The earliest Near-Eastern wooden spinning implements

Dafna Langgut[1], Naama Yahalom-Mack[2,3], Simcha Lev-Yadun[4], Eitan Kremer[1], Micka Ullman[2] & Uri Davidovich[2,5]

[1] The Laboratory of Archaeobotany and Ancient Environments, The Sonia and Marco Nadler Institute of Archaeology, Tel Aviv University, Tel Aviv 69978, Israel (E-mail: langgut@post.tau.ac.il)

[2] Institute of Archaeology, The Hebrew University of Jerusalem, Mount Scopus, Jerusalem 91905, Israel

[3] The Fredy and Nadine Herrmann Institute of Earth Sciences, The Hebrew University of Jerusalem, Edmond J. Safra campus, Givat Ram, Jerusalem 91904, Israel

[4] Department of Biology and Environment, Faculty of Natural Sciences, University of Haifa-Oranim, Tivon 3600600, Israel

[5] McDonald Institute for Archaeological Research, University of Cambridge, Downing Street, Cambridge CB2 3ER, UK

A unique set of circumstances has preserved a group of rare wooden artefacts deep within burial caves in the southern Levant. Identified as spindles and distaffs, they are fashioned from tamarisk wood and date to the Chalcolithic period. Analysis suggests that these implements were used to spin flax fibres, and they provide the earliest evidence for two distinct spinning techniques, drop spinning and supported spinning (with rolling on the thigh). One wooden spindle with the whorl still in place is the oldest such tool to survive intact in the Near East. The lead forming the whorl may have originated in Anatolia, and it is evidence, perhaps, of early long-distance trade.

Keywords: Near East, southern Levant, Chalcolithic, spinning, wood implements, whorl, spindle, distaff, lead

SUPPLEMENTARY MATERIAL

Methods and some additional results

Dating

The dating of the wooden shafts relies on the archaeological context of the findings and on two ^{14}C age measurements performed by an Accelerator Mass Spectrometry (AMS) ^{14}C (Table 1 in the main article). The shaft from Qina Cave was dated by Beta Analytic Radiocarbon Dating Laboratory in Florida, while the shaft from Ashalim was prepared in the Radiocarbon Dating Laboratory of the Weizmann Institute of Science, Rehovot, Israel, and measured by the AMS Laboratory at the NSF-radiocarbon facility of the University of Arizona. The two ages were calibrated by IntCal13 (Reimer *et al.* 2013).

Wooden items morphology

The five shafts (Figure 7 in the main article) were first visually examined in order to allow a general description of the findings in terms of structure and size. Places from which small branches were removed along the wooden items were meticulously examined. The length and diameter of each shaft was measured, and special man-made morphological structures (grooves and sharpened tips) were traced. The measurements and unique characteristics of the wooden items are presented in Table 2 in the main article.

A replica of shaft 127 was prepared from tamarisk wood, and a spinner that specialises in spindle techniques (Yonit Krystal, October 2014) then used this replica in order to evaluate its mechanical performance. For this experiment, flax fibres were used, which were purchased from a hand-spinning supplier as prepared fibres, ready for spinning. The spinner yielded a few metres of soft yet durable linen yarn easily and quickly by using our replica in the drop-spinning technique, although the shafts (original and replica) are not totally straight.

Microscopic examinations

For wood taxonomic determination, tiny, thin, free-hand sections were made in each one of the four shafts by using a razor blade along three observational axes—

transverse, tangential and radial. These thin sections were then examined under oblique-angled top-lighting using a stereoscopic Carl Zeiss SteREO Discovery V20 microscope at magnifications of up to 360×. In order to document certain micro-surface anatomical structures of the wood, a scanning electron microscope (SEM) was also used. The samples were sputter coated with gold prior to the SEM examination. For identification, a reference collection of Israeli timbers was used (Steinhardt Museum of Natural History). In addition, a metallurgical microscope was used to conduct a meticulous examination in order to track fibre remains. The fibres were extracted from the shafts by sterile tweezers and were then sent to the Israel Forensic Science Institute in Jerusalem for microscopic identification (polarisation and white light microscopy). The Qina spindle whorls were also examined under a metallurgical microscope in order to ensure their identification as basalt whorls (Shmuel Marco, *pers. comm*.). The origin of the basalt could have been nearby locations, such as the Ramon Crater and Central Transjordan, as well as from farther regions, such as the Golan Heights.

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