CHAPTER 8

MICROWEAR ANALYSIS OF CHALCOLITHIC BIFACIAL TOOLS

Richard W. Yerkes and Ran Barkai

A sample of 14 bifacial chipped stone tools from the lithic assemblage of Givʿat ha-Oranim (Chapter 7) was examined for microwear and technological traces. The sample included three chisels and 11 adzes. The bifacial tools were examined to determine if they had been utilized, to find the location of the use wear, determine the type of worked material and interpret their functions. This was accomplished by applying the method of microwear analysis developed by Semenov (1964) and refined by Keeley (1980), which involves the examination of the distinctive micropolishes, striations and damage scars that form on the edges of chipped stone tools when they are used to perform specific tasks (cutting, scraping, etc.) on certain types of materials such as bone, wood, hide, etc. (Juel Jensen 1988:53-54; Yerkes 1987:114; Yerkes and Kardulias 1993:101).

Prior to the microwear analysis, the greatest length and the thickness of the tools were measured and the widths of the working edges were recorded. Edge-angles of the bits were estimated with a goniometer (Table 8.1). The artefacts were examined with a stereomicroscope at low-power magnifications between 6x and 50x to locate and record the nature and extent of edge damage (Odell 1981) and to examine the surface of the ground and polished portions of the tools.

Following the low-power examination, the implements were cleaned in an ultrasonic cleaner with Top Job detergent and 10% solutions of HCl and KOH, and examined for use wear traces under incident light at high-power magnifications ranging between 50x and 500x (see Gijn 1990; Keeley 1980; Yerkes 1987, for details on techniques of microscopic examination).

The functions of the artefacts were determined by matching the observed microwear traces with the use wear patterns found on experimental chipped stone tools contained in a reference collection of over 160 experimental tools made of several different chert types (including many heat-treated replicas). For this study, Albert M. Pecora III, a graduate student at Ohio State University, made some replicas of chipped stone chisels and adzes. He ground the edges with sand and water (Fig. 8.1) following procedures described in the ethnographic literature. After they were flaked and ground, they were used in several wood-working experiments. The edges of other experimental bifacial tools were ground and polished, and then they were used to scrape dry hide (Fig. 8.2) and plane and scrape antler that had been soaked in water.

Fig. 8.1: Experimental chisel showing edge-grinding traces running lengthwise (¬← ®→) and wood working traces oriented normal (¯↓) to the edge. *(100x, width of figure is approx. 650 microns)*

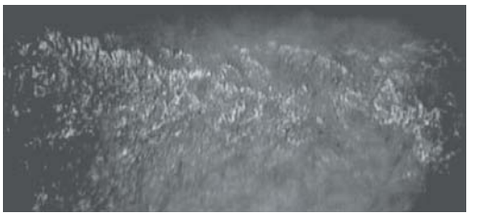

Fig. 8.2: Experimental biface edge that was ground and then used to scrape dry hide. (*100x, width of fig. is approx. 650 microns*)

TABLE 8.1: SUMMARY OF MICROWEAR AND TECHNOLOGICAL ANALYSIS

No.	Artefact Type	Edge Angle	Edge Shape	(mm) G.L.	(mm) E.W.	(mm) Th.	Edge grnd.	Edge fractures	Used	Motion	Worked Material	Other Notes
1	Chisel (narrow)	55	straight	48.0*	10.0	17.2	X	feather	X	chisel	wood	*snapped*
2	Adze fragment	50	straight	35.4*	31.5#	18.0	X	feather (+)	X	chop/adze	wood	*snapped, corner break*
3	Adze fragment	n/a	n/a	51.4*	27.5	23.2	X	battered	X	chop	wood	*recylced as core?*
4	Adze fragment	53	straight	66.8*	33.5#	24.0	X	battered	X	chop, scrape	wood, hide	*reharpened,recycled*
5	Chisel (other)	50	straight	101.3*	13.8	21.8	X	broken	?	chisel	wood?	*bi-pointed,recycled*
6	Chisel (oval)	60	straight	95.8	14.5	21.3	X	feather (2)	?	chisel?	wood?	*worn, lateral grinding*
7	Adze (long)	55	straight	100.9	37.9#	24.2	X	battered	X	chopping	wood	*cortex, patina*
8	Axe fragment	30	convex	67.0*	60.5#	30.0	X	battered	X	chopping	wood	*latral snap*
9	Adze (small)	50	straight?	81.5	28.8	21.2	X	battered	X	chopping	wood	*resharpened?*
10	Adze (small)	65	straight	81.8	31.0#	22.5	X	battered	X	chop, scrape	wood	*cortex, resharpened*
11	Adze fragment	65	convex	56.8*	39.0	24.3	X	battered	?	chopping?	?	*lateral snap, recycled?*
12	Adze (small)	60	convex	75.5	38.0	20.6	X	battered	X	chop, scrape	wood	*cortex, resharpened*
13	Adze (thick)	75	straight	89.2	47.4#	31.2		battered				*resharpened?*
14	Adze (thick)	n/a	n/a	82.6	35.9#	30.2		broken				*unfinished?*

Note **G.L.**: Greatest Length in mm * broken, not full length
E.W.: Edge width in mm # greatest width
Th.: Thickness in mm
Edge grnd.: edge is ground and polished
Edge fractures: type and number (in parentheses) of flake scars along both faces of the working edge
Used: there is microwear or macrowear evidence for utilization
Motion: how the implement was used, e.g., as an axe, adze, chisel, plane, etc.
Material Worked: the material that was modified with the implement.
battered : there is extensive edge-damage, often in the form of hinge or step fractures
cortex : some of the original exterior surface of the rock can still be seen on the artifact
heavy use : the tool seems to have been used for robust chopping or adzing
lateral grinding : the lateral margins of the tool have been ground or abraded
recycled : appears to have broken and then retouched and used for a different task
bi-pointed : both the proximal and distal ends seem to have served as the working edge
unfinished : tool may have broken during manufacturing

