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The red-stained flint crescent from Gesher: new insights into PPNA hafting technology

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ABSTRACT

A red-stained flint crescent found in the Pre-Pottery Neolithic A (ca. 9000 BC) site of Gesher, Israel, provides us with a unique opportunity to study the hafting technology of a particular tool type in the Levant. We present here a reconstruction, based on chemical and mineralogical analyses, of the hafting technologies and materials employed in the process. Use will also be made of relevant studies of the archaeological record. Local material was used for the production of an elastic adhesive paste, *mud plaster*, which was then hardened to hold the crescent securely in the haft. The study contributes insight into the hafting technology that was most probably implemented in the production and maintenance of composite tools during the Early Neolithic period.

1. Introduction

Reconstructing the hafting technologies of prehistoric cultures is a demanding task, as the archaeological record is fragmented and in most cases it is only the hafted stone artifact that is preserved. While flint assemblages can provide unequivocal data pertaining to prehistoric tool production, hafting technologies can only rarely be reconstructed.

Hafting technologies can be classified into three basic types: *wedged hafts*, where the tool is inserted into a slot in the handle and is retained by mechanical forces; *tied hafts*, where the implement is lashed to the handle; and *mastic hafts*, where the tool is attached to the handle by glue, resin, tar, or plaster (Keeley, 1982). Mastic hafts are usually very reliable, allowing virtually no movement of the hafted part. As hardened mastic is more elastic than either the insert(s) or the handle, it provides a cushioned setting that reduces the chance of breakage. The preparation of mastics, however, may demand the investment of more time and equipment than the other arrangements, because they require heating to increase their viscosity. In addition, many vegetal pitches and gums have a tendency to crystallize with dehydration, which must be counteracted by "tempering" with fibrous particles, charcoal, grit, or other materials (Keeley, 1982).

A flint crescent-shaped artifact with red staining, 5.9 cm long, found in the Pre-Pottery Neolithic A (PPNA) site of Gesher, Israel, can provide evidence for mastic hafting technology in the Levant. The results of chemical and mineralogical analyses carried out on the red stains, together with archaeological data, allow the reconstruction of a specific hafting technology using a particular adhesive paste. The crescent was probably part of a composite tool with several key elements: a handle made of bone, wood, etc., a hafted implement or implements made, for example, of flint, and a binding adhesive.

Ethnographic records attest to a wide range of mastic materials used for hafting: glue obtained from the bulbous root (Krige, 1965), hot porcupine grass resin (Basedow, 1929), boiled pieces of buffalo phallus (Ewers, 1958), beeswax paste with ashes (Suárez, 1968), and warmed pitch of bull pine (*Pinus sabiniana*) (Gifford, 1965), are only a few examples. They illustrate a great variety of materials, which are frequently gathered locally, and diverse procurement methods.

Middle Paleolithic cultures furnish data on hafting technology as a worldwide archaeological phenomenon. The earliest evidence comes from Campitello Quarry, central Italy, where a birchbark-tar adhesive was found (Mazza et al., 2006). Plant twine, resin, and ochre used as an adhesive are reported from the Middle Stone Age layers of Sibudu Cave and other sites in South Africa (Wadley et al., 2004, 2009; Lombard, 2005, 2007, 2008; Wadley, 2005). Artifacts with residue of bitumen adhesive are known from the Levantine Middle Paleolithic sites of the el-Kowm basin, Syria (Boëda et al., 1998, 2008). The site of Quneitra, Golan Heights,

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yielded a Mousterian flint scraper bearing an unusual patina pattern on both faces. Experimental analysis supported the suggestion that these patterns resulted from the hafting of the tool in a handle (Friedman et al., 1995).

The Middle to Upper Paleolithic transition in the Levant was probably accompanied by two typo-technological features affecting hafting: the appearance of the butt-thinned Emireh point, typical of the initial Upper Paleolithic (see Marks, 1983), and the beginning of microlithization (Clark, 1959; Bar-Yosef, 1987, 2002). The increased use of microliths during the Epi-Paleolithic was clearly associated with the invention of a hafting technology for composite tools (Belfer-Cohen and Goring-Morris, 2002).

Pyrotechnology was introduced to the Levant during this period in the form of the production of, among others, lime plaster (Kingery et al., 1988). The Geometric Kebaran site at Lagama North VIII, Sinai (Bar-Yosef and Goring-Morris, 1977), yielded several microliths with adhesive along the longitudinal axis. Examination of its microstructure and chemical composition, which is a nearly pure calcium carbonate, identified the adhesive material as lime plaster (Kingery et al., 1988). This technology was also identified at the late Natufian site of Saflulim, central Negev, Israel (Goring-Morris, 1999).

