Three-dimensional documentation of massaboth sites in the 'Uvda Valley area, southern Negev, Israel

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A B S T R A C T
The deserts of the Near Eastern are exceptionally rich with cult sites, among which particularly common are ones with standing stones, also termed massaboth. Despite being a common phenomenon and especially important in terms of understanding ceremonial and spiritual life of past desert societies, such sites are rarely described in adequate detail. We hereby provide case studies where two distinct and complex sites in the ‘Uvda Valley, southern Negev, Israel, that were documented three-dimensionally and in high resolution. The point clouds serve as a platform for modeling and a range of ensuing analyses. Following the extraction of geometrical attributes, their dimensions, proportions, and resulting weights are statistically analyzed as well as their spatial distribution within the site. The analyses therein provide new avenues for intra- and inter-site comparisons. Furthermore, they are incorporated in interpretations regarding religious developments in the desert, lacking the complex architecture known in the fertile lands.

1. Introduction

The Near Eastern deserts are exceptionally rich with cult sites of various types, among them are ones with standing stones, also termed batyls, menhirs, or massaboth (singular – massabeh), a biblical Hebrew-word also used in English literature (e.g., Erdmans, 1911; Mettinger, 2004; Simkins, 2012). In an incomplete survey of the Negev desert, over 450 massaboth installations have been recorded to date, 123 of them are east of ‘Uvda Valley, in the southern Negev, Israel, within an area of 60 km² (Fig. 1); six of these were excavated.

The massaboth may range from a few centimeters to several meters tall. They are set either individually or in groups and are found next to habitation sites, tent-camps and ancient roads. They are mostly set in specific ‘shrines’, but also found incorporated in tombs, open-air sanctuaries and other cult installations. Around the world, standing stones in archeological sites are commonly interpreted as representing the ancestors (e.g., Albright, 1957; Burrows, 1934; Eliade, 1978; Fergusson, 1872) but in the desert most massaboth are identified as representing deities, either as individuals or in groups of repeated numbers (Avner, 1984, 2000, 2001, 2002, Ch. 4, and references therein).

Descriptions of massaboth sites are commonly limited to general reports, elementary plans or a few photographs (e.g., Zarins, 1979; Tillner, 1981; Milburn, 1983; Wendorf and Schild, 2003, Chapters 16, 17; Ben-Ami, 2004; Gophna, 2004). Yet, for in-depth characterization and analyses of the sites and settings, a detailed documentation, preferably three-dimensional, can provide quantitative, morphological and geometric information. An objective, high-resolution documentation of the installation enables detailed characterization of sites and objects, irrespective of their shape and complexity.

In this paper we report 3-D documentation and analysis of two massaboth sites: Ma’ale Shaharut and Nahal Ya’alon, in the ‘Uvda Valley at the southern Negev, Israel (in Fig. 1). The first comprises a three-tier arrangement of a large set of stones, whereas the second is characterized by diverse and unusual stone shapes. Therefore, we address two very distinct types of sites, chosen for both the uniqueness and interpretation related matters. Based on surface artifacts, general characteristics, and 14C dating, the sites are dated to the 5th–3rd millennia BC. The dimensions, settings, and complexity of both sites motivated use of terrestrial laser scans for the study. To the best of our knowledge, documentation, analysis and spatial attributes of such sites at the accuracy-level provided herein has not been reported thus far. The results are incorporated in the interpretation of the massaboth and their role in the spiritual world of past desert societies.
Fig. 1. The survey map of 'Uvda Valley. The location of the studied sites is marked by a star.
2. Documentation and analysis

Data were acquired using the Leica ScanStation C10 terrestrial scanner (Fig. 2a) with modeled surface precision of ± 2 mm of and ± 60 μrad in angle measurements. Scans spanning 360° horizontally and ± 45° vertically were taken in order to document the settings and objects therein. Images were acquired with the scans to yield a three-dimensional photorealistic documentation.

Since securing complete coverage and obtaining a sufficient level of detail necessitated scans from several positions, designated reflector targets were enlisted for the ensuing registration of the individual scans (Fig. 2b and c). Geo-referencing of the scans into the national reference frame was performed using real time kinematic GPS (RTK-GPS) measurements in reference to the national virtual reference station (VRS) network with accuracy of ± 5 cm.