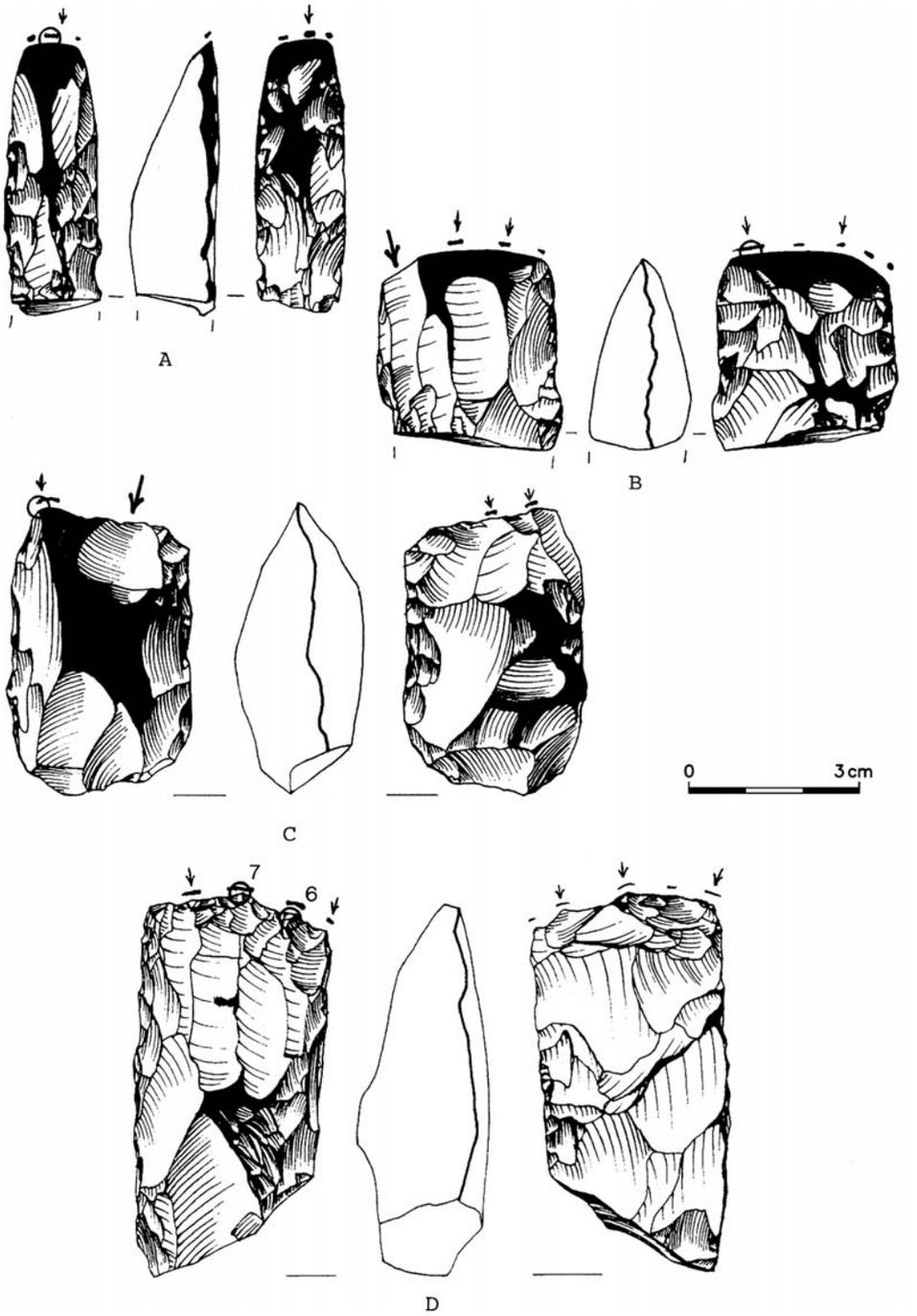

Fig. 8.3.

FIG. 8.3: DETAILS.

A. Item #1: Broken chisel. Dorsal Face is on the left, distal edge is at the top. Darkened areas show the extent of grinding and polishing. Solid lines show location of microwear traces (wood working). Small arrows show direction of use. Circle indicates the area shown in Fig. 8.4.
B. Item #2: Adze fragment. Dorsal Face is on the left, distal edge is at the top. Darkened areas show the extent of grinding and polishing. Solid lines show location of microwear traces (wood working). Solid lines show location of microwear traces (wood working). Large arrow shows location of large *point initiation fracture*. Circle indicates the area shown in Fig. 8.5.
C. Item #3: Adze fragment. Dorsal Face is on the left, distal edge is at the top. Darkened areas show the extent of grinding and polishing. Solid lines show location of microwear traces (wood working). Small arrows show direction of use. Large arrow shows location of large *point initiation fracture*. Circle indicates the area shown in Fig. 8.6.
D. Item #4: Adze fragment. Dorsal Face is on the left, distal edge is at the top. Darkened areas show the extent of grinding and polishing. Solid lines show location of microwear traces. Small arrows show direction of use. Circle 6 indicates the area shown in Fig. 8.7, where wood-working microwear traces were seen. Circle 7 shows area illustrated in Fig. 8.8, where hide-working wear traces were present.

MICROWEAR ANALYSIS

Some of the beige, brown or white flint nodules that were used to produce the bifacial tools from Givʿat ha-Oranim are chalky and coarse-grained or have a lustrous sheen on their surface that makes it difficult to identify use wear polishes. The working edges of 12 of the 14 tools in the sample were ground. A number of experimental and ethnographic studies suggest that edge-grinding and polishing of chipped stone bifaces occurs when people intensify their wood working activities. A manufacturing sequence of rough flaking, final retouching, then grinding and polishing, seems to be nearly universal for axes, adzes and chisels used for more sophisticated wood working like carpentry, rather than chopping and splitting logs (Barkai 2000; Dickson 1981:145; Hansen and Madsen 1983; Hayden 1989:14-15; Nami 1984; Olausson 1982, 1983; Pond 1930:79-83; Toth *et al.* 1992:90-91). It is believed that the carpentry tools were ground to strengthen their edges and to reduce friction during use (Boydston 1989; Dickson 1981:8; Hayden 1989; Mitchell 1959; Odell 1981: 206; Olausson 1982, 1983:30). Several of the tools from Givʿat ha-Oranim seem to have been recycled after they had broken. One broken adze was re-used as a hide scraper, and another may have been used as a core (Table 8.1).

RESULTS

The results of the microwear analysis are summarized in Table 8.1. A description of each artefact and a detailed discussion of the wear traces and technological features follows.

Item #1

This medial and distal fragment of a narrow chisel (Fig. 8.3A) has a straight working edge, a triangular transverse cross-section and a naviform longitudinal cross-section (thickest in the middle and tapering down toward the cutting edge and the butt). It seems to be an example of the Ghassulian chisels that are considered to be *fossiles directeurs* of the Chalcolithic period (Levy 1986:92; Levy and Rosen 1987:285). However, similar chisels have been found at late Pottery Neolithic sites in central Israel (Barkai 1996; Barkai and Gopher 1999; Gopher and Gophna 1993; Gopher and Orrelle 1989). In fact,

Fig. 8.4.

this broken chisel is almost identical in form to one of the chisels from the late Pottery Neolithic Wadi Rabah levels at the Nahal Zehora I site (Yerkes, forthcoming).

