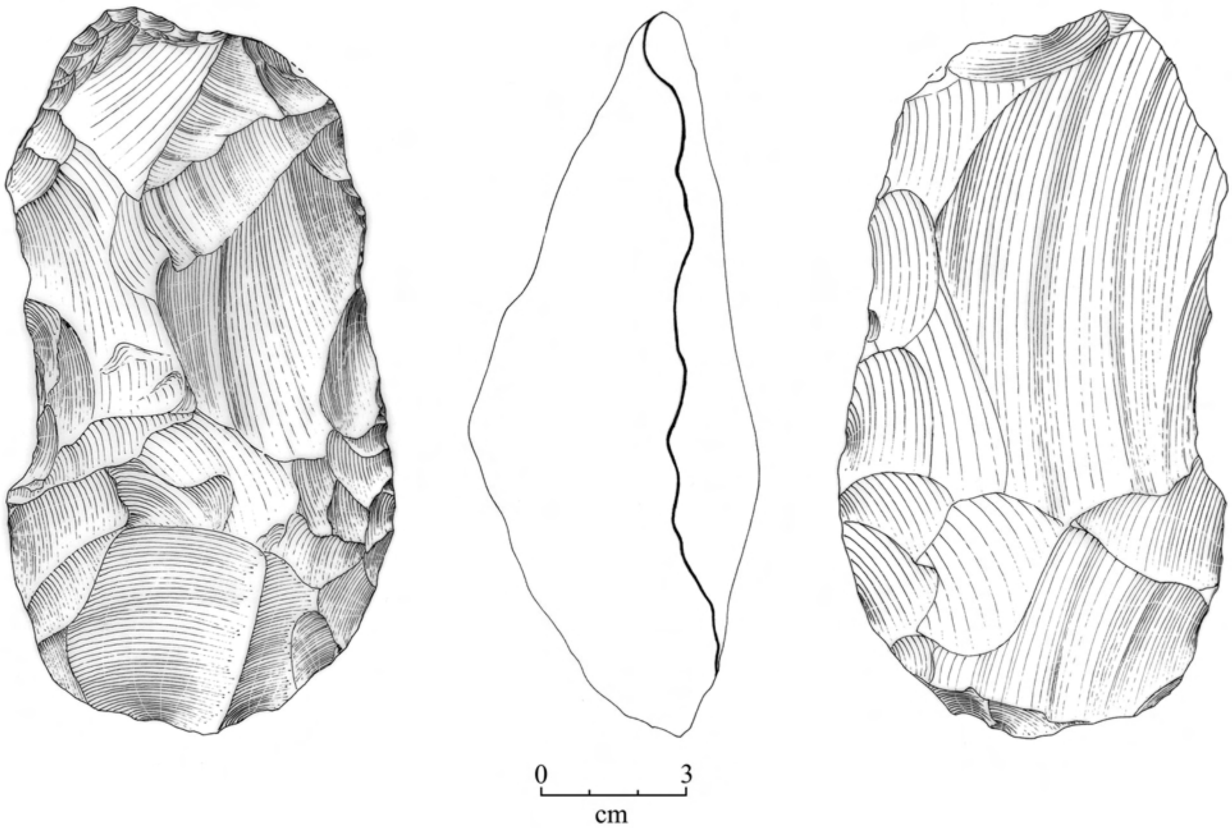


Fig. 13. Garba IV D. Partially bifacially retouched large flake utilized on the right and distal edge (MK 4482). Basalt. *Drawings by M. Pennacchioni*