2.1. Ma’ale Shaharut

The site of Ma’ale Shaharut (‘Uvda 151, G.R. 1996542384) is located east of ‘Uvda Valley, 300 m from a cliff-edge above the ‘Araba Valley, next to a seasonal water reservoir and two temporary ancient dwelling sites. When discovered, an oval of various sized elongated stones was visible on the surface; five stones were standing upright or tilted while others were fallen. Two fallen stones on the western side were notably larger than the rest (Fig. 3a and b). In appearance, the site was very different from common remains of circular habitation structures in the area, which usually have continuous walls with several adjacent rooms/units each approx. 2–4 m across.

During excavation, small and medium field-stones were removed and the area was dug to bedrock, only up to 0.2 m below surface. The shallow nature of the site may account for the fact that most stones did not remain standing. However, seven small stones were found under the debris, in situ, and still vertically set. Following the dig, the fallen masseboth were gradually raised, based on the position of each stone, their shape, patination and order of falling. Although total accuracy in resetting the stones could not be guaranteed, the outcome was clear: 61 masseboth set in tiers, forming an oval arrangement (Fig. 3c and d). The largest two are noticeable on the western side, facing E-NE, while the other 59, with varying heights, relate to the larger pair. Like many masseboth in the desert, all are of natural stones, un-hewn, selected according to their size, shape and proportions. Inside the oval, a stone basin was found lying upside down and covered by a pile of small stones. It was an unworked stone, 30 mm across with a natural 18 mm depression created by chemical weathering (Fig. 3c, center). A hearth, 60 mm in diameter, was found next to the basin; it yielded a 14C date of ca. 5670 ± 85 BC (Rt684A, BP, 4610–4360 Cal BC; Avner et al., 1994), i.e., representing the Early Chalcolithic period (Gilead, 2009).

The only finds from the dig were nine flint flakes, none diagnostic in terms of cultural/chronological attribution. However, eight flint tools were collected on the surface of the site, including one crude adze and one standardized adze; the latter is typical of the Late Neolithic and Chalcolithic periods (Barkai, 2011).

The tiered arrangement required seven scans to avoid occlusions and reach a complete coverage of all stones. An angular resolution of 1.92 mrad was used, yielding approximately 1,300,000 points per scan (smaller than the maximal amount of points for that resolution, as no returns are recorded from the sky), and totaling ~9,000,000 points (Fig. 4a). Co-registration uncertainty was ± 3 mm, and the average density was 20 points/cm². Following the removal of terrain-related returns, by applying a morphological filter (Fig. 4b), the point cloud capturing the masseboth was analyzed.

The site general arrangement is oval, with the major axis oriented NW–SE (az. 117°, Fig. 4), very close to present winter solstice. Two main tiers of masseboth can be clearly observed, with an incomplete outer tier and a few additional masseboth (Figs. 3d, and 4a, b). The two main tiers follow to an oval shape (Table 1, Fig. 5) indicating that with some local variations within each, the masseboth strongly conform to an elliptic design. The axes are 2.5 m and 1.9 m for the inner tier; and 3.4 m and 2.5 m for the middle.

Fig. 2. Terrestrial laser scanning technology: (a) the Leica ScanStation C10 and reflectors at the Nahal Ya’alon site, (b) a photorealistic rendering of the Nahal Ya’alon scanned site with colored three-dimensional point cloud, (c) reflectors used for registration positioned within the scanned scene.
Fig. 3. The masseboth at Ma’ale Shaharut: (a and b) before excavations, (c) reconstructed after excavation, from north, (d) reconstructed after excavation, aerial perspective.

Fig. 4. (a) Complete point cloud of Ma’ale Shaharut site; (b) The masseboth point cloud (isometric view) separated from ground; (c and d) Cross-sections along the site, see location in (a).
The majority are narrow, with a height-to-width ratio ranging from 1.5:1 to 4:1 (Fig. 8c and d). Only two stones (#17 and #50; Figs. 6 and 7) are conspicuously broad (see below). A tripartite distribution can be observed when studying the height-to-width ratio. The dominant group, with 41 stones, consists of a ratio of up to 2:1, i.e., from a square (broad) to oblong geometry, where the height is twice the width (Fig. 8c and d). Fifteen stones have narrow proportions (ratio > 2.5:1), and only five are wide (< 1:1). Notably, among the latter group, three stones are small (shorter than 0.2 m); having similar width as the rest of the stones. Only #17 and #50 are exceptionally wider.

