A large copper artefacts assemblage of Fazael, Jordan Valley: new evidence of Late Chalcolithic copper metallurgy in the southern Levant

Danny Rosenberg¹, Eli Buchman², Sariel Shalev³, and Shay Bar²
¹ Laboratory for Ground Stone Tools Research, Zinman Institute of Archaeology, University of Haifa, Haifa, IL
drosenberg@research.haifa.ac.il
² Zinman Institute of Archaeology, University of Haifa, Haifa, IL
eli_buchman@yahoo.com; bar.inbal.shay@gmail.com
³ Department of Archaeology, University of Haifa, Haifa, IL
sariel.shalev@univ.haifa.ac.il

ABSTRACT – Late Chalcolithic metallurgy developed in the southern Levant simultaneously with other crafts and new social institutions, reflecting advances in social organization, cults and technology. Until recently, copper items were mostly found in the Negev and Judean Desert, while other areas, specifically the Jordan Valley, were considered poor, with limited copper finds. Recent excavations at Late Chalcolithic Fazael in the Jordan Valley yielded dozens of copper items that allow for the first time a comprehensive study of copper items from this area. The assemblage is one of the largest of any site in the Late Chalcolithic period and includes most of the known components of the Late Chalcolithic copper industry. The current paper presents the new metallurgical discoveries from the Fazael Basin and discusses their significance to our understanding of the Late Chalcolithic copper industry.

KEY WORDS – Fazael; Late Chalcolithic; copper metallurgy; Jordan Valley

Velik zbir najdb iz najdišča Fazael v dolini reke Jordan: novi dokazi o pozno halkolitski metalurgiji bakra v južni Levanti

IZVLEČEK – Pozno halkolitska metalurgija se je razvila v južni Levanti sočasno z drugimi obrtmi in novimi družbenimi inštitucijami, kar odraža napredek v družbeni organizaciji, kultu in tehnologiji. Do nedavnega so bakrene predmete večinoma našli v Negevski in Judejski puščavi, medtem ko so druga območja, med njimi zlasti dolina reke Jordan, veljala za prostor z omejenimi najdbami iz bakra. Nedavna so izkopavanja na pozno halkolitskem najdišču Fazael v dolini reke Jordan prinesla na desetine bakrenih predmetov, ki nam prvič omogočajo celovito študijo bakrenih izdelkov s tega območja. Ta zbir je eden največjih iz kateregakoli najdišča iz časa poznega halkolitika in vključuje večino znanih sestavnih delov industrije bakra iz tega obdobja. V članku predstavljamo nove izsledke o metalurgiji bakra iz bazena Fazael in razpravljamo o pomenu teh najdb pri razumevanju te industrije v poznom halkolitiku.

KLJUČNE BESEDE – Fazael; pozni halkolitik; metalurgija bakra; dolina reke Jordan
Introduction

The Late Chalcolithic period of the southern Levant (c. 4500–3900 cal BC) marks significant changes from its predecessors, specifically within various aspects of social organization, subsistence economy, cult and religion (van den Brink 1998; Gilead 1988; Ilan, Rowan 2012; Joffe, Dessel 1995; Levy 1986; 2014; Perrot 1955a; Rowan, Ilan 2007; Shalem 2015), and technologies (e.g., Albright 1932; Ben-Yosef et al. 2016; Bourke 2001; Gilead 1992; Rosenberg et al. 2016; Rowan, Golden 2009). Within this system there is increased evidence for the development of craft specialization, apparent primarily in the appearance of metallurgy (e.g., Golden 2009), standardized ceramics (Roux 2003; Kerner 2010), specific components in the flint (e.g., Gilead et al. 2004; Rosen 1983; 1993; Rosenberg, Shimmelmitz 2017; Vardi 2011) and ground stone tool assemblages (e.g., Chasan, Rosenberg 2018; 2019; Chasan et al. 2019; Rosenberg et al. 2016; Rowan 1998), and probably also in the production of ivory objects and figurines (Perrot 1959a; Rosenberg, Chasan in press).

The chronology of the Late Chalcolithic is debated, but it seems that if we accept the Ghassulian as the main entity of this period then we can divided this time span into two phases (e.g., Gilead 2011; Gošić 2015): the earlier phase (c. 4500–4300/4200 cal BC) that consists of most strata at Teleilat Ghassul (and sites in the northwestern Negev such as Gilat, a few of the Nahal Besor sites, and Grar) and the later phase (c. 4300/4200–3900 cal BC) which is represented by sites along Nahal Beer Sheva (Gilead 2011; Gošić 2015). Most of the sites in the Fazael Basin may be attributed to this later phase (see below). This later phase is characterized by extensive metallurgical activities (Eldar, Baumgarten 1985; Perrot 1955b; Shalev, Northover 1987; Shugar 2000), while the earlier sites show no such finds and were thus ascribed as ‘premetallic’ (Golden 2010).

Metallurgy seems to be the most sophisticated among the Late Chalcolithic technologies, exemplifying the extraordinary achievements of the Late Chalcolithic communities, including a high investment in raw material acquisition and technological knowhow. These Late Chalcolithic advances were unparalleled among other cultures in the area and those of the succeeding Early Bronze Age I. Furthermore, it seems that at least some of the copper objects were cultic paraphernalia that were integrated into the Late Chalcolithic cultic practices with little or no utilitarian function (e.g., Bar-Adon 1980; Ben-Yosef et al. 2016; Gošić 2015; Gošić, Gilead 2015 and see Shalem 2015 for further discussion about the motifs depicted in copper artefacts).

Late Chalcolithic metallurgy comprised two discrete production techniques that refer to the later stages production, namely the open cast technique, usually using pure copper, probably originating from Fayan (Adams, Genz 1995; Golden 2010; Hauptmann 1989; 2007; Shalev 1991; 2008; Shugar 2003; Shugar, Gohm 2001), and the considerably more sophisticated ‘lost wax’ technique, frequently using non-local copper-based alloys with significant arsenic, nickel, and antimony content (Golden 2010; Goren 2014; Key 1980; Levy 1993; Levy, Shalev 1989; Levy et al. 2008; Shalev 1991; 2008; Shalev, Northover 1987; 1993; Shugar 2000; Tadmor et al. 1995). Other metals found at Late Chalcolithic sites in the southern Levant include gold, electrum (Shalev 1993), and lead (Ben-Yosef et al. 2016; Yahalom-Mack et al. 2015). While tools such as axes, chisels, and awls were typically made using relatively pure local copper, other objects, such as maceheads, standards, and crowns were commonly made of copper alloys (Shalev 2008). The origin of these copper alloys is currently unknown; however, the nearest suitable ores are in the Trans-Caucasus and Azerbaijan, more than 1500km from the sites where these objects were found (however see also Shugar 2018; Zwicker 1977). While some studies suggest that copper production took place at the Beer Sheva sites (Shugar 2000; 2018), recent studies (Goren 2008; 2014) suggest that the final production of the copper artefacts occurred closer to the copper sources, possibly in the Judean Desert.