A few examples of hafted sickle blades in handles have been found in Natufian sites (El-Wad Cave: Garrod and Bate, 1937: pl. XII; Kebara Cave: Turville-Petre, 1932; Oumm ez-Zoueitina: Neuville, 1951: pl. XIII: 24; Wadi Hammeh 27: Edwards, 1987, 1991). The bone handle found by Garrod (Garrod and Bate, 1937) in El-Wad cave was bedded in tough red earth and the blades were held in place "… by a calcareous concretion… all trace of the original sticking matter having disappeared" (Garrod and Bate, 1937: 37). Tomenchuk argued (cited in Bar-Yosef, 1987) that the calcareous concretion was indeed the limestone-based adhesive material of this specimen rather than a secondary calcareous deposit.

Backed bladelets, La Mouillah points, and geometric microlithis of the Late Epi-Paleolithic Madamaghan industry in southern Jordan often display red or yellow ochre on their retouched edges (Henry and Shen, 1995). Microscopic study confirmed the correlation between hafting abrasion polish and the distribution of ochre on the tools. Although traces of resin were not observed, it was suggested that organic material served as hafting adhesive while the ochre was used as a decoration with symbolic meaning (Henry and Garrard, 1988).

The Levantine Epi-Paleolithic cultures provide evidence for both limestone-based and possible resin adhesives (Bar-Yosef, 1987), and the European Mesolithic artifacts (e.g., Curwen, 1941) have yielded evidence for birchbark-tar or resin adhesives (e.g., Keeley, 1982); while the North African Capsian cultures used a blend of organic material and ochre as an adhesive (Inizan, 1976; Beyries, 1983). The presence of ochre traces and the microscopic analysis' results of the ochre were interpreted as part of a structured process, whereby the artifacts were dipped in a liquid made of gypsum plaster and hematite as part of the hafting technology (Inizan, 1976).

The PPNA period is marked by major changes in human culture and socio-economic behavior such as subsistence modes, as attested by the beginning of cultivation, sedentary lifestyle, and social complexity. Yet no major technological change within the realm of hafting technology has been observed to date in the archaeological record. Cauvin (1983) suggested that resin was frequently used in the Neolithic of the Euphrates to haft sickle blades but was rarely preserved, hence its absence from the archaeological record. In the southern Levant, especially in the vicinity of the Dead Sea, there was an abundance of bitumen, which explains the presence of black traces on flint tools as an adhesive for hafting. Examples are the elongated blades ("Beit Ta'amir knives"), from Salibiya IX and Netiv Hagdud, both PPNA sites located in the southern Jordan Valley (Bar-Yosef and Gopher, 1997), and the sickle made of horn (Nissenbaum, 1997) from Nahal Hemar Cave in the Judean Desert, with three blades inserted in a groove, each separated from the next by a patch of bitumen (Bar-Yosef, 1987). Cauvin herself studied sickle blades from Tell Assouad, Syria, and showed that half of them retained traces of blackish material suggested to be bitumen (Cauvin, 1973).

The selected cases of hafting technology presented above demonstrate both the early origin of hafting and the variability of the prehistoric record. The objective of the present study is to examine in detail the red substance that appears on the Gesher crescent. The various analyses provide further information on the materials and the technological processes used by the PPNA groups.

1.1. The crescent from Gesher

The PPNA site of Gesher is located in the central Jordan Valley of Israel. It was excavated in 1986–7 by Y. Garfinkel (Garfinkel, 1989, 1990a, 1990b; Horwitz and Garfinkel, 1991; Garfinkel and Belitzky, 2005; Garfinkel and Dag, 2006). It is situated on the southern bank of Nahal Tavor and the Jordan River flows about 1 km east of the site (Garfinkel and Dag, 2006: 4–6, Fig. 1.1, 1.2). The Neolithic layer, dated to 9300 calBC (ibid.), accumulated on top of varved strata of the Lisan Formation, which is interstratified with sandy layers. This anthropogenic layer is covered by sediments of the Faza'el Formation (ibid.: 32).

Architectural remains and a flint assemblage with typical PPNA tool types were identified; they include sickle blades and the crescent-shaped artifact, together with a variety of other tools (ibid.: Table 4.3).

The crescent-shaped item under discussion is 5.9 cm long and 2 cm wide. It is abruptly retouched along its curved edge (Fig. 1). Light-colored encrustation appears in no particular pattern on both ventral and dorsal surfaces. Red staining is present on both faces

Fig. 1. The PPNA flint crescent from Gesher with red staining; left: dorsal face, right: ventral face (scale = 2 cm).