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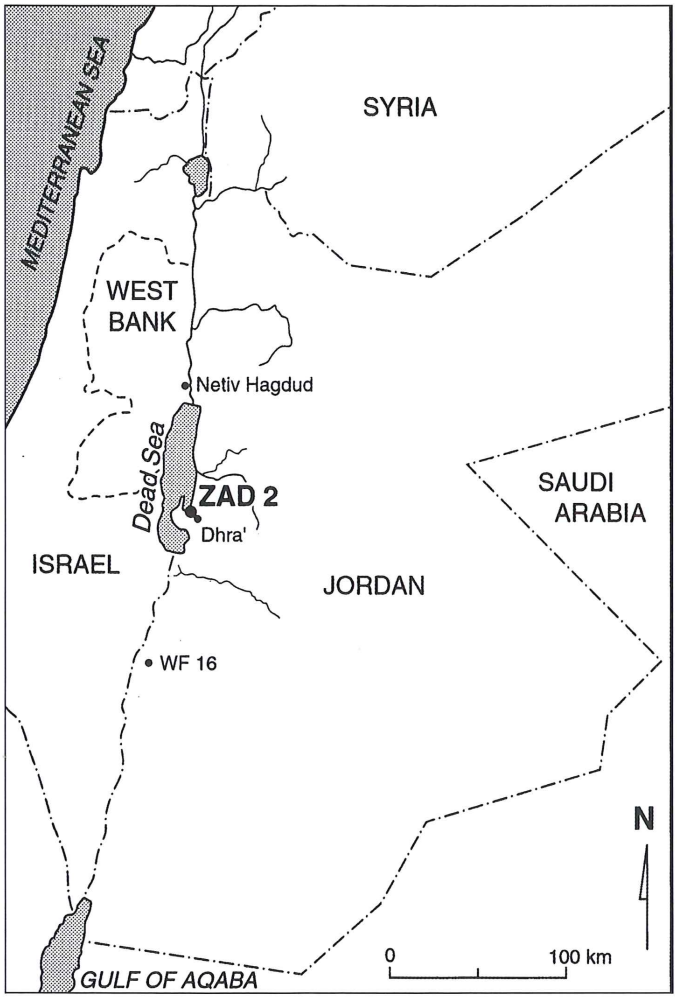
Lithic Production at the Pre Pottery Neolithic A, Site of Ẓahrat adh-Dhrā‘ 2 and its Context

Introduction

Ẓahrat adh-Dhrā‘ 2 (ZAD 2) is located on the eastern side of the Lisan Peninsula of the Dead Sea about 1.5km north of adh-Dhrā‘ village (FIG. 1). Its elevation is around 180 metres below sea level and the site receives only 50 - 100mm annual rainfall. However, the existence of a major permanent spring feeding Wādī adh-Dhrā‘ approximately 2km southeast of ZAD 2, as well as the seasonal flow during winter, made life possible for the inhabitants of ZAD 2 (Edwards *et al.* 2001; Sayej 2001a; 2001b).



1. The location of ZAD 2 and other sites mentioned in the text.

ZAD 2 is situated on a small plateau where the western side is cut by erosion, while the rest forms an oval mound about two metres thick and approximately 2,000 square meters in area. The small plateau is surrounded by steep cliffs, up to 30 metres deep, formed by heavy erosion throughout the millennia. This evidence supports the possibility that higher Dead Sea levels during antiquities may have permitted spring waters to emerge in less dissected landscape than at present (for further information see Edwards *et al.* 2001).

The Excavations

The first season of excavation was conducted in November / December 1999 and the second season was carried out in January / February 2001 by La Trobe University under the direction of Phillip Edwards, as part of the La Trobe / Arizona State University ‘Archaeology and Environment of the Dead Sea Plain’ project.

Sixty-six and a half square meters within four structures named 1, 2, 3 and 4 were excavated. The results of the excavations show well-preserved architecture for Structures 2 and 3 and less well-preserved architecture for Structure 4. After two seasons of excavations, it appears clearly that ZAD 2 was a short-lived settlement containing only one major construction phase. However, this does not mean that all structures were built contemporaneously. Structure 2, which is the most sophisticated structure, seems to be built after Structure 3 and its upper exterior walls suggest that curvilinear structures were added over time. Within each structure there were at least one level of floor, and in the case of structure 2, there were 4 floors. The depth of all Structures excluding Structure 4 was tested by digging some squares to the natural deposits at about 100 - 150cm below the surface. The site plan consists of curvilinear stone huts, which seem to adjoin each

other (FIG. 2), (see also Edwards *et al.* 2001; 2002).