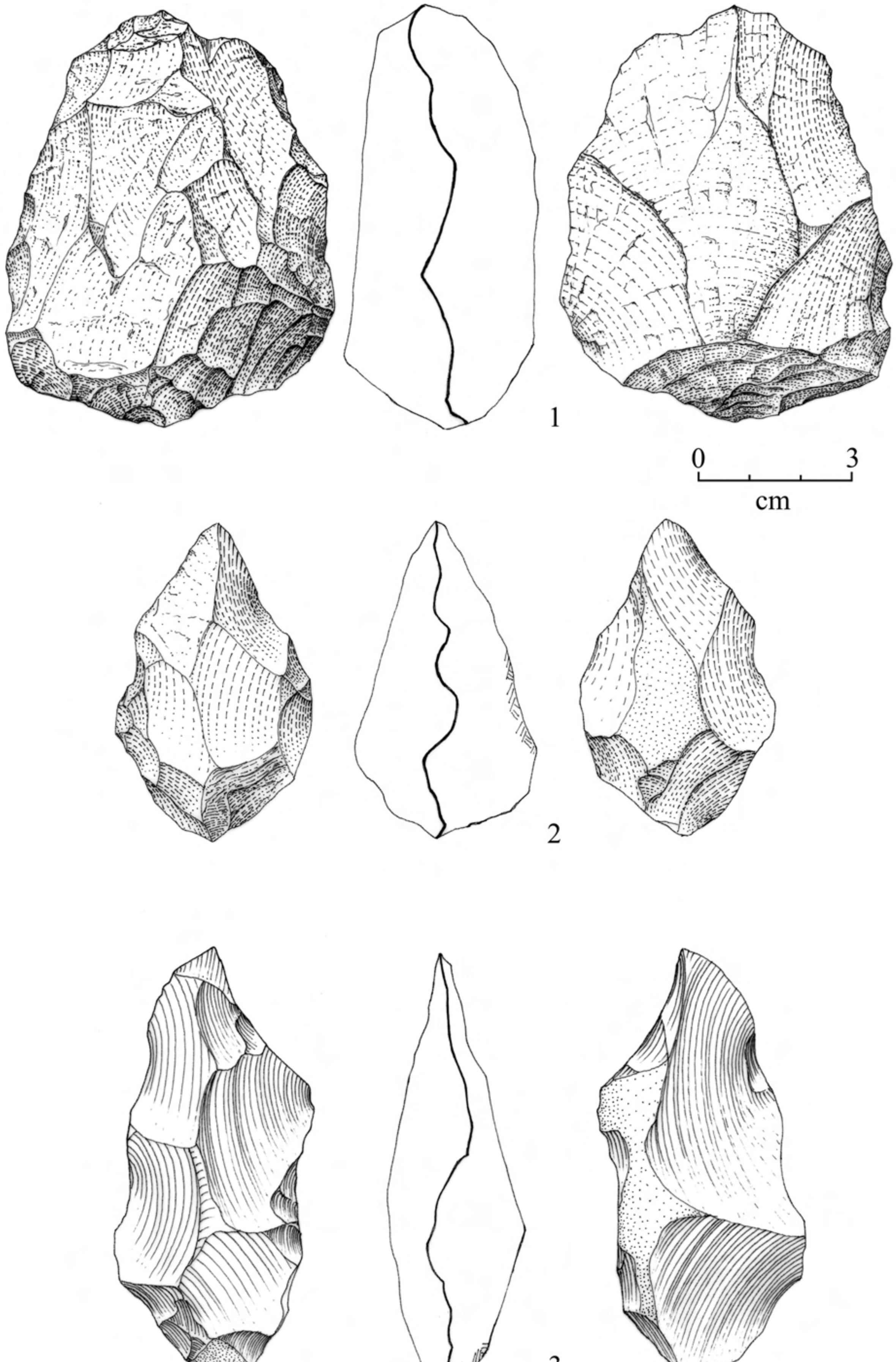


Fig. 14. Garba IV D.1: bifacially shaped flake (MK 7731); 2, 3: bifacial tools (MK 5377, 6618). 1, 2: basalt; 3: obsidian. *Drawings by M. Pennacchioni*

Type of percussion

In 51 cases the percussion is punctiform, in 16 cases linear. Seventeen battered pebbles show diffused percussion.

Localization of the percussion

In 35 cases the percussion is on the edge, in 43 cases on the extremity, in six cases on a surface.

Presence of removals due to percussion

Removals due to percussion are visible on 51 battered pebbles.

Number of zones where the percussion is localized

In most cases (56) the percussion is localized in only one zone, in 13 cases in two zones, in 15 cases in three or more zones.

Typometry

Of the 1307 total battered pebbles, 1081 have been measured; two obsidian ones (length: 47-56 mm; width: 41-45 mm; thickness: 20-23 mm; weight: 42-61 g) were not included in the Tabs. 22-25.

Length

Most of the battered pebbles have values between 61 mm and 110 mm, with a mean of 89.04 mm (Tab. 22). The values found in the small sample analyzed are similar.

Width

The length of 71.27% of the battered pebbles is between 61 mm and 110 mm, with a mean of 71.56 mm (Tab. 23). The values found in the small sample analyzed are similar.