This chisel tapers from a greatest width of 17.5 mm to an edge width of 10 mm. Its ventral surface is flat, but somewhat irregular and undulating. The dorsal ridge is parallel with the ventral face until a point about 28 mm from the edge, where it tapers down to the bit, forming an oblique angle of 155°. The working edge forms an angle of 58°. The chisel fragment exhibits a bending fracture or lateral snap (Johnson 1981:47; Olausson 1983; Titmus and Woods 1986). The experimental chisel that was used in this study also broke with a lateral snap when it was hafted in a bone sleeve and struck with a hammerstone while it was being used to plane a piece of seasoned wood.

Both the dorsal and ventral surface of this chisel have been ground and polished. The grinding on the ventral face extends all the way back to the snap, and the entire tapered portion of the dorsal face is polished. There is very little edge-damage – only two small microfeather terminations along the distal edge of the ventral face and two extremely small microflake scars on the dorsal face. There is some wood polish visible near the edge of both faces (Fig. 8.4). Some unidentified red and black stains were seen along the edge under high magnification. The edge-damage suggests that the tool was not used to chop wood but rather to plane or scrape it. It is likely that this chisel was hafted in a sleeve.

ITEM #2

This distal fragment of an adze is made of lustrous beige (almost pink) flint (Fig. 8.3:B). It has a straight, but very slightly rounded working edge, with an edge angle of 50°. Its cross-section is asymmetrical, with the ventral face flatter than the dorsal face. Its lateral edges are straight and parallel. It resembles Stekelis' (1972:15) adze Type II. The edge width of the fragment is 31.5 mm, which is also the greatest width. At the point where it snapped, it is 18 mm thick. There is extensive edge-grinding and polishing, extending back at least 30 mm from the distal edge on both faces. The adze seems to have broken with a bending fracture or lateral snap. A large *point initiation* flake scar extends 23 mm back from the dorsal left corner of the distal edge (Olausson 1982, 1983). This indicates that the break probably occurred when the adze was being used.

On the ventral face, three small microflake scars with feather terminations are visible along the distal edge, and several small scars are present opposite the *point initiation* flake scar. Some wood polish was also observed at and near the distal edge on both faces (Fig. 8.5). The edge damage, including the large *point initiation* flake scar, suggests that this fragment was used to chop wood. It was probably hafted with the cutting edge at right-angles to the handle. Spenneman (1987) noted that the oblique striking angle of an axe or adze during use creates uneven damage on the cutting edge. There is greater damage on the dorsal left lateral edge of the cutting edge of this fragment. This would suggest that the user was right-handed.

There are several flake scars on the dorsal face that suggest that the snapped surface served as the striking platform after the adze had broken. This may have been an attempt to recycle the broken implement.

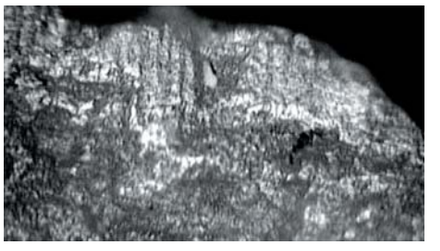

Fig. 8.5.

ITEM #3

This is a heavily-damaged distal fragment of an adze made of mottled beige flint (Fig. 8.3:C). The distal edge is so battered that the original form of the cutting edge cannot be determined, and thus the edge angle cannot be measured. The transverse cross-section seems to be trapezoidal and the lateral edges are straight and parallel. This may be another example of Stekelis' (1972) Type II adzes.

The greatest width of the fragment is 33 mm, tapering down to an edge width of 27.5 mm. The greatest thickness is 23.2 mm. There is extensive grinding and polishing on both the ventral and dorsal faces of the distal edge. A very large *point initiation* flake scar is present on the dorsal face of the edge. The ventral face has been battered, and much of the edge has been flaked away.

There are some small patches of what appears to be wood polish on the dorsal and ventral faces of the distal edge (Fig. 8.6). It appears to have been used for heavy wood chopping, and after it broke it seems to have been recycled. It may have served as a core. An alternative interpretation would be that the numerous large flakes removed after the adze snapped in half were taken off during an attempt to resharpen and reshape the adze.

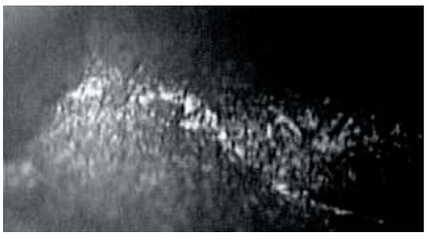

Fig. 8.6.

ITEM #4

This medial and distal fragment of an adze is made of dark brown mottled flint (Fig. 8.3:D). It appears to have a naviform longitudial cross-section, and is shaped like a larger version of the Ghassulian chisels. Its cutting edge is straight, its lateral edges are straight and parallel and it has a trapezoidal transverse cross-section. The ventral face is flat, but flake-scarred. The dorsal face is somewhat domed, with a flat triangular surface extending back about 45 mm from the edge. The remaining portion of the adze is 66.8 mm long, and the width of the working edge is 33.5 mm, which is also the greatest width of the fragment. It is 24 mm thick. Traces of edge grinding and polishing remain on both the dorsal and ventral faces, extending at least 41 mm back from the edge. The cutting edge is battered, and appears to have been resharpened. The edge-angle is 53°.

When the adze was broken it split diagonally at an angle of about 120° from the long axis. This may be an example of a perverse fracture that results when the fracture plane twists on an axis of rotation that corresponds to the direction of force (Crabtree 1972:82; Johnson 1981:46), or it could be an example of end shock or the presence of an incipient fracture plane. Such fractures can occur during bifacial reduction, but the extensive damage and the presence of several large *point initiation* flake scars on its distal edge suggest that the break occurred while the tool was being used. There are small patches of wood polish on the dorsal and ventral faces of the distal edge (Fig. 8.7), but there are also some traces of hide polish on the dorsal face (Fig. 8.8). It appears that the adze was used for heavy wood-working, but after it snapped in its haft it was reharpened and used as a hide scraper. There were no visible hafting traces on this fragment.

Fig. 8.7.

Fig. 8.8.

