In 2001, an iron metallurgical workshop was discovered in Area E at Tel Beth-Shemesh. Only a handful of iron-production and ironworking locations are known in the Near East and the Beth-Shemesh iron workshop is the earliest excavated in the region. This discovery therefore allows us a rare glimpse into the nature and organization of such a workshop. A comprehensive assemblage of metallurgical debris was found, consisting of technical ceramics (i.e., hearth wall and tuyères—blow-pipes), metal artifacts, charcoal, a single type of morphologically homogeneous slag, and very fine magnetic material (hammerscale).

The nature of this material, especially the fact that only one type of slag was present, indicates that the workshop represented a secondary smithing operation, as opposed to iron smelting or primary (bloom-) smithing. To confirm this, dedicated excavation techniques were developed and applied in 2003 and 2006, expanding the normal archaeological stratigraphical approach. The material was subsequently subjected to extensive laboratory analyses.

Stratigraphically, the smithy seems to have been established in the early days of Level 3. Radiocarbon analyses of three burned olive pits date the activities in the smithy to 905–810 B.C.E. (AMS analysis dendrocorrected). The finds were further compared to ones from the contemporaneous iron-smelting site of Tell Hammeh in Jordan, with respect to material assemblage, slag composition, choice of location, and organization of production (see Veldhuijzen and Rehren 2007).

Through dedicated metallurgical excavation techniques, we recovered and recorded the minute magnetic material associated with the iron-related metallurgical activity at the workshop. This magnetic material consists primarily of hammerscale, the re-oxidized crust formed on the surface of an iron object subsequently hammered off as flakes during forging.

The excavation of the iron workshop required dedicated techniques for recovering and recording the minute magnetic material associated with the iron-related metallurgical activity at the workshop. A grid system of 25 by 25 centimeters was laid over the smithy in order to control the spatial analysis of the finds. Photo by H. A. Veldhuijzen.
activities. It is an important indicator of the type of metallurgy practiced. By plotting its distribution within the workshop, it furthermore assists in determining otherwise invisible use of space and location of activities within the metallurgical workshop. Whereas hammerscale can also occur in the context of primary smithing, larger quantities of scale are usually associated with the more prolonged and extensively oxidizing circumstances of secondary smithing, and high quantities are indicative of the presence of a smithing hearth or anvil.

At Beth-Shemesh, a grid system of 25 by 25 centimeters was laid out over Square E/T48, the location of the workshop. The soil from each unit (arbitrary vertical spits of 5 centimeters) within each grid (horizontal location, e.g., H15) was kept separate and subsequently spread out on a plastic sheet. A magnet was then dragged over or lightly touched the soil for 90 seconds. The soil was subsequently jumbled up by hand, and a second round of dragging, again for 90 seconds, was performed.

A spatial pattern could be discerned in the hammerscale scattering when plotting the weights of scales per excavated unit on the grid plan. The highest concentration of hammerscale coincides with the large ashy area archaeologically observed in all units excavated. When a hearth or anvil are no longer present or difficult to identify, patterns within hammerscale distribution may help the reconstruction of the use of space. At Beth-Shemesh, the observed correlation between high concentrations of hammerscale with those of ash suggests that this concentration reflects the (final) hearth structure rather than the location of an anvil.

Chemistry, morphology, size, and uniformity of the Beth-Shemesh slag all point towards secondary smithing. All slag samples belong to a single type: mostly round, concave-convex shapes with a diameter of up to 10 centimeters with rust adhered to the top and soil to the bottom. These morphological features form a classic example of a "smithing hearth bottom" (SHB), where each specimen probably represents a single smithing operation or workday (Serneels and Perret 2003: 473).

The tuyères found at Beth-Shemesh are all square, measuring approximately 5 by 5 centimeters in section, with a bore of approximately 10 millimeters in diameter. All tuyères are fractured a few centimeters behind their nozzle, and no rear ends are preserved. Petrographic analysis of the tuyères conducted by Nadin Reshef under the guidance of Yuval Goren at the Laboratory for Comparative Microarchaeology at the Institute of Archaeology, Tel Aviv University, indicates that they were locally produced either at the site or in its close vicinity.

Intriguingly, the Beth-Shemesh tuyères are virtually identical in all macroscopic aspects—size, color, feel, temper, and shape—to those found at the contemporary smelting site of Tell Hammeh in Jordan. A square section is quite rare for tuyères, and it seems to suggest socio-cultural influences rather than technological ones (see Veldhuijzen and Rehren 2007).

A large number of iron artifacts were excavated in the Beth-Shemesh smithy, including billets, arrowheads, knives, and various indeterminable strips. This material was also analyzed to determine the nature and possible provenance of the metal. This revealed that the metal itself ranged from soft bloomery iron (virtually no carbon) to steel (ca. 0.8% of carbon). Analysis of (smelting) slag inclusions trapped in the metal indicate that the Beth-Shemesh objects may have
originated from up to four different production locations, and it is significant that none of them originated at Tell Hammeh (Blakelock et al. 2009).

A picture emerges of a smithing workshop that was operated regularly and at considerable (local) scale within the confines of an Iron Age urban administrative center, catering to the needs and wants of that settlement. Plotting of the magnetic remains has assisted in recreating the spatial layout of the workshop and the likely position of the last hearth in use. The quantity of SHBs, where each specimen represents a separate smithing operation, indicates that the smithing work must have been a regular operation, as opposed to an experimental or merely occasional one. Whereas the iron smelting site of Tell Hammeh is located near required natural resources, the iron smithing at Beth-Shemesh was situated within the confines of a large city, located near the consumer, which corresponds with finds identified as smithing in other sites in the Levant.

The identical design characteristics of the Beth-Shemesh and Hammeh tuyères are probably indicative of cross-cultural contacts, shared technological characteristics, or even a socio-ethnic link. This shape may therefore represent a technological choice, that is, a choice not guided by technological constraints, but one made by the person performing the technological activity based on, for example, social or cultural considerations, perceived requirements, or local traditions. It is tempting to speculate about smelters (seasonally) smelting at Hammeh, and then travelling around the surrounding area, smithing their product near the consumers, that is, in settlement contexts such as Beth-Shemesh, where this travel is reflected in identical tuyère design. However, the (ongoing) analysis of slag inclusions in the Beth-Shemesh metal seems to indicate that, notwithstanding other apparent links between the sites, the metal worked at Beth-Shemesh was not produced at Hammeh.

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