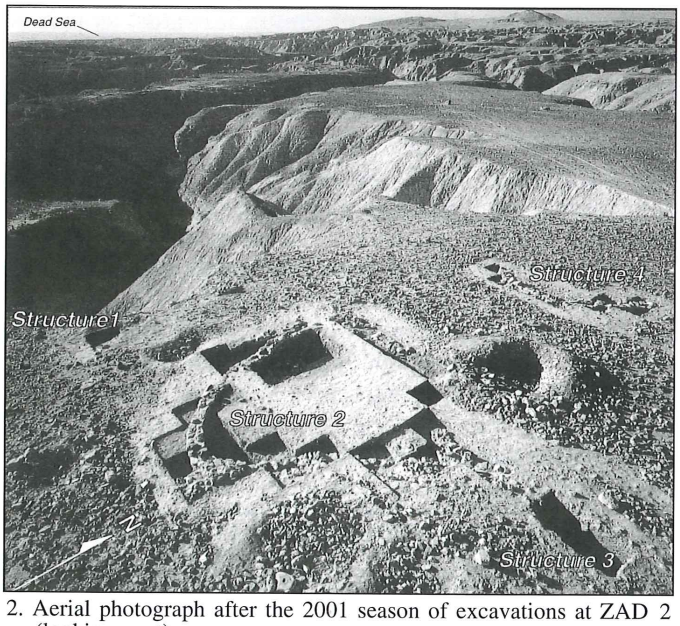
Besides having good architectural remains, a secondary burial was excavated between Structure 1 and 2. The secondary burial contained at least three individuals also accompanied by many artefacts including a small stone figurine (for further information see Edwards *el al.* 2002).

The Flaked Stone Assemblage of ZAD 2

The Dana Conglomerate Formation which surrounds ZAD 2 has massive veins of flint cobbles, used through time as flint quarries (Edwards *et al.* 1998; 2001), whereby an eastern source, for example, lies only a 10-minute walk from the site. Furthermore, the pebbles that wash down through Wādī adh-Dhrā' are widely scattered over ZAD 2 the vicinity of and might have been exploited for flint knapping.

The results of the excavations show that a small number of flaked stone tools were not only produced from flint but also from other raw materials such as quartz, quartzite, obsidian, basalt, limestone and sandstone. Geoarchaeological fieldwork in the ZAD 2 region indicates that all sources of raw materials, besides obsidian, are local (Chris Day 2001: personal communication). As for obsidian, the closest known source to the Southern Levant is Anatolia (e.g. Dixon *et al.* 1968; Yellin 1997).

A total amount of 146,626 specimens of lithics was recovered from the four structures excavated in both 1999 and 2001 seasons (TABLE 1). Structure 1 provided 27,612 specimens of debitage and debris and 448 retouched tools. Structure 2, the largest excavated area, supplied 86,291 pieces of debitage and debris and 880 retouched tools. Structure 3 had 10,445 specimens of debitage and debris and 177 retouched tools, and, finally Structure 4 has 20,643 pieces of debitage and debris and 130 retouched tools.



2. Aerial photograph after the 2001 season of excavations at ZAD 2 (looking west).

Although the majority of lithic artefacts came from the first two layers where the excavators dug the most, it was noticed that the amount of lithics and their densities within each cubic meter, decreased with depth. In order to illustrate this argument, one example from Structures 1-4 will be addressed.

Structure 1, Square E 28 has a density of 78,650 specimens of lithics per m^3 in the surface layer (locus 1). Locus 18 is approximately 80cm below locus 1 and has a density of only 3,680 pieces of lithics per m^3. Square K 22 in Structure 2, has a density of 54,300 specimens per m^3 in locus 1, while locus 2 which is directly beneath it, has a density of only 15,417 specimens of lithics per m^3. Furthermore, Square V 22 in Structure 3 has a density of 11,213 specimens of lithics per m^3 in locus 1, while it has a density of 2,525 pieces per m^3 in locus 7 that lies approximately 50cm below locus 1. Finally, Square P 10 in Structure 4 has the density of 3,090 of lithics per m^3 in locus 1, while locus 2 which is directly beneath it, has a density of 128 specimens per m^3.

The probable explanation for this pattern may relate to natural deflation whereby the surface lithics concentrated in the upper layers throughout the years due to the steady erosion of fine surface sediment. This indicates that natural causes were behind the distribution of lithics rather than human behaviour.

Technology

A very small number of burnt lithics was found, probably due to incidental burning of lithics associated with hearths. Macroscopic evidence for flint heat treatment during manufacturing was very limited, and the results of lithic analyses give strong indications that heat treatment was not a preferred technique (Sayej 2001b).

The 'Debris' class at ZAD 2 consists of 91.7 % of the total amount of recovered lithics and this category is divided between chips (85.7 %) and chunks (14.3 %, TABLE 1). This large amount of debris reflects the easy availability of raw materials and indicates that the flint knappers of ZAD 2 produced most of their tools on site. The 'Debitage' class comprises 7.2 % of the total recovered lithics at ZAD 2 and are divided as: cores (4.4 %), flakes (72.3 %), bladelets (21.6 %) blades (1.1 %) and core trimming elements (0.6 %, TABLE 1).

Core analyses demonstrate three different sizes: small (< 30 millimetres), medium (30-70 millimetres) and large (> 70 millimetres). The great majority of them (408) belong to the 'medium' size class, with 33 in the 'large' and 24 in the 'small' size categories. The smaller sizes might result from a deliberate strategy to produce small sized tool-blanks, or exhaustion of the larger cores. The major-

Table 1. Lithic artefacts in Structures 1-4, ZAD 2.