Intriguingly, until recently most of the knowledge regarding Late Chalcolithic copper objects stemmed from several sites in the southern parts of Israel (the Negev, Shephelah, and Judean Desert) and a few sites in Jordan. However, little or no copper was found in other areas, including the Golan Heights, the Galilee, the northern Coastal Plain, and parts of the Jordan Valley (Buchman 2018; Rowan, Golden 2009; Shalev 2008). Thus, it seems that our current knowledge regarding the copper industry of the Late Chalcolithic period is focused on a relatively limited geographic region, while other regions still call for further research and analyses. Recent excavations at Late Chalcolithic Fazael in the Jordan Valley yielded dozens of copper items that allow for the first time a comprehensive study of such objects from this area. The assemblage is one of the largest of any site...
in the Late Chalcolithic period, and includes most of the known components of the Late Chalcolithic copper industry.

The Late Chalcolithic of the Fazael Basin

Fazael is located in the Fazael Basin, in the central Jordan Valley (Fig. 1). The site was first described briefly by Nelson Glueck (1951). Salvage excavations were later conducted in the eastern part of the area by Yosef Porath (1985) and Yuval Peleg (2000). The area was then surveyed in the framework of the Manasseh Hill Country Survey (Zertal, Bar 2019) and further explored in the Fazael Valley Regional Project in the last 12 years (Bar 2013; 2014). Fazael is in fact a concentration of sites (Fig. 2) along the northern terrace of Wadi Fazael. While Fazael 1 was ascribed to an earlier phase of the Late Chalcolithic and Fazael 4 to the Early Bronze Age I, Fazael 2, 5, and 7 (regarded as separate sites within one large site) were attributed to the late phase of the Late Chalcolithic period, based on the lithic, pottery, and ground stone tool assemblages (Bar 2013; 2014; Bar et al. 2013; 2014; 2015). Fazael 2, 5, and 7 also yielded copper items. Interestingly, in two of the three sites (Fazael 2 and 7) Canaanean blades, a characteristic of the Early Bronze Age, were found (Pinsky 2019), although produced using Late Chalcolithic technology (Pinsky 2019; see also Bar, Winter 2010; Pinsky 2019 in this regards).

Fazael 2 is located in the northern area of the greater Late Chalcolithic Fazael site (Bar et al. 2013). Stratum II of this three-stratum site was dated to a late stage in the Late Chalcolithic continuum, with radiometric dates falling within the 1st century of the 4th millennium BC (Bar 2014.319–320). The main feature discovered in Stratum II is a large courtyard house, covering an area of approx. 620m². The courtyard itself is 560m² in area (28x20m), bounded by 80–100cm thick stone walls. Most of the courtyard has not yet been excavated. One broad room (62m²; 4x15.5m) was found abutting the southeastern section of the courtyard. The room was divided into two large cells, and its entrance faced east. At least five successive beaten-earth floors were detected, all abutting the room’s walls, implying a long period of habitation. The second room was excavated in the western part of the courtyard. It was 60m² in area (4x15m) and divided into two large cells. An entrance flanked by two standing monoliths was set at the southern part of the room. This room was built in the early phase of Stratum 2, and in the later phase of this stratum it went out of use, becoming part of the main courtyard. The pottery assemblage matches other contemporaneous sites, although churns were not recovered, only one cornet was found, and the flint assemblage is also typical of the Late Chalcolithic, but with notable evidence for the presence of the Canaanean industry (Bar, Winter 2010; Pinsky 2019).

Fazael 5 is located at the middle of the presumed area of the ancient settlement (Fig. 2), c. 250m southeast of Fazael 2, and c. 70m west of Fazael 7. The area of this site was estimated to be 3ha. (Bar et al. 2015). Three layers were identified (Stratum I–III). Stratum I consists of two pits cutting most of the eastern part of a building identified in Stratum II. The finds in these pits are similar to the Stratum II assemblages, and therefore suggest that the pits were
A large copper artefacts assemblage of Fazael, Jordan Valley: new evidence of Late Chalcolithic copper metallurgy in the southern Levant

formed close to the abandonment of the Stratum II building. Stratum III was discovered in two trenches below the foundations of the Stratum II building. Pottery dated to the Late Chalcolithic period was found, but there were no architectural remains apart from a single ash pit. It seems that there was some activity here before the construction of the Stratum II broad room. Two large courtyard houses were documented in Fazael 5, including a large broad room in Stratum II, the main habitation level of the site (Bar et al. 2015). The pottery assemblage of Stratum II has many parallels to other Late Chalcolithic sites (churns and cornets, however, are missing altogether), and the flint assemblage is also typical of the period (Pinsky 2019).

Fazael 7, east of Fazael 5, exposed one of the largest architectural complexes ever uncovered in the south Levantine Late Chalcolithic (Bar et al. 2017). The architectural elements were designated Stratum II, as they are stratigraphically below a flimsy construction attributed to the Roman period (Stratum I). Two probes below the Stratum II foundation levels revealed Late Chalcolithic remains which predate the large architectural complex and were thus designated as Stratum III (Bar et al. 2017). The architectural complex in Stratum II is unique, dissimilar to typical Late Chalcolithic broad room structures, like those found at Fazael 2 and Fazael 5. The architectural complex was likely roofed, and it consists of four almost identical rectangular rooms cre-
ated by the division of two roughly square units (Fig. 2). Its overall dimensions, about 8 x 15m and 120m², make it one of the largest Late Chalcolithic structures in the southern Levant. The structure is massively built, with walls about 1m thick, preserved to more than 1m high in places and typically made of two rows of medium and large-sized field stones with smaller stones and sediment in between. This is surrounded by three wide courtyards, which contain a subsidiary structure and adjoin the main structure on the east and north, altogether covering an area of about 1300m². The pottery assemblage of Stratum II parallels other Late Chalcolithic sites (however, here also it lacks some of the common types such as churns and cornets), and the flint assemblage is also typical of the period, but with presence of Canaanese blades (Pinsky 2019).

A large group of copper items and a few related finds were noted (Buchman 2018). These mark an important discovery and the first copper finds found in this area. Moreover, the assemblage is one of the largest Late Chalcolithic copper assemblages in southern Levant (with only the ‘Cave of the Treasure’ in the Judean Desert and sites in the Beer Sheva Basin having more). The present paper focuses on Late Chalcolithic metalworking in the Fazael Basin. While the chemical and isotopic analyses are ongoing, we present here the assemblage and offer preliminary insights, discussing their significance to our understanding of the management of copper items during the Late Chalcolithic period in the southern Levant.

**Methodology**

The copper artefacts from Fazael were found during the 2007–2018 excavation seasons. The items were handpicked during the excavations, sometimes using the aid of a metal detector, or during sifting (5mm mesh) of the sediments. These were documented, cleaned, and studied at the Zinman Institute of Archaeology in the University of Haifa. The cleaning process was performed by plastic media blasting (PMB), using plastic particles 50 microns in size with Barcol hardness values of 40–60. The artefacts were cleaned with a Model-2 Ze- ro Production Instrument (CYSTRIP®). After cleaning, morphometric data was obtained from each artefact using digital calipers with ±0.0mm accuracy, and each find was weighed with laboratory scales with ±0.01g accuracy. The artefacts were then typologically classified and measured. While chemical data were collected (with pXRF) to classify the artefacts into chemical groups, this analysis should be regarded as preliminary, and a more thorough chemical analysis that includes stable lead isotope analysis that can further characterize the assemblage and its origin is ongoing.

