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From *Gat* to *Bet-Gitot*: Wine Production in the Southern Levant

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This article summarizes many years of field research and resultant insights into the technology of wine production and the function of various winemaking installations in antiquity in the Southern Levant. A concise overview is given of the evolution of the ancient winemaking installations in the region, the *Gat* and the *Bet-Gitot*, with examples representing the main stages of development. Established theories are reexamined and challenged in light of recent discoveries. An algorithm outlining the wine production process is presented, and a methodology is proposed for the field identification of wine production installations, defining their various components and reconstructing their mode of operation, even in cases where the archaeological remains are scarce.

Keywords: wine, winemaking, winepress, Gat, Bet-Gitot, 'free-run' wine, pressed wine, treading floor

Introduction

For many years, research of the ancient wine industry in the Southern Levant was based on a misconception of the winemaking process. This has led to a misunderstanding of the installations used in the wine-production process and consequently, to an incorrect naming and definition of the various components of these installations, as well as a misinterpretation of wine terminology in ancient sources. Some of the installations were even wrongly identified as having been used in wine production.

Hundreds of winemaking installations have been uncovered in the Southern Levant over the past few decades, most of them in a moderate to poor state of preservation. However, even as research has progressed, including the excavation of well-preserved installations, such as the one discovered at Khirbat Mulabbis in Petaḥ Tiqwa (Gudovitch 2009:203–211; see below), the explanation for these new discoveries were adapted to comply with old erroneous theories concerning their function, design and means of operation.

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This article pursues two interconnected objectives. First, it examines the stages of the wine-production process in relation to the discoveries in the field. As the ancient installations adapted to the intricate mechanical and biochemical nature of wine production, each stage, from grape harvesting to wine production, was examined in light of up-to-date archaeological evidence. Then, the article reevaluates the terminology used to describe the remains of the winemaking installations and their components, proposing a more accurate identification thereof. It is suggested to replace the various heretofore employed terms, like 'basic winepress', 'simple winepress', 'improved winepress', 'complex winepress', 'elaborate winepress', 'composite winepress' and 'developed winepress'[2] with two key ancient Hebrew terms: *Gat* and *Bet Gitot* (Dray 2003:219).[3] *Bet Gitot* is conceived as the plural form of *Gat* and hence the logic underlying this terminology (see below). Moreover, the *Bet Gitot* installation evolved from the *Gat* installation in a process elaborated on below.[4]

THE ARCHAEOLOGICAL EVIDENCE

The increasing number of archaeological excavations throughout the Southern Levant in recent decades has led to the unearthing of many agricultural and industrial installations, most notable of which are the winemaking installations. These installations operated in different periods on various scales of production. While their design varies, ranging from small to large (from *Gat* to *Bet-Gitot*), they all comply with a basic model designed to produce wine.

This section describes in chronological order a representative sample of ancient wine-producing installations, which together allow for a reconstruction of their original plan and mode of operation (for the location of the archaeological sites mentioned here, see Fig. 1).

THE *GAT* INSTALLATION

The earliest version of *Gat* dates to the Middle Bronze Age. It was found in and around the Jezreel Valley, where it was termed "the Ta'anakh-type" (Getzov, Covello-Paran and Tepper 2011). This installation's remains consist of a surface and an adjacent vat; a pair of outlets drain the surface into the vat, and two deep recesses are carved on opposite sides of the surface. Such installations were excavated, e.g., at Gan Ner (Figs. 2, 3; Porat 2008).

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[2] For publications using these terms, see, e.g., 'basic winepress' (Hadas 2007); 'simple winepress' (Hirschfeld 1983; Frankel 1999; 2009; Avrutis 2015); 'improved winepress' (Frankel 1999; Avrutis 2015); 'complex winepress' (Seligman 1999; Avshalom-Gorni et al. 2008; Gudovitch 2009; Taxel 2009; Israel and Erickson-Gini 2013); 'elaborate winepress' (Hirschfeld 1983; Dayan et al. 2020); 'composite winepress' (Frankel 1999; Avrutis 2015); 'developed winepress' (Frankel 2009).

[3] The author uses these terms as there are no satisfactory English equivatents.

[4] I wish to thank Ilana Gonen, for her scientific assistance, and Michael Watts, for his translation, English editing and proofreading.

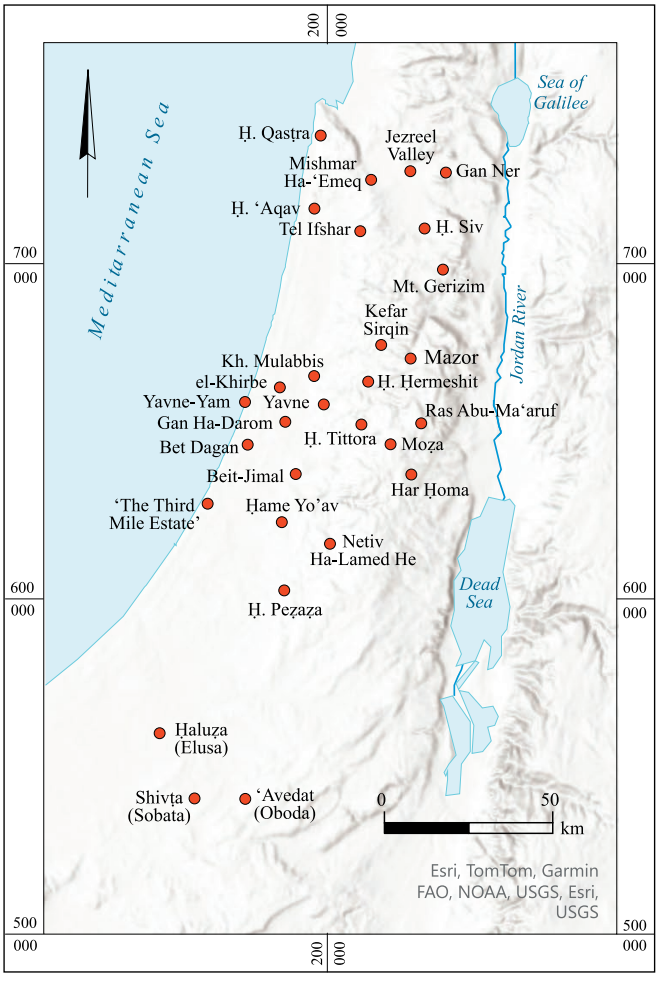


Fig. 1. Location map of sites mentioned in the article, in which winepresses were uncovered.

