Ṭabūn, Tannūr or Mustawqad? Fire Devices and Their Use in the Early Islamic Period

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Abstract

Ovens, hearths and furnaces were used by early Islamic societies for baking, cooking, and the production of various artefacts. The archaeological evidence from one research area in central Israel, from the seventh–eleventh centuries, accordingly presents a variety of fire installations. This paper offers an interpretation of their function through the analyses of terminology in contemporary texts, ethno-archaeological data, and spatial relations in the archaeological record. The paper suggests that domestic baking and cooking left almost no remains in the archaeological context. Instead, fire installations in the research area were almost exclusively related to crafts.

Keywords

Big Data – spatial archaeology – ethno-archaeology – Early Islam – Palestine – ṭabūn – crafts – pottery production

1 Introduction

Archaeologists, perhaps more than any other practitioners of a discipline that studies the human past, are interested in the purpose and operation of technologies. Technologies reflect both daily life and the sources of income of ancient individuals, settlements, and regions. Installations (e.g. winepresses) and specific remains (e.g. pottery waste) enable the reconstruction of production activities, which play a part in the economic texture of places. The function of some installations is unquestionable, such as that of wells, but most have uncertain purposes or operation methods. For example, built channels that are covered by stones can be interpreted diversely as conduits for the supply of drinking water, as irrigation channels, as tunnels for greywater, or as sewage lines.

The solutions for interpreting the purpose of installations are not straightforward. Scholars compare installations and related activities to the ones used and fashioned by modern societies (“ethno-archaeology”), to devices in semi-contemporary art (e.g. Roman mosaics, Ottoman miniature paintings), or to facilities described in narrative sources, documentary evidence and legal literature (“ethno-history”). Other studies test these theories physically on similar devices (“experimental archaeology”). This paper will follow two of these methods, ethno-archaeology and ethno-history. However, it also confronts the inherited challenges of these analogical tools, as will be discussed

shortly. In addition, it utilizes two less-common methods of analysis: terminological and spatial.

One group of installations that are commonly found in excavations from the prehistory onward is fire-related. The fire installations in the focus of this article derive from sites of the seventh–eleventh centuries CE (early Islam) in one area in central Israel. The main aim of this study is to interpret their function. A supplementing question involves the reasons of the inhabitants for preferring one installation over another, or for employing installations in parallel.

In archaeology, scholars often hope to reveal *in situ* circumstances, reflecting Binford's "Pompeii Premise" (Binford, 1981). Accordingly, animal bones inside fire installations, for example, might signify cooked meat, or at least fuel (Balossi Restelli, 2015: 142; Rova, 2014: 132). Likewise, built fire installations with remains of pottery or glass in their surroundings are interpreted as kilns. Correspondingly, the absence of finds inside these installations or in their immediate surroundings allegedly represents their relation to bread baking, which indeed leaves nothing but ash (e.g. Crawford, 1981: 108, 114). In reality, the life-cycle of any archaeological artefact is complex and often remains unknown to the excavator (Schiffer, 1987). Ovens could be secondarily used for storage, for example (London, 2000: 108; Van der Steen, 1991: 137), though not necessarily by concurrent residents. Moreover, people tend to regularly keep their surroundings clean, so household activities are expected to only seldom leave traces (LaMotta and Schiffer, 1999).

Some scholars sketch a direct line between the archaeological remains and modern ovens studied through ethno-archaeology. Using phrases such as "[they] are still in use" (e.g. McQuitty, 1984: 259; Rova, 2014: 121; Smogorzewska, 2012: 242; van der Steen, 1991: 135), these studies thus suggest a technological stasis for hundreds and even thousands of years. In contrast, Ebeling and Rogel (2015) criticize this method and call for a historical approach. A number of research works indeed find typological shifts in ancient installations over time (Balossi Restelli, 2015; Parker and Uzel, 2007; van der Steen, 1991).

Pursuing the domestic-bread interpretation of ovens, scholars who face the clustering of these installations in non-domestic contexts in the Near East explain them also as food related. The food-production interpretations include the notions of commercial quarters of bakers, centralized bakeries, shared spaces for ovens, or cooking areas for seasonal workers (Crawford, 1983; Rova, 2014: 141, 144; Van der Steen, 1991: 142).

The simplistic analogy between modern ovens and ancient fire installations is not the only one. In parallel, modern terminology gets combined with ancient terminology along with its imagined descriptions in texts. The two analogies are then integrated into one interpretation. The clearest example is pinning the name of one of the modern domestic ovens, *ṭabūn*, to its earliest possible citation. The term in plural (*al-ṭawābīn*) is mentioned by the geographer al-Maqdisī in the tenth century. Based on translations of the Arabic text, some scholars hold to the resemblance between the modern and the virtual *ṭabūns* in their baking technique (placing dough loaves over hot pebbles) (Dalman, 1935: 80, followed by Rova, 2014: 126). They ignore the significant differences in form: the modern *ṭabūn* is a built oven and the ancient one is an ephemeral stone pavement. They also ignore the variety of meanings of *ṭabūn* in modern communities (at Ebeling and Rogel, 2015: 329). Nuha Khoury (1998) discusses a similar problem regarding the mihrab in mosques. Thus she advocates a clear division between "term," "form" and "function"; each category has its own history and the meeting point of the three might be the result of a later process.

Another pitfall in linking archaeological finds with textual descriptions, particularly in the case of installations, is the imbalance of their survival. On the one hand, many technologies leave physical traces, but are silent in the sources (e.g. pottery production)

and on the other hand, many of the described industries leave scarce remains or none (e.g. textile). Two relevant examples of industries with a produce absent from the archaeological record are dyeing and soap production. Some installations are associated with these activities (e.g. Gat, 2007: 46–8),¹ but their interpretation is debatable. Their descriptions in texts point to general devices, which would be hard to detect.

2 Method

My approach is twofold. First, following Ian Hodder, naming archaeological finds and interpreting their function is postponed until their context is better understood (Hodder and Hutson, 2003: 167–90). Thus, I do not use the term “kiln” in the archaeological record, for example, but neutral names invented for that purpose. Moreover, instead of drawing direct analogies between individual specimens in the different source groups (i.e. archaeology, ethno-archaeology and ethno-history), I analyze each corpus independently and then compare their complete sets.

To that end, a broad scale of “Big Data” was collected for each source group separately. To provide a sufficient context, the scope of sources used was expanded in some cases far beyond the research area. The relevance of the data can be proved only after the fact, thus some elements are redundant. As an example from ethno-archaeology, surveys of all the fire apparatuses that communities used during the ethnographers’ fieldwork are more valuable than studies of bread baking ovens or pottery kilns alone. The former represent a full range of parallel functions, which provides a complete context, even though some of the activities and apparatuses are irrelevant to the archaeological case study. To follow such an intellectual process can be tiring for the reader, but it ensures a higher level of objectivity and transparency.

A supplemented approach follows Khoury’s division; I separate the “terms” in written sources from physical characteristics (“form”) in archaeological contexts, and from “function” as expressed in ethnography and in texts. As will be presented, the ancient *tannūr* did not have one form or even one function, and bread was not necessarily baked in a built fire installation. Therefore, the name and function of archaeological fire places with their various types, in different periods, should be justified. Naming them with a modern term before such a justification, and even after, is misleading.

Regarding the terminology used in the article, the term “installation” is principally reserved for archaeological finds, while other terms such as “device” or “apparatus” are used with texts and ethnography. In this context, “hearth” means fire remains without a built installation. Importantly, no effort was made to characterize devices, or spaces, as “rural” or “urban.” If one chooses to follow such a dichotomy, one must first clearly define its classifications and then consistently compare it to the historical or archaeological context (e.g. Nol, 2020). As this might be invalid categorizations, and surely restricting, I chose to avoid such labels.

In the following, I first study the terminology of relevant apparatuses in semi-contemporary texts, including their descriptions and assigned function. The texts indicate a variety of oven forms and baking techniques, the common use of ephemeral devices and portable utensils, and the possibility to share an oven or use baking services. At the same time, they show the use of furnaces for “industry” and for bathhouses, along with activities, which require no device such as soap production and dyeing.

