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Tomorrow's mundane is today's extraordinary: A case study of a plastered installation during Neolithization

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For reconstructing past human ways of life we study mundane remains, but in order to detect special worldviews and behaviors we endeavor to observe the extraordinary embedded in those remains. There are many ways to define the 'extraordinary'. Here we center on early occurrences of phenomena that later become mundane, rendering them 'extraordinary' through being rare compared to later frequent appearances. This study explores such extraordinary phenomena with relation to the processes of Neolithization in the Southern Levant, focusing on a round plastered installation (Feature 6) that was unearthed in the Late Natufian village of Nahal Ein Gev II (ca. 12,000 calBP). To investigate the feature's function, we conducted a micro-geoarcheological analysis of the walls and fill to understand its use and formation processes, using Fourier-transform infrared (FTIR) spectroscopy and micro-morphology. Our results show that the walls were not exposed to elevated temperatures and that the interior of the installation was filled with mixed sediments. We therefore rule out the use of the feature as a cooking installation or a kiln. The interior mixed assemblage indicates secondary infilling after the feature was no longer in use for its initial purpose, thus challenging the identification of its original function. To date, there are no parallels for such lime and clay plastered installations in the Natufian culture. Yet, this type of feature becomes increasingly common with the advance of Neolithization where such features served as storage installations, integral to the farming way of life. We conclude that Feature 6 in NEG II is 'extraordinary' in the context of the Late Natufian, heralding the development of clay lined storage installations. We argue that this example of 'extraordinary' within the long process of Neolithization in the Near East helps to illuminate the gradual process of cultural innovation in which new features appear at first as extraordinary phenomena which later will become mundane.

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Introduction

V. Gordon Childe once argued that “...It is only because they are results of human behavior, and therefore express human thinking, that archeologists eagerly collect, scrupulously measure and record and systematically classify bits of junk and holes in the ground” (Childe, 1956, p. 4). One might add that as archeologists we indeed search intensively for the meaning and implications imbued in those remains to recognize their makers and users. We study everyday objects and attempt to reconstruct mundane activities to understand past societies. Yet, as part of this special issue on “Extra-Ordinary: Unique and Common Artifacts as Social Actors” we wish to consider the most mundane of features, a “hole” in the ground, as an extraordinary feature which provides us with new insights regarding changes and processes during Neolithization.

Archeological research often centers on the most frequent finds, the ordinary “mundane” artifacts, characterizing cultural units through their most common elements. This is underpinned by the assumption that a multi-generational process of thousands of instances of production resulted in a fixed ‘standard’ of the material culture of any specific cultural entity. Accordingly, the definition of an archeological unit in time is largely statistical, based on a set of criteria whereby the same material phenomena are closely associated, with great probability, reflecting a shared pattern of behavior. The mundane mass of artifacts presents the baseline for the cultural assignment and the nature of a site or assemblage. They provide us with valuable information on everyday existence and a better definition of the dynamics involved in the inhabitants’ traditions.

Even though the ‘ordinary’ delineates this baseline, the ‘extraordinary’ fascinates us. In order to detect special worldviews and behaviors, we endeavor to observe the extraordinary elements embedded in mundane remains. There are many ways to define the ‘extraordinary’. As the term implies, the simplest way is to determine what goes beyond the ordinary. For example, the handaxe found at the site North of Bridge Acheulian (NBA) (Fig. 1, Sharon

et al., 2010) is extraordinary, since it deviates considerably from typical Lower Paleolithic handaxes. Tremendous effort was put into its shape and beauty, beyond the ordinary (personal communication with Gonen Sharon), suggesting it was unique in the eyes of the maker ca. 650 thousand years ago. This object, and many others preserved in the prehistoric record, are extraordinary in beauty, style, and complexity, and exist beyond the common baseline.

An ‘extraordinary’ phenomena can be defined also through the specific unique contexts in which the artifacts were found. For example, ‘mundane’ objects take on new meanings through playing part in ritual practices, such as the everyday basalt bowl that was placed under the burial of a shaman 12,000 years ago (Dubreuil et al., 2019). There is evidence that such items, some at the end of their utilitarian use life, were intentionally discarded in human graves, thereby becoming extraordinary through their selection, placement, and contextual associations (e.g. Dubreuil et al., 2019; Klein et al., 2017). This is also valid for spaces and architectural features; whereby seemingly ordinary locations attain unique value due to their use as depositories of uncommon artifacts. For example, a unique Neolithic depository of ceremonial masks (Yakar and HersHKovitz, 1988) and unique “Nahal Hemar knives” were found within the small cave at Nahal Hemar (Bar-Yosef, 1985).