Remains of different versions of the *Gat* installation are scattered throughout the Southern Levant, basically consisting of a shallow surface and an adjacent vat, with an outlet draining the surface into the vat. These small installations are usually carved in bedrock, hampering our ability to date them, except when they are found in a stratigraphic context. However, this type of installation is considered to be dated to the Iron Age, continuing into the Persian, Hellenistic and Roman periods (see, e.g., Walsh and Zorn 1998:160).[5] *Gat* installations of

[5] There are a few examples of *Gat* installations from this type that have been dated by their excavators to the Chalcolithic period, such as the ones from Megiddo Stratum XX, dated to the fourth millennium BCE (Loud 1948:57–61). In this regard, Frankel's skepticism should be mentioned, according to which these installations served for olive oil production, as vines in the Southern Levant in the Chalcolithic period were extremely rare (Frankel 2009:2).

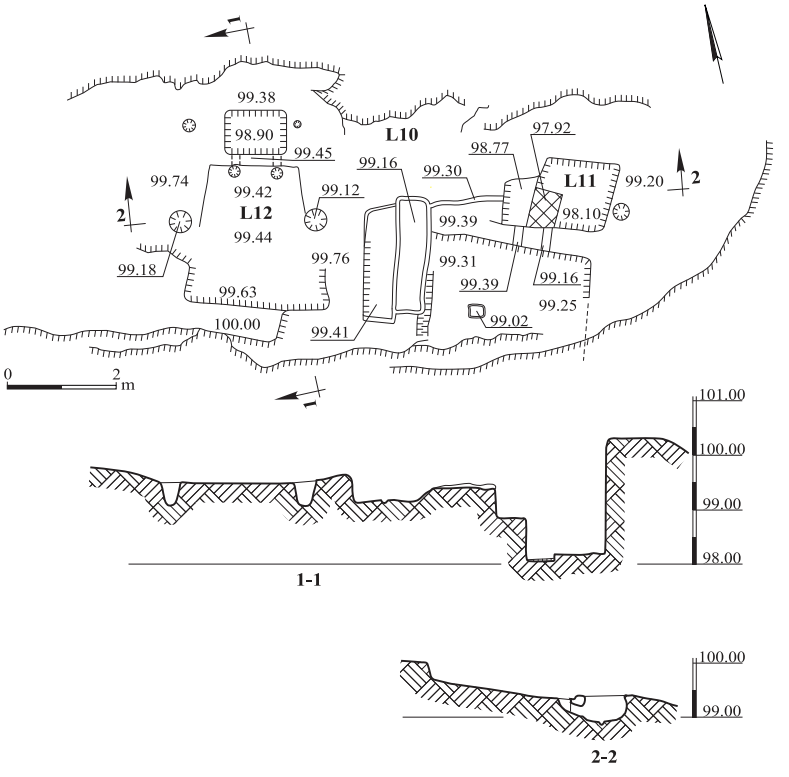


Fig. 2. The winepress at Gan Ner, plan and sections
(see Porat 2008: Fig. 1).

Fig. 3. The winepress at Gan Ner, looking south (photography: Y. Dray).

this type exhibit various shapes—rectangular, rounded and irregular—and are carved into various types of rock. Typical examples are the installations unearthed at Ḥorbat Tittora (Fig. 4; Lass 1998:102) and Netiv Ha-Lamed He Area F7 (Figs. 5, 6; Zilberbod 2015); the dating at both sites was not determined by the excavators.

Fig. 4. The winepress at Ḥorbat Tittora, looking south (see Lass 1998: Fig. 136).

Fig. 6. The winepress at Netiv Ha-Lamed He, looking northeast (see Zilberbod 2015: Fig. 14).

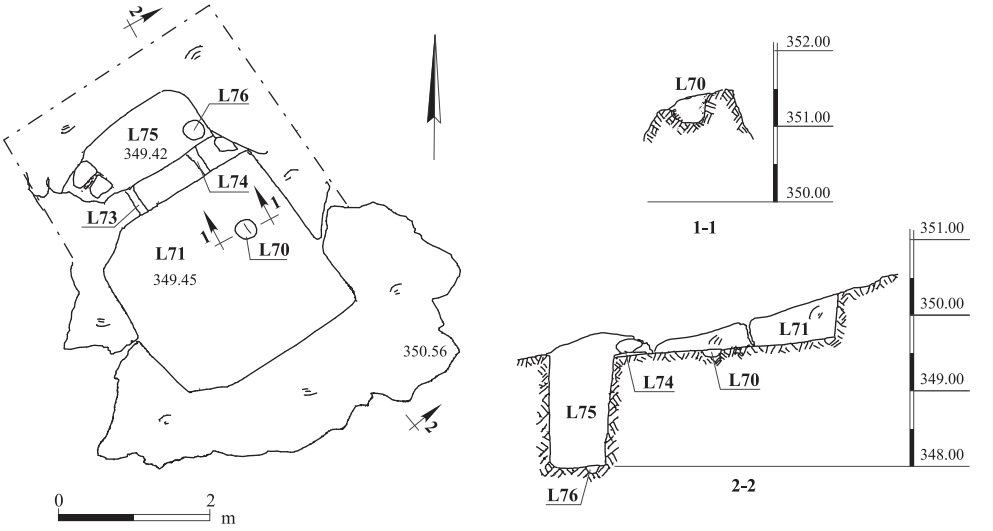


Fig. 5. The winepress at Netiv Ha-Lamed He, plan and sections (see Zilberbod 2015: Fig. 13).

THE *BET-GITOT* INSTALLATION

The earliest versions of the *Bet-Gitot* installation are represented by remains that are larger than the *Gat* installation, featuring a wide surface, meticulously cut into bedrock, and an adjacent vat; some examples comprise a small basin between the two components. Outlets drain each component to the next, and a small sump is occasionally carved at the bottom of the vat. Such a *Bet-Gitot* installation was unearthed at Ḥorbat Peẓaẓa, dated to the Late Roman–early Byzantine period (Figs. 7, 8; Ganor and Klein 2012). Other *Bet-Gitot* installations were built rather than rock-cut, such as the ones unearthed at Yavne-Yam, dated from the Persian or Hellenistic until the Roman period (Ajami and ʻAd 2009: Figs. 3, 7). A few rare examples comprise, apart from the surface and vat, a heavy weight set in a designated space besides them; one was unearthed at el-Khirbe in the Nesher-Ramla quarry (Avrutis 2015:21–24, Figs. 2.20–22) and another at Har Ḥoma (Zelinger 2022:278–280, Plan 1, Fig. 27), both dated to the Byzantine period.