Second, I look at ethnographic studies in the Near East, Afghanistan, and Morocco to understand function and operation of fire devices, along with their residues. These studies show, surprisingly similar to the ethno-history, a variety of oven forms and baking techniques, the common use of ephemeral devices and portable utensils for domestic

cooking, the possibility to share ovens or to use professional baking services or bakeries, and the uniformity of pottery firing in a kiln or a bonfire. In addition, it demonstrates quick changes in the preference of one device over another in the food-production sphere. Most significantly to the archaeologist, they present the scarce remains of domestic cooking and household pottery firing, in contrast to “industrial” kilns.

Third, I classify fire remains in the research area into three built types, along with general hearths, and identify their spatial relations. This section connects most fire installations (FI) to specific crafts and activities. In contrast, one built type (found only once on most sites) shows no relation to any other remains. More general observations include the absence of any built FI on a number of excavated sites, the clustering of FI on the edges of a number of sites, and the absence of fire remains in “residential areas” inside the site/s of Ramla. The patterns together suggest that most fire remains in the archaeological record result from activities related to crafts and that domestic cooking and baking is mostly absent. This interpretation correlates with the ethno-archaeological and ethno-historical evidence that pointed to the common usage of devices other than ovens at the household. Even more distinct is its accord with the limited domestic residues vs. visible industrial remains according to the ethnographic evidence.

3 Ovens and Kilns: the Textual Evidence

The relevant textual and artistic evidence of technologies is very rich, but mostly fragmentary. Social historians, who investigate daily life in early Islam or earlier periods through texts, often use the Geniza (tenth–eleventh centuries), Talmud Bavli (third–sixth centuries), Pliny the Elder (d. 79), or Arabic geographers (ninth–fifteenth centuries). This study employs additional sources, including the *muḥtasib* manuals by al-Shayzarī (d. 1193), the rabbinic *responsa* of the eighth–tenth centuries, the lexicon *Kitāb al-Mukhaṣṣaṣ* (The Book of the Designated) by Ibn Sida (d. 1066), a cookbook attributed to Ibn Sayyār al-Warrāq from the tenth century, and the alchemy of al-Rāzī (d. 925).

These sources were chosen for their relevant depictions of daily life in Palestine, or their relatively rich descriptions of fire activities elsewhere. The evidence, as we shall see, is so scarce that the temporal and geographical contexts had to be expanded. Due to the wide contexts and scarce data, variations and nuances caused by time or space were possibly overlooked. Nevertheless, the method does highlight correlations and discrepancies, which could not have been achieved with a smaller sample.

The scattered information on fire apparatuses surfaces in various sources. The more common terms in Arabic are *tannūr*, *atūn*, *furn*, *kūr* and *mustawqad*. They involve cooking and baking, heating the bathhouse, pottery firing, and many more industries. The common terms in Hebrew are *tannūr* and *kîrâ* for food, and *kivshān* for pottery. These terms will be presented shortly according to their possible form and function. A clear terminological cut can be made between installations for food preparation, or alchemy, and furnaces. The latter are utilized in metal smelting, in pottery firing, and in the bathhouse. A typology of the imagined apparatuses suggests further division between built implements and portable devices. A later comparison with ethnographic evidence supports such a typology. The comparison also demonstrates how most installations leave no physical traces.

In the entry *maṭbakh* (kitchen) in the *Encyclopedia of Islam, second edition*, Waines introduces two terms for food ovens based on Ibn Sayyār: *tannūr* for bread and *mustawqad* for cooked dishes (Waines, 1991). However, Table 1 and the following examples offer a more complex interpretation for *tannūr*, suggesting a dual meaning. The term

TABLE 1

Terminology and function of fire apparatuses in the varied sources

Term	Geonim	al-Rāzī	Ibn Sayyār	al-Maqdisī	al-Shayzarī
<i>tannūr</i>	baking, heating	baking	baking, cooking	baking	baking, cooking, perfumes- related
<i>furn</i>	baking (<i>fūrnī</i>)		baking (or <i>fūrnī</i>)	baking (<i>al-ifrana</i>)	baking
<i>mustawqad</i>		alchemy	cooking		
<i>ṭābashdān</i>		cooking, alchemy, minting			
<i>ṭābaq</i>	baking (<i>ṭapaqā</i>)		baking		
<i>ṭabūn</i>				baking, cooking	
<i>mulla</i>			baking		
<i>kīrā</i>	baking, cooking				
<i>nāfikh nafsīhi</i>		alchemy	cooking		
<i>kānūn</i>	? (<i>kanūnā</i>)		cooking		
<i>kūr</i>		alchemy, gold smithing			gold smithing
<i>atūn</i>		pottery, bones			bones, bath house
<i>kivshān</i>	pottery				

was first used for a specific baking device, and later mainly as a general term for any cooking installation. Indeed, some rabbinic sources relate the term solely to bread baking, to the bakery, or to keeping food warm during Shabbat.² It seems to be a specific device, distinguished from *kīrā* or *fūrnī*, and it can be communal, as in “you should bake, ten women, your bread in one *tannūr*.”³ A more general meaning for *tannūr*, still for baking, is offered by al-Shayzarī as a synonym for *furn*: “when the baker has finished lighting the *tannūr* he should first wipe inside it with a clean rag before baking the bread,” then make wide holes in the roofs of the *furn*, for the smoke to come out (al-Shayzarī: 22, translated at Buckley, 1999: 47). Likewise, al-Maqdisī (d. after 990) uses three synonyms in the context of domestic cooking in Syria: “and they have *al-ifrana*, the villagers in particular, *al-ṭawābīn*, which is a small *tannūr* in the ground and furnished with pebbles (*ḥaṣā*)” (al-Maqdisī: 183).

Still, other cooking activities are also related to *tannūr*. Most distinctly, the recipes by Ibn Sayyār involve varied cooking techniques in it (Ibn Sayyār al-Warrāq: 176, 339, 374). Moreover, the synonyms al-Rāzī uses for *tannūr* (*mustawqad* and *nāfikh nafsīh*) are never linked to baking (Stapleton et al., 1929: 383–4). The general meaning of the term is also implied in its varied operations in the rabbinic texts: the metal *tannūr* was fueled externally and the clay *tannūr* was stoked internally.⁴

The designated term for a baking device is *furn* (Heb. *fūrnī*). Ibn Sīda explains it as the place where Syrian bread (*al-khubz Shāmiyya*) is baked (Ibn Sīda, vol. 5: 7). Two pieces of evidence imply it was specifically a bread oven and not a bakery, and that it was privately owned: it is mentioned in one rabbinic text about properties, which cannot be

FIGURE 1
Imagining fire apparatuses
according to the textual evidence
Details: a) *furn*; b) *mustawqad*
or *tannūr*; c) *ṭabūn* or *mulla*; d)
ṭābashdān?; e) *ṭābaq*; f) cooking
on fire; g) pot with ash (or
charcoal); h) *nāfikh nafsīhi* (with a
cover), *kānūn* or *kīrā*

rented out to non-Jews,⁵ and al-Shayzarī notes oven-keepers (*farrānīn*) who bake the doughs of different customers and get paid with a portion of dough (al-Shayzarī: 24, translated at Buckley, 1999: 49). It seems that in the early Islamic period *furn* was not a common innovation, at least not everywhere. The rabbis answer in the Jewish *responsa*, for example, is that they “do not possess a *fūrnî* and do not know what it does” (*Ānû ên ’immānû fūrnî we-ên ānû yôd’în m’e’aseyha*).⁶

The fragmentary details on each of the cooking apparatuses enable a sketchy typology (Fig. 1). The significance of this division lies on the level of the physical remains each type leaves. The four main types are: built structures, ephemeral structures, portable utensils that are placed on a fire, and others that carry fire. The built apparatuses are the only group that is expected to be distinctly recognized in an excavation. It includes the *mustawqad* and the *furn*. According to al-Rāzī, the *mustawqad* is a cylindrical structure with one door for stoking, a hole for ventilation, and a pit underneath, used in various techniques and with various contents (Stapleton et al., 1929: 355, 381–3). Similarly, the *mustawqad* of Ibn Sayyār has one high rectangular-trapezoid type, with an outlet for smoke, and a cylindrical type (Nasrallah, 2010: 86–90; Zaouali, 2007: 52). The *furn* has a shelf, and holes in its roof (al-Shayzarī: 22, translated at Buckley, 1999: 47).