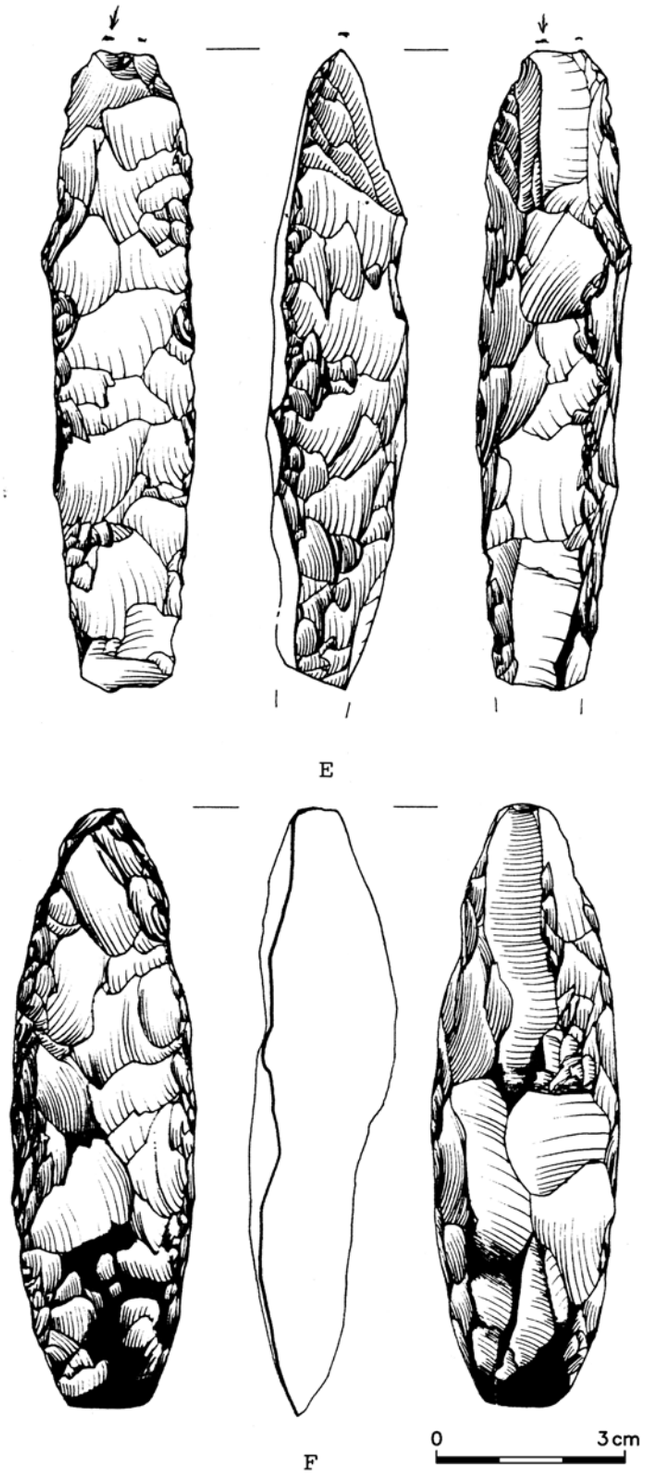

Fig. 8.9.

E. Item #5: Long narrow chisel. Ventral Face is on the left, distal edge is at the top. Darkened areas show the extent of grinding and polishing. Solid lines show location of microwear traces (wood working). Solid lines show location of microwear traces (wood working).

F. Item #6: Oval chisel. Ventral Face is on the left, distal edge is at the bottom. Darkened areas show the extent of grinding and polishing.

ITEM #5

This long, narrow chisel is made of grey flint (Fig. 8.9:E). It has snapped at the proximal end, but still is over 101 mm long. It is 21.5 mm wide and 21.8 mm thick at its mid-section, and tapers down to a width of 13.8 mm at the distal edge. It has a straight distal edge, and the tip has been flaked to create an edge angle of 50°. It resembles the thicker 'other type' of chisels in the Late Pottery Neolithic assemblages from Nahal Zehora I and Nahal Zehora II. In Stekelis' (1972:16) classification, it would be a Type III chisel (straight sides, straight and narrow working edge). In Olami's (1970) system, it would be Type 9 (*partie active rectiligne étroite, section surélevée*).

However, this bi-pointed chisel has traces of edge grinding and polishing on its snapped proximal end. This, together with the lateral snap, suggests that this end was used. There are several small flake scars on the ventral face of the distal edge, and there are some small patches of wood polish on this edge as well indicating that it too was used, even though it was not ground and polished. The proximal end of this chisel may have snapped during use, and then the tool was reversed in its haft and the distal end was used for wood-working.

There were no visible hafting traces, but their absence is not proof that the tool was not hafted. Hafting traces result from the stone implement moving in the haft. Secure hafting would prevent the tool from rubbing against the binding and leaving traces of wear.

ITEM #6

This large oval chisel is made of a coarse-grained light grey flint (Fig. 8.9:F). Its form is similar to Stekelis' (1972) Type I chisel, with its convex sides and narrow tip and butt, but it has a straight cutting edge with a steep edge angle (60°). Its transverse cross-section is roughly trapezoidal. It is 95.8 mm long and 21.3 mm thick. Its greatest width at the mid-section is 30 mm, tapering down to a width of 14.5 mm at the distal edge. The dorsal and ventral faces of the distal edge have been ground and polished for more than half the length of the chisel. The lateral edges are also ground and worn. There is a thick knot on the dorsal surface near the mid-section. This knot formed where bifacial thinning flakes terminated in step or hinge fractures. The thinning could not be completed, and the finished chisel was left with a thickened mid-section.

There are some small flake scars with feather terminations on the ventral face of the distal edge, but there were no other visible usewear or hafting traces. The chisel may have been used for light wood-working.

ITEM #7

This large adze is made of coarse beige flint with some chalky cortex remaining on the dorsal and ventral faces of the proximal end (Fig. 8.10:G). It is triangular in outline, with a trapezoidal transverse cross-section, similar to Stekelis' adze Type III. The ventral face is flat, but the dorsal face has a convex longitudinal cross-section with a flat triangular surface extending back about 58 mm from the edge. The ventral and dorsal faces have been ground and polished, and traces of the polish extend 65 mm back from the edge. At the proximal end, the lateral edges have also been ground and polished. This may have been done to facilitate hafting. It is nearly 101 mm long, 24.2 mm thick and its greatest width (at the dorsal cutting edge) is 37.9 mm. The angle of the cutting edge is 55°.