Thickness

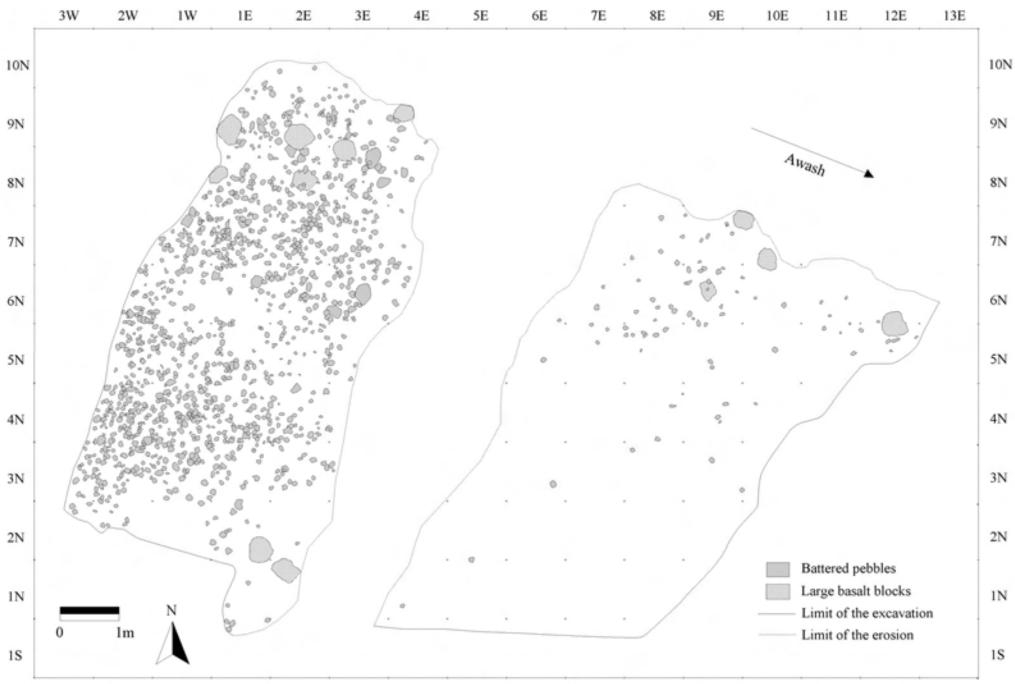
The thickness of 82.02% of the battered pebbles is between 31 mm and 80 mm, with a mean of 52.33 mm (Tab. 24). The values found in the small sample analyzed are similar.

Weight

The weight of 67.46% of the battered pebbles is from few dozen grams to 500 g. The values found in the small sample analyzed are similar (Tab. 25).

Spatial distribution

The distribution of battered pebbles is characterized by a sharp numerical disproportion between WS (1223 specimens, 93.57%) and ES (84 specimens; 6.43%). In WS, battered pebbles were distributed almost over the whole extension of the sector, except for its south-eastern part, where the numbers decreased markedly. The most significant concentrations are observable in the western area of the lower part and in the central area of the upper part, with a higher frequency in squares 2-1W/4N, with respectively 77 and 82 specimens, and square 1E/7N (78). In ES, battered pebbles appear almost exclusively in the northern part of the sector, with a slightly higher frequency (7 and 15 remains) in a zone straddling squares 8-9E/6N (Plate 2).



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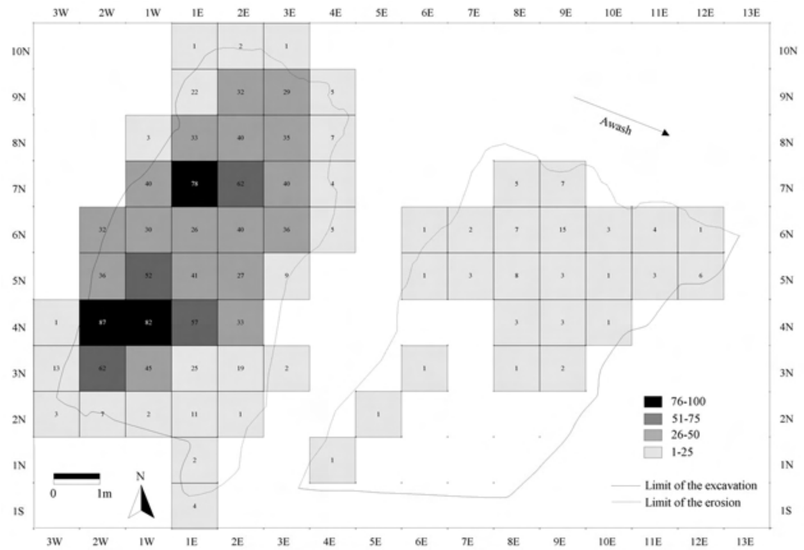

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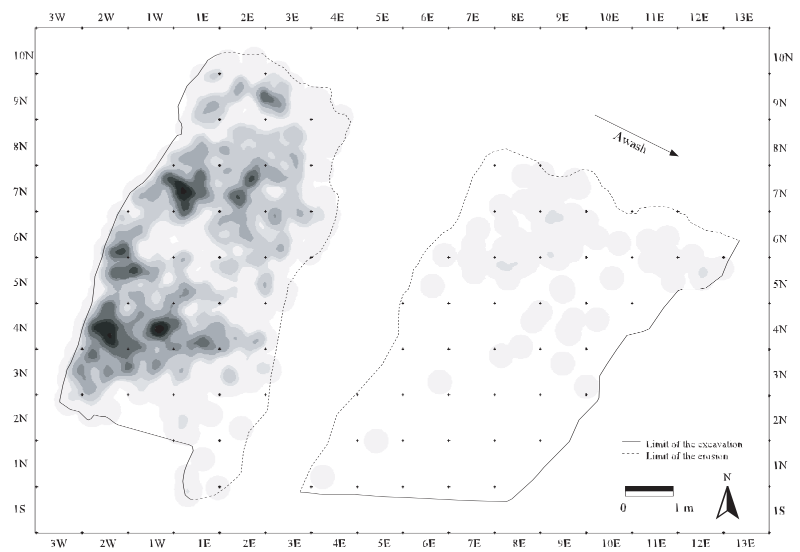

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Plate 2. Garba IV D. 1. Plan of battered pebbles. (*Original plan by G. M. Bulgarelli and M. Piperno, digital map by R. Gallotti*) 2. Frequency of battered pebbles. 3. Density areas of battered pebbles.