The second type is the ephemeral built structures, which includes what seem to be, subjectively speaking, simple arrangements and constructions. It comprises a pit of stones (*ṭabūn* or *mulla*) and maybe the *ṭābashdān*. Al-Maqdisī explains that *al-ṭawābīn* are pebbles, stoked with dung (*al-zibl*), whereupon the dough loaves are placed, as well as lentils and other dishes (al-Maqdisī: 183). Nasrallah interprets Ibn Sayyār’s *mulla* similarly, as a “pit with hot ashes and stones” (Nasrallah, 2010: 118, 335). The *ṭābashdān/ṭabīštān* might fit into this group, but can alternatively be a portable apparatus. It is an “inverted” device, in which the fire is placed on the top. It is used for superficial heating or for the removal of greasy surfaces. Al-Rāzī writes that similar facilities are used by mint masters to soften dirhams by fire, and by food hawkers (Stapleton et al., 1929: 359, 384). Moreover, one rabbinic text offers two cooking methods directly on the ground using embers (*geḥālīm*) for cooking an egg, or placing “fire” beneath a cauldron (*q’derā*) and stabilizing it with stones (*avānīm mikān wu-mikān*).⁷

The next two groups of apparatuses are portable. Portable devices placed on fire include *ṭābaq* (Heb. *ṭapaqâ*) and varied utensils. The clay *ṭapaqâ* is stoked from underneath, and the bread is baked on its upper side.⁸ Nasrallah translates *ṭābaq* as a “large flat pan” that is used for baking bread (Nasrallah, 2010: 118, 410). In the drawing (Fig. 1.e), the device has a domed shape, but it similarly could be flat. Other portable devices are recommended for the alchemist: a variety of crucibles such as jugs (*kīzān*), two-part vessels with a punched upper part (*būṭ-bar-būṭ*), a rag or a bag (*ṣurra* or *yusrra*), glass flasks (*qannānī*) and other (Stapleton et al., 1929: 354–8, 379–84).

Portable apparatuses that carry fire mainly include *kîrâ*, *nāfikh nafsîhi*, and its synonym *kānūn* (Heb. *kanûnâ*). *Nāfikh nafsîhi* is described by al-Rāzī as a device that stands on three legs, has a grate (*kūwa*) in its bottom center, a cover, and holes in the grate and on the legs. It is stoked with charcoals and can exploit breezes. About a century later, al-Khwārazmī calls the same device *kānūn* (Stapleton et al., 1929: 359–63, 384). The synonymy is repeated by Ibn Sayyār, who advises using *nāfikh nafsîhi* or *kānūn* *ʿajlān* in one meat recipe (Nasrallah, 2010: 284). In the rabbinic texts, the term *kanûnâ* relates to a portable device with wood and ash.⁹ A much more common term in Hebrew is *kîrâ* (pl. *kîrâyim*), which is made of stone or metal. It is chiefly used for the cauldron to be placed on its top over embers, but can be used also for baking.¹⁰ Another portable device is a pot with ashes that is recommended to the beginner alchemist (Stapleton et al., 1929: 381–4).

Information on furnaces is much more scarce and does not allow their reconstruction. In addition, it is not clear if the terms are typological or functional. According to al-Rāzī, the *kūr* (pl. *kîrān*) has a cover and a perforated container (*māsik*) fitted in the interior. Substances such as iron or steel should be smelted in large *kîrān* (Stapleton et al., 1929: 379). Next, “the (alchemical) *atūn* is exactly like a potter’s *atūn* except that it is smaller. You place in it whatever you desire to calcine, and keep the fire burning until the substance is calcined.” Thus, the *ṭābashdān* (that is fueled externally) is “an inverted *atūn*” (Stapleton et al., 1929: 359). Illustrations from the sixteenth century demonstrate two different apparatuses named *atūn*: one for glass manufacturing, with two shelves and two chimneys, and a smaller one for glazed jewelry (al-Hassan and Hill, 1986: 154, 167). The earlier rabbinic sources, according to Brand, distinguish between the *kūr* or *bôr* of the glass makers,¹¹ and the *kivshān* of the glass-vessel craftsmen (Brand, 1978: 142–3). In the later rabbinic *responsa*, *kivshān* is linked to pottery.¹² At least two sources relate burnt bones to *atānīn*: apothecaries could fake bamboo with it; and the recipe for mercury required it together with fresh bones (al-Shayzarī: 73, translated at Buckley, 1999: 66; Stapleton et al., 1929: 386). The term *atūn* is also related to heating the bathhouse. Al-Shayzarī instructs on the amount of fuel (*wuqūd*) in the furnaces (*al-attān*), which must provide the right temperature (al-Shayzarī: 87–9, translated at Buckley, 1999: 104–7).

Table 2 summarizes the varied terms and their possible function. Designated baking was done in the *furn*, but other devices were additionally employed: a built oven fueled internally (*tannūr* or *mustawqad*), an oven stoked externally (*ṭābashdān*), a hearth (*ṭabūn* or *mulla*), or a portable surface (*ṭābaq*). Domestic cooking used either the warm oven after baking, or a portable brazier (*nāfikh nafsîh* or *kānūn*). Finally, smelting was conducted in a possibly portable melting pot (*kūr*), whereas the bathhouse and most crafts used the furnace (*atūn*).

TABLE 2
A summary of terms and
functions of fire apparatuses

Arabic	Hebrew	Function	Translation
<i>tannūr, mustawqad</i>	<i>tannūr</i>	domestic cooking	built oven
<i>ṭābashdān</i>		domestic cooking	oven
<i>ṭabūn, mulla</i>		domestic cooking	hearth
<i>furn</i>	<i>fūrnî</i>	baking	bread oven
<i>nāfikh nafsîh, kānūn</i>	<i>kîrâ, kanûnâ</i>	heating, cooking	portable brazier
<i>ṭābaq</i>	<i>ṭapaqâ</i>	baking	baking surface
<i>kūr</i>		metals softening	a melting pot?
<i>atūn</i>	<i>kivshān</i>	pottery, glass, bones, bathhouse	kiln, furnace

In addition to cooking or heating, the sources present two explicit uses of fire without explicitly mentioning a device: dyeing and soap production. In Palestine, dyeing or the production of dyes is ascribed chiefly to al-Ramla and to its neighbor Ludd/Diospolis, for example in Talmud Bavli (Avi-Yonah, 1966: 196), or by al-Balādhurī (d. 892: 143). Dyeing used to include two chief steps: soaking the threads, cloth or garment in a liquid, which would assist in absorbing the dye (mordant), then soaking it in the dye (al-ʿAlī, 2003: 132; Forbes, 1964: 134–5). According to Pliny the Elder, purple dyeing involved a pot with water that was heated by a pipe from some distant furnace. Moreover, a wall picture in Pompeii shows a dye vat on a furnace (Forbes, 1964: 116, 132). Recipes of dyes in Greek, on the Papyrus Holmiensis (the fourth century), mention boiling the dye over a fire, or using hot water. The containers that are mentioned in the recipes were translated as “pot” and “kettle” (German: *Topf* and *Kessel*) (Caley, 1926; Lagercrantz, 1913: 200–30). For dyeing in the thirteenth century, for which it was claimed fake dyes were used, the dyers employed large mobile containers (*al-khābiya*) (al-Shayzarī: 72, translated at Buckley, 1999: 92), but warming water is not specified. In short, the textual evidence points to a process which necessitates non-distinctive elements – mobile containers and fire.

The export of soap is also associated with al-Ramla in tenth and eleventh-century sources (al-Maqdisī: 180; Gil, 1983: 254). In principle, soap is produced through a chemical process of mixing fats or oils with alkali salts. That mixture splits into alkali salt of fatty acids, which is the soap, and glycerol. The salts can be of lye (NaOH), soda (Na₂CO₃) or any other, gained from minerals or plant ashes (Konkol and Rasmussen, 2015). Al-Rāzī describes the process of saponification of olive oil, which he entitles “the creation of salts with oil.” He explains that one must “take food salt and make it into a paste with olive oil and heat it for one night with dung fire in a luted pot, which has its head closed. Do this seven times, it will melt and flow” (Stapleton et al., 1929: 393). The described process of heating oil with salt requires a hearth and containers, which cannot, in principle, be specified for that purpose archaeologically.