	Types	Structure 1		Structure 2		Structure 3		Structure 4		TOTAL	
		N	%	N	%	N	%	N	%	N	%
Debris											
	Chunks	2,502	9.6	12,716	16	1,378	14.1	2,699	14	19,295	14.3
	Chips	23,570	90.4	66,576	84	8,382	85.9	16,649	86	115,177	85.7
134,472	**Subtotal**	**26,072**	**92.9**	**79,292**	**91**	**9,760**	**91.9**	**19,348**	**93.2**	**134,472**	**91.7**
Debitage											
	Cores	62	4	329	4.7	40	5.8	34	2.6	465	4.4
	Flakes	1,127	73.2	5,073	72.6	492	71.9	918	71	7,610	72.3
	Blades	9	0.6	87	1.2	5	0.7	11	0.8	112	1.1
	Bladelets	330	21.4	1,480	21.1	143	20.9	320	24.7	2,273	21.6
	Core trimming elements	12	0.8	30	0.4	5	0.7	12	0.9	59	0.6
10,519	**Subtotal**	**1,540**	**5.5**	**6,999**	**8**	**685**	**6.4**	**1,295**	**6.2**	**10,519**	**7.2**
Retouched Tools											
	Scrapers	17	3.8	71	8.1	14	7.9	8	6.2	110	6.7
	Burins	5	1.1	5	0.6	3	1.6			13	0.8
	Retouched flakes	176	39.4	263	29.8	60	33.9	24	18.5	523	32
	Backed flakes	6	1.3	6	0.7	4	2.3	2	1.5	18	1.1
	Truncated flakes			1	0.1			1	0.8	2	0.1
	Retouched blades	9	2	32	3.6	7	4	8	6.2	56	3.4
	Truncated blades							2	1.5	2	0.1
	Sickles/Beit Ta'amir	1	0.2	2	0.2			1	0.8	4	0.2
	Retouched bladelets	159	35.6	286	32.6	63	35.6	36	27.6	544	33.4
	Backed bladelets	2	0.4	1	0.1			4	3.1	7	0.4
	Truncated bladelet			1	0.1					1	0.0
	Projectile points	4	0.9	3	0.3	1	0.6	3	2.3	11	0.7
	Hagdud truncations	10	2.2	44	5	1	0.6	6	4.6	61	3.7
	Notches	21	4.7	66	7.5	9	5.1	7	5.4	103	6.4
	Perforators	26	5.8	43	4.9	9	5.1	14	10.7	92	5.6
	Multiples	2	0.4	6	0.7	2	1.1	3	2.3	13	0.8
	Bifacial	8	1.8	45	5.1	2	1.1	10	7.7	65	4
	Varia	2	0.4	5	0.6	2	1.1	1	0.8	10	0.6
1,635	**Subtotal**	**448**	**1.6**	**880**	**1**	**177**	**1.7**	**130**	**0.6**	**1,635**	**1.1**
	TOTAL OF LITHICS 146,626	**28,060**	**19.1**	**87,171**	**59.5**	**10,622**	**7.2**	**20,773**	**14.2**	**146,626**	**100**

ity are pyramidal or conical single platform cores (226), while 54 have two platforms, 26 have multiple platforms and for 159 of them, the platforms are missing. The average scars on these cores are 5 scars for each core and the majority have scars of flakes (282), whereas (183) cores are predominantly blade/ bladelet scars. Remains of both burnt and heat-treated cores are very limited, with only 13 cores burnt and 4 showing signs of heat treatment.

The existence of cortex on both cores and many flaked elements supports the idea that the local cobbles provided the main source for flaking flint elements. With regard to the cores, 84 have 30-100 % coverage, 234 cores have < 30 % coverage, and 147 cores do not have any. The predominantly brown flint colour of the cores is also reflected in the ZAD 2 region quarries, with other colours in lower frequencies (Edwards *et al.* 1998: 31-34, see also 2001; 2002).