Here, we identify a phenomenon as ‘extraordinary’ according to the time of its appearance. An object that later becomes ubiquitous and ordinary can be considered extraordinary in an earlier time period where the object is extremely rare. The frequency of specific artifacts through time is used in seriation techniques in archeology to place artifacts in chronological order (Robinson and Brainerd, 1951; Renfrew and Bahn, 2016), which then provides a relative dating method. The principle of frequency seriation relies predominantly on measuring changes in the proportional abundance of artifacts. By focusing on the point in time where the frequencies are low or almost invisible, we can examine phenomena that were regarded as extraordinary in the social and economic context of that time.

The rapid rate of cultural change occurring during the Neolithization in the Southern Levant makes it an ideal period in which to observe the emergence of extraordinary phenomena that later become common and ordinary. Many consider the Neolithization of the Southern Levant as a long-term socio-cultural evolution (Table 1) (Sterelny and Watkins, 2015), with its initial stages already observed during the Epipaleolithic, developing further through the Late Neolithic. This transformation involves many aspects of society which go beyond a mere change in subsistence strategy, from extractive to productive economy. During this prolonged time-span the general population density and the size of sites increased substantially, with groups typically residing in relatively large sedentary communities (Goring-Morris and Belfer-Cohen, 2011; Grosman, 2004). These processes went hand in hand with shifts in technologies, social organization related to increasing sedentism, new social interactions, etc., culminating in the formation of permanent agricultural villages. It also involved changes in the spiritual domain, observed through clear ritual evidence (Cauvin, 2000; Grosman et al., 2016; Hayden, 2017; Kuijt, 1996; Nadel et al., 2013; Power et al., 2014).

During the Late Epipaleolithic Natufian culture (15,000–11,500 calBP) there is a striking leap in complexity in many domains of daily life (Bar-Yosef and Valla, 2013 and references within). Already from the initial phases of the Natufian there is the appearance of more permanent architectural features, commensal animal taxa, on-site human burials, increased average site size, thicker and denser archeological deposits, and non-transportable, heavy-duty food processing utensils (Grosman and Munro, 2017). The Natufian is of special interest not only because of the

Fig. 1 Handaxes from North of Bridge Acheulian (NBA) (Courtesy of Gonen Sharon). Note the ‘extraordinary’ handaxe in size and dexterity at the upper right of the figure. Photo taken by Gonen Sharon.

Table 1 The chronological order of Neolithization—in the time range between the Epipaleolithic to the Chalcolithic period.		
Chronology ca. years ago		Sites mentioned in text
7500	Chalcolithic	Tel Tsaf
8400	Pottery Neolithic	Tel Tsaf
9000	Pre-Pottery Neolithic C (PPNC)/final PPNB	
9500 Late	Pre-Pottery Neolithic B (PPNB)	'Ain Ghazal, Basta, Es-Sifyia, Jericho, Yiftahel
10,150 Middle		
10,500 Early		
11,750	Pre-Pottery Neolithic A (PPNA)	D'hra, Netiv Hagdud, Wadi Faynan 16
12,500	Late Natufian	'Ain Mallaha (Eynan), Hayonim Terrace, Nahal Ein Gev II, Nahal Oren, Raqefet
15,000	Early Natufian	'Ain Mallaha (Eynan)

significant cultural changes but because it sets the stage for the subsequent fundamental transformation into agricultural societies. Many important trajectories of social change began in the Natufian, such as permanent settlement infrastructure, heightened symbolic communication, ritual practice, and the concentration of burials in settlements, all continuing and evolving into the Neolithic period (Belfer-Cohen, 1991; Grosman et al., 2008; Valla, 2018).

Still, the Natufian chipped stone assemblages are deeply entrenched in the earlier Epipaleolithic microlithic technological traditions (Goring-Morris, 1987; Valla, 1984). The most characteristic tool type of the Natufian is the microlithic lunate that continues the Epipaleolithic tradition of high frequencies of small microlithic tool types. Yet, there are other tool types that emerge in the Natufian that are considered a cultural hallmark; most importantly, the sickle blade used for harvesting plant foods (Abadi and Grosman, 2019). This tool represents a mundane activity that will expand and become standardized during the Neolithic, portraying the Natufian as harbinger of the forthcoming farming way of life.

Another phenomenon of Neolithization is the production of Lime plaster. During the earlier Epipaleolithic there is local incipient production of partially carbonated lime plaster (Bar-Yosef and Goring-Morris, 1977; Goring-Morris et al., 1997; Kingery et al., 1988; Valla et al., 2007) with a technological leap observed at the end of the Natufian enabling the unprecedented large-scale production of high quality lime plaster, observed in a burial context (Friesem et al., 2019). While the large scale production of lime plaster is considered common and mundane among the Neolithic farming societies during the Pre Pottery Neolithic B (ca. 10,000 years ago), its rarity during the Epipaleolithic merits its consideration as an ‘extraordinary’ Natufian phenomenon, both in time and context.

The case study we present is a structured pit (Feature 6) in the Late Natufian village Nahal Ein Gev II. Here we demonstrate how what first appears as a simple “hole in the ground”, following a micro-geoarcheological analysis, emerges as an extraordinary feature in its Natufian cultural context. Our goal is to illustrate the uniqueness of feature 6 and how it represents a gradually expanding phenomenon that became mundane in the Neolithic.