Length (mm)	Catalogue		Studied material	
	N	%	N	%
21\30	1	0.09		
31\40	18	1.67		
41\50	48	4.45	3	3.66
51\60	62	5.75	6	7.32
61\70	144	13.35	8	9.76
71\80	164	15.20	10	12.20
81\90	176	16.31	16	19.51
91\100	149	13.81	14	17.07
101\110	136	12.60	11	13.41
111\120	59	5.47	3	3.66
121\130	60	5.56	8	9.76
131\140	28	2.59	2	2.44
141\150	9	0.83		
151\160	9	0.83	1	1.22
161\170	2	0.19		
171\180	5	0.46		
181\190	3	0.28		
191\200				
201\400	6	0.56		
Total	**1079**		**72**	

Tab. 22. Length of battered pebbles.

Width (mm)	Catalogue		Studied material	
	N	%	N	%
21\30	1	0.09		
31\40	18	1.67	3	3.66
41\50	48	4.45	5	6.10
51\60	62	5.75	10	12.20
61\70	144	13.35	21	25.61
71\80	164	15.20	20	24.39
81\90	176	16.31	12	14.63
91\100	149	13.81	6	7.32
101\110	136	12.60	4	4.88
111\120	59	5.47		
121\130	60	5.56		
131\140	28	2.59	1	1.22
141\150	9	0.83		
151\160	9	0.83		
161\170	2	0.19		
171\180	5	0.46		
Total	**1079**		**82**	

Tab. 23. Width of battered pebbles.

Thickness (mm)	Catalogue		Studied material	
	N	%	N	%
1\10	1	0.09		
11\20	30	2.78	1	1.22
21\30	94	8.71	6	7.32
31\40	192	17.79	17	20.73
41\50	227	21.04	10	12.20
51\60	211	19.56	23	28.05
61\70	146	13.53	12	14.63
71\80	109	10.10	12	14.63
81\90	32	2.97		
91\100	25	2.32		
101\110	6	0.56	1	1.22
111\120	3	0.28		
121\130	2	0.19		
131\200	1	0.09		
Total	**1079**		**82**	

Tab. 24. Thickness of battered pebbles.

Weight (g)	Catalogue		Studied material	
	N	%	N	%
1\100	138	12.79	9	10.98
101\200	162	15.01	10	12.20
201\300	175	16.22	11	13.41
301\400	143	13.25	13	15.85
401\500	110	10.19	13	15.85
501\600	69	6.39	7	8.54
601\700	56	5.19	4	4.88
701\800	54	5.00	8	9.76
801\900	49	4.54	2	2.44
901\1000	25	2.32	1	1.22
1001\1100	18	1.67	1	1.22
1101\1200	16	1.48	1	1.22
1201\1300	16	1.48		
1301\1400	8	0.74	1	1.22
1401\1500	6	0.56		
1501\1600	4	0.37		
1601\1700	5	0.46		
1701\1800	2	0.19		
1801\1900	3	0.28		
1901\2000	2	0.19		
2001\5000	14	1.30	1	1.22
5001\10000	4	0.37		
Total	**1079**		**82**	

Tab. 25. Weight of battered pebbles.

Passive hammerstones

Differently from the evidence of Gombore I, where passive hammerstones are relatively frequent, the presence of this type is limited at Garba IV D to a few specimens, while many others medium to large sized pebbles show possible evidences of impact marks. Only 12 passive hammerstones have been identified, one of them on a trachyte pebble, while the others are on basalt pebbles. Dimensions and weight of ten of them are indicated in Tabs. 26, 27.

Length	Width	Thickness	Weight
200	155	92	3570
200	170	94	3770
200	180	125	5000
155	130	70	2040
200	180	110	4140
202	192	104	4390
190	110	91	1830
165	125	101	2860
250	180	150	6000
195	180	140	5500

Tab. 26. Dimensions and weight of passive hammerstones.

	Length	Width	Thickness	Weight
Min	155	110	91	1830
Max	360	180	150	6000
Mean	206,42	148,75	120,5	4047,5

Tab. 27. Minimum and maximum values of length, width, thickness and weight of passive hammerstones.

Broken pebbles

A total of 1313 broken pebbles are present in Level D. Only 76 (6.42%) of these have been studied in detail.

In the general catalogue 130 broken pebbles are associated with battered ones, and in the inventory of pieces with only two.

Raw material

Similarly to the battered pebbles, most of the broken pebbles are of basalt (Tab. 28).