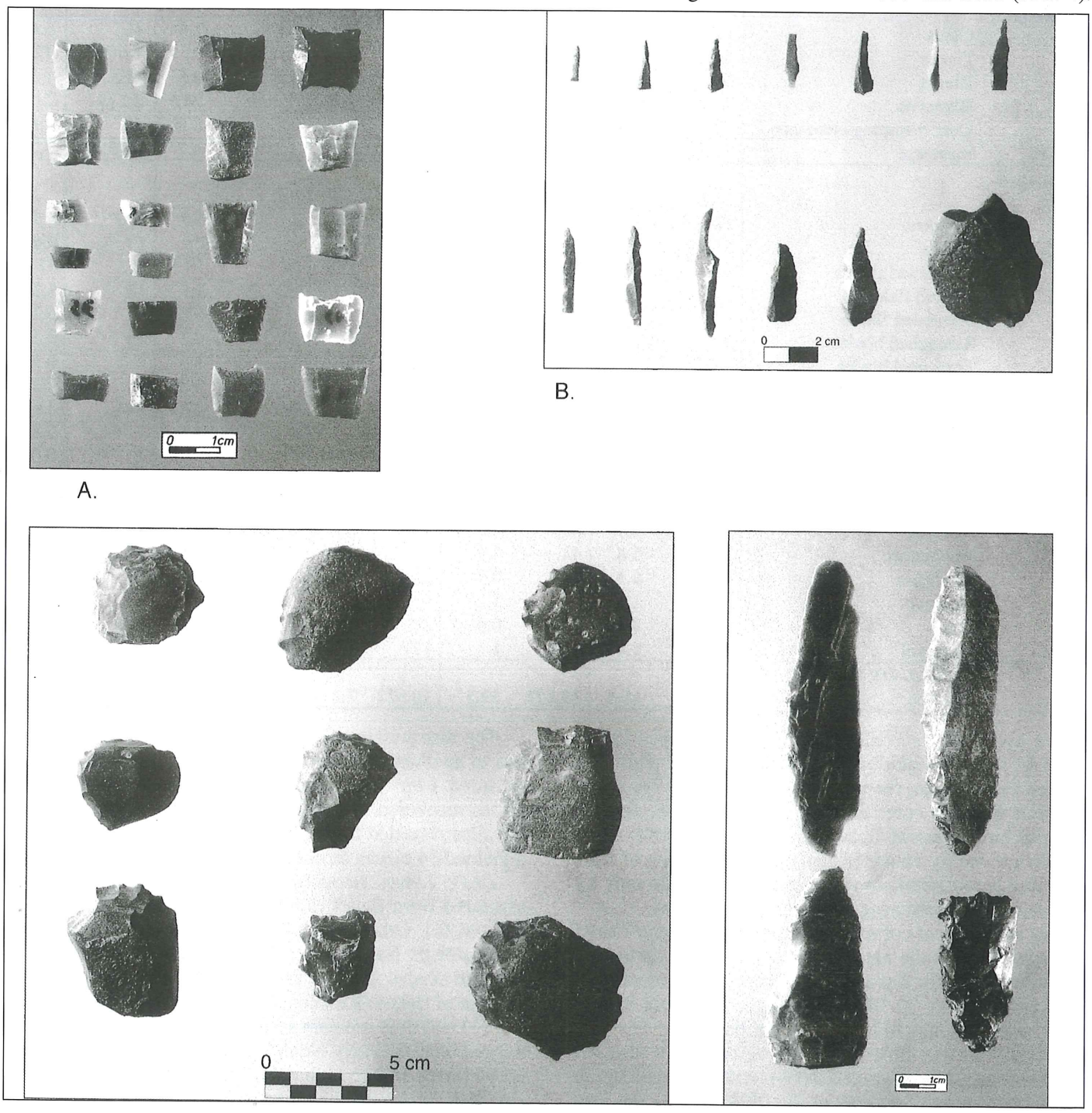
The distribution of cores within structures varies from one to another. Structure 1 (TABLE 1) provided 62 cores recorded from eight squares. Structure 2 supplied 329 pieces recovered from thirty-five squares. Structure 3 had 40 cores recorded from two squares, and finally, Structure 4 yielded 34 pieces recorded from ten squares.

ZAD 2 has retouched tools almost equally manufactured from flakes (52 %) and from blades and bladelets (48 %). Other Pre-Pottery Neolithic A (PPNA) sites, such as Netiv Hagdud show that the amount of both bladelets and blades are less than 50 % in comparison to the amount of flakes (Bar-Yosef *et al.* 1991: 413; Nadel 1997: 72, 81) and thus scholars such as Belfer-Cohen (1994: 97) suggest that the early Neolithic assemblages are dominated by flakes among both debitage and tools. However, Pirie (2001: 11) recently analysed the lithics of Nachcharini cave in Lebanon, which showed that the assemblage is

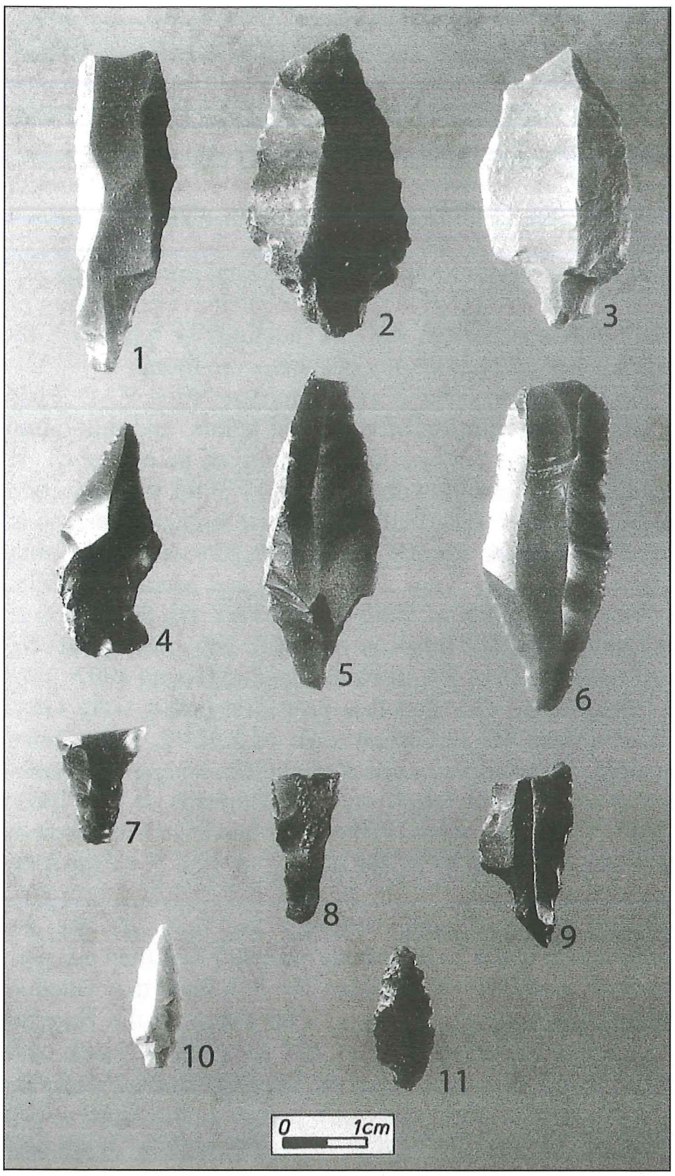
very blade let oriented and that 76 % of the retouched tools were made on bladelets. This might lead us to conclude that despite the technological and typological similarities between the various PPNA sites, archaeologists should be cautious when generalising. What might be the case for one site does not necessarily mean the same for the other.