Background

Nahal Ein Gev II (NEG II). NEG II is located on a flat alluvial terrace on the bank of the Wadi Ein Gev, which flows westwards from the Golan to the Sea of Galilee two kilometers west of the site (Fig. 2). NEG II was briefly tested in 1973 by expanding a small modern ‘foxhole’ at the southeastern edge of the site exposing a ca. 1.2 m deep stratigraphic section (Bar-Yosef and Belfer-Cohen, 2000). An exploratory survey using electrical resistivity tomography (ERT), suggested that the site extends over an area of 3600 m² centered on the eastern slope of the wadi and

part of the alluvial terrace. Radiocarbon dating provided calibrated dates ranging between 12,550 and 12,000 years calBP (Grosman et al., 2016).

Thus far, excavations have focused on the eroded south section (ca. 540 m long) on the eastern slope of the site (Fig. 2). The sediments reach in some places more than 3 m in depth, suggesting intensive occupation by a single cultural entity. The stratigraphic relationship between the dense architectural features reveal at least four Late Natufian occupation levels. Dense accumulations of chipped stone artifacts are distributed throughout the site. Chipped stone artifacts typical of the Pre Pottery Neolithic A (PPNA) are completely absent. In contrast, the art objects from NEG II resemble more closely those from the early PPNA than those from the Late Natufian elsewhere, yet they do have deep roots in the Early Natufian tradition (Grosman et al., 2016, 2017; Shaham and Grosman, 2019). The analysis of the lithic and art assemblages also suggests a local ‘fingerprint’ of the NEG II material traditions, in terms of artistic expression and unusual numbers of perforators (>33% of tools) and perforated items. Several other cultural markers, including burial customs and hunting strategies, show considerable continuity of Natufian traditions.

Currently, the excavations on-site revealed several architectural features, including eight buildings and a cemetery bounded by a massive wall (Fig. 2b), among them—Feature 6, a plastered pit which is the focus of this paper.

Feature 6. Feature 6 is located at the south eastern part of the eroded south section of the site (Fig. 3b). The feature was exposed while excavating the area of structure 3. The structure’s boundaries include two walls of which the outer wall (wall 3) is higher than the inner wall. Several stones of the inner wall are laying horizontally suggesting that the inner part of the wall was in fact a bench. To better understand the nature of this structure we cut a section through it, aiming to expose its floor. The section helped verify the level of the floor (level 585–587, below local excavation datum) and the pebble fill below. The floor is made of a gray, sandy sediment rich in anthropogenic materials, mostly lithics, but also shell beads, bones, and other cultural residues.

Below, as the excavation deepened (ca. level 620), the top layer of Feature 6 was unearthed (Fig. 3b). Although the material culture remains at the site suggest one cultural entity of Late Natufian origin throughout the occupation sequence, the location of Feature 6, below structure 3, places it within the earliest occupation phase at the site.

Feature 6 is a round installation, dug into the virgin soil, ~80 cm in diameter, with plastered walls. Due to erosion of the slope on which it resides, the walls of the feature were preserved to a higher elevation in the west (ca. level 650), than in the east (670). The floor of the installation was found at the level of

Fig. 2 The site of Nahal Ein Gev II (NEG II). **a** A map of the Southern Levant showing the location of NEG II and the sites discussed in the text. **b** An aerial photograph of NEG II following the 2018 excavation.

ca. 700, making it ~50 cm deep in the best preserved part (Figs. 4a and 5a).

The installation walls exhibit alternating layers of plaster made of: (1) a brown-red material with white inclusions of different sizes; and (2) a white-gray material. In a section of the feature's rim a clear and uniform separation between the layers indicates at least three plastering episodes (Fig. 5b, c). The inner plaster layer is more brown-red with a massive structure, transitioning gradually into gray in the outer layers, resulting in a diffused boundary between the installation wall and the external virgin soil. The interior part of the wall and floor of the installation is covered by a brown and hard sediment, distinct from the fill with small fist-sized stones found firmly attached (Figs. 4a and 5a).

The sediment infilling the installation is very heterogeneous. Between 650 and 678 the infill deposit is composed of brown-red hard patches of a crumbly structure, which are sterile of finds and found mostly on the south-eastern part. At the north-western part of the installation's interior, a gray powdery sediment was found rich in flint and fauna with many pebbles and angular stones, although the separation between the two sediments is diffuse in some areas (Fig. 5b).

Below was exposed a patchy layer of plaster fragments, under which the fill is a homogenous, gray, and loose anthropogenic sediment with stones of various sizes and shapes (5–30 cm), flint and bones (Fig. 4a). The installation floor is made up of plaster layers similar to the walls, topped with a few flat horizontal stones.