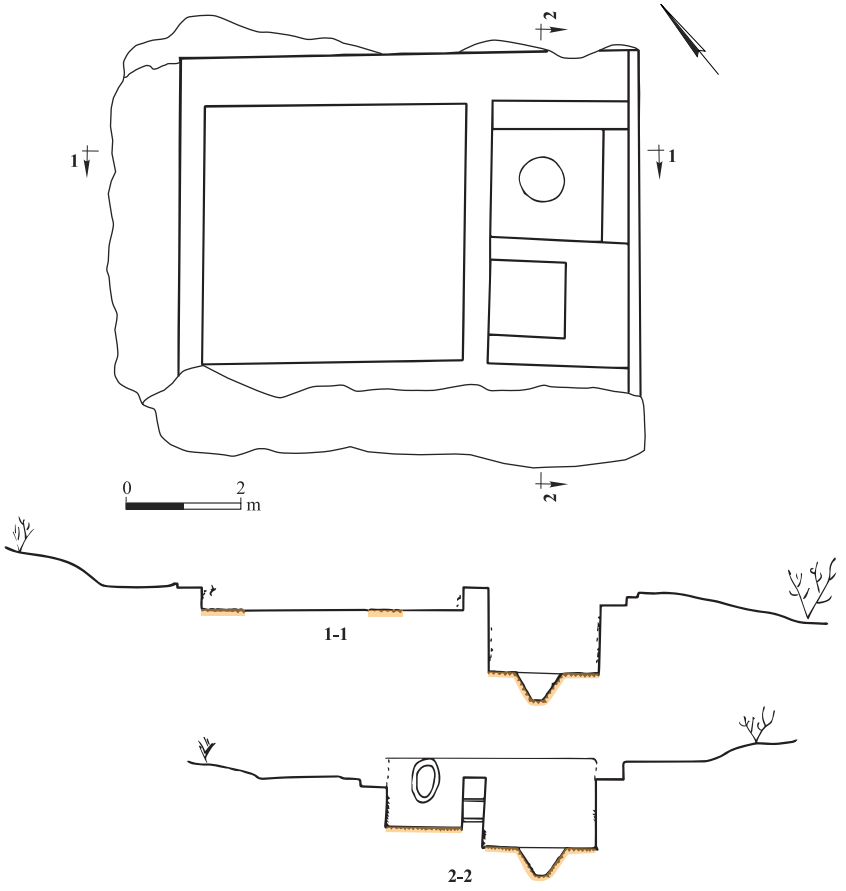


Fig. 7. The winepress at Ḥorbat Peẓaẓa, plan and sections (see Ganor and Klein 2012: Fig. 1).

Fig. 8. The winepress at Ḥorbat Peẓaẓa, looking west (see Ganor and Klein 2012: Fig. 2).

Fig. 9. Aerial view of the winepress at Har Ḥoma (see Zelinger 2022:278–280, Fig. 27).

The *Bet-Gitot* at Har Ḥoma (Fig. 9) comprised a square surface cut into bedrock (0.2 m deep) and paved with a white mosaic; the surface is flanked on its eastern side by two components: a hewn rectangular surface with a round, deep depression accommodating a heavy rounded weight on the south, and a rectangular plastered collecting vat, paved with white mosaic, with an embedded ceramic sump in the corner on the north; a gutter drained the square surface into the vat.

In the Byzantine period (fourth–seventh centuries CE), we witness the appearance of the widespread version of *Bet-Gitot* installations, scattered throughout the region in multitudes. The remains of this version mainly comprise a large, mostly rectangular surface, in which a monolith with a carved mortice was embedded. The surface is surrounded by elevated spaces separated by partition walls, whose remains were preseved between them; outlets drain from each space onto the central surface, which in itself drains through an opening into one or two collecting vats via a small basin. The better-preserved components are paved, usually with coarse white mosaics but also with stone slabs, plaster or upright pottery sherds embedded in mortar. Other additional components may be small basins incorporated in the external walls of the installation or just outside them.

The *Bet-Gitot* installation unearthed at Mishmar Ha-'Emeq (Figs. 10, 11; Avshalom-Gorni, Frankel and Getzov 2008:49–53) was quite poorly preserved. It comprised a

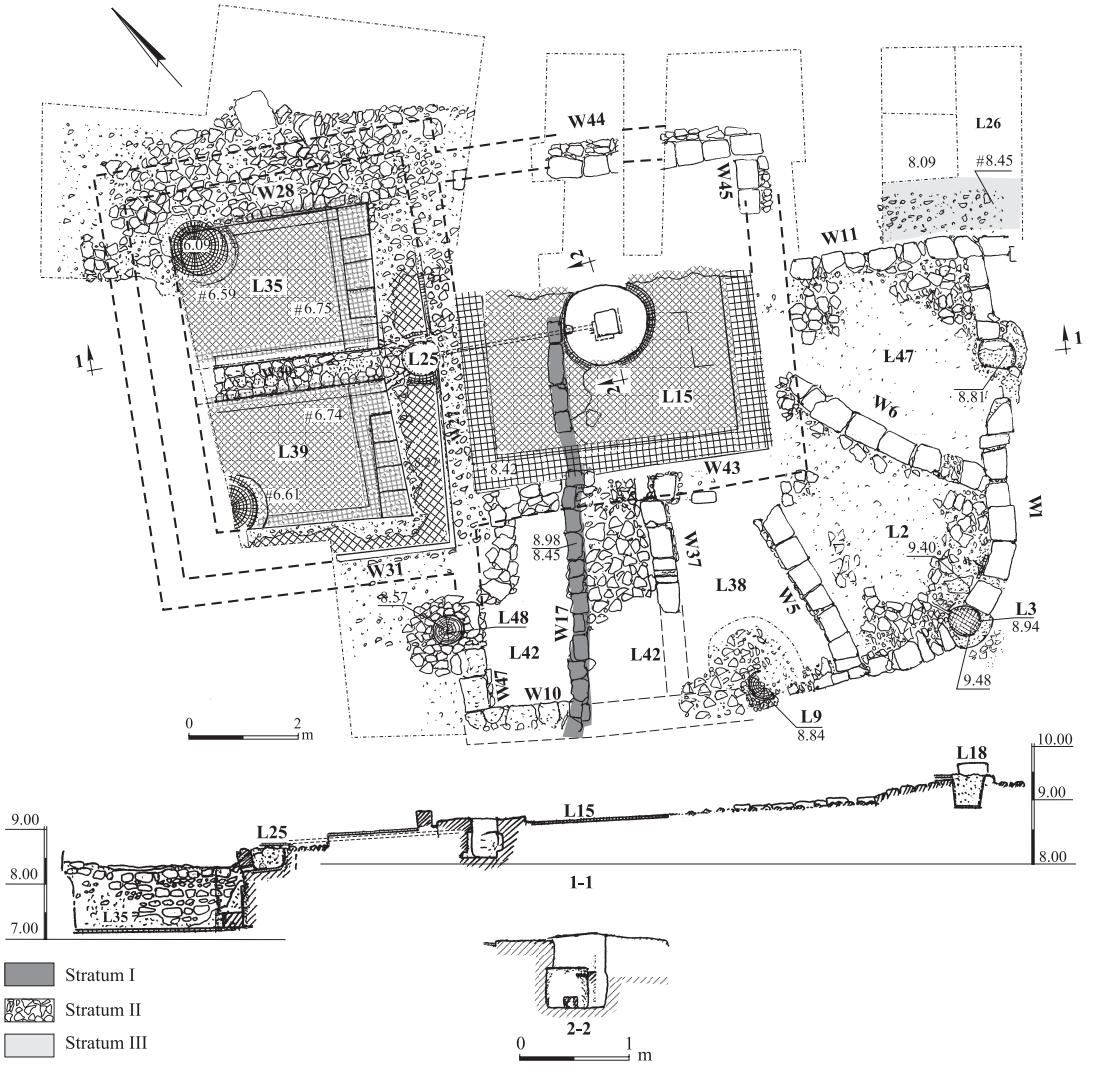


Fig. 10. The winepress at Mishmar Ha-'Emeq, plan and sections (see Avshalon-Gorni, Frankel and Getzov 2008: Plan 1).