Typology

The site has produced many tool types such as Hagdud truncations, bifacial tools, borers, scrapers, notches, burins, and Beit Ta'amir sickles, but only a few Jordan Valley points and other atypical projectile points (TABLE 1, FIG. 3). Only 11 projectile points were found and recorded during the excavation of 1999 and 2001 (FIG. 4).



3. Retouched tools from ZAD 2: A) Hagdud truncations, B) Borers, C) Scrapers, and D) Ta'amir sickles.



4. Projectile points, ZAD 2: (Nos. 1, 5-8) Jordan Valley 2, (No. 9) Jordan Valley 5, (Nos. 2-3) Jordan Valley 6, (No. 4) El Khiam, and (Nos. 10-11) Type 3?

All of them are made on bladelets and the retouch mode shows steep (N = 5), semi-steep (N = 4), steep notches (N = 1), and flat retouch (N = 1). The retouch positions indicate that one of them has proximal and right lateral retouch, five have proximal and bilateral retouch, one has bilateral retouch and finally four have bilateral, distal and proximal retouch. Except for one gray point, all of them were brown. Four points have less than 5 % of cortex. Six points are broken from the distal end. The mean dimensions of these projectile points are 2.7 x 1.2 x 0.4cm and the mean weight is 1.5 gram.

According to the typology of Gopher (1994) and Nadel (1997), two of the three types found at ZAD 2 could be identified as: 1) Jordan Valley points (N = 8) and 2) El Khiam points (N = 1). The third type (N = 2) however, does not have any parallel examples from other contemporaneous sites and therefore it will be referred to as Type 3 (see below).

1) The Jordan Valley points

Eight projectile points belong to the Jordan Valley group and all of them but two have broken distal ends. They can be divided into three sub-groups:

1.a) *Jordan Valley 2: long rectangular tang:* Five points belong to this subgroup when the angle between the tang and the body of all of them is greater than 90 degrees. Three of them are almost complete but missing the distal ends (F 27, locus 1.1; U 22, locus 5.1 and F 26, locus 8.1), while the other two have only the proximal tangs (F 26, locus 8.2 and Q 10, locus 1.1). Four of them have steep retouch on the proximal tangs, whereas one has semi-steep retouch (FIG. 4: 1, 5-8).

1.b) *Jordan Valley 5: Long, drop-shaped tang:* One point belongs to this subgroup (L 24, locus 1.2), which is characterized by the shoulder or neck positioned between the tang and the body at an angle greater than 90 degrees. The tang is modified by steep and direct unilateral retouch, whereas the distal half is missing (FIG. 4: 9).

1.c) *Jordan Valley 6: Tang and barbs:* This subgroup is characterized by the angle between the tang and the body, whereby the angle must be less than 90 degrees. Two points belong to this subgroup (F 26, locus 1.1) and (L 11, locus 1.1). Both points have semi steep bifacial retouched tangs and unifacial proximal retouch (FIG. 4: 2-3).

2) El Khiam type

One of the ZAD 2 points might be counted as El Khiam 1 type (K 23 Locus 1.2). It has two notches on the proximal half of the piece (one is smaller than the other), fashioned by direct unilateral retouch. The rest of the body is hardly retouched whereas the distal end has direct unilateral retouch (FIG. 4: 4).

3) Type 3?

The third type of projectile point is very diminutive and two of them were recovered during the excavations. These points, to my knowledge, do not have any clear parallel examples from other contemporaneous sites, and therefore they will be discussed them separately.

Both points are made from flint and have similar dimensions, shapes and techniques (FIG. 4: 10-11). The first was recovered from Structure 2 (Square K 22, locus 2.1) and the second was recovered from Structure 4 (Square M 12, locus 1.1). Both of them have only one

notch on the left side of the tang. The retouch mode is bifacial semi-steep, made on both the distal and the proximal ends. None of them have any remains of cortex and there is no evidence for heat treatment or burning. One of them has a pale brown colour (10 YR: 6/3) and the second has a dark brown colour (7.5 YR: 3/2). Both pieces are complete and their mean dimensions are more or less the same: 1.70 (L) x 0.65 (W) x 0.20 (Th.) cm, and both weigh 0.20 grams.

Projectile points are represented within structures (TABLE 1). Structure 1 provided 4 points recorded from two squares. Structure 2 supplied 3 pieces recovered from three different squares, whereas Structure 3 had only 1 point, and finally, Structure 4 yielded 3 pieces recorded from three different squares.

The second retouched tool type that will be discussed in this paper is the Hagdud truncation. Both seasons of excavations yielded 61 Hagdud truncations, or 3.7 % of the recovered retouched tools (TABLE 1 and FIG. 3), that so far forms the second largest absolute amount recovered in the southern Levant after the 63 from Netiv Hagdud (Nadel 1997: 111). At ZAD 2, the Hagdud Truncations' distal and proximal truncations are formed by a steep retouch. None of the specimens are burnt or show evidence of heat-treatment. Three specimens are partially broken. Flint was the only raw material used to produce them with the colour being mainly brown (45 specimens or 74 %), followed by gray (11 specimens or 18 %) and black (5 specimens or 8 %). The tools were shaped by either one or two sub-parallel distal and proximal truncations on a small bladelet segment, and may be classified into 6 subtypes:

a) Double straight truncation (23 specimens).
b) Straight-concave truncation (15 specimens).
c) Double concave truncation (8 specimens).
d) Single concave truncation (7 specimens).
e) Single straight truncation (7 specimens).
f) Concave-convex truncation (1 specimen).