Identification of function. In archeological contexts plastered installations are usually thought to serve one of three possible functions: a hearth or cooking installation; a lime kiln; or a storage installation. It is important to note that other functions are also possible, but due to preservation conditions, ephemeral uses are difficult to identify. Moreover, following the initial use of an installation, it often serves a secondary function as a refuse bin

(e.g., Ziadeh-Seely, 1999) which challenges the identification of the original function.

It has been suggested that the key for identifying the function of such installations may lie in the detection of pyrogenic alteration to the installation walls caused by fire (e.g., Goren and Goring-Morris, 2008; Gur-Arieh et al., 2013, 2014; Kingery et al., 1968; Toffolo et al., 2017). Gur-Arieh et al. (2014) noted that in cooking installations the inner plaster wall shows evidence of clay heating to above 500 °C, even though the actual cooking temperature was only ca. 200 °C. In contrast to the inner part of the walls, the outer wall layers are unaltered. In lime kilns, Toffolo et al. (2017) argued that in addition to the alteration of clay by exposure to high temperatures (>500 °C), wood ash, burnt lime, and lime plaster will provide a signal of altered calcite (see also Weiner et al., 2020). Based on these studies we carried out mineralogical analysis of the installation walls in search for heat-induced alteration in order to determine whether the function of Feature 6 involved the use of fire. In addition, we microscopically characterized the interior sediment infilling the installation in search of activity residues that will shed light on its use.

Materials and methods

Materials. We collected samples from the feature's wall ($n = 4$) and another plaster sample found inside the installation ($n = 1$). In addition, we took samples from different locations inside the installation representing the different types of fill throughout the installation's depth ($n = 5$, Fig. 4). Control samples were taken from a terrace a few hundred meters beyond the boundaries of the site ($n = 4$). Two of these were taken from a pit excavated on the terrace surface; one from the topsoil and one from 10 cm below. The other two samples were taken from the terrace wall, from a depth of 10 and 20 cm (Table 2). Experimental burning at the laboratory was carried out on these control samples in order to compare the effect of heat on the local soil with the archeological samples (Berna et al., 2007; Forget et al., 2015). Atomic disorder of calcite as a proxy for exposure to elevated

Fig. 3 Plan of the site. a The excavation plan of the area where Feature 6 was found, next to structure 4 and structure 3. **b** Cross section of the same excavation area (after Grosman et al., 2016).

temperatures and presence of lime was evaluated by comparing the results of a previous analysis of regional rock and lime-plaster in NEG II (Friesem et al., 2019). One undisturbed monolithic sediment block (NEG 15-1) was collected using Plaster-of-Paris jackets from the center of the installation (Fig. 4).

Method

Heating experiment. In order to identify the alteration of the archeological sediments by heating, control samples of 3–5 g from the terrace sediment were homogenized by grinding and stones were removed. These samples were heated in a furnace using ceramic crucibles heated for an hour at 300, 500, and 700 °C.

Infrared measurements. All samples (control and archeological; $n = 14$) were analyzed using Fourier-transform infrared (FTIR) spectroscopy. A few milligrams of each sample were powdered and homogenized in an agate mortar and pestle. Spectra were obtained using a Nicolet iS5 instrument (Thermo scientific), using transmission mode following the KBr method. Spectra were collected between 4000 and 250 at 4 cm^{-1} resolution with 32 scans (see Weiner (2010) for overview on the application of

FTIR in archeology). Evaluation of clay alteration due to the exposure to high temperatures ($>500\text{ °C}$) was based both on the disappearance of absorption bands related to the hydroxyl groups at 3695 , 3650 , 3620 , and 915 cm^{-1} , and on a shift in the location of the main silicate absorption band at $1030\text{--}1040\text{ cm}^{-1}$ (Berna et al., 2007). In addition, the main clay absorption band location was plotted against its width at 66% of height (main silicate width (MSW)) in order to identify heating intensity (Forget et al., 2015).

Micromorphology. One petrographic thin section for micro-morphological analysis was prepared from an undisturbed monolithic sediment block (NEG 15-1). The block was dried in an oven at 50 °C for 3 days and then impregnated using a 9:1 mixture of polyester resin and acetone and 1% v-v MEKP. A pre-cut sample slice ($66 \times 140\text{ mm}$) was ground to a $30\text{ }\mu\text{m}$ -thick thin section following the method described by Murphy (1986) at the McBurney Laboratory for Geoarchaeology at the University of Cambridge. The thin section was first studied at a scale of 1:1, scanned using a flatbed scanner, and then analyzed with a petrographic microscope at magnifications ranging from $\times 4$ to $\times 400$ with plane-polarized light (PPL) and cross-polarized light (XPL).

Fig. 4 Illustration of Feature 6 and location of samples. a The installation profile and **b** a top plan of the installation.

The micromorphological descriptions employ the terminology of Stoops (2003).