The height distribution of the set is also tripartite (Fig. 8b). The first group consists of 57 stones ranging in height between 0.12–0.59 m, with an average height is 0.3 ± 0.1 m. The other two groups consist of two masseboth each; two are ~0.8 m tall (#15 and #23), and the tallest two are 1.04 and 1.16 m tall (#50 and #57). As noted, the latter two sets are positioned on the opposite sides of the major axis of the central tier, facing each other (Figs. 4 and 5). The average height of the masseboth positioned in the two inner tiers shows no statistically significant difference, 0.30 m and 0.32 m, for the inner and middle tiers, respectively. The inner tier is, however, more uniform with a ±0.07 m standard deviation, compared to ±0.11 m in the middle (ignoring the four tallest stones in the second tier, which standout).

The width of the regular-sized masseboth (55 of the 61, ignoring the four largest and the two exceptionally wide ones) is uniform to a great degree, 0.18 ± 0.05 m.

Weights of the masseboth can be derived from the point cloud by estimation of their volume. A weight density of 2.6 gr/cm³ of the local limestone was used for that purpose. The weight analysis shows that 72.1% of the masseboth (44 of the 61) weigh less than 20 kg, with an average of 10.3 ± 5.0 kg (Fig. 8e). Seven are in the range of 20–30 kg, six between 30–50 kg, and the remaining four are heavier. The two tallest masseboth (#50, #57) are also outstanding in their weight, 117.3 kg and 205.1 kg. Closest to them is #23 with 78.0 kg, while the next one weighs only 55.6 kg (#19). Considering that some of the specimens may still be partially underground, actual volumes and weights may be slightly increased.

2.2. Nahal Ya’alon

The Nahal Ya’alon site (G.R. 2050044074) is located 10 km north of ‘Uvdah Valley, 17 km from Ma’ale Shaharut (Fig. 1), on a low hill next to an ancient road connecting the ‘Araba Valley with the southern Negev and Sinai. The site is oval, approx. 4 × 5 m², surrounded by a low stone wall and loosely divided into two 2.7 × 1.7 m² and 2.8 × 2.5 m² cells (Fig. 9).

Contrary to the Ma’ale Shaharut site, the masseboth here are naturally cylindrical stones, selected and brought to the site from the nearby Senonian ‘Menucha formation’. Due to their unique shape and dimensions, they stand out on the barren landscape. Furthermore, once set on edge and arranged in a vantage point and in high density, they are even more conspicuous on the landscape, otherwise devoid of large stones.

The site was scanned from six stations to collect sufficient details and to avoid occlusion effects (Fig. 10a). An angular resolution of 0.99 mrad was used here. On average 3,000,000 points were acquired from each position, again, smaller than the maximal amount of points for that resolution, as no returns are recorded from the sky. In total, ~17,500,000 points with an average resolution of ~35 points/cm² were acquired (Fig. 10).

The pair of largest masseboth is located on the southeast side. The first (#1, Fig. 10c) is composed of two stones: a globular base which is topped by a cylindrical stone (the top stone reconstructed); the second is a cylindrical monolith (#2), whose top
is missing. Next to this pair there is an inner 1.2 x 1.1 m² oval cell contains seven small masseboth of natural cylinder-like stones. Stone #3 was found broken, and the top was lying next to the base and placed back by us. Quite unusually, they all face north, most probably to the nearest mountain, about 1 km in that direction. No excavation took place here while on the surface only a few flint flakes were found. Therefore, the site is only generally dated to the 6th–3rd millennia BC.

The geometry and derived dimensions of each massebah show the range of stones incorporated at this site (Fig. 11, Table 2). The masseboth arrangement is more-or-less linear, where the small group (masseboth #3–9) is aligned in a crescent-like arrangement. The largest pair (#1, #2) are at the eastern end while the next highest specimen is at the western end (#9; Fig. 12).