The mean dimensions are 1.00cm for length, 0.85cm for width, 0.18cm for thickness and 0.14 grams for weight.

Despite the fact that the majority of the Hagdud truncations recovered from Structure 2 where the excavators dug the most, this tool type is represented within each structure (TABLE 1). Structure 1 provided 10 specimens recorded from six squares. Structure 2 supplied 44 pieces recovered from twenty-six squares, whereas Structure 3 had 1 specimen recovered from one square and finally Structure 4 yielded 6 pieces recorded from four squares.

The Economy of ZAD 2 in Comparison to other Contemporaneous Sites

The general framework of the late PPNA settlements in the Jordan Valley shows that the economy was based on hunting and on intensive collection or cultivation of cereals such as barley and wheat (Bar-Yosef and Belfer-Cohen 1989: 476-484). The botanical analysis of remains collected during the excavations at ZAD 2 produced four main types. They are pulses, grains, fig seeds and pistachio nutshells (Meadows in Edwards *et al.* 2001). Many ground stone artefacts, such as pestles, cup-hole mortars and querns, were uncovered during the excavations as well as 65 bifacial tools (4 % of the total retouched tools). This evidence support the idea that intensive processing of plant foods occurred, but not necessarily harvested by sickles, because hardly any of them were found.

In contrast to other contemporaneous sites, ZAD 2 has a very low proportion of projectile points, and this raises many questions concerning the nature of its economy. At ZAD 2 they constitute only 11, or 0.7 % of the retouched tools, and more than half of them are broken, whereas at Dhrā' they make up 309, or 18.3 % (Goodale and Smith 2001: 2, see also Kuijt 2001; Kuijt and Mahasneh 1998: 159), 66, or 17.4 % at Wādī Faynān (WF 16) (Finlayson *et al.* 2000: 16, 21; Mithen *et al.* 2000: 661; Pirie 2001: 6), and finally 120, or 3 % at Netiv Hagdud (Nadel 1997: 83).

Despite the fact that few projectile points were identified among the retouched tools of ZAD 2, a few bone samples identifiable as goats or gazelle, badger and freshwater crabs were found on site (Edwards *et al.* 2001; 2002). Other tool types on the other hand, such as scrapers and borers, which form 202 pieces, or 12.3 % of the total amount of retouched tools, indicate either meat / skin processing or wood/reeds working. So, how did the inhabitants of ZAD 2 catch these animals? Did they use perishable materials for hunting or did they use Hagdud truncations instead of points? The shape of the Hagdud truncations dose not support this idea (cf. Edwards and Sayej 2002), and thus either the inhabitants of ZAD 2 discarded most of their projectile points in the fields while hunting, or used perishable materials such as bone and wooden projectiles, or even exchanged the meat with their plant production from the nearby site of Dhrā'. These results suggest that hunting was not a major preoccupation for the inhabitants of ZAD 2, whereas the quantities of ground stone equipment and botanical remains imply an emphasis on plant food processing.

Although the recent microwear analyses by Goodale and Smith (2001) indicate the use of Dhrā' projectile points as borers, it does not necessarily mean that points were not used for hunting. Thus, it will be assumed here that hunting at Dhrā' was, at least, one of the major sources of the site economy and therefore, several explanations can be suggested:

1) If the two sites are contemporary, then Dhrā' may have supplied ZAD 2 with meat and the gathered products from the highlands such as pistachio nuts and figs,

whereas ZAD 2 supplied the cultivated products to the inhabitants of Dhrā' such as barley and lentils.

2) If ZAD 2 is a little bit younger than Dhrā', as the dates so far suggest (see below), then ZAD 2 with its extensive tracts of irrigable flat land, might represent a successor site to Dhrā'.
3) If there was no connection between the two sites whatsoever, then it is possible that ZAD 2 was a seasonal site, with an emphasis on crop growing (Edwards *et al.* 2001), and that its inhabitants moved to the highlands during the hot dry season to practise foraging.

However, if projectile points had only symbolic or ritual status, then such purely functional conclusions may be inaccurate.

Furthermore, both ZAD 2 and Dhrā' completely lack microliths (specifically lunates), while WF 16 has 22.4 % (including 2.6 % identified as geometric) and Netiv Hagdud has 13 %. This typological difference might be due to either functional distinction between the various sites, or to the suggestion that microliths were part of the continuity in flint knapping technologies between the late Natufian and the early Neolithic periods (e.g. Nadel 1998: 8) and therefore one might assume that these sites are Khiamian. However, microliths existed in particular sites during the later Sultanian phase, as was the case at WF 16 (Pirie 2001: 6). The similarities and differences between the above four sites arises the question as to whether or not they date to the same phase within the PPNA? In order to be able to answer this question, an examination of C14 dates is needed.