Results

Infrared (FTIR) analysis. In all the samples the indicative absorption bands that usually diminish or shift due to heating did not show any changes from the natural unburnt control sample. Figure 6 showing clay absorption band location plotted against MSW of experimentally heated control samples exhibits a typical distribution due to heating at 500 °C and above, allowing a clear separation between: (1) samples that were unaltered or heated below 500 °C; (2) heated to and above 500 °C; and (3) heated to 700 °C. The infrared spectra of the samples from the installation show no signs of clay alteration, and their values of main silicate absorption band location/MSW cluster in the area of samples which were unaltered or heated below 500 °C (Fig. 6). The

samples taken from inside the installation also showed no alteration.

In most of the archeological samples the calcite presented atomic order that is associated with unaltered natural calcium carbonate. The exception was found in the pit walls' white plaster material (Table 2). Based on comparison with the data presented by Friesem et al. (2019) who studied lime plaster at NEG II, we interpret the wall white plaster as lime plaster. Few white-gray aggregates found within the infill deposits also showed relatively high atomic disorder associated with pyrogenic alteration of the calcite and are interpreted as fragments of lime plaster, likely deposited inside the installation following the collapse of some wall parts (Table 2 and Fig. 4).

Micromorphology. The thin section made from the sediment infilling the center of the installation displays at the top a crumbly

Fig. 5 Photographs of Feature 6 during excavation. **a** The installation at the end of its excavation showing its depth. Note the installation wall on the left showing a layer of brown mud plaster (red arrow) attached to the white lime plaster, and the curved shape of the walls. The sediment block in the center of the installation is the sample (NEG 15-1) used for micromorphological analysis. **b** The upper part of the installation when excavated to level 675. Note the two types of sediment infill: the brown-red hard sediment showing a crumbly structure and the gray powdery sediment. **c** A close-up of the plastered wall displaying several layers of lime and clay plaster. Numbers mark three different plastering layers.

structure and light color sediment with few fragments of brown and white materials attached to one another, interpreted as fragments of wall plaster layers. Below, a gray-brownish sediment includes flint and bone fragments presenting different colors of yellow, white, and black.

Microscopically, the sediment presents an open poorly sorted structure (Fig. 7) including: quartz (15%), large fragments of limestone, bones, and flint (10%), microcharcoal, shells, organic matter, and poorly preserved ash (<5%). The upper part of the sample contains large fragments of mud plaster. The presence of planner voids is indicative of shrinkage fractures and the relatively dark color of the clay suggests this feature is a fragment of an earthen-based construction material (Fig. 7c). In some parts, the mud plaster is still attached to fragments of a gray material characterized by dense cemented calcite-rich matrix, interpreted as lime plaster (Fig. 7d). An admixture of fire residues is found throughout the sediment in the form of burnt bones, carbonized aggregates, rubified clayish aggregates, charred organics, and few partly preserved ash particles (Fig. 7e). The infill sediment seems to be best characterized as a chaotic microstructure of mixed archeological deposits (e.g., flint and bone fragments, and fire residues). Overall, we could not identify any bedding or distinctive spatial concentration of activity residues inside the installation in contrast to internal structures often reported from installations interpreted as used for cooking or storage (e.g., Gur-Arieh et al., 2013; Kadowaki et al., 2015; Matthews, 2010; Portillo et al., 2017; Toffolo et al., 2018).

Discussion

Reconstruction of the installation. The semi-concave inclination observed at the top part of the preserved walls may suggest a dome-like shape which could help protect the interior of the installation from the elements. It is not clear whether the alternating use of mud and lime plastering of the walls was part of a pre-planned design of the installation or is due to repetitive plastering as part of the installation's maintenance during its use. The production of lime plaster in NEG II has been previously reported from the site's burial ground as evidence for communal effort and technological innovation (Friesem et al., 2019). However, lime plaster was not yet found as a building material in other domestic areas at the site, in particular combined with earth-based plaster. We therefore conclude that Feature 6 represents a level of investment that is uncommon compared to other architectural features at NEG II, highlighting the importance and uniqueness of this feature.

Based on the heating experiment of the control soil samples, the earthen construction material of the walls was not exposed to elevated temperatures above 500 °C. We therefore argue that this installation was not used as a kiln and likely not for roasting or cooking by fire. The deposit infilling the installation is made of the local unburnt sediment mixed with high profusion of bones and fire residues which appear to be in a secondary context due to their chaotic orientation. We therefore reconstruct the infilling as waste produced by various activities (bones, fire residues, and the local sediment) which was dumped inside the installation. Unfortunately, this secondary fill affected the preservation of

Table 2 Description of samples and Fourier-transform infrared results.