**The Fazael copper industry**

Altogether 52 copper artefacts and seven copper-related artefacts (crucibles and burnt glazed sediments with no metal processing remains) were found at Fazael (2, 5, and 7, see Tables 1–3). These were mainly found at Fazael 2, featuring the largest excavated area so far (n = 34 copper items), but also at Fazael 5 (n = 4) and Fazael 7 (n = 14). Five crucibles and two burnt glazed sediments containing no metal processing remains were also found at Fazael 2. Excluding these, no additional tools related to metallurgy or high temperature fire sources have yet to be exposed at any of the Fazael sites. Among the copper artefacts found, only three were found complete (a chisel, a standard, and a macehead); the rest are fragments or pieces and chunks of copper items. As these sites are near one another and represent segments of one larger site, we present and discuss the three assemblages as a single assemblage.

Following the common terminology (Bar-Adon 1980; Klimscha 2013; Levy, Shalev 1989; Shalev 2008), Fazael’s copper assemblage (Tab. 2) includes ‘utilitarian’ objects as well as ‘prestige’ objects. These include chisels, axes/chisels, and picks/awls, as well as crown fragments, maceheads, and standards. Also included are unidentified copper tool fragments and

| Site | Copper items | Crucibles | Burnt glazed sediments | Total |
|------|--------------|-----------|-------------------------|-------|
| Fazael 2 | 34           | 5         | 2                       | 41    |
| Fazael 5 | 4            |           | 4                       |       |
| Fazael 7 | 14           |           | 14                      |       |
| Total   | 52           | 5         | 2                       | 59    |

Tab. 1. Distribution of copper and related artefacts at the Fazael sites.

| Site | Celts | Maceheads | Crowns | Standards | Unidentified fragments | Chunks | Total |
|------|-------|-----------|--------|-----------|-----------------------|-------|-------|
| Fazael 2 | 3     | 2         | 6      | 5         | 6                     | 12    | 34    |
| Fazael 5 | 2     | 1         | 1      |           | 1                     | 1     | 4     |
| Fazael 7 | 1     | 1         | 2      | 1         | 1                     | 9     | 14    |
| Total   | 6     | 3         | 8      | 6         | 8                     | 21    | 52    |

Tab. 2. Distribution of types in the copper assemblages of the Fazael sites.
A large copper artefacts assemblage of Fazael, Jordan Valley: new evidence of Late Chalcolithic copper metallurgy in the southern Levant

| Cat. No. | Type      | Site    | Fig. No. | Dimensions (mm) | Weight (g) |
|----------|-----------|---------|----------|-----------------|------------|
|          |           |         |          | l   | w  | t  | d   |            |
| 207      | axe       | Fazael 2| 4.3      | 23.40 | 16.41 | 4.35 | 9.68 |
| 234      | axe       | Fazael 2| 4.4      | 25.64 | 16.76 | 7.96 | 15.24 |
| 240      | axe       | Fazael 2| 4.1      | 145.70 | 12.71 | 5.96 | 113.10 |
| 502*     | axe       | Fazael 5| 8        | 54.40 | 22.50 | 4.30 |        |
| 503*     | awl       | Fazael 5| 8        | 109.00 | 8.50  |      |        |
| 701      | chisel    | Fazael 7| 4.2      | 140.34 | 10.61 | 3.80–6.89 | 108.92 |
| 202      | macehead  | Fazael 2| 5.1      | 27.30  | 27.30 | 49.10 | 34.50 |
| 241      | macehead  | Fazael 2| 5.2      | 40.73  | 36.27 | 55.60 | 44.20 |
| 704      | macehead  | Fazael 7| 5.3      | 40.52  |        | 40.63 | 206.42 |
| 201      | crown     | Fazael 2| 6.1      | 61.60  | 49.10  | 6.60  | 53.80 |
| 210      | crown     | Fazael 2| 6.2      | 14.35  | 17.16  | 7.79  | 6.54  |
| 230      | crown     | Fazael 2| 6.3      | 31.2   | 25.56  | 3.95  | 15.26 |
| 231      | crown     | Fazael 2| 6.4      | 39.29  | 49.10  | 5.31  | 32.71 |
| 232      | crown     | Fazael 2| 6.8      | 24.87  | 23.93  | 3.30  | 10.04 |
| 238      | crown     | Fazael 2| 6.5      | 33.09  | 32.38  | 7.46  | 17.78 |
| 702**    | crown     | Fazael 7| 6.6      | 38.04  | 1.1–12.65 | 2.34–4.09 | 9.08 |
| 705      | crown     | Fazael 7| 6.7      | 50.69  | 29.54  | 32.15 | 67.12 |
| 203      | standard  | Fazael 2| 7.1      | 23.50  | 3.3    | 34.70 | 41.90 |
| 204      | standard  | Fazael 2| 7.2      | 39.96  | 12.90  | 6.74  | 9.76  |
| 209      | standard  | Fazael 2| 7.3      | 18.17  | 5.32   | 5.08  | 5.32  |
| 211      | standard  | Fazael 2| 7.4      | 14.06  | 20.10  | 5.06  | 7.46  |
| 217      | standard  | Fazael 2| 7.5      | 31.34  | 11.09  | 5.54  | 9.78  |
| 501*     | standard  | Fazael 5| 8        | 67.90  |        | 38.3  |        |
| 206      | unidentified fragment | Fazael 2| 9.1 | 20.48 | 19.10 | 6.80 | 9.42 |
| 212      | unidentified fragment | Fazael 2| 9.2 | 14.17 | 20.21 | 3.30 | 2.81 |
| 216      | unidentified fragment | Fazael 2| 9.3 | 10.57 | 7.7   | 4.93 | 1.76 |
| 220      | unidentified fragment | Fazael 2| 9.4 | 31.66 | 22.25 | 12.07 | 26.11 |
| 233      | unidentified fragment | Fazael 2| 9.5 | 24.86 | 24.25 | 8.68 | 22.08 |
| 239      | unidentified fragment | Fazael 2| 9.6 | 11.53 | 10.21 | 5.36 | 1.2 |
| 504*     | unidentified fragment | Fazael 5| 8 |      |      |      |        |
| 703      | unidentified fragment | Fazael 7| 9.7 | 10.5 | 0.79 | 3.11 | 2.4 |
| 205      | copper chunk | Fazael 2| 10.1 | 35.64 | 12.82 | 7.11 | 8.92 |
| 208      | copper chunk | Fazael 2| 10.2 | 20.27 | 16.22 | 8.32 | 9.28 |
| 213      | copper chunk | Fazael 2| 10.3 | 19.34 | 11.96 | 8.72 | 6.92 |
| 214      | copper chunk | Fazael 2| 10.4 | 11.23 | 7.84 | 6.27 | 2.14 |
| 215      | copper chunk | Fazael 2| 10.5 | 11.43 | 7.3 | 5.59 | 1.18 |
| 218      | copper chunk | Fazael 2| 10.6 | 14.1 | 9.13 | 3.25 | 1.52 |
| 226      | copper chunk | Fazael 2| 10.7 | 21.61 | 4.73 | 5.66 | 0.92 |
| 227      | copper chunk | Fazael 2| 10.8 | 8.84 | 4.45 | 2.76 | 0.22 |
| 235      | copper chunk | Fazael 2| 10.9 | 11.45 | 7.64 | 4.75 | 1.02 |
| 236      | copper chunk | Fazael 2| 10.10 | 4.22 | 25.71 | 7.32 | 4.22 |
| 237      | copper chunk | Fazael 2| 10.11 | 9.58 | 8.96 | 2.96 | 0.22 |
| 242      | copper chunk | Fazael 2| 10.12 | 16.70 | 9.83 | 7.60 | 2.26 |
| 706      | copper chunk | Fazael 7| 10.13 | 7.89 | 3.66 | 3.29 | 0.10 |
| 707      | copper chunk | Fazael 7| 10.14 | 15.55 | 9.66 | 5.11 | 0.68 |
| 708      | copper chunk | Fazael 7| 11.1 | 50.29 | 25.71 | 4.81 | 17.86 |
| 709      | copper chunk | Fazael 7| 11.2 | 29.20 | 16.35 | 8.93 | 6.40 |
| 710      | copper chunk | Fazael 7| 11.3 | 13.56 | 6.26 | 4.51 | 0.34 |
| 711      | copper chunk | Fazael 7| 11.4 | 7.38 | 5.10 | 2.35 | 0.10 |
| 712      | copper chunk | Fazael 7| 11.5 | 13.66 | 5.42 | 4.15 | 0.24 |
| 713      | copper chunk | Fazael 7| 11.6 | 10.59 | 9.02 | 5.43 | 0.54 |
| 714      | copper chunk | Fazael 7| 11.7 | 11.64 | 9.79 | 3.39 | 0.42 |