Fig. 11. The winepress at Mishmar Ha-'Emeq, looking southwest
(see Avshalon-Gorni, Frankel and Getzov 2008: Fig. 1).

rectangular surface, including a monolith with a carved mortice in its center. The lower parts of trapezoidal spaces flanking the central surface survived, each with a small, rounded basin incorporated into their exterior walls. Two collecting vats, each including a staircase, were attached to the third side of the central surface, which drained into both of them via a small basin interposed between the three. No remains had been preserved of the fourth side of the central surface. The surface and collecting vats were paved with coarse white mosaics and the walls of the collecting vats and basins were plastered.

A better-preserved *Bet-Gitot* was excavated in Area C at 'The Third Mile Estate' in Ashqelon (Figs. 12, 13; Israel and Erickson-Gini 2013:191–194). It had a stone-paved, rectangular central surface with a depression in its center, indicating a robbed element. On the southwestern side of the surface were the lower parts of two rectangular, plastered compartments separated from one another by a massive *debesh* (rubble and mortar) wall. Remains of lead pipes were found at the bottom of each compartment, draining into the central surface. On the southeastern side of the central surface were shallow construction remains; the northeastern side was not preserved. On its northwestern side, the central surface drained into two octagonal vats via an intermediate oval vat. All three vats were plastered and paved with stone slabs and had a shallow sump at their bottom. A channel ran under the central surface, extending from the depression in the central surface to the oval vat.

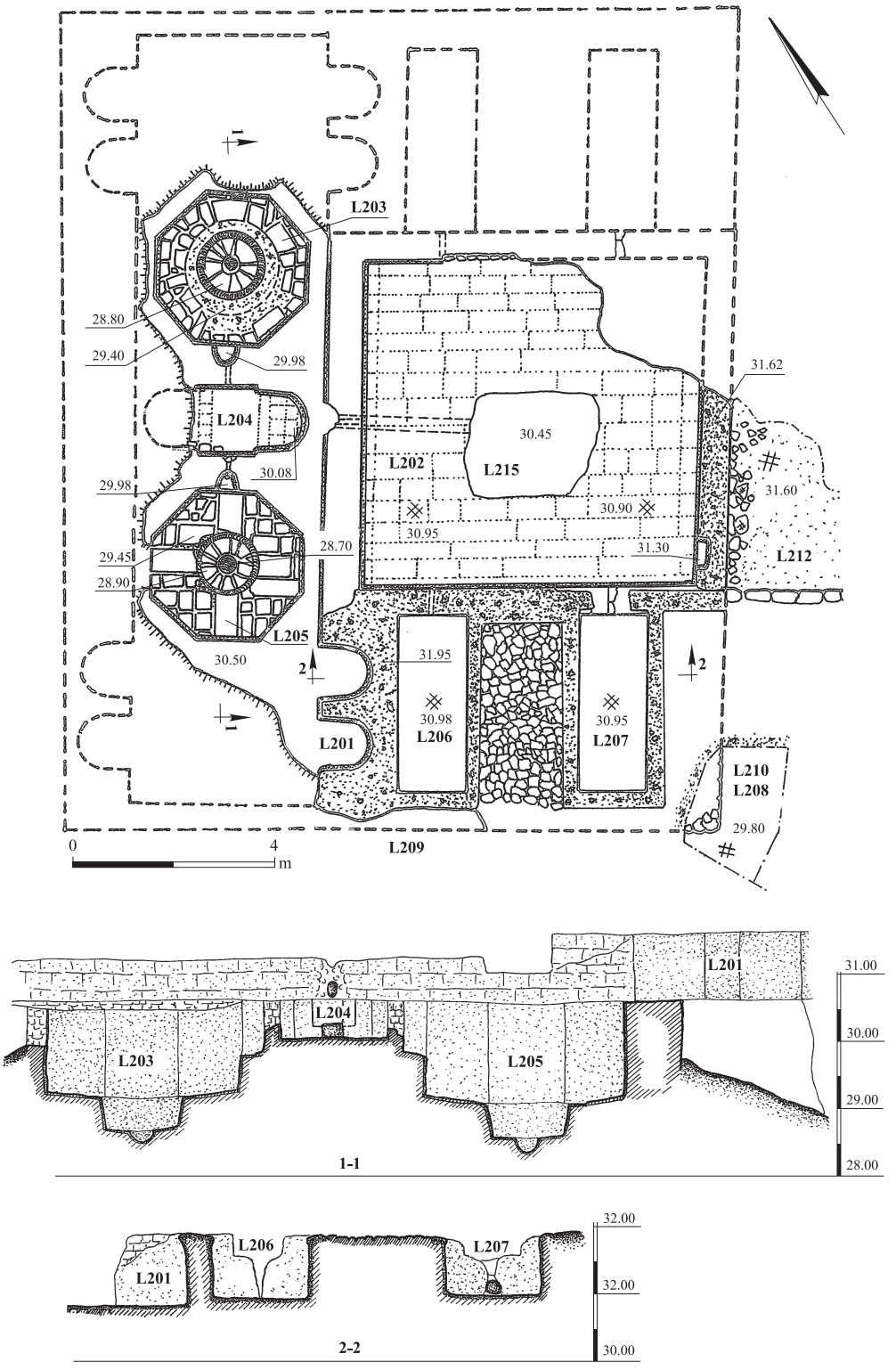


Fig. 12. The winepress at 'The Third Mile Estate' in Ashqelon, plan and sections (see Israel and Erickson-Gini 2013: Plan 6).

Fig. 13. The winepress at 'The Third Mile Estate' in Ashqelon, looking southeast (Israel and Erickson-Gini 2013: Fig. 18; 'Ofek Aerial Photography', courtesy of Y. Israel, Israel Antiquities Authority).

One of the best-preserved *Bet-Gitot* was unearthed at Khirbat Mulabbis in Petaḥ Tiqwa (Figs. 14, 15; Gudovitch 2009:204–205). To the north and east of a rectangular central surface, four vaulted compartments were uncovered below upper trapezoidal floors, which extended about twice as far beyond the compartments and drained into them through small openings; remains of partition walls separated the upper trapezoidal floors from each other. The compartments were separated from the central surface by high partition walls, in which a central bottom pipe was integrated, draining into the central surface. On the southern side of the central surface was a square basin leading to two round vats.