Sample	Context	Description	Excavators' comments	Major minerals	Clay peak (cm ⁻¹)	MSW (cm ⁻¹)	Clay pyrogenic alteration	Interpretation
IR5	RI57b-6.78	Very pale brown hard blocky mass 10YR 7/3, with white inclusions and white dots. The blocky mass is covered with gray sediment 10YR 6/1	Plaster "floor" in Locus 6	Ca = Cl » Q	1032	122	Unaltered	Mixed pyrogenic lime Plaster + unaltered sediments
S0049	RI57a-6.76	Light brown 7.5 YR 6/4 Hard blocky with white inclusions and few white dots	Red fill above 'plaster' material	Cl > Ca > Q	1032	108	Unaltered	Mixed anthropogenic Sediment with lime plaster
S0050	RI57a-6.78	Grayish brown 10YR 5/2 hard and crumbly with white-orange inclusions in various sizes from 1 mm to 0.5 cm	Gray fill under the stone in the middle of the installation	Cl > Ca > Q	1039	79	Unaltered	Anthropogenic sediment
S0066	RI56c-6.70	Grayish brown 10YR 5/2 Powdery with faunal bone fragments	Gray fill in defined area inside the installation	Cl = Ca > Q	1032	112	Unaltered	Unaltered anthropogenic sediment
S0168	RH57b-6.85	Pinkish gray 7.5 YR 6/2 Hard and dense With many white and black specks	From the wall, sample of red-brown crumbled sediment that touches the plaster wall Bottom of feature 6	Cl > Ca > Q	1033	90	Unaltered	Mixed unaltered sediment with lime plaster
S0189	RI57a-6.98	Brown 7.5 YR 5/2 Hard with white and black specks	Second plaster layer	Cl » Ca > Q	1032	88	Unaltered	Mixed unaltered Sediment with lime plaster
NEG II 19-4	RI57b-6.73	2 main components: main mass is light yellowish brown 10YR 6/4 With whitish inclusions and specks 10YR 8/2		Ca = Cl > Q	1031	117	Unaltered	Mixed unaltered sediments with pyrogenic lime plaster
NEG II 19-5	RI57b-6.78	And covered with grayish layer 10YR 7/2 Two main components: main mass is light yellowish brown 10YR 6/4 With whitish inclusions and specks 10YR 8/2	Inner plaster layer	Ca = Cl > Q	1032	111	Unaltered	Mixed unaltered sediments with pyrogenic lime plaster
NEG II 19-7	RI57b-6.78	And covered with grayish layer 10YR 7/2 Hard and blocky Three main components: Pale brown 10YR 6/3 Whitish 10YR 8/2 Grayish 10YR 7/2 The whitish and gray are more prevalent in this layer	Third plaster layer	Cl = Ca > Q	1031	121	Unaltered	Mixed unaltered sediments with pyrogenic lime plaster
NEG II 19-9	RI57b -6.73	Grayish 10YR 7/2 crumbly	Installation wall outer layer	Ca > Cl > Q	1031	124	Unaltered	Mixed unaltered sediments with pyrogenic lime plaster
EGT 19-8	Terrace pit	Grayish brown 10YR 5/2		Cl > Q = Ca	1031	107	Unaltered	Natural soil
EGT 19-9	Terrace pit	dark brown 10YR 4/1		Cl > Q > Ca	1035	147	Unaltered	Natural soil
EGT 19-15	Terrace wall	Brown 10YR 5/3		Ca > Cl > Q	1034	137	Unaltered	Natural soil
EGT 19-16	Terrace wall	Yellowish brown 10YR 5/4		Ca > Cl > Q	1034	123	Unaltered	Natural soil

Fig. 6 Plot of clay pyrogenic alteration. Plot showing the results of FTIR analysis of experimentally heated control samples (marked in squares) and archaeological samples from Feature 6 (marked in circles). The plot presents the location of the main clay absorbance band against the width of the band at 66% of its height (MSW). The black lines mark the division between the areas associated with: (1) unburnt/low burning; (2) moderate burning; and (3) high burning, based on the experimentally heated sediment samples from the terrace near NEG II. Note how the archaeological samples all fall within the unburnt/low burning range.

intact primary residues making the reconstruction of the original use of the installation extremely difficult.

While we cannot provide direct empirical evidence for its original function, the architectural design of Feature 6, reconstructed as a plastered domed pit, displays high similarity with later Neolithic installations which provided direct evidence for storage, mainly of cereals and legumes (see below). Following its initial use, the installation was used as a refuse bin or left abandoned allowing the local archaeological sediment to fill the installation interior. Lastly, the walls collapsed sealing the secondary infilling of the installation.

Feature 6 in the context of the evolution of storage. The scale and details concerning the development of storage facilities, silos in particular, in the archaeological record are very difficult to identify (Kuijt, 2009 and references within). To date, the earliest appearance of archaeologically visible storage installations in the Near East has been argued to emerge in the Early Natufian, associated with a few plastered pits found at ‘Ain Mallaha (Eynan) (Perrot, 1966). In the Late Natufian, one pit paved with slabs was found at Hayonim Terrace, in a structure with several barley seeds (Valla et al., 1989). In addition, a few small installations interpreted as perhaps silos were identified at Nahal Oren (Stekelis and Yizraeli, 1963). Aside from these, the Late Natufian seems to be devoid of installations that can be unequivocally interpreted as storage facilities. However, in the absence of direct evidence for storage, such as botanical remains, the interpretation of storage is still debated (Boyd, 2006). Similarly, some are hesitant to interpret the pits from the Final Natufian at ‘Ain Mallaha as storage facilities (Samuelian et al., 2006). As Kuijt (2009, p. 642) argued, “[the physical data show that] there was no substantial food storage for the 1200 years before the start of the Neolithic and origins of agriculture”.