The Reality of C14 Dating

ZAD 2 provided many charcoal samples and nine of which were analyzed by accelerator mass spectrometry, providing the basic chronology of the site. The un-calibrated dates at ZAD 2 (TABLE 2) show a range of ca. 300 years between 9,635 to 9,323 BP (Edwards *et al.* 2001; 2002 ;Edwards and Higham 2001; Sayej 2001b). At Dhrā' the un-calibrated dates show a range of ca. 450 years between 9,610 to 10,059 BP (Kuijt 2001; Kuijt and Finlayson 2001; Kuijt and Mahasneh 1998). WF 16 shows a range of ca. 1,000 years between 9,180 to 10,220 BP (Finlayson *et al.* 2000; Mithen *et al.* 2000; Pirie 2001) and finally Netiv Hagdud shows a range of ca. 800 years between 9,400 to 10,180 BP (Bar-Yosef *et al.* 1980; Bar-Yosef *et al.* 1991; Bar-Yosef and Gopher 1997).

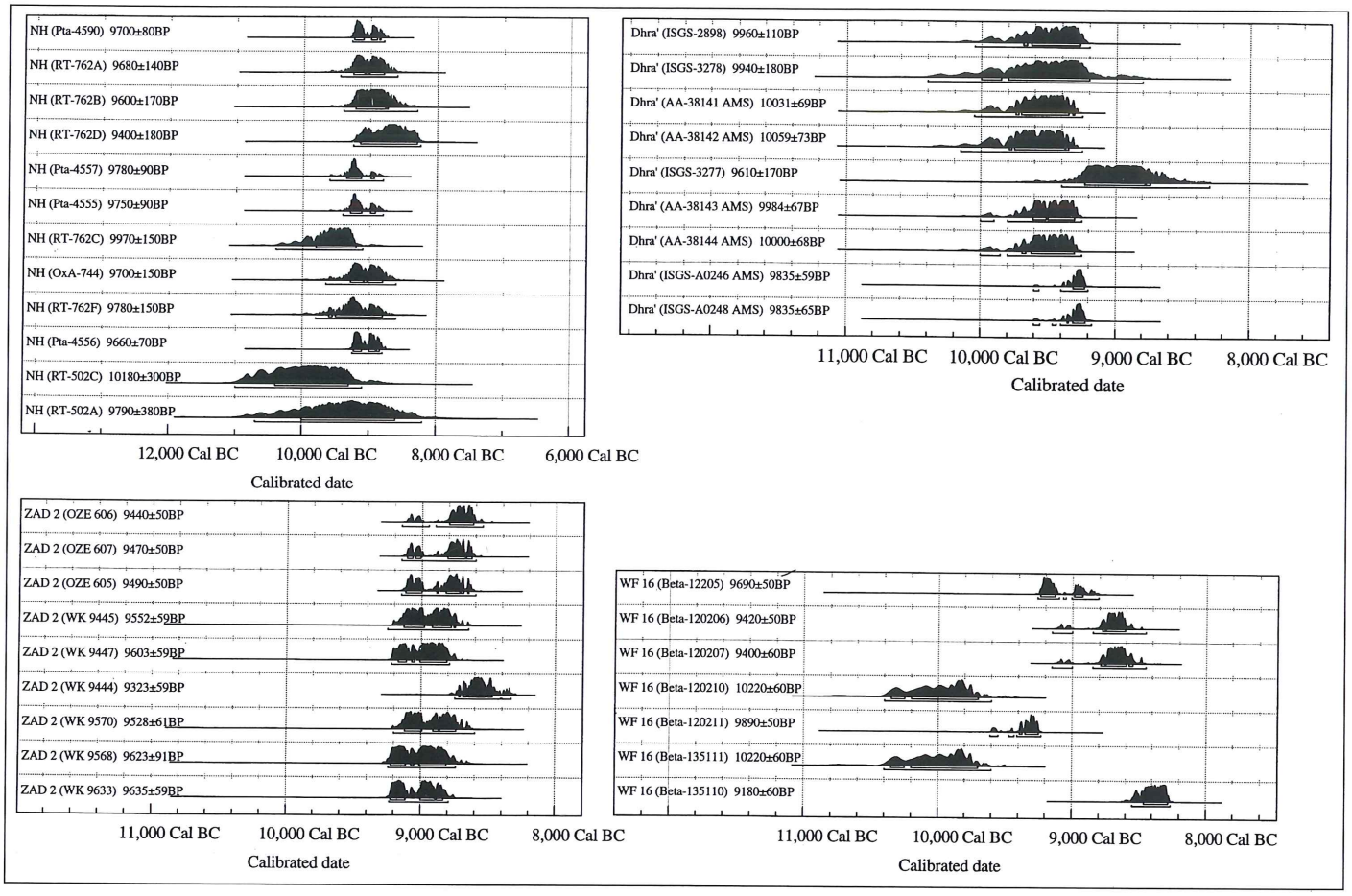
This indicates that ZAD 2 is the youngest and the shortest-lived site among these sites. The second youngest is WF 16 where 3 dates are similar to ZAD 2 (Beta-12205, Beta-120206 and Beta-120207). However, WF 16 has a longer life span than ZAD 2 (ca. 750 years more). Dhrā' on the other hand, is at least 300 years older than ZAD 2 and has a life span of ca. 450 years. Finally, Netiv Hagdud has 4 dates (RT-762A, RT-762B, RT-762D and Pta-4556) that are similar to ZAD 2, while the other 8 dates show that Netiv Hagdud is at least ca. 250 years older than ZAD 2 and has a life span of ca. 500 years more than ZAD 2.