* Part of the items found together as a group in Fazael 5
** Ibex horn?

Tab. 3. The copper assemblages of Fazael.
copper chunks of various sizes, shapes, and weights. A rare find from Fazael 5 is a standard in which a chisel, awl, and an unidentified bent item were inserted.

Spatial distribution of the copper items
Copper artefacts were found in various loci at Fazael 2. Some of these were found in primary contexts in the rooms and courtyard (Fig. 3). Of note is Locus 225, where three copper artefacts, four crucible fragments, and the two slags were found. The fifth crucible fragment, without traces of copper or slag, was found in the north-eastern room that also yielded an axe, two unidentified copper objects fragments, and four copper chunks. The interior room yielded seven items: three crown fragments, a chisel fragment, a macehead fragment, fragments of an unidentified copper tool, and a copper chunk. A fragment of a standard was found hidden in wall W270. The standard with the three inserted items from Fazael 5 was found in the southern cell of a broad room, the only room so far excavated at this site. At Fazael 7, most of the copper artefacts were found in two rooms of the southwestern building, the main structure excavated in this area.

Axes and an awl
Of these, two are whole. All items in this group are characterized by a cutting edge that is wider than the body (Fig. 4, Tab. 3). Both items found at Fazael 5 – an axe and an awl – were inserted in the standard. Similar items were found at other Late Chalcolithic sites in the southern Levant and reflect a somewhat limited number of types and sub-types.

Fig. 3. Distribution of copper items at Fazael 2.
A large copper artefacts assemblage of Fazael, Jordan Valley: new evidence of Late Chalcolithic copper metallurgy in the southern Levant

(e.g., Bar-Adon 1980; Ben-Yosef et al. 2016; van den Brink et al. 2016; Eldar, Baumgarten 1985; Klimscha 2013; Lee 1973; Namdar et al. 2004; Perrot 1955a; 1959b; Segal, Goren 2013; Segal, Kamenski 2002).

**Maceheads**

Three maceheads were recovered (Fig. 5, Tab. 3): two fragments and one complete item. The two macehead fragments (Fig. 5.1–2) are globular, and the complete item is piriform (Fig. 5.3). No core material survived in the holes. Similar items were found at other Late Chalcolithic sites in the southern Levant, reflecting a preference for specific morphologies (e.g., Bar-Adon 1980; Ben-Yosef et al. 2016; Dothan 1959; Golden 2010; Goren 2008; Namdar et al. 2004; Perrot 1955b; 1959b; Segal, Goren 2013; Segal, Kamenski 2002 and see Sebbanne 2009).

**Crowns**

Seven flat slightly convex fragments that seem to be parts of crowns (Fig. 6.1–7) were found (Tab. 3) although not in all examples it is entirely clear that this are in fact crown fragments. A single ibex horn (Fig. 6.8) that was probably part of a crown (or a standard, see Bar-Adon 1980) was also found. The crown rims appear to have a rounded end, facing outward and at least one may bear some kind of decoration (e.g., Fig. 6.4). Similar finds were found at only limited additional sites (Golden 2010; Klimscha 2013).

**Standards**

Five standard fragments and one complete standard were found (Figs. 7 and 8, Tab. 3). Two fragments were parts of upper and lower disc-shaped rims with a short straight plain neck and a hollow cylindrical shaft (Fig. 7.1,4). Three other fragments were parts of a straight hollow cylindrical shaft. No decoration was observed on any of the external surfaces. Standards were found at a few additional Late Chalcolithic sites in the southern Levant (e.g., Bar-Adon 1980; Golden 2010; Dothan 1959; Eldar, Baumgarten 1985; Israel et al. 2014; Klimscha 2013; Lee 1973; Milevski et al. 2013; Perrot 1955b; Shalev 1996).

The complete standard from Fazael 5 (Fig. 8) contained a chisel, awl, and a bent item with a rectangular section that were inserted into the standard through the base (the chisel and awl protrude). The standard’s base was pressed, preventing the inserted items from falling out. The upper area of the standard has an opening. The standard is adorned with a large protruding nose and two eyes with three or four eyelashes. A horizontal groove encircled the body near the base. This standard bears some resemblance to the famous figurine-standard from the Cave of the Treasure (Bar-Adon 1980.49); however, clear stylistic differences in the standard morphology and figure design are...
noted as well, including two elongated protrusions on the sides (ears?), the remains of a third one on the back of the head, and a potential mouth.

**Unidentified fragments**
These comprise fragments and various copper pieces that could not be included in the former groups (Fig. 9, Tab. 3). These fragments vary in size, shape, and density. One of these is a bent fragment that was found inside the standard at Fazael 5 (seen through the hole in the standard head and in an X-ray image).

**Copper chunks**
Copper chunks could be remnants of the casting process (Figs. 10 and 11, Tab. 3). They are of various sizes and shapes.