Another well-preserved *Bet-Gitot* was recently removed from its original site at el-Khirbe in the Nesher-Ramla quarry and reconstructed in the Ne'ot Qedumim Park (Figs. 16–18; Avrutis 2015:42–54). In this *Bet-Gitot* (F-494), ten plastered semicircular vaulted niches were set along three sides of a rectangular central surface, including a monolith with a carved mortice. The niches were separated from the central surface by a low wall, each incorporating an outlet at the bottom of the wall draining into the central surface (half of

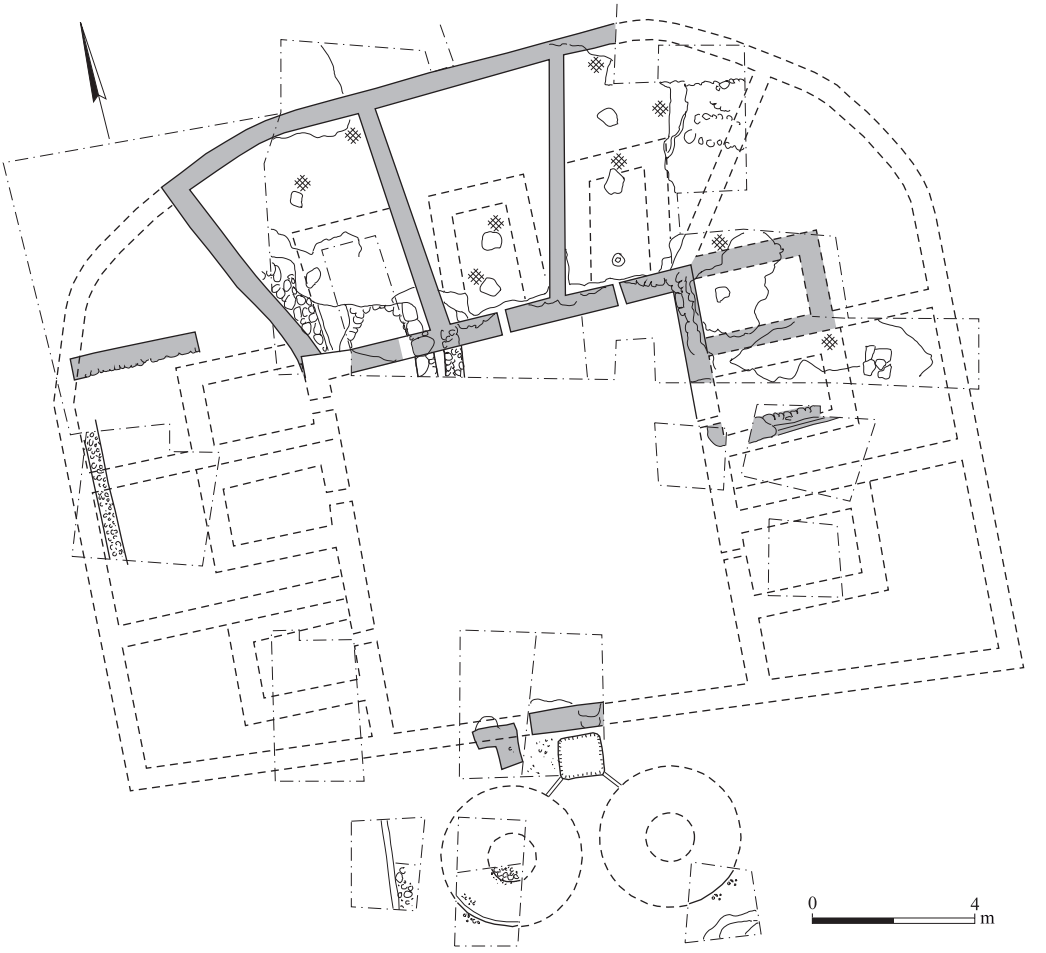


Fig. 14. The winepress at Khirbat Mulabbis in Petaḥ Tiqwa, plan (see Gudovitch 2009: Fig. 37.2).

Fig. 15. The winepress at Khirbat Mulabbis in Petaḥ Tiqwa, looking northwest (photography: T. Sagiv, courtesy of S. Gudovitch, Israel Antiquities Authority).