Two groups of masseboth are clearly distinguished by their height and volume, namely the larger pair and the smaller seven. The globular base of the largest massebah is 0.44 m high, the cylindrical stone on top is 0.45 m high, totaling 0.89 m. The second largest specimen is 0.72 m high, but it is incomplete. The other seven in the inner cell are much smaller, 0.13–0.41 m high (Figs. 10c and 13), five of which share similar heights: 0.24 ± 0.02 m, and six share similar width: 0.16 ± 0.03 m. Only #3 is narrower and shorter.

The height-to-width ratio of the stones is even more uniform. All nine masseboth (ignoring the base of #1), are in the range of 1.3:1–2.3:1 with an average ratio of 1.75:1 ± 0.3 (Fig. 14),
significantly more compact range than that of the Ma'ale Shaharut assemblage.

The stones' weight was derived from their volume estimation (see above). For massebah #1, the globular base weighs 266.8 kg and the top stone 41.7 kg, totaling 308.5 kg. Massebah #2 weighs 193.5 kg while the seven others are significantly lighter, with an average of 9.3 ± 5.7 kg (ignoring the smallest, #3, whose weight is only 2.2 kg).

3. Discussion and interpretation

The 3-D scanning offered a detailed, accurate documentation of those two masseboth sites enabling a series of analyses that enhance our research possibilities. Analyses we have performed (Torgman, 2015) show that the laser data accuracy is ± 2 mm of modeled surfaces within the range of 50 m (similar findings have been reported also by Guidi et al., 2011). The acquired 3-D data also provide broad coverage of the sites and their position in the landscape, a detailed recording of each massebah in terms of its morphology, geometry, and location, and presents the complex arrangement of the variety of stones.

The derived dimensions of the sites show that the Ma'ale Shaharut site covers an area of 10.84 m², while the sector with masseboth therein covers 7.19 m². The total area occupied by just the masseboth is 1.65 m², with a density of 5.63 specimens/m² for

Fig. 7. Individual characterization of nine masseboth at Ma'ale Shaharut, as derived from the point cloud.
the entire site, and 8.48 specimens/m² for the sector with masseboth. The average stone spacing (distance between neighboring stones) in the inner tier is $0.45 \pm 0.06$ m and $0.39 \pm 0.10$ m in the middle one. In general, the stones are set in three concentric ovals and spacing is fairly uniform within and between tiers.

The area containing the masseboth at Nahal Ya'alon site is 2.07 m², and only 0.55 m² for the masseboth alone. The density is 4.35 specimens/m², a little less than the first site. The general arrangement is a crescent-like alignment, opening to the north.

The arrangement in three oval tiers at Ma'ale Shaharut seems intentional, as arrangements of masseboth in accurate circles are known in other places, such as the site of Rizqeh, southern Jordan, with a $^{14}$C date close to that of Ma'ale Shaharut (Kirkbride, 1969). More so, accurate circles, up to 400 m in diameter, and other complex structures were constructed throughout the Near Eastern deserts (Kennedy, 2013). Therefore, the shape, combination, accuracy, and orientation of small cult sites in the desert, such as the examples discussed here, seems intentional.
The middle tier at Ma‘ale Shaharut is the most complete, containing the largest masseboth, and most homogeneous in terms of stones’ height and spacing. It is therefore suggested to have been erected first, while the inner and outer tiers were added later, corresponding to the first tier and maintaining its regular shape.

In terms of weight, the total for Ma‘ale Shaharut is 1173.5 kg (above surface only). The pair of the largest stones amounts to 27.5% of the assemblage, while all other 61 stones form the rest. At Nahal Ya‘alon the total weight is 567.3 kg, with the largest pair reaching 88.5% of the assemblage, a figure that speaks for itself.
These data quantitatively indicate the importance and energy invested in carrying the large pair to each site. Furthermore, the weight ratio between the second and third heaviest masseboth is 1.5 for the former and 10 for the latter. These data emphasize again the difference between the two largest masseboth in each site, in relation to all others and to the third stone in particular.

**Interpretation** – A major challenge presented by desert masseboth sites is their interpretation. The common, worldwide interpretation is the representation of ancestors (e.g., Albright, 1957; Burrows, 1934; Eliade, 1978; Fergusson, 1872). However, in the desert they appear to be abstract representations of deities, as opposed to figurative representations in the fertile lands (by statues, reliefs, glyptics etc.). In the Negev, where over 450 masseboth sites are presently recorded, they contain either a single stone

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**Fig. 11.** Individual characterization of the largest three masseboth (#1, 2, and 9) and a typical small one (#7) at Nahal Ya‘alon.