The distal edge has been battered, particularly on both corners, but there is more attrition on the distal left edge of the dorsal face. This would suggest that the user was right-handed (Spenneman 1987). A patina on the surface of the tool may have obscured some of the wear traces, but there are some microscopic fibres on the edge that resemble the wood fibres that were seen on the experimental adzes and chisels. However, cleaning the experimental tools with weak acids and bases usually removed these fibres. There were no other visible microwear or hafting traces. The location and extent of the edge damage suggests that this adze was used for heavy wood-chopping.

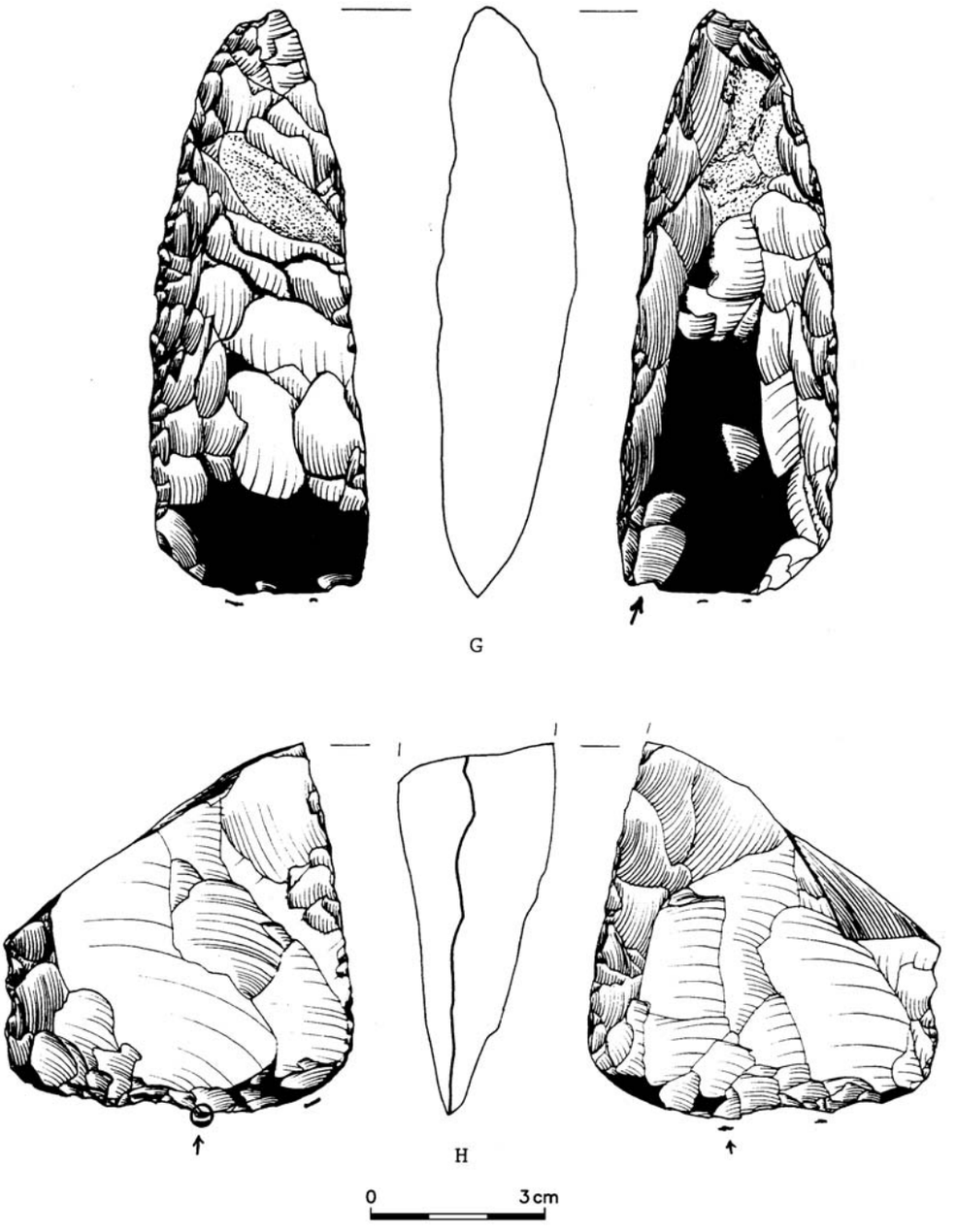

Fig. 8.10.

G. Item #7: Adze. Dorsal Face is on the right, distal edge is at the bottom. Darkened areas show the extent of grinding and polishing. Solid lines show location of possible microwear traces (wood working?). Large arrow shows location of possible *point initiation fracture*.

H. Item #8: Adze fragment. Ventral Face is on the left, distal edge is at the bottom. Darkened areas show the extent of grinding and polishing. Solid lines show location of microwear traces (wood working). Small arrows show direction of use. Circle indicates the area shown in Fig. 8.11.

Item #8

This distal fragment of an adze is made of mottled grey, pink, and beige flint Fig. 8.10:H). It has a slightly convex cutting edge that has been thinned down to form an edge-angle of 30°. Like Item # 4 above, when this large adze broke it split diagonally at an angle of about 120° from the long axis. This may be another example of a lateral snap, perverse fracture or end shock. It is also possible that the adze snapped along an incipient fracture plane in the flint. The greatest width of the adze fragment is at the cutting edge (60.5 mm) and its greatest thickness is 30 mm. The fragment is 67 mm long. Like Item #6 (above), there is a thick knot on the ventral surface near the mid-section that formed where bifacial thinning flakes terminated in step or hinge fractures. The edge is heavy battered with several large *point initiation* flake scars, but evidence of edge grinding and polishing is present on both faces of the distal edge. There are some weakly developed wood traces on the ventral face of the distal edge (Fig. 8.11). It appears to have been used for heavy wood chopping, and seems to have broken during use. There were no visible hafting traces.

Fig. 8.11.

Item #9

This small adze is made of beige flint with some dark and light inclusions (Fig. 8.12:I). It is similar in form to Item #7 (above) and Stekelis' (1972) Type III triangular adze. However, this adze is small, with a length of 81.5 mm and a thickness of 21.2 mm. Its greatest width is 31.5 mm near the distal edge, but damage to the cutting edge has reduced the edge width to 28.8 mm. It has an edge angle of 50°. The ventral face is flat, but the dorsal face has a convex longitudinal cross-section, with a flat triangular surface extending back about 53 mm from the edge. The distal edge has been battered, particularly on the left edge of the dorsal face. This would suggest that the user was right-handed (Spenneman 1987).