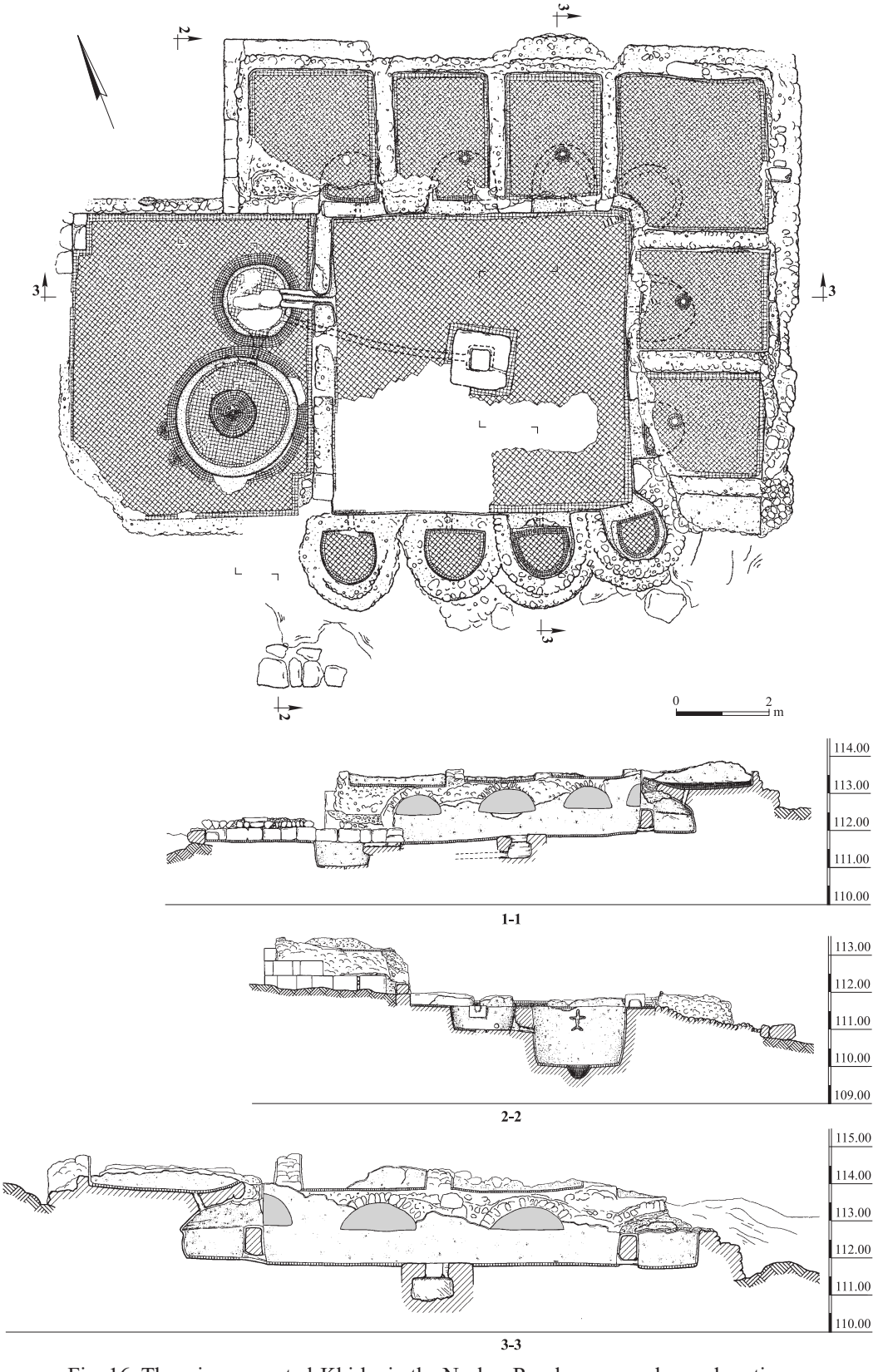


Fig. 16. The winepress at el-Khirbe in the Nesher-Ramla quarry, plan and sections (see Avrutis 2015: Figs. 2.57, 2.58).

Fig. 17. The winepress at el-Khirbe in the Nesher-Ramla quarry, looking east (photography: D. Silberman, courtesy of V.W. Avrutis, The Zinman Institute of Archaeology, University of Haifa).

Fig. 18. The el-Khirbe winepress reconstructed at Ne'ot Kedumim Park (photography: Y. Dray).

these outlets were found blocked with mortar). Above six of the niches on the northern and eastern sides of the central surface six rectangular spaces were preserved with partition-wall remains in between them. A ceramic pipe was embedded in the floor of each space, draining into the niche below it. On the southern side of the central surface only the lowermost parts of four niches were preserved. On the same level as the central surface and to its west, a rectangular surface had been constructed, incorporating two round vats, the southern of which was larger and deeper than the northern one. The central surface drained into the smaller vat through a stone gutter, and the mortice drained through a ceramic pipe beneath its floor into the same vat. The small vat drained in turn via a hole into the larger one. All the components were plastered and paved with mosaic floors.

Another *Bet-Gitot* installation featuring niches and a single collecting vat is the one unearthed at Kefar Sirqin (Figs. 19, 20; Sidi, Amit and Ad 2003:253–258). It comprised ten semicircular niches set around three sides of a rectangular central surface, including a monolith with a carved mortice at its center. Remains of outlets to the central surface were identified at the bottom of three of the niches. Another rectangular surface was built on the fourth side of the central surface, with almost the same dimensions, and incorporated a square basin and a round deep vat. A gutter extended from the central surface to the basin, which in turn drained into the vat through a hole. All the components were plastered and paved with mosaic floors.

Fig. 19. The winepress at Kefar Sirqin, looking west
(see Sidi, Amit and Ad 2003: Fig. 2).

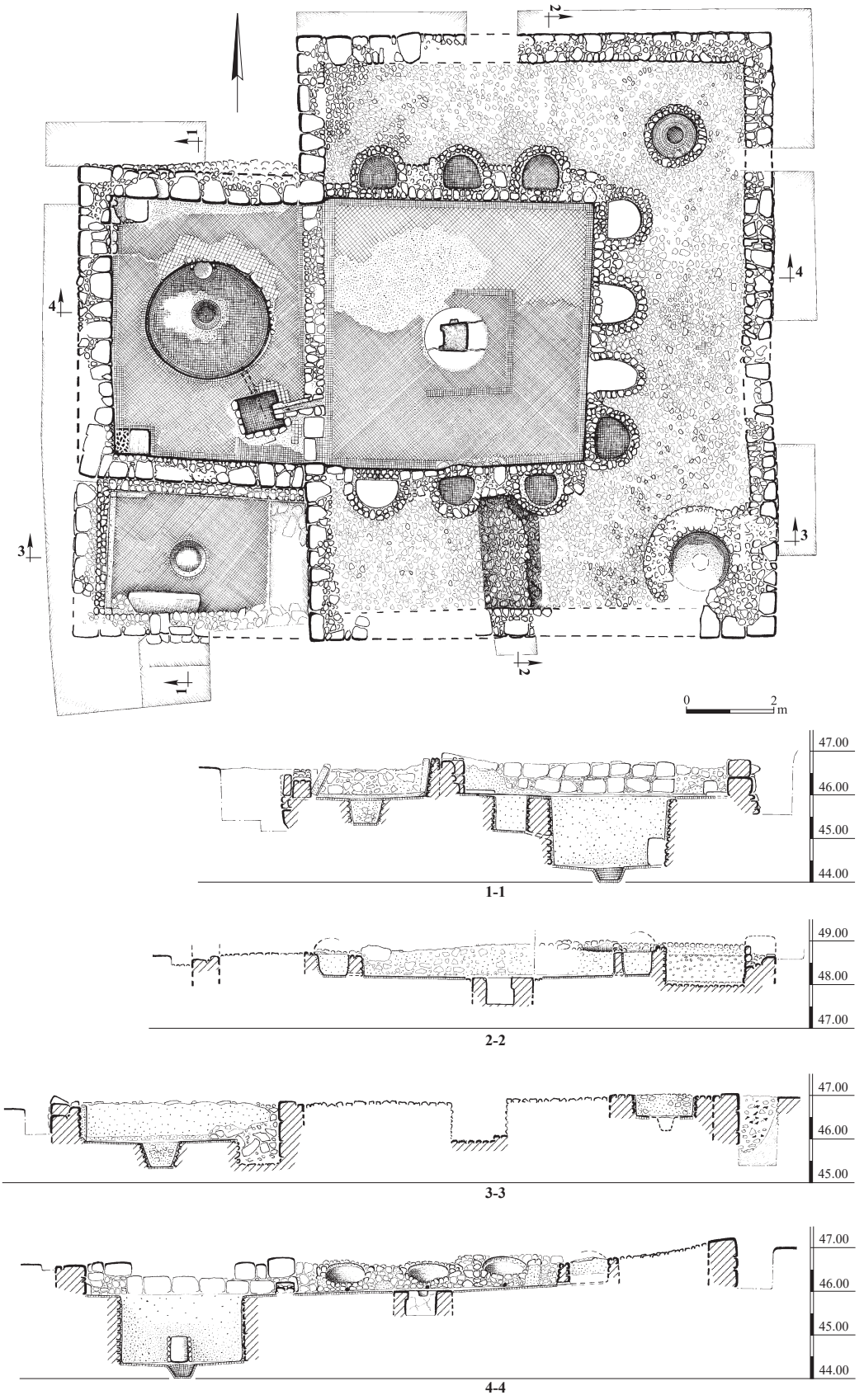


Fig. 20. The winepress at Kefar Sirqin, plan and sections (see Sidi, Amit and Ad 2003: Plan 1).