4 Ethno-Archaeological Evidence of Fire-Related Activities

Ethno-archaeology has undergone strong criticism over the years, being blamed chiefly for conducting simplistic analogies and projecting the present onto the past (Wendrich, 2002; Wylie, 1985). One of the difficulties is proving the ethnographies of specific target groups as relevant to the archaeological comparison (e.g. Lyons and Casey, 2016). Compelled to limit the study domain, I have chosen to look at relevant ethno-archaeological studies mainly from the Mediterranean and the Middle East, as they share a similar climate and landscape with the research area. This ecological analogy is not immune to criticism either (Wylie, 1985: 101). However, the wide context and varied case studies I utilize should balance most biases. Another precaution is the avoidance of a direct analogy with archaeology and the attempt to extract information from ethno-archaeology in its own context. At any rate, the distance from Morocco or Iraq to Israel is less relevant than the contribution of these studies to our research question.

The main aim of this section is to present various fire-related activities by modern communities in what can generally be defined as pre-industrial economies. Unfortunately, only little attention had been paid to “trash handling” in time and space, including the disposal of ash, or the fate of charcoal and broken ovens. Three of the studies I looked at offer an overview of various fire apparatuses and usages in the domestic sphere from present-day Morocco (Zapata Peña et al., 2003), from Iraq in the 1970s (Ochsenschlager, 1974), and from early twentieth-century Palestine (Dalman, 1928, 1935). These studies show a range of activities and installations that communities

enjoy and exploit in different situations and for different needs. Another set of publications focus on bread ovens in Egypt (Rizqallah and Rizqallah, 1978), Jordan (McQuitty, 1984), Syria (Mulder-Heymans, 2002), and Turkey (Balossi Restelli, 2015: 142; Parker and Uzel, 2007). Two of the domestic case studies are introduced in detail shortly, followed by additional examples. Finally, a number of studies focuses on workshops of specific industries, mostly on pottery.

Ethno-archaeological inquiries on pottery firing were conducted, as examples, in Turkey (Batmaz, 2019), Syria (Bresenham, 1985), Palestine (Crowfoot, 1932), Jordan (Sidoroff, 2015), and Egypt (Henein, 1997; van der Kooij and Wendrich, 2002; Nicholson and Patterson, 1985). The studied pottery workshops went through the complete production process, including clay preparation, vessel forming, and firing. Most workshops used updraft kilns, where the pottery is stacked on a shelf from an upper opening (Fig. 2) and the fuel is stoked into a firebox below, which is sometimes dug in the ground. The main categories where these cases differ are the upper coverage of the vessels during firing (without, with a layer of sherds, with a slip and a layer of sand, or with a metal sheet, Fig. 3), the presence or absence of holes in the shelf, and the specific timing of the firing process, including drying the vessels before firing and letting the kiln cool afterwards. The large size of these kilns, at least 4 m in diameter, helps to gain the right temperature and thus to minimize cracks in vessels (Batmaz, 2019).

FIGURE 2
Fired vessels inside kiln, Jizza,
Jordan
COURTESY OF MARIA-LOUISE
SIDOROFF

FIGURE 3
The kiln during firing, Jizza,
Jordan
COURTESY OF MARIA-LOUISE
SIDOROFF

One workshop in Cairo used a smaller kiln besides two big devices (van der Kooij and Wendrich, 2002). Two other workshops, in Buṣrā (Syria) and Sinjil (Palestine), are a one-woman operation. Similar to the households in Morocco, which will be discussed shortly, these workshops did not fire ceramics in a built kiln, but in a bonfire. The vessels were organized within a circle of big stones and covered by dung cakes or dried branches (Bresenham, 1985; Crowfoot, 1932). Interestingly, in Sinjil, before firing the vessels, they were “smoked” in the “oven-house,” probably the shed for the domestic baking oven.

Ethno-archaeological works on metal, glass and soap production seem to be scarce. Regarding metals, one case study from modern Cairo presents a gas-operated melting furnace that is a pit in the workshop hall with an adjacent chimney. Brass is melted in it in a fifty-liter crucible (Shalev and Freund, 2002). Also in Cairo, a glass workshop was thoroughly documented, showing a complex rectangular furnace of 2.5 m in length and 1.2 m in height. The firebox is situated in the middle of the furnace, while other parts provide varied levels of heat for melting the glass through multiple openings (Henein and Gout, 1974: 1–11). A similar operation was observed in Herat, Afghanistan, where the craftsmen produce both glass from raw materials and glass vessels (Brill, 1979. See also the film: *The Corning Museum of Glass*, 1979). Details on a soap factory in Jaffa are presented in a semi-popular book on nineteenth-century Palestine. In that workshop, lime was mixed with ashes of local plants and with water and was then cooked with olive oil for eight to twelve days in a huge copper container. The fire device is not specified (Avitsur, 1976: 265).

Studies in the domestic sphere demonstrate much more variation of fire installations for cooking and baking. The most comprehensive study for our purposes was conducted in the Jebala region, Northern Morocco (Zapata Peña et al., 2003). During fieldwork in a number of villages in the region, households showed the usage of four chief types of installations. For cooking and water boiling, braziers (*mishmar*) and winter/summer ephemeral devices (*kanun*) were used. In the past, bread had been baked on the ground using a pan (*maqla*), but it was baked in ovens during the time of research (with no terminology noted). The fourth type is an open fire, 30–50 m from the house, for firing pottery. The apparatus is made of a stone circle and an inner circle of wood. The vessels are placed inside, on and between them dry dung cakes are situated, and above them fresh dung is placed for slow and stable burning and slow cooling. After the main firing, the operation is left to cool overnight. Thereafter, the vessels are brought to the market. Only stones are left in place. Charcoal and ashes are collected for secondary use and other remains are disposed nearby. For a small number of vessels, only a domestic hearth is used to fire them.

In Syria, ethnographic research has focused on bread baking in different regions (Mulder-Heymans, 2002). During the time of research, the households of the various communities had either a single permanent high cylindrical oven (*tannūr*), three permanent concurrent ovens (each for a different type of bread: *tannūr*, *ṭabūn* and *waqdiyya*), or a portable utensil (*ṣāḥ*). The ovens were located outside the house, sometimes very far away. When baking was done, the hot *tannūr* often served for heating a pot. In the village Abtaa, home ovens operated simultaneously with a village bakery and with a business where one woman baked the dough of five families. The village Tell Mardikh had ovens in the past, but during this research used the more fuel-economic portable device.

These and other ethno-archaeological studies display a variety of devices that sometimes operated simultaneously in single households or in one area. It also indicates the popularity of portable devices in domestic food production. Bread baking was

conducted either on portable utensils or in clay ovens with a dome or cylinder shape, on their floor, walls or on a designated shelf. Cooking was often done in the same ovens after baking or on portable devices. In Tell al-Hiba in southern Iraq, the main domestic installations included a clay brazier for cooking and water heating (*manqala*), *tannūr* for bread baking, and a portable *tabaq* mainly for baking rise bread (Ochsenschlager, 1974). In the village Kafr el-Deir in Egypt, in the 1970s, the devices included the bread oven (*furn* or *al-qubba*), a clay-built stove or an ephemeral arrangement for cooking (*kānūn*), and a flat metal disc for heating bread over the stove (*ṣāja*) (Rizqallah and Rizqallah, 1978: 1–8). Dalman lists four main types of built devices for bread baking in Palestine and Transjordan, along with an arrangement for cooking and baking over fire (*nuqra*), utensils for baking over fire or embers (*zanṭū*, *ṣāj*, *miqlā*), and metal or clay basins and boxes, which contained embers for cooking or heating the house (*manqal*, *kānūn*, *mūqada*, *ṭabbāḥ*) (Dalman, 1928: 226–7, 1935: 39–41, 73–139, figs. 5, 12, 17, 28).

The parallel use of a small baking device and a few stones to hold a pot can be seen in Fig. 4 from Beer Sheva in the early twentieth century. A portable device might also be used in parallel with a built oven in winter or during work in the fields (Dalman, 1935: 39). In southeastern Turkey, only one type of oven was used for baking bread in the domestic sphere, the *tandir*, but an alternative would be “factory bread.” Despite it being more labor intensive, the *tandir* bread was considered cheaper, tastier, more accessible, and linked to tradition (Parker and Uzel, 2007: 15).