There are grinding and polishing traces on both faces of the working edge, but much of the polished area on the ventral face has been removed by what appear to be *point initiation* fractures. Alternatively, these flakes may have been removed in an attempt to re-sharpen the adze. There also is a large *point initiation* flake scar on the dorsal left corner of the edge. There are some very small patches of wood polish along the cutting edge. There were no visible hafting traces. It appears to have been used for chopping wood.

Item# 10

This is another small adze (Fig. 8.12:J) with a triangular outline similar to Item #9. However, its edge has been battered and appears to have been re-sharpened. It is 81.8 mm long, 22.5 mm thick, with an edge-width of 31 mm (which is also the greatest width). These dimensions are almost identical to Item #9. It is made of mottled beige flint. Chalky cortex remains over much of the dorsal surface. Traces of edge grinding and polishing are present back from the edge on the ventral face, but it seems that much of the polished area has been removed by re-sharpening. Re-sharpening of the dorsal face seems to have removed the polished surface (if the dorsal face was polished). The re-sharpening has created a steep edge-angle (65°). The lateral edges have also been ground and polished. This may have been done to facilitate hafting. Some possible hafting traces were seen on the right lateral edge of the dorsal face about 35 mm from the proximal end.

There are some small patches of what seems to be wood polish along the edge. This wear may have formed after the adze was re-sharpened and it was used to scrape or plane wood. It may have used to chop wood before it was re-sharpened.

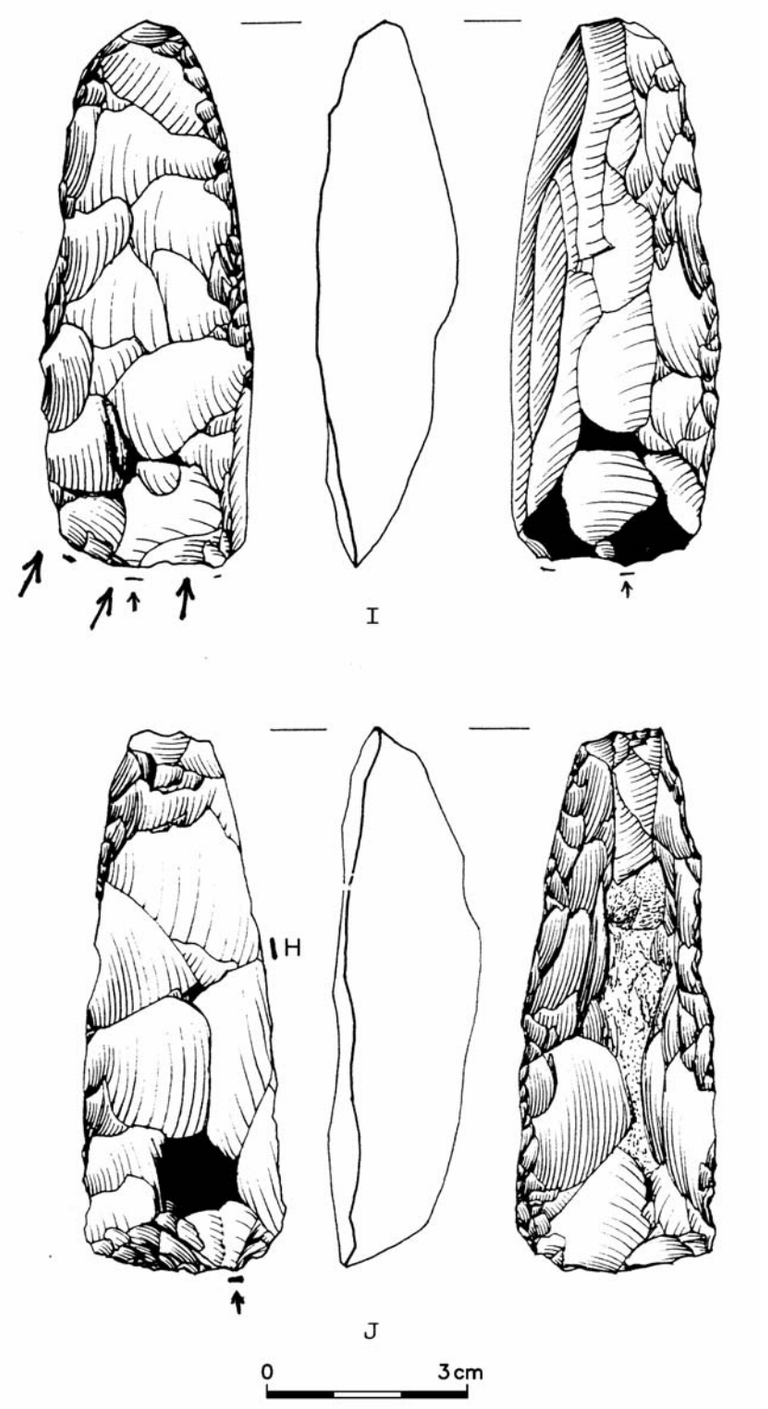

Fig. 8.12.

I. Item #9: Adze. Ventral Face is on the left, distal edge is at the bottom. Darkened areas show the extent of grinding and polishing. Solid lines show location of microwear traces (wood working). Small arrows show direction of use. Large arrow shows location of possible *point initiation fracture*.

J. Item #10: Adze. Ventral Face is on the left, distal edge is at the bottom. Darkened areas show the extent of grinding and polishing. Solid lines show location of microwear traces (wood working?). Small arrows show direction of use. Possible hafting traces at H.

ITEM #11

This distal fragment of a large adze is made of light grey flint with many crystalline inclusions (Fig. 8.13:K). Its lateral edges are straight and almost parallel, but the unbroken adze may have been trapezoidal in outline like Stekelis' (1972: 14) Type Ib adzes (sides straight, working edge straight and the widest part of the tool). The fragment is 56.8 mm long, 24.3 mm thick. The greatest width (40.6 mm) is slightly back from the edge which is heavily battered and re-sharpened. The edge width is 39 mm. The lateral edges have been ground. The working edge has been re-sharpened to create an edge angle of 65°. The re-sharpening gives the adze a scooped-out edge that resembles the working edges of North American wood-working tools that are called gouges (Hester *et al.* 1973). There are traces of grinding and polishing on both faces, but re-sharpening has removed much of the ground surface.

The adze exhibits a lateral snap where it broke, and the tool may have snapped during use. However, the snap could have been caused by end shock or the presence of an incipient fracture plane. The adze may have snapped when it was being re-sharpened. There are no visible wear or hafting traces. The heavy battering and possible *point initiation* fractures suggest that the adze could possibly have been used to chop wood.