**Table 2**

Masseboth dimensions at Nahal Ya‘alon site.

<table>
<thead>
<tr>
<th></th>
<th>Height [mm]</th>
<th>Width [mm]</th>
<th>h/w</th>
<th>Volume [m³]</th>
<th>Weight [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (base)</td>
<td>40.7</td>
<td>66.2</td>
<td>0.71</td>
<td>0.0953</td>
<td>266.8</td>
</tr>
<tr>
<td>1 (top)</td>
<td>45.2</td>
<td>22.2</td>
<td>2.04</td>
<td>0.0149</td>
<td>41.7</td>
</tr>
<tr>
<td>2</td>
<td>72.0</td>
<td>39.5</td>
<td>1.82</td>
<td>0.0691</td>
<td>193.5</td>
</tr>
<tr>
<td>3</td>
<td>13.2</td>
<td>8.7</td>
<td>1.52</td>
<td>0.0008</td>
<td>2.2</td>
</tr>
<tr>
<td>4</td>
<td>20.5</td>
<td>16.8</td>
<td>1.30</td>
<td>0.0027</td>
<td>7.6</td>
</tr>
<tr>
<td>5</td>
<td>26.3</td>
<td>18.4</td>
<td>1.43</td>
<td>0.0040</td>
<td>11.2</td>
</tr>
<tr>
<td>6</td>
<td>26.2</td>
<td>15.1</td>
<td>1.74</td>
<td>0.0047</td>
<td>13.2</td>
</tr>
<tr>
<td>7</td>
<td>23.4</td>
<td>16.2</td>
<td>1.44</td>
<td>0.0023</td>
<td>6.4</td>
</tr>
<tr>
<td>8</td>
<td>24</td>
<td>11.1</td>
<td>2.16</td>
<td>0.0019</td>
<td>5.3</td>
</tr>
<tr>
<td>9</td>
<td>40.9</td>
<td>17.7</td>
<td>2.31</td>
<td>0.0069</td>
<td>19.3</td>
</tr>
</tbody>
</table>
(40.6% of the sites) or groups of repeated numbers: pairs (19.8%), trios (18.4%), and groups of five (4.3%), seven (6.8%) and nine (2.9%). Since groups of four, six, eight and 10 are absent, the repetition of specific numbers reflects a system in which odd numbers were preferred. Indeed, the same numbers are known in groups of deities in the ancient Near East, from dedication inscriptions, artistic representations and ancient mythologies (Avner ibidem). Several characteristics are common in these groups. The stones are aligned, set very close to each other, arranged symmetrically or in other reasoned order, and usually facing east.

In that context, Ma’ale Shaharut and Nahal Ya’alon belong to a separate group of sites, comprising 7.2% of all sites with an arbitrary number of stones (notably, the masseboth in Nahal Ya’alon differ from the organic group of nine (Avner, 1993)). This group is characterized by several criteria: in addition to their number, they are set spaced, individually, and their orientation varies. In all of these sites there are dominant larger stones, either single, pair or others, accompanied by a greater number of smaller ones. Due to their large, arbitrary numbers, it is difficult to see the smaller stones as representing deities, rather, they seem to represent ancestors. Ancestral masseboth are known from ancient Near Eastern written sources, mentioning “...massebah (skn) for ancestral spirits...” (Ugaritic- “il-ib”, KTU 1.17. I:26-27, etc.). Ancestral standing stones are also well known in recent traditional societies. Whenever a person eligible for a massebah died, a stone was added to an existing group (Frazer, 1913: V: 107, VI: 203; Crooke, 1920: 873 with references; Goody, 1962: 383–389; Buxton, 1973: 62–63; Eliade, 1978: 114–118; Stiles, 1985; Sandarupu, 1987: 44–57, 67–71; Harris, 1982: 46; Middleton, 1982: 141). This may explain why the
smaller masseboth stand individually and their numbers are arbitrary. It is most likely that in sites of this group there is a combination of stones for deities and stones for ancestors. In ancient records and anthropological studies ancestors are perceived as sitting and dining in communion with the gods. The gathering of ancestors alongside deities is known in Ugaritic myth, in the Emar documents and even in the Bible (Gray, 1948; Pope, 1981: 169–175; de Moor, 1995: 15–18; Pitard, 1994; Schmidt, 1994) as well as in the Egyptian Book of the Dead (e.g., Spells 95–97, 100, 114; Faulkner, 1990: 88–98, 112–13). The same belief still prevails in recent traditional societies (e.g., Buxton, 1973: 21, 154–156; Middleton, 1982: 141, 15).