**Crucibles**
Among the pottery assemblage of Fazael 2, there are five crucible fragments (Fig. 12, Tab. 4). The Fazael crucibles are similar to finds from the Negev (Eldar, Baumgarten 1985; Notis et al. 1984; Shalev, Northover 1987). Four of the crucible fragments were found in close proximity to installation Locus 225, located in one of the western rooms of Fazael 2, and they contained slag and copper remains. The fifth crucible fragment was found on the eastern side of Fazael 2 and contained no slag.

**Burnt glazed sediments**
The two burnt glazed sediments (Fig. 13) are characterized by melted or partially melted local sediment that contacted an extremely hot heat source (for similar burnt glazed sediments see Notis et al. 1984; Shalev, Northover 1987). These were found in installation Locus 225 (which contained no signs of fire or ash remains). They are porous, and the cross-section is black in colour.

**Preliminary chemical analysis of the copper artefacts**
While still preliminary, it seems that the copper artefacts from Fazael show a clear division into two main chemical groups (Buchman 2018). The groups are characterized by the absence or differences in quantities of elements in the copper alloys. Group I
A large copper artefacts assemblage of Fazael, Jordan Valley: new evidence of Late Chalcolithic copper metallurgy in the southern Levant

is characterized mainly by copper and iron, while arsenic, antimony, and nickel are absent. The concentration of iron and iron oxides depends mainly on the purity of the copper in the alloy. Group II is characterized by copper alloys, and it can be further separated based on typology and chemical composition (see Buchman 2018). In a few artefacts in this group, the concentration of some elements (e.g., arsenic, bismuth, lead, and antimony) seems higher than in the natural ores, however, in general the average concentrations of antimony, arsenic, lead, and nickel are lower than those found in natural ore (Buchman 2018). The lack of control over the copper composition of some of these (nine items) produced copper alloys that differed from those produced directly from the copper ore, and seems to suggest recycling of copper artefacts (Buchman 2018).

Most of the analysed ‘prestige’ objects at Fazael have lead concentrations higher than about 0.5wt.% and the artefacts that generally contain high lead concentrations lack one of the other elements (nickel, arsenic, or antimony). In this regard, Miriam Tadmor et al. (1995) suggested that the exotic copper-arsenic-antimony alloys were chosen to facilitate production using the lost wax technique, which requires highly fluid liquid metal that can be obtained using alloys. The metallic lead was probably obtained from different sources than the polymetallic ore used for the copper-arsenic-antimony alloys (e.g., Yahalom-Mack et al. 2015). Our preliminary chemical analysis also seems to suggest that in the Fazael copper assemblage some artefacts have lead or bismuth added to pure copper or copper alloys. This may have been used to improve the quality of the final alloys; alternatively, this may represent a break in the trade of

| Cat. no. | Dimension (mm) | Internal wall coating | Depth (mm) |
|----------|----------------|-----------------------|------------|
|          | inner rim diameter | external rim diameter |            |
| 221      | 58.60           | 82.00                 | slag       | 45.30      |
| 222      |                 |                       | slag       |            |
| 223      | 65.00           | 81.00                 | slag + copper | 43.65     |
| 224      | 65.40           | 87.80                 | slag       |            |
| 225      |                 |                       |            |            |

*Fig. 8. The copper standard containing copper objects from Fazael 5.*

*Fig. 9. Unidentified fragments of copper items.*
copper-arsenic-antimony alloys and an attempt to find alternatives (see also Ben-Yosef et al. 2016). At Fazael, four items contain lead in concentrations above 1.2wt.%. However, only one item (an unidentified tool fragment) contains mainly copper and lead, while another item, a chunk, contains 2.76wt.% bismuth.

The distinction between copper objects with more ‘utilitarian’ characteristics and more prestigious and less utilitarian forms is still debated (e.g., Barkai 2011; Golden 2009; Kerner 2001; Polazkin, Bar-Avi 1980; Shalev, Northover 1987). Our preliminary chemical study shows that the traditional classification of copper items into these two typological groups, characterized by different manufacturing techniques and chemical compositions (e.g., Key 1980; Shalev 1991; Shalev, Northover 1993; Tadmor et al. 1995), does not always apply. This pattern, while characteristic of most of the Late Chalcolithic copper industry, is challenged by the presence of copper items (such as a few of the Fazael objects) that are commonly associated with one functional group (‘utilitarian’ or ‘prestige’) yet are produced from ore typically associated with the other functional group. Similar examples are observed at Giv’at Ha-Oranim (Namdar et al. 2004), Peqi’in Cave (Segal, Goren 2013), and the Cave of the Sandal (Segal, Kaminski 2002). It is interesting to note that most of the objects that cross the proposed guidelines are (unalloyed) maceheads, and this may relate to their function.

**Discussion and conclusion**

The new information accumulated from the recent excavations in the Late Chalcolithic Fazael Basin sites adds critical evidence for the dispersal of copper metallurgy into the Jordan Valley and furthers our understanding of this time span and its reflection in this region. The Fazael sites are characterized by large courtyard structures, pottery assemblages that lack certain key components (e.g., churns and cornets), minimal basalt vessels, Canaanite blades typical of the Early Bronze Age and the later stages of the Late Chalcolithic period (Pinsky 2019; Rosen 1997), perforated discs that are found mainly in the Golan, northern Jordan Valley, and Galilee (see Rosenberg, Shimelmitz 2017), and the general absence of bifacial tools and ivory objects, the latter are found mainly in southern Israel (see Rosenberg, Chasan in press). Based on the available data, all three sites (Fazael 2, 5, and 7) had a phase that pre-dates the construction of the large courtyard houses. Notably, in the more extensively researched sites of Fazael 2 and 7 these layers were rich in finds, including...
plete vessels and a few copper artefacts. Although we should be cautious in stating this, as the division between the pre-architecture and the main architecture phases is not always clear, this suggests that copper artefacts may have been present in the Fazael Basin sites before the onset of the major construction phases.

The significance of the new copper assemblage found at Late Chalcolithic sites in the Fazael Basin lays in its size and geographic location, as well as in its composition and chemical attributes. The assemblage is currently one of the largest copper assemblages for the Late Chalcolithic period in the southern Levant, and Fazael is the richest site in copper objects beyond the borders of the northern Negev and the Judean Desert. The Fazael assemblage reveals that typologically varied copper objects and waste materials (e.g., copper chunks) found their way to Fazael, probably as scrap metal, reflecting the complexity of this industry in the region at the very end of the Late Chalcolithic period. The results of the current study and our preliminary chemical analysis indicate that Fazael is the first Late Chalcolithic site in the Jordan Valley with evidence for a local metallurgical industry, one that probably involved the recycling of copper items that were produced or, at least in some cases, brought from elsewhere to Fazael when they went out of use. This conclusion is based on the large number of fragments and pieces of copper objects, as only a few items were found whole or undamaged, and on our preliminary chemical analysis. It is further supported by the many copper chunks found as well as the presence of the crucibles and burnt glazed sediments.