ITEM # 12

This small adze has a crude appearance with large areas of cortex remaining on its surface Fig. 8.13: L). It seems to have been made from an irregularly shaped nodule of dark grey flint. Its outline is roughly trapezoidal (like Stekelis' Type Ib adzes). It is 75.5 mm long and 20.6 mm thick. Its greatest width (39.5 mm) is just back from the cutting edge. The edge width is 38 mm. There are small traces of grinding and polishing on the dorsal and ventral faces. It appears that the cutting edge has been re-sharpened and this has removed most of the ground surface. The re-sharpening has given this adze a gouge-like working edge like Item #11 (above). The edge angle formed by re-sharpening is 60°.

The edge seems to have been battered after it was re-sharpened, and there is some weakly-developed wood polish along the ventral face of the distal edge. This pattern of wear has been observed on experimental replicas of gouge-like North American adzes (Dalton adzes) that were used to hollow out wooden objects like wooden troughs or bowls (Yerkes and Gaertner 1997). This adze may also have been used to chop wood or scrape and hollow out wooden objects.

ITEM #13

This large trapezoidal adze also has a crude appearance. It is made of dark mottled flint (Fig. 8.14:M). It has a prominent dorsal ridge and a triangular transverse cross-section. It is 89.2 mm long and 31.2 mm thick, with an edge thickness of 47.4 mm (which is also the greatest thickness). The working edge is straight, but beveled, with a very steep edge angle (75°). There is some battering along the distal edge but no evidence of edge grinding or polishing. There are no visible use wear or hafting traces. Is this an unfinished preform for an adze? Its general appearance suggests that it is unfinished, and it looks like it has not been flaked into the form of the finished utilized adzes in the sample.

ITEM #14

This is also a crude, probably unfinished, adze (Fig. 8.14:N). Chalky cortex remains on the proximal end and dorsal face. It has a prominent dorsal ridge and a triangular transverse cross-section. It seems to be in the early stages of manufacturing before the fine retouching and edge grinding stages have been reached. It is 82.6 mm long, 30.2 mm thick, and has an edge width of 35.9 mm (which is also the greatest width). There are no visible use wear or hafting traces.

CONCLUSIONS

Ethnographic, archaeological and replicative studies have shown that bifacially retouched stone tools with ground and polished working edges are almost always used as wood-working tools (Hayden 1989;

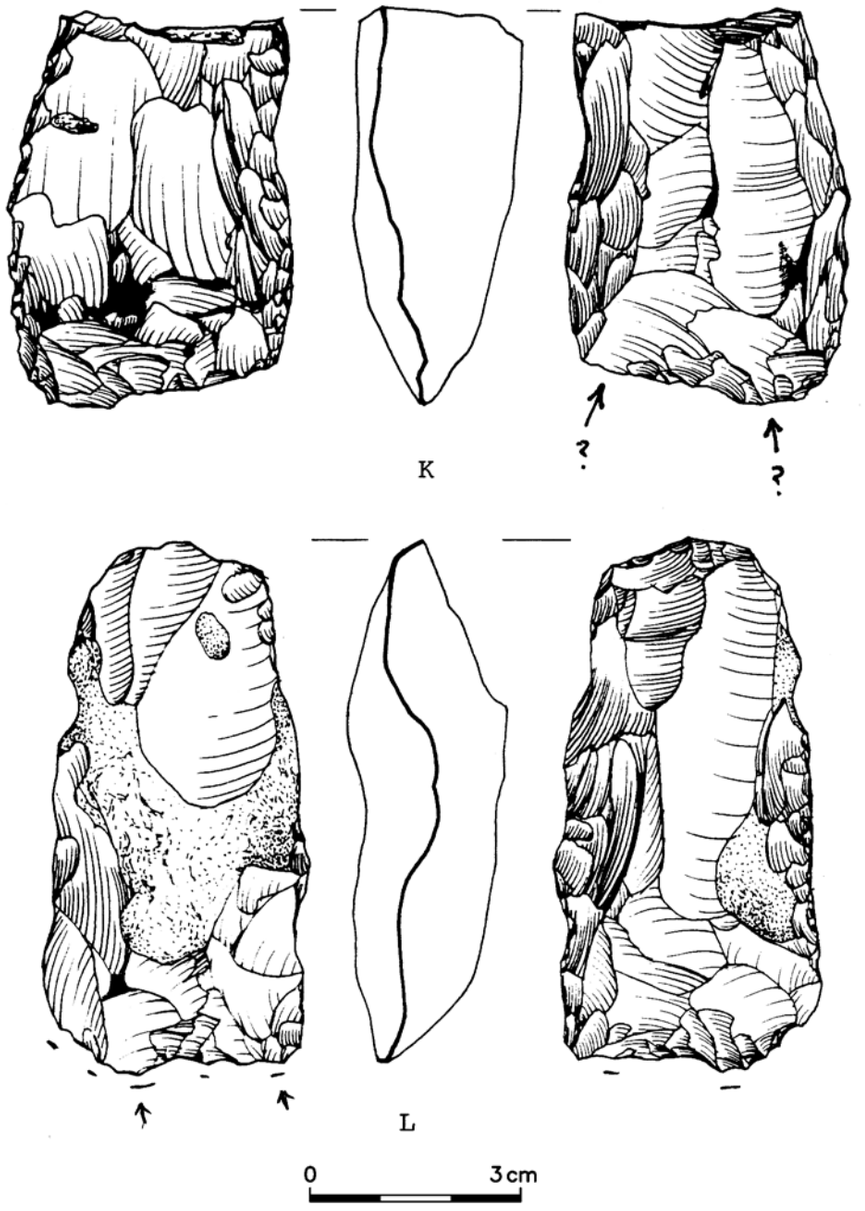

Fig. 8:13.

K. Item #11: Adze fragment. Ventral Face is on the left, distal edge is at the bottom. Darkened areas show the extent of grinding and polishing. Large arrow shows location of possible *point initiation fracture*.

L. Item #12: Gouge-like adze. Ventral Face is on the left, distal edge is at the bottom. Stippled areas show cortex remaining on surface. Solid lines show location of microwear traces (wood working). Small arrows show direction of use.