Fig. 21. The winepress at Ḥorbat Siv, looking south (see Sa‘id and ‘Ad 2011: Fig. 13).

A few *Bet-Gitot* installations excavated in the region exhibit a circular rather than a rectangular central surface. One such example was unearthed at Ḥorbat Siv (Figs. 21, 22; Dray 2011:89–92; Sa‘id and ‘Ad 2011:75–77), where a monolith with a carved mortice was embedded in the center of a round central surface paved with a mosaic floor. At least seven spaces were uncovered around the surface, sharing partition wall remains and shaped as segments of a circle. Small plastered basins, both round and rectangular, were uncovered outside of, but attached to, the external wall. The southern part and the rest of the installation was not excavated.[6]

Another component sometimes found in *Bet-Gitot* installations are small basins, either incorporated in the external walls of the installation or just outside them, such as those discovered at Mishmar Ha-‘Emeq (Figs. 10, 11; Avshalom-Gorni, Frankel and Getzov 2008:52) and Ḥorbat Siv (Figs. 21, 22; Sa‘id and Ad 2011:77). Basins located in the periphery of *Bet-Gitot* installations were unearthed at other sites where they are set in a designated space. An example of this is the Tel Ifshar installation (Figs. 23, 24; Yannai and Ayalon 2021:16–21), where part of it (that had been preserved) consisted of a row of three rectangular adjacent spaces built on the southern side of a rectangular central surface and

[6] Other *Bet-Gitot* installations comprising a central circular surface have been unearthed at Beit Jimal (Di Segni and Gibson 2007:122–132) and Ḥorbat ‘Aqav in Ramat Ha-Nadiv (Hirschfeld 2000:70–73).

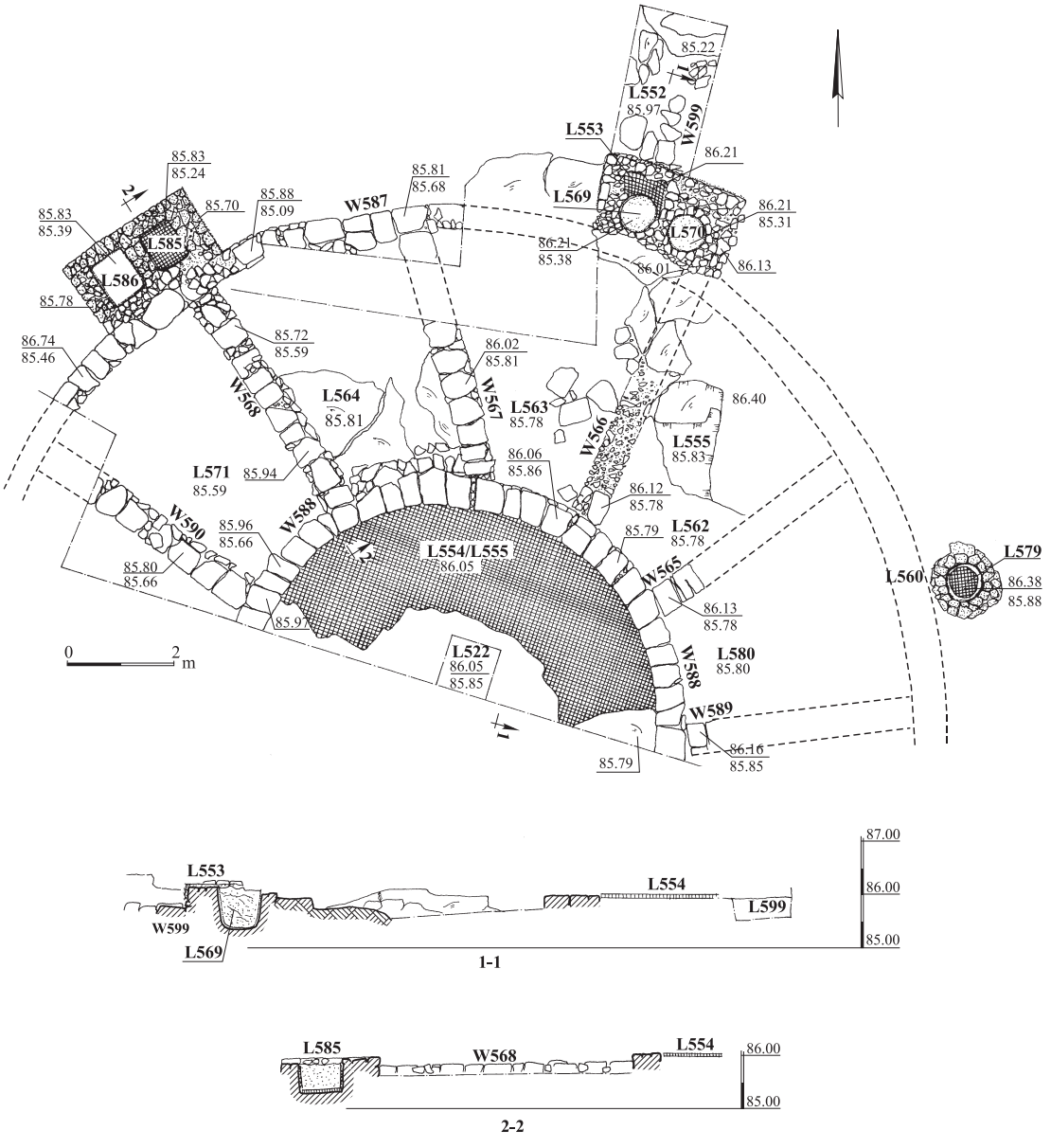


Fig. 22. The winepress at Ḥorbat Siv, plan and sections (see Sa‘id and ‘Ad 2011: Plan 10).

at a higher level. Attached to these spaces, on the opposite side, is a long, perpendicular, narrow space with three round basins, each connected to the space in front of it through a gutter. All the components were plastered and paved with mosaic floors.