Another point these studies highlight is the way baking technologies change over a short period of time, moving to either simpler or more complex apparatuses. In Morocco, it was the shift from a pan on the ground to an oven, whereas in Tell Mardikh in Syria the change was reversed, from ovens to a portable device. A study of bread ovens in various settlements in northern Jordan also revealed changes. Before employing gas, all cooking activities were performed in ovens, but during fieldwork these were employed only for baking. One type of oven (*tannūr*) could still be found in bakeries, but was reported as having been out of use for twenty years (McQuitty, 1984). Notably, such changes were not observed for kilns. Even when rebuilt, the form of the kilns was maintained.

A fourth issue that comes up from additional studies is the use of communal ovens for baking in specific regions. In southeastern Turkey, in three of the four settlements that were studied, the ovens are communal and serve seven to eight families on average (Parker and Uzel, 2007: 16). A similar picture comes from eastern Turkey (Balossi Restelli, 2015: 142) and from northern Jordan (McQuitty, 1984: 265). Dalman (1935: 76)

FIGURE 4
Baking and cooking in Beer Sheva,
Palestine, early twentieth century
(after Dalman, 1935:
fig. 26a, public domain)

also notes the rotation of shared bread ovens by a number of women in Palestine. Clearly, other case studies demonstrate the private ownership of devices, such as in Syria and Morocco. Even more so, in the case study from Egypt, families would use the wide roof of their oven for sleeping in cold nights (Rizqallah and Rizqallah, 1978: 1–3).

Most relevant to our purposes are the physical residues that all fire devices leave in the short and in the long term. The example from Morocco demonstrates how all remains from fire-related activities were removed from site or were reused, so that firing and cooking cannot be recognized archaeologically. A similar result can be expected from the brass workshop in Cairo where casting facilities are natural (e.g. sand) and metal remains are immediately recycled (Shalev and Freund, 2002: 27), and from the soap factory in Jaffa (Avitsur, 1976: 265). In contrast, a pottery workshop in Deir el-Gharbi in Egypt left detectable traces: bowl-shaped impressions in the ground, which represented former kilns and high amounts of sherds, as 5–10% of the fired vessels are wasters (Nicholson and Patterson, 1985: 231, pl. 9). Still, high rates of sherds are obviously also found in the vicinity of the site, several miles away (*ibid*: 238). The evidence is thin, but still implies that even activities, which involve non-perishable elements, or are non-domestic, leave traces that are difficult to identify, whereas distinct remains relate to an intensive manufacture of specific products.

5 Fire Installations in Central Israel

The research area is a triangle on the Mediterranean coast, which lies between the modern municipalities of Tel-Aviv-Jaffa, Ashdod and Ramla in Israel. Its maximal dimensions are 41 km north-south, 21 km west-east, and 46 km along the shore. The archaeological research in the area is intensive, involving surveys and excavations. Until 2014, these studies recovered remains from the seventh–eleventh centuries in a total of 364 “nodes,” a term that will be discussed shortly (Fig. 5). More than 120 of the nodes are in modern Ramla or neighboring Mazliah (Fig. 6). At least twenty excavations have been published as final reports and others have been published as interim reports in archaeological journals. The research area is also composed of eleven “maps”

FIGURE 5
Excavated and surveyed nodes in the research area, central Israel

FIGURE 6
Excavated nodes in Ramla and
Mazliah

(10×10 km blocks) from the Archaeological Survey of Israel, six of which were published from 2014 onward.

The region is abundant with architecture, portable artefacts, and worked raw materials. The physical remains of fire activities comprise built installations, jars or bowls with fire remains (such as ash and charcoal), carbonized bricks, and broken and disposed clay-built (or lined) installations. In some interim reports, built fire installations are only noted, for example in most publications from Jaffa. Nevertheless, in most other publications, their measures are presented, accompanied by figures. The fire installations are preserved only partially, similarly to elsewhere (van der Steen, 1991: 137; Rova, 2014: 127), so that their maximum height, or their upper part, is unknown.

5.1 *Fire Installation Types*

The bulk of built installations are classified into four types. This typology is primarily based on construction methods and size, and secondarily on their correlations with related archaeological contexts. The names I gave to the types are as neutral as possible, and reflect their main characteristics in size (big, medium or small) and construction method (“built” with bricks; “lined” or built with clay). Another built FI, which seems to be associated with baths, but that was found only on three sites (Mazliah, Ashdod-Yam, and Yavne-Yam), was excluded from this study. Its interpretation is bound to developments in the bathhouse heating system and will be discussed elsewhere.

Cross-referencing the types with specific contexts or elements (e.g. the waste of crafts) might point to non-random trends, patterns of correlation, or geometric orders (Clarke, 1977: 10. See also Hodder and Hutson, 2003: 167–90). “Archaeological context” has a dual meaning in this study. One meaning is the find’s adjacent remains in its immediate surroundings, which are preferably connected to it physically (henceforth, the contextual level). The second meaning is wider, and expresses elements found at the same node as the examined find (henceforth, the node level). The term “node” is borrowed from the Network Analysis world and means small areas of archaeological investigation, such as “sites” in archaeological surveys, or limited-scale excavations. Nodes diversely comprise two to sixty excavation squares (often 5×5 m) and measure

between 5 to 200 m in diameter. Unlike the term “site,” which is a modern observation and is often imagined as a synonym for “settlement” (Thomas, 1975; Dunnell, 1992), the node is envisaged as more neutral.

A correlation between two finds on node level would mean that they come from the exact same excavation or from an adjacent node up to 100 m away. Correlations are not calculated statistically, as samples are small and can be observed by the naked eye. Moreover, this section presents only successful and semi-successful trends, based on wider research. The interpretation of these trends will be offered later, in order to consider all of them and the supporting evidence. Notably, the term “site” is also used in this paper, meaning a cluster of nodes that are usually found in one modern municipality or neighborhood. Following the analyses of their architecture and portable finds, I indeed interpret these sites as settlements.

Archaeological contexts from node perspective or node-cluster perspective allow for the identification of links between a number of installations or specific activities that are practiced at some distance from each other. Likewise, it bypasses interpretation challenges, which relate to Schiffer’s “cultural formation processes,” such as emptying installations and disposing refuse (or recycling it) in another location. While patterns I observe can be random, their repetition or supplementation implies a realistic trend. The validity of the trend can be supported by external evidence.

The first type is the Big-Built fire installation (BB) that is often called a “kiln” in literature. It is dug, round or oval, 2–3 m in internal diameter (or larger), and frequently built of mud-bricks. The type may have an internal pillar or a pilaster, which likely carried a second floor (Fig. 7, nodes: 108, 140, 291 and 351). Two installations of a similar type were unearthed in Aqaba, Jordan, 250 m north of the fortified site of Ayla (Melkawi et al., 1994). In the research area, this type can be found surrounded by pottery waste, including ash and deformed vessels (nodes 132 and 265) or only adjacent to such waste contexts (nodes 108, 134 and 140). On the node level, the only correlation is that nine out of fourteen nodes also contain refuse (Table 3), but that is not much of a contribution.