Nevertheless, by calibrating these years other results will be achieved (TABLE 2, FIG. 5). ZAD 2, with 95.4 % probability, shows a range of ca. 900 years sandwiched between 9,250 to 8,330 BC. Dhrā' shows a range of ca. 2,100 years (8,300 to 10,400 BC), WF 16 shows a range of ca. 2,150 years (8,260 to 10,400 BC) and finally, Netiv Hagdud shows a range of ca. 2,800 years (8,200 to 11,000 BC). This means that ZAD 2 is the shortest-lived site, whereas WF 16 and Dhrā' are similar in their range and Netiv Hagdud has the longest range among the four sites.

The similarities and differences between the calibrated and the un-calibrated dates are quite complicated and this

Table 2. Un-calibrated and calibrated C14 dates the calibrating dates analyzed by using Atmospheric data from Stuiver *et al.* (1998); OxCal v3.5 Bronk Ramsey (2000); cub r:4 sd:12 prob usp[chron]). WF 16 (after Finlayson et al. 2000; Mithen *et al.* 2000; Pirie 2001), ZAD 2 (after Edwards *et al.* 2001; 2002 Edwards and Higham 2001; Sayej 2001b), Dhrā' (after Kuijt 2001; Kuijt and Finlayson 2001; Kuijt and Mahasneh 1998), and Netiv Hagdud (after Bar-Yosef *et al.* 1980; 1991, Bar-Yosef and Gopher 1997).

ZAD 2			Adh-Dhra'			WF 16			Netiv Hagdud		
Lab code	Un-cal. BP	Cal. BC	Lab code	Un-cal. BP	Cal. BC	Lab code	Un-cal. BP	Cal. BC	Lab code	Un-cal. BP	Cal. BC
OZE 606	9,440 ± 50	9,150 – 8,550	ISGS-2898	9,960 ± 110	10,050 - 9,200	Beta-12205	9,690 ± 50	9,260 - 8,810	Pta-4590	9,700 ± 80	9,280 - 8,800
OZE 607	9,470 ± 50	9,150 – 8,550	ISGS-3278	9,940 ± 180	10,400 - 8,800	Beta-120206	9,420 ± 50	9,150 - 8,450	RT-762A	9,680 ± 140	9,450 - 8,600
OZE 605	9,490 ± 50	9,150 – 8,600	AA-38141 AMS	10,031 ± 69	10,050 - 9,250	Beta-120207	9,400 ± 60	9,100 - 8,450	RT-762B	9,600 ± 170	9,400 - 8,300
WK 9445	9,552 ± 59	9,250 – 8,650	AA-38142 AMS	10,059 ± 73	10,150 - 9,250	Beta-120210	10,220 ± 60	10,400 - 9,600	RT-762D	9,400 ± 180	9,250 - 8,250
WK 9447	9,603 ± 59	9,220 – 8,790	ISGS-3277	9,610 ± 170	9,400 - 8,300	Beta-120211	9,890 ± 50	9,610 - 9,230	Pta-4557	9,780 ± 90	9,600 - 8,800
WK 9444	9,323 ± 59	8,750 – 8,330	AA-38143 AMS	9,984 ± 67	10,000 - 9,250	Beta-135111	10,220 ± 60	10,400 – 9,600	Pta-4555	9,750 ± 90	9,400 - 8,800
WK 9570	9,528 ± 61	9,200 – 8,600	AA-38144 AMS	10,000 ± 68	10,000 - 9,250	Beta-135110	9,180 ± 60	8,550 – 8,260	RT-762C	9,970 ± 150	10,400 - 9,100
WK 9568	9,623 ± 91	9,240 – 8,740	ISGS-A0246 AMS	9,835 ± 65	9,600 – 9,170				OxA-744	9,700 ± 150	9,650 - 8,600
WK 9633	9,635 ± 59	9,230 – 8,790	ISGS-A0248 AMS	9,835 ± 59	9,600 – 9,200				RT-762F	9,780 ± 150	9,800 - 8,600
									Pta-4556	9,660 ± 70	9,250 - 8,800
									RT-502C	10,180 ± 300	11,000 - 9,100
									RT-502A	9,790 ± 380	10,700 - 8,200



5. C14 dates analyzed by using Atmospheric data from Stuiver *et al.* (1998); OxCal v3.5 Bronk Ramsey (2000); cub r:4 sd:12 prob usp[chron]). WF 16 (after Finlayson *et al.* 2000, Mithen *et al.* 2000, Pirie 2001), ZAD 2 (after Edwards *et al.* 2001, Edwards *et al.* 2002 Edwards and Higham 2001, Sayej 2001b), Dhrā' (after Kuijt 2001; Kuijt and Finlayson 2001; Kuijt and Mahasneh 1998); and Netiv Hagdud (after Bar-Yosef *et al.* 1980; 1991; Bar-Yosef and Gopher 1997).

issue is beyond the scope of this paper (for further information see Edwards and Higham 2001).

Concluding Remarks

The importance and distinctiveness of ZAD 2 is the feature of its apparently short period of occupation. This might help in clarifying the tool typology / technology of the PPNA period, without having any doubts of being mixed with either previous or later periods of occupation. By combining the analyses of architecture, ground stone, lithics, as well as the availability of a tight range of radiocarbon dates, one can infer that ZAD 2 belongs to the later phase of the PPNA period (the Sultanian).

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