Raw material	Catalogue		Studied material	
	N	%	N	%
Obsidian	1	0.08		
Basalt	1180	89.87	58	76.32
Trachyte	81	6.17		
Trachybasalt	7	0.53	3	3.95
Tuff	13	0.99	2	2.63
Rhyolite	31	2.36	13	17.11
Total	**1313**		**76**	

Tab. 28. Frequency of different raw materials utilized for broken pebbles.

Morpho-technical aspects

The following data refer to the studied pieces.

Number of fractures

Most of the broken pebbles (54) present a single fracture; 15 present two fractures; 7 present multiple fractures.

Orientation of the fractures

47 broken pebbles present fractures that are longitudinal to the axis, 10 oblique, 12 transversal, 5 both longitudinal and transversal, 2 both longitudinal and oblique.

Outline of the fractures

18 broken pebbles present fractures that are perpendicular to the axis, 44 parallel, 8 oblique, 4 both perpendicular and parallel, 2 both perpendicular and oblique.

Mode of the fractures

In 28 cases the fractures are flat, in six cases convex, in 27 concave, in eight irregular, in two V-shaped. In the pieces with multiple fractures they are in two cases both flat and concave, in one case flat, concave, and irregular, in one case both flat and V-shaped, in one case both concave and irregular, in two cases both irregular and V-shaped.

Localization of the fractures

In the pieces with multiple fractures, they are in 18 cases adjacent, in four non-adjacent.

Relationship between fractures

In the cases of adjacent fractures, the angle is in six cases straight, in six acute, in six obtuse.

Typometry

In the general catalogue 1007 broken pebbles have been measured and weighted. The only broken obsidian pebble reported in the general catalogue (length.: 41 mm; width: 23 mm; thickness: 18 mm; weight: 19 g) has not been considered in the general counts.

Length

The length of most of the broken pebbles (87.26%) is between 41 mm and 100 mm, with a mean of 84.21 mm (Tab. 29). The values found in the small sample analyzed are similar.

Width

The width of 74.97% of the broken pebbles is between 31 mm and 80 mm, with a mean of 61.39 mm (Tab. 30). The values found in the small sample analyzed are similar.

Thickness

The thickness of 75.08% of the broken pebbles is between 21 mm and 60 mm, with a mean of 44.53 mm (Tab. 31). The values found in the small sample analyzed are similar.

Length (mm)	Catalogue		Studied material	
	N	%	N	%
21\30	6	0.60		
31\40	44	4.37		
41\50	105	10.43	3	3.95
51\60	102	10.13	5	6.58
61\70	149	14.80	11	14.47
71\80	164	16.29	13	17.11
81\90	152	15.09	16	21.05
91\100	116	11.52	15	19.74
101\110	75	7.45	6	7.89
111\120	43	4.27	4	5.26
121\130	23	2.28	2	2.63
131\140	10	0.99	1	1.32
141\150	11	1.09		
151\160	4	0.40		
161\170	1	0.10		
171\180	1	0.10		
181\190				
191\200	1	0.10		
Total	**1007**		**76**	

Tab. 29. Length of broken pebbles.

Width (mm)	Catalogue		Studied material	
	N	%	N	%
11\20	1	0.10		
21\30	67	6.65	1	1.32
31\40	115	11.42	3	3.95
41\50	145	14.40	6	7.89
51\60	182	18.07	16	21.05
61\70	176	17.48	19	25.00
71\80	137	13.60	12	15.79
81\90	93	9.24	11	14.47
91\100	49	4.87	6	7.89
101\110	29	2.88	1	1.32
111\120	7	0.70	1	1.32
121\130	1	0.10		
131\140	4	0.40		
141\150	1	0.10		
Total	**1007**		**76**	

Tab. 30. Width of broken pebbles.

Thickness (mm)	Catalogue		Studied material	
	N	%	N	%
1\10	2	0.20		
11\20	63	6.26		
21\30	170	16.88	3	3.95
31\40	237	23.54	20	26.32
41\50	199	19.76	19	25.00
51\60	150	14.90	19	25.00
61\70	99	9.83	8	10.53
71\80	57	5.66	6	7.89
81\90	19	1.89	1	1.32
91\100	4	0.40		
101\110	4	0.40		
111\120	2	0.20		
121\130				
131\140	1	0.10		
Total	**1007**		**76**	

Tab. 31. Thickness of broken pebbles.

Weight (g)	Catalogue		Studied material	
	N	%	N	%
1\100	250	24.83	5	6.58
101\200	222	22.05	17	22.37
201\300	152	15.09	15	19.74
301\400	114	11.32	11	14.47
401\500	74	7.35	10	13.16
501\600	66	6.55	9	11.84
601\700	35	3.48	1	1.32
701\800	24	2.38	2	2.63
801\900	18	1.79	3	3.95
901\1000	15	1.49	2	2.63
1001\1500	26	2.58	1	1.32
1501\2000	6	0.60		
2001\3000	5	0.50		
Total	**1007**		**76**	

Tab. 32. Weight of broken pebbles.