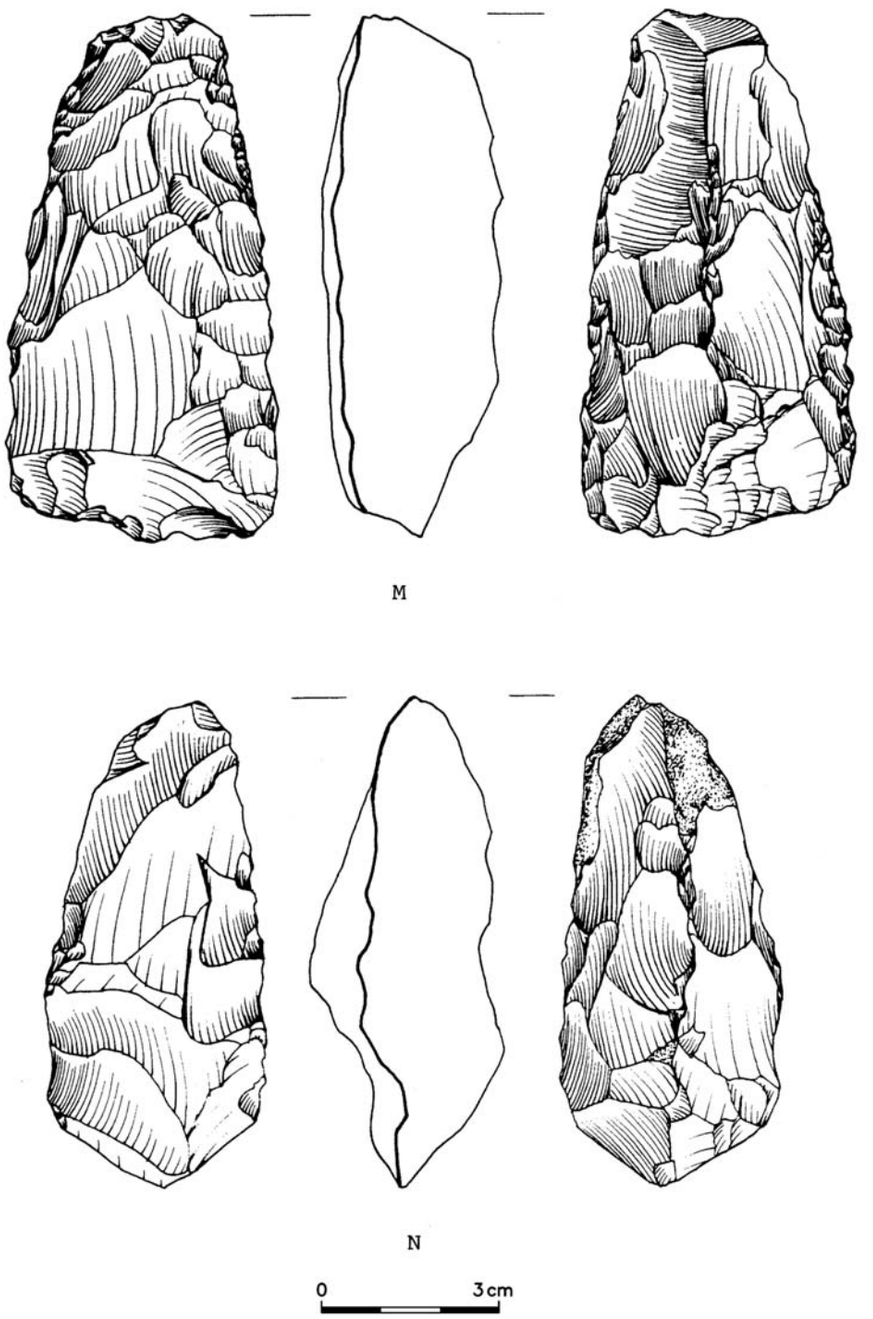

Fig. 8.14.
M. Item #13: Adze. No visible use wear or hafting traces. Maybe unfinished.
N. Item #14: Adze. No visible use wear or hafting traces. Maybe unfinished.

Olausson 1982, 1983; Woodman 1992). The sample from Givʿat ha-Oranim fits this pattern, but a few of the bifaces seem to have been recycled after they were damaged while chopping wood. The chisels seem to have been used for lighter wood working or carpentry rather than chopping or splitting wood. Some of the adzes have gouge-like working edges and may have been used to hollow out wooden objects. The adzes in this sample seem to have a more standardized form than the adzes from the Pottery Neolithic assemblages at Nahal Zehora I and Nahal Zehora II. The form of the Pottery Neolithic adzes was more variable (Yerkes forthcoming). Eleven of the 14 bifaces exhibited wear traces suggesting they were used in wood carpentry tasks, and one other (Item #11) may have been used to chop wood. One adze fragment seems to have been recycled and used to scrape hide after it had broken when it was used to chop wood (Item# 4).

When compared to the bifacial tools of the preceeding Neolithic periods, the bifaces of the Chalcolithic exhibit a greater degree of standardization in form. There are also significant changes in the frequencies of bifacial tool types. Axes are very rare at Chalcolithic sites, and adzes have become the most common bifacial tool (Barkai 2000). Over two-thirds of the bifacial tools in Chalcolithic assemblages are adzes, and they even dominate the bifacial assembles to a greater degree than the axes found in PPN lithic assemblages (data from Barkai 2000). Chisels are present in Chalcolithic assemblages but in much lower frequencies, accounting for around 15% of the bifacial tools (data from Barkai 2000).

Microwear analysis of the Chalcolithic adzes showed that they are multi-purpose tools used in heavy and light wood-working tasks. The adzes were used to fell trees and chop wood and for more delicate tasks, like making boards and wooden tools. Chalcolithic adzes are efficient, effective and useful tools and they were suitable for a wide range of wood-working activities. Chalcolithic groups produced these standardized bifacial tools at a time when their architecture also became standardized, and planned farming villages of large courtyard rectangular houses were established for the first time. In fact the layout of these larger Chalcolithic villages is very similar to the traditional villages seen in the Near East today (Levy 1986: 88). The Chalcolithic pottery industry is very standardized as well, and it has been suggested that the production of copper, ceramic and lithic artefacts was now in the hands of craft specialists (Levy 1986:89; Rosen 1997).

The efficient, multi-purpose and standardized character of Chalcolithic adzes and chisels may also reflect the establishment of new perceptions and world views during the Chalcolithic period in the Levant, when well organized cemeteries and temples appear. Chalcolithic groups seemed to have designed their tools so that they could exploit their environment with more intensity and efficiency. These changes in Chalcolithic lithic technology also correspond to the changes in food production that occur during the 'Secondary Products Revolution' (Sherratt 1983) when there was an unprecedented manipulation and exploitation of resources and a stable economy based on mixed farming and herding was established. Standardization in bifacial tool form and function is one of the many socio-economic changes experienced by the societies that lived in the Levant during the Chalolithic period. These changes also had a profound effect on the development of the historic cultures of the region, and in many ways mark the emergence of the traditional Near Eastern lifestyle.