From the PPNA onward, clay plastered bins and other installations begin to appear more regularly in the archaeological record providing clearer and direct evidence for storage. Several clay bins with similar dimensions to those of Feature 6 appear at the Early PPNA village of Netiv Hagdud (Bar-Yosef and Gopher, 1997). Larger semi-subterranean clay storage installations were found in Wadi Faynan 16 (Mithen et al., 2018), and granaries 3 m in diameter at D’hra, were built with suspended floors and outer

mud walls (Kuijt and Finlayson, 2009). Since these installations predate full-fledged domesticated agriculture, they were suggested to evince storage of wild plant resources (Kuijt, 2008).

In the Middle Pre-Pottery Neolithic B (PPNB), large-scale storage practices begin occurring inside and outside houses. At Yiftahel, a mud-plastered bin was found in the corner of a room, in which 2000 horse bean seeds (*Vicia faba*) were discovered. In the same room, a concentration of lentil seeds (*Lens culinaris* Medik) were also exposed, which were likely stored in sacks or baskets of perishable material (Garfinkel, 1987). Similar installations were also found in Jericho (Kenyon, 1981). At ‘Ain Ghazal stone curved walls in the corner of rooms delineated small spaces which likely served as storage. In one such niche seeds of peas, lentils, and barley were recovered (Rollefson and Simmons, 1986). In the Late PPNB, there is dramatic architectural change, with the construction of dedicated storage rooms (Mahasneh, 1997). These rooms, at Basta and Es-Sifyia for instance, had no windows and were accessed by small half-door entrances at a height of ~1 m (Mahasneh, 1997; Nissen et al., 1987). Additionally, large rounded containers were found to be made of dried clay, such as the ones found at ‘Ain Ghazal (Rollefson et al., 1992), and most likely served as silos.

Direct evidence for cereal storage, with multiple silos on site, was unearthed at Tel Tsaf, the Middle Jordan Valley, dated to ca. 7000 BP associated with the Late Neolithic and Early Chalcolithic (Garfinkel et al., 2009; Rosenberg et al., 2017). The silos at the site follow the principles of construction for the long-term protection of cereals. Recently, a small clay vessel was found in a burial context at the site possibly representing a model of a silo (Rosenberg et al., 2017). The clay vessel is closed and resembles an elongated, bag-shaped jar with a dome-shaped top. The vessel widens from the base until the mid-point and then narrows to the top, very similar to our reconstruction of Feature 6 at NEG II. The domed shape and the plastered walls of pits dug in the ground allow grains to be stored undamaged for many years in a cool and relatively airtight environment (Mobolade et al., 2019).

In sum, Feature 6 has very few contemporaneous parallels for its design (only from ‘Ain Mallaha and Hayonim Terrace) and no parallels for its construction technology using a combination of lime and earth-based plaster. Feature 6 construction materials are quite durable and tend to preserve well in the archaeological record. We therefore believe that the absence of similar

Fig. 7 Micromorphology of the installation infill. All microphotographs were taken in plain polarized light (PPL). **a** Scan of the thin section showing large rock, flint, and bone fragments. Note the areas with pellet aggregates due to animal burrowing at the bottom, and at the top the presence of dense fragments of wall plaster. **b** The installation's infill matrix showing some areas cemented by micritic calcite, flint fragment, burnt shell (S), dark rubified clay aggregate (C), charred organic matter (O), and a large fragment of bone (B). **c** Clay-rich construction material showing a dense structure, moderately sorted with planar voids indicative of shrinkage fractures. **d** Mud plaster (brown color in the upper part) attached to lime plaster (gray color in the bottom). Note the different composition of the two construction materials; **e** partly preserved ash particles (A) in association with a large bone fragment (B).

installations in the Natufian time in contrast to later periods represents a genuine uniqueness of Feature 6 for its time of construction.

The preservation of Feature 6 does not allow unequivocal identification of its original function and specifically as a storage installation. Yet, the same type of structure becomes increasingly common with the advance of Neolithization where such structures functioned as storage installations, mainly for cereal. We therefore, based on its structural features, suggest that it most

likely served as a storage installation, whether for wild plants or for other materials. Future investigations will aim at understanding the exact original content of this feature which are beyond the scope of present article.

During the Natufian there may have been short-term storage "to maintain an adequate food supply over the winter months" (Olszewski, 1991, p. 339). This may have served as the basis for the Neolithic demographic transition, long before full-fledged domesticated agriculture (Grosman et al., 2008; Kuijt, 2008).