The second type is the Medium-Lined FI (ML). It is round, 1–1.5 m in internal diameter, made of mud, and partly dug. It is defined in literature diversely as a “kiln,” a *ṭabūn*

FIGURE 7
Big-Built fire installation from
Na'an
COURTESY OF GIL TSIONI, THE
UNIVERSITY OF HAIFA

TABLE 3
Correlations on the node level of
Big-Built fire installations

Site	Node	Node/area size (in diameter)	Certain type	Refuse	Bib
Ramla	67	200			Avni et al. (2008)
Ramla	93	~40			Shor (1999)
Na'an	108	35	yes	yes	Tsioni (2008): section II, 39–44, photos 4–7, fig. 7
Mazliah	132	50	yes	yes	Gorzalczany (2006): area B
Mazliah	137	~100		yes	Tal and Taxel (2008): 63
Mazliah	140		yes	yes	Gorzalczany (2009)
Or Yehuda	181	70	yes		Barkan and Jakoel (2010): areas B, C
Ramat Gan	186	15	yes	yes	'Ad (2000)
Tell Qasile	206				Bar-Nathan (2002): 131, A-610/76, A-1006/81-01
Hadar Yosef	207			yes	Bar-Nathan (2002): 131, A-230/70
Jaffa	253	~140			Peilstöcker (1998)
Tel Yavne	265	110	yes	yes	Yannai (2014): area C
Horvat Hermas	291	120	yes	yes	Elisha (2007)
Gan Yavne	345	~70	yes	yes	Gadot and Tepper (2003)
Total 14			8	9

FIGURE 8
Medium-Lined fire installation
from Khirbat Dayrān, Rehovot
PHOTO: TSILA SAGIV, COURTESY
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AUTHORITY

or an oven. In Khirbat Dayrān in Rehovot, this type has an additional side air-tube made of two or three long jars, which cannot be seen in the picture (Fig. 8), but in its restoration (Bouchenino, 2007: 122; Kogan-Zehavi, 2008: 83, figs. 6–7). In Tel Yavne, scholars consider this type to be a glass kiln (Fig. 9) (Feldstein and Shmueli, 2011: figs. 3–4). In Nishapur, Iran, a similar installation was unearthed from many of the rooms, with a broken jar at the bottom of the installation and a channel of several other jars. The excavators interpreted that installation as a brazier that was also used as a grill or a heater

Site	Node	Node size	Details			Correlations			Bib
			Certain type	Vent	Waste	Structures	Fieldstone	Conduits	
Ramla	17	5						yes	Masarwa (2011)
Mazliah	134	~80	yes		pottery, glass	yes	yes	yes	Gorzalczany et al. (2010)
Azor	166	~160	yes			yes	yes	yes	'Ad et al. (2014)
Azor	178	30	(also SL)		glass (slag)	yes	yes		Torgö (2005a)
Yad Eli'ezer	216	30			glass (slag)	yes			Gorzalczany (2004)
Tel Yavne	274	65	yes	yes	glass (slag)	(installation)		yes	Feldstein and Shmueli (2011)
Weizmann Institute	276	5		yes	pottery	yes	yes		Ovadia (1962)
Khirbat Dayrān	283	30		yes		yes	yes	yes	Bouchenino (2007)
Khirbat Dayrān	284	5	yes	yes		yes	yes	yes	Kogan-Zehavi (2008)
Horvat Hermas	291	120	(also BB)		pottery, glass	yes	(installation)		Elisha (2007)
Kefar Gabirol	292	40	yes			yes	yes		Volynsky and Talmi (2011): area P
Ganne Tal	300	110	(also SL)	yes	glass	yes	yes	yes	Arbel (2011): areas D1, D2
Tel Ashdod	351				pottery	yes	yes	yes	Dothan and Porath (1982): 44–5
Total 12				5	8	11	10	8	

(Wikinson, 1986: 224–5, figs. 3.8, 3.9). In the research area, eleven/twelve of the thirteen nodes of that type have structures (with a clear preference for fieldstone) and/or conduits (eight nodes). In addition, six nodes contain glass-production remains, mainly slag, and four pottery waste (Table 4).

The Small-Lined (SL) FI is known in archaeological literature as *ṭabūn*. Through analogies to modern communities, scholars often associate it with domestic baking (Ebeling and Rogel, 2015). Similar to the former type, it is rounded and made of mud. In contrast, it was not dug, but built on the ground, its internal diameter is 0.4–0.8 m, and its remains vary between 0.3 and 1 m in height. A contextual examination of this type shows that it is almost always adjacent to walls (Fig. 10, nodes 15, 141, 148, 162, 176, 284, 300), sometimes in a corner (nodes 46, 213).

TABLE 4
Correlations on the node level of
Medium-Lined fire installations

FIGURE 9
Medium-Lined fire installation
from Tel Yavne
PHOTO: AMIR FELDSTEIN,
COURTESY OF THE ISRAEL AN-
TIQUITIES AUTHORITY

FIGURE 10
Small-Lined Fire installation and
two jars from Bet Dagan
PHOTO: AMIR GORZALCZANY,
COURTESY OF THE ISRAEL AN-
TIQUITIES AUTHORITY

TABLE 5
Small-Lined F1 type 1 and the
characteristics of its nodes

Site	Node	Node size	Certain type	Waste	Refuse	Walls	Conduits	Bones	Copper	Bib
Ramla	15	25	yes			yes			yes	Jakoel (2011)
Ramla	26	30				yes	yes			Torgë (2011)
Ramla	46	10	yes			yes	yes			Gudovitch (2004)
Na'an	109	100	yes	pottery			yes	yes		Torgë (2010): areas C and D
Kafr Jinnis	123	25			dug pit	yes			yes	Messika (2006): area C, 89
Mazliah	141	150	yes		yes		yes		yes	Gorzalczy and Spivak (2008)
Bet Dagan	162	40	yes			yes		yes		Gorzalczy and Jakoel (2013)
Azor	166	~150	yes			yes	yes			'Ad et al. (2014)
Ramat Gan	184	30	yes			yes			yes	Volynsky (2009)
Tell Qasile	208	4	(not <i>in situ</i>)	metal slag			yes	yes		Ayalon and Bashkin-Yosef (2008)
H. Zerifin	213	30	yes		yes	yes	yes	yes		Govrin (2013): area A
Jaffa	257	50								Peilstöcker et al. (2006)
Yad Binyamin	302	20								Weksler-Bdolah (2000)
Ashdod-Yam ^a	319	~70				yes	yes	yes	yes	
Total 14				2	3	9	8	5	5	

a Israel Antiquities Authority Archives: Excavation Files: Ashdod-Yam, Yosef Porath and Shlomo Pipano, A-1353/1985 (Area B, L826).

Two reverse patterns on the node level divide the Small-Lined F1 into two sub-types (Tables 5 and 6). Small-Lined fire installation type 1 (SL1) is related to structures and conduits, as well as to portable finds: animal bones and copper-alloy objects. It is rarely related to industrial waste or to other refuse. Interestingly, it appears in most sites, but usually only in one node (except for Ramla/Mazliah with four nodes). Small-Lined F1 type 2 (SL2) is distinctly different. On the one hand, its nodes have almost no conduits, no animal bones, and no metals. On the other hand, in half of the nodes, the installation is found in a complex of several adjacent fire installations of the same type. In six of the nodes there is a designated refuse pit (which is not common), and in three, the remains of glass production have been found.

TABLE 6
Small-Lined FI type 2 and the
characteristics of its nodes

Site	Node	Node size	Certain type	Waste	Refuse	Walls	Conduits	Bones	Copper	Bib
Ramla	12	20	yes (3)							Kanias and Tueg (2012)
Na'an	108	60	yes (4)	glass		yes				Tsioni (2008): section IV, 45–7
Lod	144	~10	yes		dug pit	yes				Torgë (2003)
Lod	148	10	yes		dug pit	yes				Golani (2012)
Bet Dagan	163		yes		dug pit	yes	yes			Peilstöcker and Kapitikon (1998)
Azor	167	20	yes		dug pit	yes				Dagot (2014)
Azor	176	12	yes (2)		dug pit	yes				Rauchberger (2009)
Azor	178	30	yes (4), also ML	glass slag	dug pit?	yes				Torgë (2005a)
Ganne Tal	300	110	yes (4), also ML	glass		yes	yes			Arbel (2011)
Total 9			5 multiple	3	6	7	2	0	0	

5.2 Spatial Patterns of Fire Installations

The distribution of three fire installations types shows a clear geographical division (Fig. 11). The SLI installations dominate the eastern side of the research area, whereas ML is distributed from Azor to the south with a concentration on the sites of Rehovot, and BB forms a northern cluster and another cluster near Ramla. This could mean a geographical division either of the construction technique of FI, or of their function.

In order to examine if FI types can be associated with specific industries, they are cross-referenced with the waste and raw materials of crafts. In the research area, remains of pottery production include deformed vessels and molds; remains of secondary glass production include deformed vessels, molds, and glass chunks; and remains of metal smelting include slag or raw metals. Cross-referencing glass waste with Medium-Lined FI resulted in a clear relation, with only a few exceptions (Fig. 12). Cross-referencing pottery waste with Big-Built FI resulted in a less distinct relation, with exceptions on the northern part of the map and around Ramla (Fig. 13).