Thus, the results suggest that the Fazael Basin was well integrated into the circulation of copper objects during the very end of the Late Chalcolithic period, and Fazael also seems to have been an important site for copper objects that were no longer suitable for use in their original function, possibly in cultic activities. While the social, economic, and technical mechanisms behind the extensive metallurgical industry must await further study of the site, the present study reflects the complexity and centrality of the copper industry in the Fazael Basin. The copper assemblage found at Fazael expands the distribution of Late Chalcolithic copper metallurgy into an area nearly devoid of copper objects, while the typologi-
cal variability and discard patterns of the assemblage, its size, and chemical characteristics suggest that Fazael was an important depot in the production/recycling of copper objects during the period. This accumulated data combined with the massive architecture suggests that the site, located along the main trading routes, had special significance within the Late Chalcolithic social and economic systems.

We would like to thank S. Haad, A. Regev-Gisis, and R. Chasan for all their help with the graphics and to J. Tresman for perusing and editing the text. We also would like to thank anonymous reviewers for their most helpful comments.

ACKNOWLEDGEMENTS

References

Adams R. B., Genz H. 1995. Excavation at Wadi Fidan 4: A Chalcolithic village complex in the copper ore district of Feinan, Southern Jordan. *Palestine Exploration Quarterly* 127: 8–20. https://doi.org/10.1179/peq.1995.127.1.8

Albright W. F. 1932. The Chalcolithic age in Palestine. *Bulletin of the American Schools of Oriental Research* 48: 10–17.

Bar-Adon P. 1980. *The Cave of the Treasure: The Finds from the Caves in Nahal Mishmar*. Israel Exploration Society. Jerusalem.

Bar S. 2013. *Yogvim Venokdim I. Seker*. Haifa. (in Hebrew)

2014. *The Dawn of the Bronze Age*. Culture and History of the Ancient Near East 72. Brill. Leiden and Boston.

Bar S., Bar-Oz G., Ben Yosef D., Boaretto E., Raban-Gerstel N., and Winter H. 2013. Fazael 2, One of the latest Chalcolithic sites in the Jordan Valley? Report of the 2007–2008 excavation seasons. *Journal of the Israel Prehistoric Society* 43: 5–23. https://www.researchgate.net/publication/266672831

Bar S., Bar-Oz G., Cohen-Klonymus H., and Pinsky S. 2014. Fazael 1, A Chalcolithic site in the Jordan Valley: Report of the 2013–2014 excavation seasons. *Journal of the Israel Prehistoric Society* 44: 180–201. https://www.researchgate.net/publication/266672606

Bar S., Cohen-Klonymus H., Pinsky S., Bar-Oz G., and Shalvi G. 2015. Fazael 5, Soundings in a Chalcolithic site in the Jordan Valley. *Journal of the Israel Prehistoric Society* 45: 193–216. www.jstor.org/stable/26572637

Bar S., Cohen-Klonymus H., Pinsky S., Bar-Oz G., Zukerman R., Shalvi G., and Davidovich U. 2017. Fazael 7: A large Chalcolithic architectural complex in the Jordan Valley, the 2009–2016 excavations. *Journal of the Israel Prehistoric Society* 47: 208–247.

Bar S., Winter H. 2010. Canaanean Flint blades in Chalcolithic context and the possible onset of the transition to the Early Bronze Age: A case study from Fazael 2. *Tel Aviv* 37: 33–47. www.jstor.org/stable/26572673

Barkai R. 2011. The evolution of Neolithic and Chalcolithic woodworking tools and the intensification of human production: axes, adzes, and chisels from the southern Levant. In V. David, M. Edmonds (eds.), *Stone Axe Studies III*. Oxbow Books. Oxford: 39–53.

Ben-Yosef E, Vassal Y., van den Brink E. C. M., and Beeri R. 2016. A new Ghassulian metallurgical assemblage from Bet Shemesh (Israel) and the earliest leaded copper in the Levant. *Journal of Archaeological Science: Reports* 9: 493–504. https://doi.org/10.1016/j.jasrep.2016.08.010

Bourke S. J. 2001. The Chalcolithic period. In B. MacDonald, R. Adams, and P. Bienkowski (eds.), *The Archaeology of Jordan*. Sheffield Academic Press. Sheffield: 107–163.

van den Brink E. C. M. 1998. An index to Chalcolithic mortuary caves in Israel. *Israel Exploration Journal* 48 (3/4): 165–173. https://www.jstor.org/stable/27926516

van den Brink E. C. M. and 13 co-authors. 2016. Late Chalcolithic settlement remains east of Namir Road, Tel Aviv. *Journal of the Israel Prehistoric Society* 46: 20–121. https://www.jstor.org/stable/26572646

Buchman E. 2018. *Copper finds in the Fazael sites and their Meaning in Understanding the Copper Industry in the Chalcolithic Period in the South of the Levant*. Unpublished MA thesis. University of Haifa. Haifa. (in Hebrew)

Chasan R., Rosenberg D. 2018. Basalt vessels in Chalcolithic burial caves: Variations in prestige burial offerings during the Chalcolithic period of the southern Levant and their social significance. *Quaternary International* 464: 226–240. https://doi.org/10.1016/j.quaint.2017.02.026
A large copper artefacts assemblage of Fazael, Jordan Valley: new evidence of Late Chalcolithic copper metallurgy in the southern Levant. *Paléorient* 45(1): 53–68.

Chasan R., van den Brink E. C. M., and Rosenberg D. 2019. “Crossing the lines” – Elaborately decorated Chalcolithic basalt bowls in the southern Levant. *Bulletin of the American Schools of Oriental Research* 381: 145–162. https://doi.org/10.1086/703077

Dothan M. 1959. The excavations at Horvat Beter (Beer-sheva). *Atiqot* 2: 1–42.

Eldar I., Baumgarten Y. 1985. Neve Noy: A Chalcolithic site of the Beer Sheva culture. *Biblical Archaeologist* 48: 134–139. https://doi.org/10.2307/3209928

Gilead I. 1988. The Chalcolithic period in the southern Levant. *Journal of World Prehistory* 2(4): 397–443. https://doi.org/10.1007/s10965-009-9016-4

1992. Farmers and herders in southern Israel during the Chalcolithic period. In O. Bar-Yosef, A. Khazanof (eds.), *Pastoralism in the Levant*. Prehistory Press. Madison, WI: 29–42.

2011. Chalcolithic culture history: The Ghassulian and other entities in the southern Levant. In J. L. Lovell, Y. M. Rowan (eds.), *Culture, Chronology, and the Chalcolithic: Theory and Transition*. Oxbow Books. Oxford: 12–24.

Gilead I., Marder O., Khalaily H., Fabian P., Abadi Y., and Yisrael Y. 2004. The Beit Eshel Chalcolithic flint workshop in Beer Sheva: A preliminary report. *Journal of the Israel Prehistoric Society* 34: 245–263. https://www.jstor.org/stable/23380638

Glueck N. 1951. *Exploration in Eastern Palestine IV (Part I: Text)*. American Association of Oriental Research. New Haven, CT.