Weight

The weight of 73.29% of the broken pebbles is between a few dozen grams and 400 g with a mean of 317.85 g (Tab. 32). The values found in the small sample analyzed are similar.

Spatial distribution

Like battered pebbles, broken pebbles are much more abundant in WS and in ES, but the difference is reduced: 1048 (79.82%) in WS, 265 (20.18%) in ES. In the latter sector, they occupy the northern half with a concentration along a SW-NE strip straddling squares 6-9E/5N, 7-10E/6N and 8-9E/7N, with the highest density in square 9E/6N (34 specimens). Another small concentration straddles squares 11-12E/5-6N, but with less significant frequencies. Only a few specimens were found in the lower half of this sector.

In WS, broken pebbles were strewn almost over the whole surface, except for the south-eastern margin. The highest concentration was recorded in square 2W/4N, with 89 finds, while dispersal was highest in the central part and near the northern margin (Plate 3).

Conclusions

The elaboration of the typological and metrical data of the lithic industries from Levels C and D allowed the main characteristics of the Oldowan site of Garba IV to be identified and described.

Raw materials

The first aspect characterizing Garba IV D is the clear dichotomy in raw material selection: basalt and, less commonly, other volcanic rocks like trachyte, tuff, etc. on the one hand, and obsidian on the other. The latter raw material at Garba IV plays the same role as flint in complexes of the European Lower Palaeoltithic. Obsidian was preferentially utilized for the production of flakes and flake artefacts, but was only sporadically used for tools on pebble, as shown by the very rare obsidian choppers.

The only limit for obsidian at Garba IV is the small-medium size of the cores available, with a few rare exceptions when large flakes were used as blanks for bifacial tools.

The intensive use of obsidian is probably one of the main reasons for the technologically mature appearance of part of the Garba IV industry. This raw material is certainly more versatile than other volcanic rocks. It is obtained from alluvial pebbles or from formless blocks and allows the proliferation of flakes and tools on flake that, for the first time in the Melka Kunture record, become a significant element in lithic tool production.

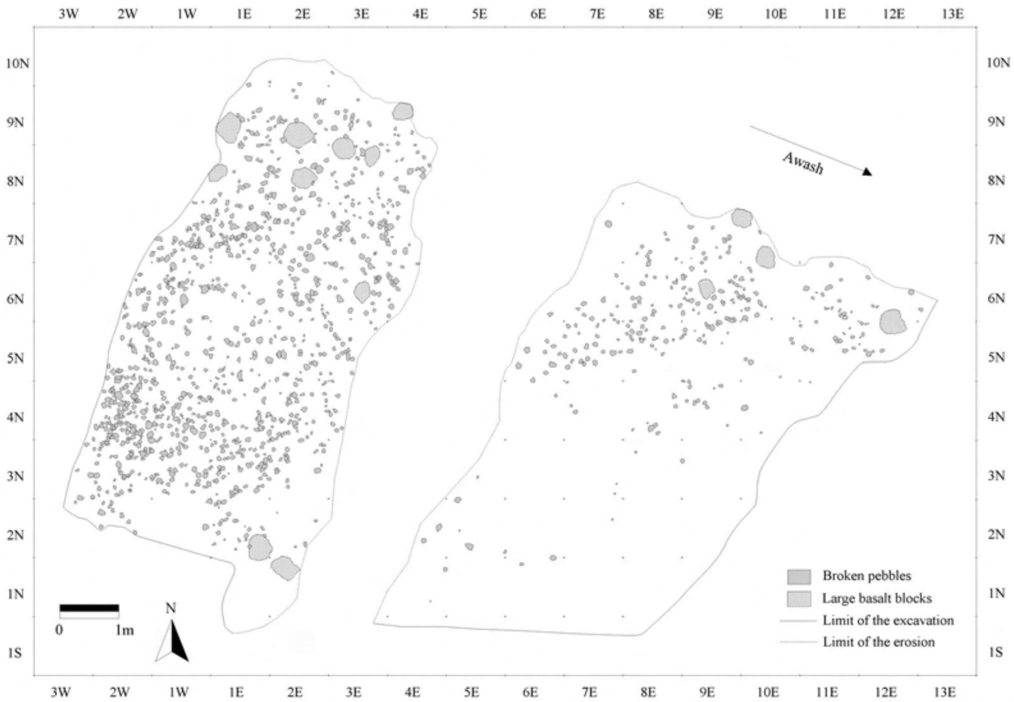
It appears that the utilization of obsidian represented a stimulus or, better, a technological facilitation, for the production of flakes. Whether or not the frequent use of such raw material can be considered a "discovery" of great importance in influencing technological capability and orienting its results, remains to be interpreted. In any case, in later periods and in different sites at Melka Kunture, such as Simbiro III and Gombore II, obsidian was used in large quantities for the production of handaxes, while in sites that are even more recent, such as Garba I, basalt again played a dominant role in the production of large artefacts such as handaxes and cleavers.