Metal waste is too limited for any observation. Some correlation was found between Small-Lined FI type 1 and a copper-alloy object with a lollipop form (Fig. 14). The copper “lollipops” (Fig. 15) are found in most big excavations of Greater Syria and appear in museum collections. The object has elicited diverse interpretations, starting with a cosmetic mortar, an indigo crucible, a lamp, or a lamp-filler (e.g. Grabar et al., 1978: 183, 282–3, figs. 39–40; Allan, 1982: 37–8; Whitcomb, 1988: fig. 25:c; Messika, 2006: 105, fig. 23:6). I believe it to be a mortar of some sort, for cosmetics and/or medicine.

FIGURE 11
The dispersion of fire installations
in the research area

FIGURE 12
Cross-referencing glass waste with
Medium-Lined FI

An interesting pattern emerges when looking at the distribution of fire remains within sites. Five sites with sufficient numbers of salvage excavations were investigated (Jaffa, Azor, Lod, Tel Yavne, and Gan Yavne). On each site, the four types of fire installations were mapped in relation to all relevant excavated nodes of the site (Fig. 16). Except for Azor that had a big number of fire installation and three types, these sites had one or two types of installations, and only in very few nodes. Notably, the installations in Lod, Gan Yavne and Tel Yavne were clearly situated on the edge of the site.

The location of fire remains inside Ramla can be mapped and compared to Ramla's established "activity areas." Many installations, together with some other elements,

FIGURE 13
Cross-referencing pottery waste
with Big-Built FI

FIGURE 14
Cross-referencing lollipop-form
objects with Small-Lined FI type 1

FIGURE 15
A lollipop-form object from
Ramat Gan
PHOTO: CLARA AMIT, COURTESY
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AUTHORITY

FIGURE 16
Fire installations and fire remains
within five sites

correlated with specific areas within the modern domain. Furthermore, territories of specific elements were distinct from others (Nol, forthcoming). The first type of activity area is three clusters of flagstone pavements which also comprise Medium-Lined or Big-Built fire installations and a floorless installation with a barrel-shaped vault. A comparison to Caesarea and Acre, where similar structures (albeit not subterranean) were paved with mosaics or flagstones (Avni, 2014: 51), suggests their interpretation as warehouses. The rich terminology for storage rooms from that period, and specifically for subterranean spaces (i.e. *madāfin*, *Specubus subterraneis*), supports that interpretation. Two of these three clusters are also characterized by the presence of objects made of iron, by vessels made of soapstone, and by clay “grenades” (sphero-conical vessels).

A second type of activity area in Ramla that is situated in different territories than the former, consists of bell-shape plastered containers along with *in situ* sunken jars. The bell-containers, many approached by clay pipes, are suggested to collect drinking water from floors and roofs, whereas sunken jars may relate to storage. The third type of activity area is found on the site’s edges or within the flagstone pavements. It is characterized by designated refuse pits along with rotary querns made of basalt and with marble basins. I interpret these three activity areas as industrial, domestic, and refuse related (Fig. 17). Henceforth, the flagstone pavement is interpreted as a public space, an industrial area, or an industrial market.

A comparison between fire installations and dwelling areas in Ramla (Fig. 18) shows some correlation with hearths and with Small-Lined FI type 1. One Big-Built FI is also found in the dwelling neighborhood. Otherwise, BB can be found in the industrial areas of Mazliah and the Stadium (Fig. 19). The latter map also illustrates the position of hearths and ML in or around the industrial areas. Regarding specific crafts at Ramla, a good correlation can be noticed for pottery waste with BB or with hearths, especially in the industrial areas (Fig. 20). Very different, but also distinct, is the wide distribution of glass-production remains in one cluster outside any of the activity areas, and with no distinct relation to any particular FI (Fig. 21).

FIGURE 17
A summary of activity areas in
Ramla

FIGURE 18
Fire installations in the dwelling
areas of Ramla

6 Discussion: Interpreting the Fire Installations and Related Activities

Preferring one fire installation over another relates to function and geography, though not exclusively. The best example is the Medium-Lined fire installations which are concentrated in Rehovot and its vicinity. In fact, the Yarqon area was excluded of this type altogether. The spatial distribution on the node level shows the possible link between this type and glass production, with examples from Ganne Tal, Tel Ashdod and Azor, in

FIGURE 19
Fire installations in the industrial
areas of Ramla

FIGURE 20
Cross-referencing fire installations
and pottery waste at Ramla

addition to the Rehovot cluster. However, in the Rehovot cluster, sites were alternatively found only with waste of another craft, such as pottery (e.g. Weizmann Institute) or metal (e.g. Khirbat Dayrān). In Ramla, ML is the best candidate for glass production, as the widespread distribution of glass remains is in its proximity. In summary, I support the suggestion made by Feldstein and Shmueli (2011) to interpret this type as a glass kiln. However, on the Rehovot sites, where it was the sole type of fire installation, it might have had multiple uses.

FIGURE 21
Cross-referencing fire installations
and glass waste at Ramla

Big-Built fire installations and pottery production cannot be related to each other at face value. BB installations were indeed found with pottery waste *in situ* in two nodes, and adjacent to waste in another three nodes. In addition, this type was found on the edges of other sites – a location, which strengthens its industrial character – and at industrial Mazliah. Nevertheless, pottery was fired through a number of methods, and pottery kilns are not the only big-built FI; some might have been bread ovens. First, on the node and nodes-cluster levels, BB installations were only partially connected to pottery waste. Second, our distribution maps from Ramla clearly showed the relation of simple hearths (an inverted jar in one case) with pottery waste even inside the industrial area. Indeed, firing pottery in an open fire was demonstrated in three ethno-archaeological case studies. Third, sites with fire installations other than BB, such as the Weizmann Institute, provided pottery waste and thus possibly also produced pottery. Fourth, both the *furn* and *mustawqad* for bread baking were, according to our reconstruction, big-built apparatuses. The *furn* even comprised a shelf. The location of one BB in the domestic area of Ramla, with no pottery waste around it, enables its interpretation as a bread oven.

Small-Lined fire installations were divided into two sub-types based on their context and their relations to other elements in the same nodes. Small-Lined FI type 1 is distributed on the northern and eastern parts of the research area. On the contextual level, it was related to structures and conduits. It was rarely related to industrial waste or to other refuse. One less evident spatial correlation was with copper-alloy lollipop-shape objects. Thus, this installation might have been used for baking bread, an interpretation, which accords with literature. Based on the terminological reconstruction, the *ṭābashedān* is the most suitable fit for SL1. According to al-Rāzī, the *ṭābashedān* was used by mints and recommended for the alchemist, which correlates with its metal finds. Interestingly, the installation appears on most sites, but only in one node, except for Ramla/Mazliah with four nodes. Relying on both the textual and ethnographical evidence, this can be explained as a communal apparatus for several households, or a business that offered baking services, if its small dimensions allow for such an interpretation.

Small-Lined FI type 2 is highly productive in its nature, consisting of several fire installations together and dug refuse pits nearby. It has a relatively strong presence in

FIGURE 22
Cross-referencing oil presses, olive pits and Small-Lined FI type 2

Azor (in three nodes) and Lod (in two). Nonetheless, no strong correlation was found between SL2 and the known crafts – pottery, glass, or metal. One might guess that the products involved were perishable. Two candidates for that speculation are soap and dyes that are assigned to the area in written sources. Both operations necessitated fire for heating liquids. The dug refuse pits that were found in these contexts can be explained by plant material and fruit peels, for dyes (see al-‘Alī, 2003: 147–88; Forbes, 1964; al-Shayzarī: 72, translated at Buckley, 1999: 92; Ibn Sīda: vol. 4, 95–6, vol. 11, 209–13),¹³ or olive waste, for soap. That waste could be composted under the right conditions or get recycled. The justification for digging refuse pits in these scenarios would be selling the composted waste, and/or sanitation.

One way to test the relation between Small-Lined FI type 2 and soap manufacture is through remains of olive oil production, as oil was one of the two basic ingredients of soap according to al-Rāzī (Stapleton et al., 1929: 393). Cross-referencing SL2 with possible oil presses (nodes 91, 117, 127, 137, 216, 283), oil-press weights or millstones in secondary use (nodes 140, 176, 212), and olive pits, usually charred (nodes 27, 41, 54, 93, 183), shows a poor relation (Fig. 22).¹⁴ On the one hand, there are no adjacent nodes with fire installations and finds related to olive oil, except for Azor. On the other hand, their distribution is similar, with neighboring domains, which enables some link between the two. While olives could have been transported to these locations, this remains a guess.