Golden J. 2009. New light on the development of Chalcolithic metal technology in the southern Levant. *Journal of World Prehistory* 22: 283–300. https://doi.org/10.1007/s10965-009-9022-6

2010. *Dawn of the Metal age: Technology and Society during the Levantine Chalcolithic*. Equinox. London.

Goren Y. 2008. The location of specialized copper production by the lost wax technique in the Chalcolithic southern Levant. *Geoarchaeology* 23(3): 374–397. https://doi.org/10.1002/gea.20221

2014. Gods, caves, and scholars: Chalcolithic cult and metallurgy in the Judean Desert. *Near Eastern Archaeology* 77(4): 260–266. https://doi.org/10.5615/neareastarch.77.4.0260

Goşić M. 2015. Skeumorphism, boundary objects and socialization of the Chalcolithic metallurgy in the southern Levant. *Issues in Ethnology Anthropology* 10: 717–740. https://doi.org/10.21301/eap.v10i3.8

Goşić M., Gilead I. 2015. Casting the sacred: Chalcolithic metallurgy and ritual in the southern Levant. In N. Laneri (ed.), *Defining the Sacred: Approaches to the Archaeology of Religion in the Near East*. Oxbow Book. Oxford: 161–175.

Hauptmann A. 1989. The earliest period of copper metallurgy in Feinan, Jordan. In A. Hauptmann, E. Pernicka, and G. A. Wagner (eds.), *Old World Archaeometallurgy*. Selbstverlag des Deutschen Bergbau-Museum. Bochum: 119–135.

2007. The *Archaeometallurgy of Copper: Evidence from Feynan, Jordan*. Springer. Berlin.

Han D., Rowan Y. M. 2012. Deconstructing and recomposing the narrative of spiritual life in the Chalcolithic of the southern Levant (4500–3600 B.C.E). In Y. M. Rowan (ed.), *Beyond Belief: The Archaeology of Religion and Ritual*. Wiley. Hoboken, New York: 89–113.

Israel Y., Aladjem E., and Milevski I. 2014. Nahal Shalva. *Hadashot Arkheologiyot* 126. http://www.hadashot-esi.org.il/Report_Detail_Eng.aspx?id=12656

Joffe A., Dessel J. 1995. Redefining chronology and terminology for the Chalcolithic of the southern Levant. *Current Anthropology* 36(3): 507–518. https://www.journals.uchicago.edu/doi/10.1086/204388

Kerner S. 2001. *Das Chalkolithikum in des Südlichen Levante. Die Entwicklung Handwerkslicher Spezialisierung und ihre Beziehung zu Gesellschaftlicher Komplexität*. Orient-Archäologie 8. Verlag Marie Leidorf. Rahden.

2010. Craft specialization and its relation with social organization in the late 6th to early 4th millennium BCE of the southern Levant. *Paléorient* 36(1): 179–198. https://www.jstor.org/stable/41496894

Key C. A. 1980. Trace element composition of the copper and copper alloys of the Nahal Mishmar hoard. In P. Bar-Adon (ed.), *The Cave of the Treasure*. Israel Exploration Society. Jerusalem: 238–243.

Klinschka F. 2013. Another great transformation: Technical and economic change from the Chalcolithic to Early Bronze Age in the southern Levant. In R. Eichmann, M. van Ess (eds.), *Zeitschrift für Orient-Archäologie. Vol. 6*. German Archaeological Institute. Berlin: 82–112.
Lee J. R. 1973. Chalcolithic Ghasoul: New Aspects and Master Typology. Unpublished PhD dissertation. Department of Archaeology. Hebrew University. Jerusalem.

Levy T. E. 1986. Social archaeology and the Chalcolithic period: Explaining social organizational change during the 4th Millennium in Israel. *Michmanim* 3: 5–20.

1993. Production, space and social change in protohistoric Palestine. In A. Holl, T. E. Levy (eds.), *Spatial Boundaries and Social Dynamic: Case Studies from Food Producing Societies*. International Monographs in Prehistory. Ann Arbor: 63–68.

2014. Cultural transformations – The Chalcolithic southern Levant. In J. Chi (ed.), *Faces of the Chalcolithic*. Princeton University Press. Princeton: 40–60.

Levy T. E., Shalev S. 1989. Prehistoric metalworking in the southern Levant: Archaeometallurgical and social perspectives. *World Archaeology* 20(3): 352–372. https://doi.org/10.1080/00438243.1989.9980078

Levy T. E., Levy A., Sthapathy R., Sthapathy S., and Sthapathy S. W. 2008. Masters of Fire – Hereditary Bronze Casters of South India. German Mining Museum. Bochum.

Milevski I., Vardi J., Gilead I., Eirikh-Rose A., Michal B., Mienis H. K., and Horwitz L. K. 2013. Excavations at Horbat ‘Illit B: A Chalcolithic (Ghassulian) site in the Haelah Valley. *Journal of the Israel Prehistoric Society* 43: 73–147. https://www.jstor.org/stable/23784048

Namdar D., Segal I., Goren Y., and Shalev S. 2004. Chalcolithic copper artifacts. In N. Schefelowitz and R. Oren (eds.), *Giv’at Ha-Oranim: A Chalcolithic Site*. Salvage Excavation Reports No. 1. Tel Aviv University. Tel Aviv: 70–83.

Notis M. R., Moyer H., Barnisin M. A., and Clemens D. 1984. Microprobe analysis of early copper artifacts from the northern Sinai and the Judean Caves. In A. D. Roming and J. Goldstein (eds.), *Microbeam Analysis – 1984*. San Francisco Press. San Francisco: 240–242.

Peleg Y. 2000. Fasa’el (North). *Hadashot Archeologiot* 112: 67–68. (in Hebrew)

Perrot J. 1955a. Bir es Safadi (Notes and news). *Israel Exploration Journal* 5: 125–126.

1955b. The excavation at Tell Abu Matar near Beersheba. *Israel Exploration Journal* 5(3): 167–189. https://www.jstor.org/stable/27924619

1959a. Statuettes en ivoire et autres objets en ivoire et en os provenant des gisements préhistoriques de la région de Beersheba. *Syria* 36(1/2): 8–19.

1959b. Bir es Safadi (Notes and news). *Israel Exploration Journal* 9: 141–142.

Pinsky S. 2019. The Late Chalcolithic Lithic Industries of the Fazael Sites and their Relations to Other Late Chalcolithic Lithic Industries. Unpublished MA thesis. University of Haifa. Haifa.

Porath Y. 1985. A Chalcolithic building in Fas’ael. *Atiqot* 17: 1–19.

Potazkin R., Bar-Avi K. 1980. A material investigation of metal objects from the Nahal Mishmar hoard. In P. Bar-Adon (ed.), *The Cave of the Treasure*. Israel Exploration Society. Jerusalem: 235–237.

Rosen S. 1983. The tabular scraper trade: a model for material culture dispersion. *Bulletin of the American Schools of Oriental Research* 249: 79–86.