Another point that comes to light is the shape and proportion of the stones. The study of desert masseboth sites shows that the ancients consistently distinguished between broad and narrow stones. Based on both ancient and ethnographic materials, it can be said that broad stones represented females (goddesses or ancestresses) while narrow ones represented gods (Avner, 1993, 2000, 2002 Ch. 4, with references). This distinction helped identifying several types of masseboth-pairs, several types of triads, etc., considering the relative size, shape and position of each stone in the group. In both sites, the pair of larger stones consists of a broad and a narrow stone. At Ma‘ale Shaharut stone #50 is broader while stone #57 is very narrow (almost half the width). At Nahal Ya‘alon, stone #1 has a broad, globular ‘body’, while the cylindrical stone #2 is narrower. Based on parallels with other pairs and ample ancient artistic examples, the pairs discussed here appear as gender-specific, most probably representing a goddess and a god. Support of this interpretation comes from several sources. For example, a cache of statues from a Sumerian temple at Tell Asmar, Iraq (3rd millennium BC) consists of 12 statues. Two are larger, featuring the god Abu and his wife; others are smaller, representing distinguished deceased individuals (Jacobson, 1989).

As to the smaller masseboth, they also show variations in height and height/width proportions. Similarities and differences may relate to the social status of the individuals for whom the stones were erected. In this respect it is interesting to note that stones #13 and #23 at Ma‘ale Shaharut, the tallest ones after the dominant pair, are set just in front of the latter, i.e., facing the deities. At Nahal Ya‘alon all seven small stones are narrow with a height/width ratio ~2:1. At Ma‘ale Shaharut, 44 stones are narrow (Figs. 6 and 7, stones 3, 10, 47, 52, etc.; Fig. 8c and d). Assuming that ‘broad’ stones were not chosen at an exact ratio of < 1:1, but are relative to the neighboring stones, it can be said that sixteen masseboth are broad (ratio of <1:1.3: #3, 4, 6, 10, 17, 44, 47, 52, and others). As a result, the majority of the smaller stones are narrow and represent male ancestors, while the number of broad stones, representing female ancestors, is notably larger than expected (Avner, 1993). In traditional societies, ancestral cult is mainly directed to male individuals while women rarely gain ancestral cult (Goody, 1962: 383–384; Middleton, 1982: 141; Mundkur, 1983: 162–3; Colson, 2005: 1509; Watson et al., 1982: 178–179). In most similar sites in the southern Negev, broad ancestral stones are rare. Therefore, it seems that the site of Ma‘ale Shaharut was built by a clan that paid more respect or admiration to women. A similar situation was found in the site of Rizqeh, where a number of relief-baring masseboth represent women images (Kirkbride, 1969).

The interpretation given here to multiple masseboth sites gains additional support from the observations of the third author who visited five islands in Indonesia in 1999; all with either effigies, menhirs or small masseboth for the ancestors. At Tana Toraja, Sulawesi, Avner was able to question (through translation) peasants near the village of Bori about the meanings of menhirs in a cluster (rante) of several dozens of stones. Although the custom of setting menhirs ceased a decade earlier, they still knew which stone belonged to whom and explained the differences in size as related to social status in life. The smallest stones belonged to men who died young. In this site all stones were narrow, set for male members of the community (however, a burial ceremony of a woman he attended in the same village was highly invested).

Thus, it is suggested that the masseboth sites addressed here represent ancestors, set next to pairs of deities. They were set not only to commemorate the ancestors, but were perceived as containing their power and spirit (Avner, 2002 Ch. 4, with references). Indeed, the desert masseboth are simple, crude and unshaped stones; yet, a detailed documentation and analysis of their context and specific characteristics, prove helpful in the attempt to better understand the spiritual realms of past desert societies.

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