An alternative interpretation for SL2 would follow studies on fire installations in earlier periods. In those, the explanations for “domestic” FI clustering in non-domestic contexts were limited to food-production contexts (e.g. centralized bakeries). This line of interpretation, however, has in most cases no support from other finds and rarely from ethno-archaeology. The following example from Aqaba, Jordan, suggests that relating clay installations to food production is so engrained that it restricts excavators from exploring an industrial interpretation. In Areas M and O at Aqaba, waste of pottery production from the second century CE was found over a large area (i.e. wasters, slag, and natural clay), with no production loci. No link was suggested between that waste and the large number of clay ovens in the same domains. Instead, the excavator interpreted the clay ovens as domestic (Parker, 2000: 378–9, 2002: 412), and another scholar

explained them as a commercial bakery (Tomber, 2008: 70). In short, a large number of SL fire installations can certainly be a cluster of bread ovens, but many more interpretations should be considered, involving other perishable remains as well as visible remains from the vicinity.

7 Concluding Remarks

This case study demonstrates the importance of separating physical remains from “terminology” and “function,” after Khoury (1998). It shows that the possible function of an archaeological fire installation does not necessarily correlate with the function of specific “ovens” in texts, even though we imagine both to have the same shape and operation techniques. Nevertheless, a contextual analysis of each of these categories, independently, gives coherent results. Regarding the terminology, some of it is very specific, and signifies particular forms and function, e.g. the portable *ṭābaq*, which is a surface placed on fire and utilized for baking bread. Other terms, especially *tannūr* and *atūn*, were more general, with several functions and no clear form.

The second arm of the triangle is “form,” namely, the archaeological evidence. Following the typology of fire installations, their function can be suggested by tentative analogies. The terminology ancient authors used to describe these fire installations is unknown. The third arm is “function,” that is, listing possible activities that require fire. A contextual analysis of ethno-archaeology and texts shows the methods and devices that can be used in fire-related activities. The repetition of specific functions in the two source groups, and in different places, strengthens their possible validity for the archaeological case study.

The case study also highlights the importance of a spatial analysis in archaeology, in addition to varied analogies. In the excavations of early Islamic Cairo (Fustāt), in areas that were defined as domestic, ovens were absent. Lewicka explains that absence by suggesting that most Cairenes purchased cooked food in the market (Lewicka, 2011: 91–6). Also in the dwelling areas in Ramla, relatively wide domains lacked any built fire installations or even hearths. In contrast to Lewicka, I suggest that in both cases – Ramla and Cairo – people used fire devices that leave very few traces that can hardly be tracked by archaeological methods. The ethno-historical and ethno-archaeological evidence supports such an interpretation, together with other spatial analyses.

Ethnography and texts presented many cases of cooking and baking using portable elements such as braziers, or organic ones, like dung, both mostly untraceable. Moreover, built fire installations are scarce in the research area. From most sites, only one or two could be classified, including Jaffa, Lod and Gan Yavne, whereas sites such as Yavne-Yam had none. More support comes from the location of built FI within sites. On several sites, such as Lod, they were concentrated on the edges of the site, which implies their “industrial” nature. In Ramla, most of the built FI were either in the industrial area of Mazliah or around the industrial area of northern Ramla. Fourth, many of the built fire installations were found related to craft waste, and/or in a cluster of adjacent installations, clearly indicating their industrial role. The ethno-archaeological evidence from Dei el-Gharbi in Egypt implies how intensive production of pottery indeed leaves distinct remains.

To conclude, built fire installations and hearths are to be interpreted chiefly as kilns and furnaces. They certainly cannot represent household cooking at face value. Even the common Small-Lined fire installation that archaeologists often call *ṭabūn* and interpret

as a domestic oven seems to be used during early Islam for either the production of another organic product, or as a communal oven. Its location on sites – and mainly its rarity on sites – implies that it was not in domestic use.

The complete list of terms for fire devices in texts does not correlate with the full corpus of fire installations in the archaeological record. Therefore, the link between these two lines of investigation cannot be sketched automatically. The rich domestic activity in the texts is largely “absent” from the archaeological evidence.

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Acknowledgements

This paper is part of my PhD dissertation submitted to the Universität Hamburg (2019). I am grateful to my supervisors, Stefan Heidemann and Donat Wehner, as well as to Greg Fisher, Anja Rutter, Gil Tsioni, Maria-Louise Sidoroff, Sarel Shalev, Ron Haran, Nelly Beyman, and the anonymous readers, for their suggestions and help.

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Notes

- 1 Recently, archaeologists have identified an early Islamic “soap factory” in southern Israel, but the data and the reasoning for this identification await publication. For the press release, see: <https://www.timeofisrael.com/earliest-soap-factory-in-israel-discovered-in-negev-shows-seeds-of-early-islam/>.
- 2 Teshûvôt Rav Natrona’î Ga’ôn – Brûdî (Ôfeq), Ôrah Ḥayîm, simānîm q.k.g., q.k.d., s.d., s.h.; Teshûvôt ha-G’ônîm – sh’e’arê teshûvâ, simān r.‘a.g.; Teshûvôt ha-G’ônîm – sh’e’arê teshûvâ, simān r.‘s.a.; Teshûvôt ha-G’ônîm – G’ônê Mizrāḥ wu-Ma’arāv, simān q.y., simān s.a.; Sh’e’iltôt d-Rav Aḥāy, pārāshat ṣ.w., sh’e’iltâ ‘.z.
- 3 Sh’e’iltôt de-Rav Aḥāy, pārāshat ṣ.w., sh’e’iltâ ‘a.z.; Teshûvôt ha-G’ônîm – G’ônê Mizrāḥ wu-Ma’arāv, simān q.y.
- 4 Sh’e’iltôt de-Rav Aḥāy, pārāshat maṭôt, sh’e’iltâ q.l.z.
- 5 Teshûvôt ha-G’ônîm – G’ônê Mizrāḥ wu-Ma’arāv, simān n.w.
- 6 Teshûvôt ha-G’ônîm – G’ônê Mizrāḥ wu-Ma’arāv, simān q.y.
- 7 Teshûvôt ha-G’ônîm – G’ônê Mizrāḥ wu-Ma’arāv, simān ‘a.d.
- 8 Teshûvôt Rav Natrona’î Ga’ôn – Brûdî (Ôfeq), Ôrah Ḥayîm, simānîm q.k.g., q.k.d.
- 9 Sēfer Halakhôt G’dôlôt, simān z. – Hilkhôt Shabbât, pereq 17.
- 10 Teshûvôt ha-G’ônîm – G’ônê Mizrāḥ wu-Ma’arāv, simān q.y.; Teshûvôt Rav Natrona’î Ga’ôn – Brûdî (Ôfeq), Ôrah Ḥayîm, simān s.g.; Sēfer Halakhôt Gedôlôt, simān z. – Hilkhôt Shabbât, pereq sh’e’lishî; Safrâ sh’minî, pārāshâ ḥ., pereq y.
- 11 In the Hebrew script, the letters *k* and *b* look similar, and both words make sense in this context.
- 12 Sēfer Halakhôt G’dôlôt, simān n.h. – Hilkhôt Yayin Nesekh; Teshûvôt ha-G’ônîm – sh’e’arê teshûvâ, simān r.n.g.

- 13 Talmûd Bavli masekhet shabbâat pereq ٢ - âmar Rabbî 'Aqîvâ.
 14 Node 27: Tueg and Arnon, 2011. Node 41: Sion, 2009. Node 54: Torgë, 2005b. Node 91: Glick and Gamil, 1997. Node 93: Shor, 1999. Node 117: Wolff and Shavit, 1999. Node 127: Kogan-Zehavi and Hadad, 2013. Node 137: Tal and Taxel, 2008: 53. Node 140: Gorzalczany, 2009. Node 176: Rauchberger, 2009. Node 183: Taxel, 2007: 14. Node 212: Shavit, 2009. Node 216: Gorzalczany, 2004. Node 283: Bouchenino, 2007: 122, figs. 3–4.