1993. Metals, rocks, specialization, and the beginning of urbanism in the northern Negev. In A. Biran and J. Aviram (eds.), *Biblical Archaeology Today, 1990*. Proceedings of the Second International Congress of Biblical Archaeology. Israel Exploration Society. Jerusalem: 4–56.

1997. *Lithics after the Stone Age: A Handbook of Stone Tools from the Levant*. Altamira Press. Walnut Creek, CA.

Rosenberg D., Shimelmitz R. 2017. Perforated stars – Networks of prestige item exchange and the role of perforated flint objects in the late Chalcolithic of the southern Levant. *Current Anthropology* 58(2): 295–306. http://dx.doi.org/10.1086/690646

Rosenberg D., Chasan R. in press. Ivories in the Late Chalcolithic period and their significance for understanding the contacts between Egypt and the southern Levant. *Eurasian Prehistory*.

Rosenberg D., Chasan R., and van den Brink E. C. M. 2016. Craft specialization, production and exchange in the Chalcolithic of the southern Levant: Insights from the study of the basalt vessel assemblage from Namir Road (Tel Aviv, Israel). *Eurasian Prehistory* 13(1/2): 105–128.

Roux V. 2003. A dynamic systems framework for studying technological change: Application to the emergence of the potter’s wheel in the southern Levant. *Journal of Archaeological Method and Theory* 10(1): 1–30. https://doi.org/10.1023/A:1022869912427

Rowan Y. M. 1998. *Ancient Distribution and Deposition of Prestige Objects: Basalt Vessels during Late Prehistory in the Southern Levant*. Unpublished PhD dissertation. University of Austin. Austin.
A large copper artefacts assemblage of Fazael, Jordan Valley: new evidence of Late Chalcolithic copper metallurgy in the southern Levant

Rowan Y. M., Golden J. 2009. The Chalcolithic period of the southern Levant: A synthetic review. *Journal of World Prehistory* 22(1): 1–92. https://doi.org/10.1007/s10963-009-9016-4

Rowan Y. M., Ilan D. 2007. The meaning of ritual diversity in the Chalcolithic of the southern Levant. In C. Malone, B. Barrowclough (eds.), *Cult in Context: Reconsidering Ritual in Archaeology*. Oxbow Books. Oxford: 249–254.

Rowan Y. M., Levy T. E. 1994. Proto-Canaanean blades of the Chalcolithic period. *Levant* 26: 167–174. https://doi.org/10.1179/lev.1994.26.1.167

Segal I., Goren Y. 2013. A Chemical, Metallurgical, Isotopic and Petrographic Study of the Copper finds. In D. Shalem, Z. Gal, and H. Smithline (eds.), *Peqi’in. A Late Chalcolithic Burial Site, Upper Galilee, Israel*. Kinneret Academic Collage. Ostracon.

Shalem D. 2015. Motifs on the Nahal Mishmar Hoard and the ossuaries: Comparative observations and interpretations. *Journal of the Israel Prehistoric Society* 45: 217–237. https://www.jstor.org/stable/26572638

Shalev S. 1991. Two different copper industries in the Chalcolithic culture of Israel. In C. Eluère, J. P. Mohen (eds.), *Découverte du Metal*. Picard. Paris: 413–424.

1993. The earliest gold artifacts in the southern Levant: Reconstruction of the manufacturing process. In C. Eluère (ed.), *Outils et Ateliers D’orfèvres des Temps Anciens*. Antiquités Nationales Memoire 2. Saint Germain en Laye. Paris: 9–12.

1996. Copper objects. In A. Gopher, T. Tsuk (eds.), *The Nahal Qanah Cave: Earliest Gold in the Southern Levant*. Monograph Series of the Institute of Archaeology 12. Tel Aviv University. Tel Aviv: 155–163.

2008. A brief outline summary of nonferrous archaeometallurgy in Israel. *Israel Journal of Earth Sciences* 56: 133–138. https://doi.org/10.1560/IJES.56.2-4.133

Zertal A., Bar S. 2019. *Manasseh Hill Country Survey. Vol. 5*. Brill. Boston and Leiden.

Zwicker U. 1977. Investigations on extractive metallurgy of Cu/Sb/As ore and excavated smelting products from Norsuntepe (Keban) on the Upper Euphrates (3500–2800 BC). In W. A. Oddy (ed.), *Aspects of Early Metallurgy*. The British Museum. London: 13–26.

1993. Metallurgy of the Nahal Mishmar hoard reconsidered. *Archaeometry* 35: 35–47. https://doi.org/10.1111/j.1475-4754.1993.tb01022.x

Shugar A. 2003. Reconstructing the Chalcolithic metallurgical process at Abu Matar, Israel. In *International Conference on Archaeometallurgy in Europe, Milan, 24–26 September 2003*. Italian Association for Metallurgy. Milan: 449–458.

2018. Extractive metallurgy in the Chalcolithic southern Levant: Assessment of copper ores from Abu Matar. In E. Ben-Yosef (ed.), *Mining for Ancient copper, Essays in Memory of Beno Rothenberg*. Tel Aviv University. Tel Aviv: 276–296.

Zertal A., Bar S. 2019. *Manasseh Hill Country Survey. Vol. 5*. Brill. Boston and Leiden.

1993. Metallurgy of the Nahal Mishmar hoard reconsidered. *Archaeometry* 35: 35–47. https://doi.org/10.1111/j.1475-4754.1993.tb01022.x

Shugar A., Gohm C. J. 2001. Developmental trends in Chalcolithic metallurgy: A radiometric perspective. In J. L. Lovell and Y. M. Rowan (ed.), *Culture, Chronology and the Chalcolithic: Theory and Transition*. Levant Supplementary Series 9. Oxbow Books. Oxford: 133–149.

Tadmor M., Kedem D., Begeman F, Hauptmann A., Pernicka E., and Schmitt-Strecker S. 1995. The Nahal Mishmar hoard from the Judean Desert: Technology, composition, and provenance. *Atiqot* 27: 95–148.

Vardi J. 2011. *Sickle Blades and Sickles of the Sixth and Fifth Millennia BCE in Light of the Finds from the Chalcolithic Sickle Blade Workshop Site of Beit Esheil*. Unpublished PhD Dissertation. The Ben-Gurion University of the Negev. Beer-Sheva.

Yahalom-Mack N., Langgut D., Dvir O., Tiros O., Eliyahu-Behar A., Erel Y., Langford B., Frumkin A., Ulman M., and Davidovich U. 2015. The earliest lead object in the Levant. *PLoS ONE* 10(12): e0142948. https://doi.org/10.1371/journal.pone.0142948.

Zertal A., Bar S. 2019. *Manasseh Hill Country Survey. Vol. 5*. Brill. Boston and Leiden.

Zwicker U. 1977. Investigations on extractive metallurgy of Cu/Sb/As ore and excavated smelting products from Norsuntepe (Keban) on the Upper Euphrates (3500–2800 BC). In W. A. Oddy (ed.), *Aspects of Early Metallurgy*. The British Museum. London: 13–26.