Handaxes and bifacial tools

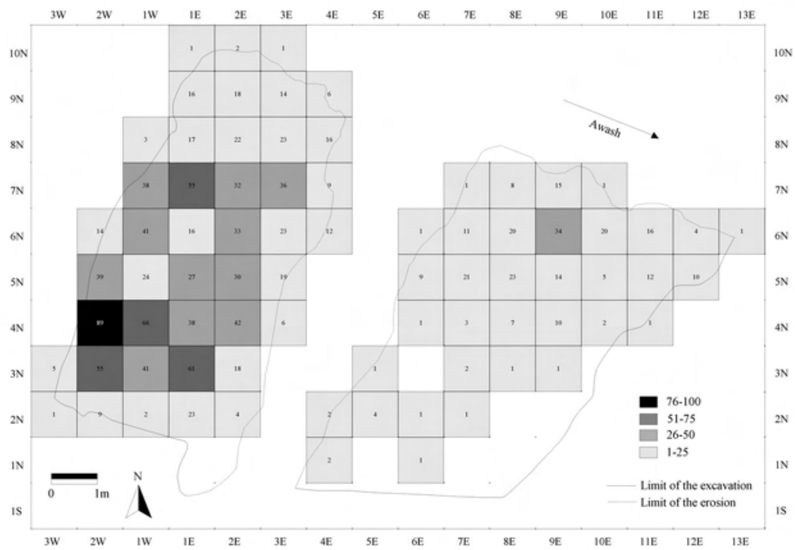
The sporadic presence of handaxes, as also at Gombore I, together with their limited technological elaboration, indicates occasional and insignificant recourse to this kind of tool. The concept of "handaxe" is practically non-existent at Garba IV. The scarcity of large flakes seems to confirm this conclusion. On the other hand, it is possible to affirm that the handaxes of Garba IV follow a knapping sequence and technological concept different from that shown in the oldest Acheulian sites at Melka Kunture, such as Garba XII and mainly Simbiro III, or other East African localities, for example Konso-Gardula (Asfaw *et al.* 1992).

With regard to their frequency in Level D, Garba IV is closer to Garba XII, where handaxes are similarly sporadic, than it is to Simbiro III where they represent an important factor within the tool kit. At Simbiro III they are relatively abundant and show great typological variability that is lost in the more recent sites.

Apart from the true handaxes, at Garba IV there are also some very thick flakes with an almost rectangular shape and with some peripheral removals on the ventral face. This kind of artefact is comparable to analo-



1



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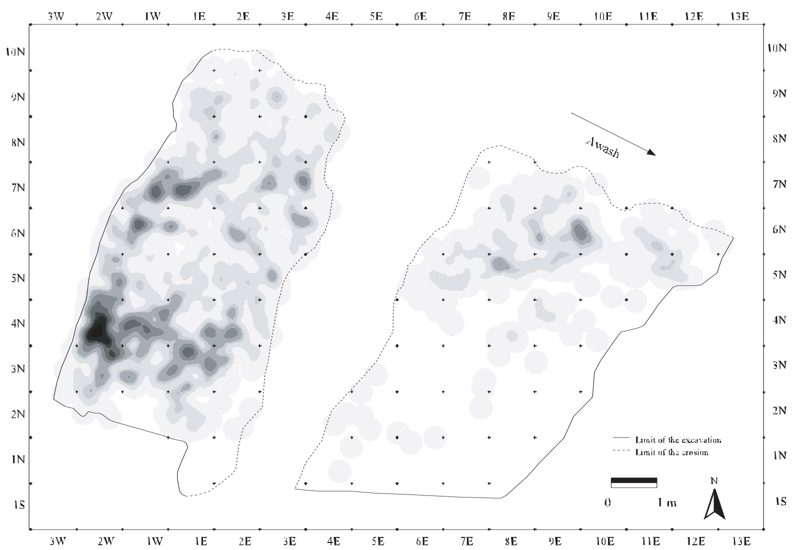

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Plate 3. Garba IV D. 1. Plan of broken pebbles. (*Original plan by G. M. Bulgarelli and M. Piperno, digital map by R. Gallotti*) 2. Frequency of broken pebbles. 3. Density areas of broken pebbles.

gous tools recently reported from the site of Peninj (Domínguez-Rodrigo *et al.* 2002; Torre de la and Domínguez-Rodrigo 2001; Moreno *et al.* 2003; Torre de la *et al*. 2003; Torre de la and Mora Torcal 2004).

Cleavers

Among the large flake artefacts recovered at Garba IV, the presence of two cleavers needs to be particularly emhasized. In terms of their techno-typological characteristics, these two artefacts are very different from the cleavers that later characterize the oldest Acheulian levels of Melka Kunture. They are quite thick, have few removals, do not have secondary retouch, and are characterized by a transversal edge that is of limited extent. Except for their general conception, they do not seem to anticipate the large Acheulian cleavers that are almost always very flat, often retouched on one or both edges and usually have a wide distal cutting edge.