Thus, regardless of the original function of Feature 6 in NEG II, we conclude that it is ‘extraordinary’ in the context of the Late Natufian and it heralds the development of clay-lined installations that appear as mundane storage features during the Neolithic period.

Final comments—storage and neolithization. Childe (1951), and later others (e.g., Bogaard et al., 2009; Harris, 1959; Hayden, 1990, 2014; Testart, 1982), suggested a connection between the transition to agricultural subsistence and the initiation of food storage leading to large-scale storage. Additionally, many researchers identified the development of storage as a way of reducing risk primarily due to unexpected climatic conditions (e.g. Binford, 1980). Additional explanations were also given for the development of storage as part of a society’s subsistence strategy unrelated to agriculture (Goland, 1991; Testart, 1982).

Yet the main question is when does the development of surplus exist in the timeline of the Neolithization process? Was it before, during, or after? Here, the famous paradox of Zeno (Kirk et al., 1984, p. 258) is relevant: “Drop a millet seed on the ground and it makes no sound. But then how can dropping a bushel of millet seeds make a sound, since it contains only millet seeds?” The following questions arise: How shall we identify the ‘bushel’? Does it consist of a sum that will make a sound that will dissipate if we remove one seed, or should we advance our listening device and hence improve our ability to distinguish between the impacts of each seed on the ground? The logician Charles Dodgson concluded that we should just draw a line somewhere and pretend: “It seems a tiny sacrifice for the convenience” (McNeill and Freiburger, 1993, p. 27). In other words, where should we draw the line of the Neolithization process? Where is the line that separates between ways of life during Neolithization? In more recent research, the previous simplistic, rigid distinction between hunter–gatherers and agriculturalists has broken down and been replaced by a more flexible approach. Indeed, it was already suggested through ethnographic and prehistoric research that many societies do not fit this dichotomy (Zvevil, 1995; Ellen, 1988). Childe (1951, p. 87) commented on this as well: “The Neolithic revolution...was the climax of long process. It has to be presented as a single event because archeology can only recognize the results: the several steps leading up thereto are beyond the range of direct observations”. Here in our analysis and conclusions we were able to enhance our “listening devices” and to find direct observation on a finer scale. Other intermediate phases between gathering and agriculture are becoming large and diverse, followed by the introduction of a new conceptual approach to these societies (Smith, 1998, 2001). It is interesting to add the Competitive Feasting Theory (Hayden, 1992), that suggests that emerging social needs were the initial catalyst to cultivation. According to Hayden, in these early stages of cultivation, cultivated plants represented only a small portion of the diet while the majority was obtained through hunting and gathering. In light of this interpretation, and various archeological and genetic evidence, the transition to a fully fledged agricultural economy was probably less abrupt and clear-cut but rather a continuous process (e.g. Asouti and Fuller, 2012). Therefore, the change in subsistence may first occur as the growing practice of food storage and small-scale cultivation, which holds a low visibility in the archeological record.

Since the definition of an archeological phenomenon depends on its visibility in the archeological record, archeologists intuitively recognize the fact that the information, upon which we base our interpretations of past processes, is erratic, incomplete, and lacks the ‘silent’ phases. Consequently, we remain unable to find supporting botanical evidence for

cultivation during the Natufian, yet the growing data suggest intensification of cereal harvesting. In addition, the emerging evidence, like the one showed here, for technological and social dynamics during the Natufian suggests that the characteristic features of the Neolithic were already forming earlier.

The time of occupation at NEG II is positioned on this imaginary line, marking the end of the Paleolithic and the beginning of the Neolithic. In the present study we “improved our listening device” and incorporated micro-geoarcheological analysis for understanding the nature of Feature 6 merging this data with archeological observations. It enabled us to identify the ‘extraordinary’ nature of this feature even for the people of NEG II. By contextualizing the extraordinary characteristics of this Natufian installation within the long process of Neolithization, we argue for an early appearance of the storage phenomena. In fact, we can argue that this example of ‘extraordinary’ within the long process of Neolithization in the Near East helps to illuminate the gradual process of cultural innovation in which new features appear initially as extraordinary phenomena which later will become mundane. We hope that the ongoing study of the remains unearthed at NEG II will add information regarding the ‘extraordinary’ appearance of early manifestations of mundane Neolithic activities.

The present article focused on defining the ‘extraordinary’ as a function of time. Methodologically it is similar to the seriation methods which are primarily harnessed for establishing relative chronology. In this article, we have shown that the extraordinary/mundane perspective also provides the intangible social aspect of this common practice. This brings to light not only the technical and archeological order, but the nature and mechanism of transition and its intangible implications. We look at occurrences of tools and artifacts, but these tools have meaning and the examination of what makes something ‘extraordinary’ at its time is exactly taking the material into the social and even the perceptual.

Data availability

All data generated or analyzed during this study are included in this published article.

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Competing interests

The authors declare no competing interests.

Additional information

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