Flakes

Notwithstanding the post-depositional disturbance that certainly affected Level D, the frequency of often small flakes and of a high frequency of flaking debris smaller than a centimeter, indicates that the possible episodes of sheet erosion did not significantly influence the dimensional selection of the materials.

Furthermore, the analysis of the spatial distribution of the obsidian flakes indicates that in certain sectors of the excavation there are significant concentrations which can be interpreted as the result of areas of intense knapping of this raw material, while the flakes obtained from other volcanic rocks seem to be more uniformly distributed over the whole explored area.

As already mentioned, the production of flakes probably represents one of the most obvious characteristics of Level D. They occur frequently, there is an intense utilization of obsidian, and in particular they include retouched artefacts which, although present in small numbers, are sometimes well made.

However, a large proportion of the flakes, both of obsidian and of other volcanic rocks, do not have any retouch or traces of use. Such absence may also in part be due to the strong patina covering all the tools from Garba IV. In some cases this leads to a sort of edge rounding, especially in the basalt artefacts, that was probably caused by some kind of abrasive action in the sandy sediments, rather than by episodes of intense displacement.

The irregular morphology of the flakes, the dimensional variability and the absence of clear preparation of the butt, indicate casual knapping techniques with consequently unpredictable products. In terms of this perspective, flakes made of basalt and other volcanic rocks, usually obtained from medium sized pebbles, have a greater degree of morpho-technical repetition, while the obsidian flakes come from cores that are extremely variable both in shape and in size, including quite rare examples obtained from pebbles.

Side-scrapers

Although they do not occur particularly frequently, the typological diversification of the side-scrapers, mainly of obsidian, observed in Level D at Garba IV, represents a particularly interesting aspect of this industry. Compared to Gombore I B, where there are also different kinds of side-scrapers, also mainly of obsidian, the side-scrapers from Garba IV D are more frequent and are often represented by types, such as the simple or double déjeté side-scrapers, that are surprising for their small dimensions as well as for the intensity and the accuracy of the retouch.

Denticulates and notches

Casual choice of blanks is apparent in these tools which are often made with quite regular retouch.

End-scrapers, burins and borers

Although generally typical, their number is insignificant in the tool kit of Garba IV D. Compared to the frequency of end-scrapers found at Gombore I, those of Garba IV D are much less numerous. Burins and borers are uncommon at both sites.

Tools on pebble

As has been already mentioned, the frequency of choppers makes it difficult to distinguish between choppers and cores in complexes similar to Garba IV D. As at Gombore I, there is a great typological variability within this category that represents a little more than 9% of the total lithic assemblage, but as much as 49.63% of the tools on pebble, reaching a frequency similar to that of the choppers at Gombore I (44%).

Compared to typical but unique artefacts such as the spheroid from Garba IV D, other tools on pebble, as for example the polyhedrons and, most of all, the rabots, they appear with higher frequency, although without reaching the percentages observed at Gombore I.

In particular the rabots, to which heavy end-scrapers can also be added as they are not easily distinguishable from them, are relatively numerous and very characteristic, as observed also at Gombore I.

In order to draw some conclusions from this study, and as it is also apparent from the recent researches carried out at Peninj, the technological complexity of the Oldowan is much greater than previously assumed. The complexity of the reduction chains, the proliferation of flakes, the accentuated typological diversification, and the presence of prototypes like cleavers and spheroids, make this complex very different from the simplicity that scholars often wanted to observe in the oldest technologies. Their erroneous "evolutionary" concept was based on the hypothesis that complexity increased as the antiquity of the sites decreased.

In the second place, it seems very important to observe that notwithstanding the large number of sites identified at Melka Kunture, and although many of them present long stratigraphic sequences, often with superimposition of numerous occupation levels, as at Garba IV, nowhere has it been possible thus far to observe a sequence of Oldowan or Developed Oldowan levels and Acheulian ones. Different hypotheses have often been suggested for the different choices of living sites in the Oldowan and in the Acheulian (for a synthesis see Chavaillon *et al.* 1979) and these may in part explain the situation. But it should also be observed that the oldest Acheulian levels identified so far at Melka Kunture are not older than 1.0 Ma, while it is well known that the oldest Acheulian complexes in Ethiopia, such as Konso-Gardula, are dated to about 1.4-1.5 Ma.

Therefore it does not seem possible to demonstrate a derivation and continuity between the Developed Oldowan and the Acheulian at Melka Kunture. The hypothesis of a continuous transition, suggested for example at Olduvai, is not confirmed by the archaeological evidence at Melka Kunture. Oldowan and Acheulian at Melka Kunture seem to be two really distinct worlds, probably separated by a chronologically relevant gap.

It is therefore possible to suggest the hypothesis that this lack of continuity and the clear gap in the archaeological sequence may be due to an abandonment of this part of the Ethiopian plateau for some hundred thousand years for reasons that are not easily identifiable.

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