Based on the archaeological evidence, it seems that in the Byzantine period every town, village and agricultural estate in the Southern Levant had at least one large *Bet-Gitot*. In many sites, two or even more such installations have been discovered. The larger the

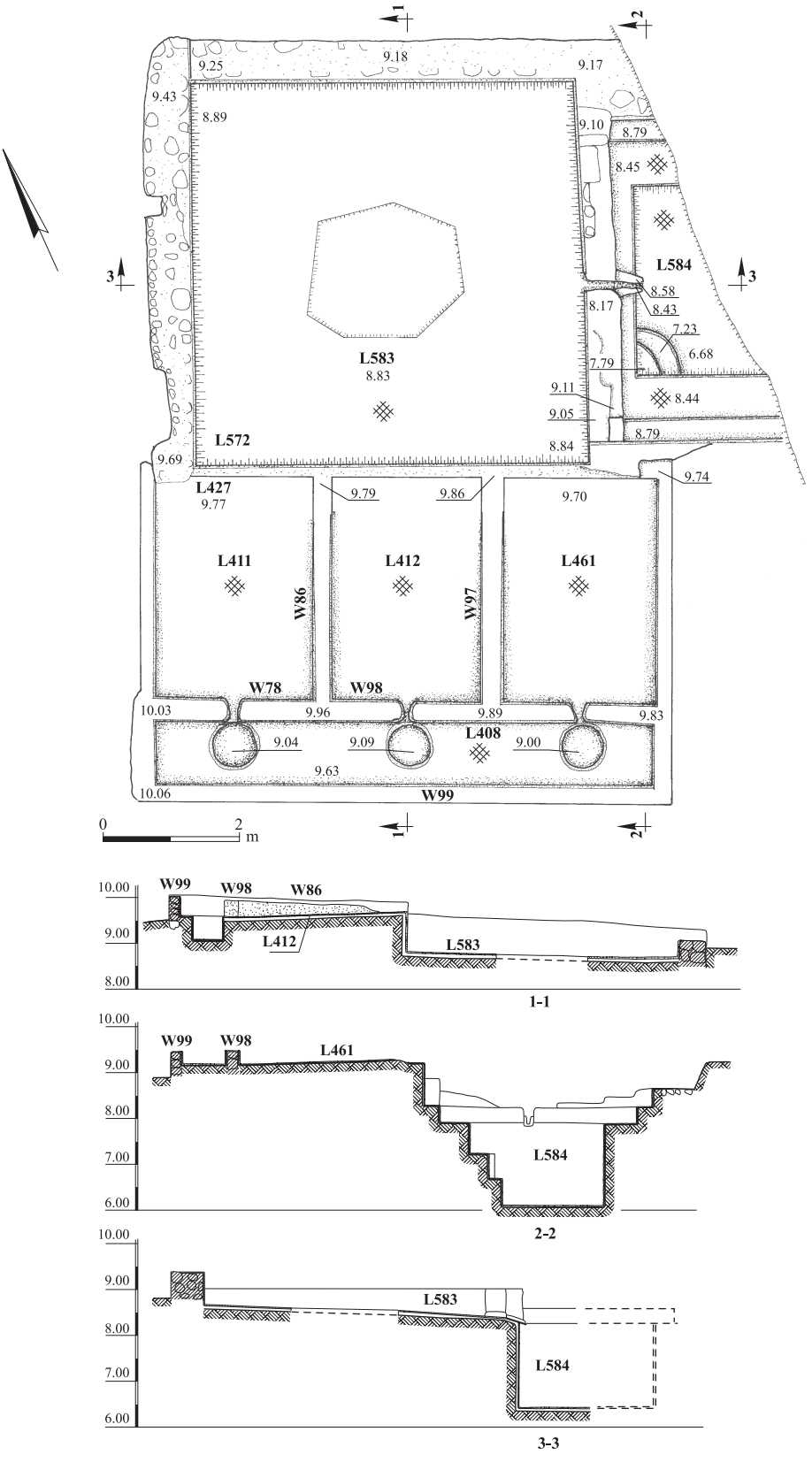


Fig. 23. The winepress at Tel Ifshar, plan and sections (see Yannai and Ayalon 2021: Plan 5).

Fig. 24. The winepress at Tel Ifshar, looking south (see Yannai and Ayalon 2021: Fig. 13).

number and scale of these winepresses, the larger the amount of wine produced within them, substantially exceeding the needs of the local population (Ayalon 1997:163). This evidence, as well as the distribution throughout the Mediterranean basin and Europe in the fourth–sixth centuries CE of locally made pottery jars, in which wine was marketed (Fig. 25; Zemer 1977:61; Mayerson 1992:76–77; Kingsley 2002: 80)—further supported by historical sources (Mayerson 1985:75)—demonstrate that the Southern Levant was an important exporter of wine in the Byzantine period.

Most of the *Bet-Gitot* installations were abandoned following the Muslim conquest in the seventh century CE (Ayalon 1997:163–164), probably due to the severance of trade relations. Recently published archaeobotanical research has shown that the decline of viticulture in the Negev and the southern coastal plain in Israel occurred earlier, in the mid- to late sixth century CE, a few decades before the Muslim conquest, probably due to a combination of climate change, plague and sociopolitical developments (Fuks et al. 2020; Avni, Bar-Oz and Gambash 2023). However, there is also evidence of winepresses of this type still functioning up until the eighth century CE (Seligman et al. 2023:20).

Fig. 25. Distribution map of the major locations of exported Gaza and bag-shaped jars beyond the Southern Levant, according to Kingsley (2002:80) (graphics: Y. Dray).

From Grapes to Wine

The action of treading initiates a complex biochemical process, in which the grapes are cracked open, releasing their chemical components. In this process, the components dissolved, eventually leading to an alcoholic beverage with a unique color, aroma and taste.[7]

Grapes consist of seeds, flesh and skin (Fig. 26), which, along with attached vine stalks, have a role in producing wine: the seeds and stalks contain tannin; the skin has pigments, tannin and stabilizing anthocyanins and polyphenols; and the flesh contains water, sugars and acids. The yeasts, which occur naturally on the vines and in the surrounding environment, are crucial to breaking down the grapes and separating their constituent chemicals. The purpose of treading the grapes is to crack the skin and to crush the fruit, the result of which is to promote accelerated and comprehensive interaction between all the physical and chemical components of the grapes. Once the skin is cracked, the grape juice seeps out, thereby creating an absorption substrate for the pigments being released from the plant cells. In addition, the treading action oxygenates the liquid, which in turn helps provide optimum conditions for the yeasts to multiply and facilitates dissolution of compounds from the grape skin into the solution and creating conditions for a successful fermentation.

[7] I wish to thank the enologist, Yiftah Perets, for sharing his knowledge with me.

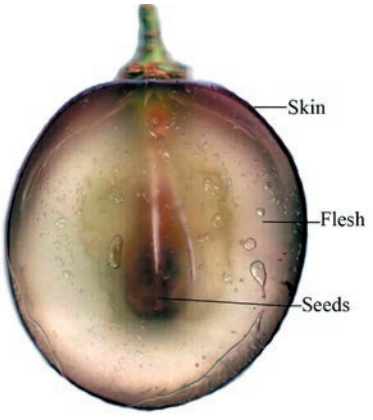


Fig. 26. Grape cross-section (photography: Y. Dray).

Oxygenation at this early stage is important for creating and stabilizing the red color of the wine. The gradual dissolving of skin pigments in the sugary grape juice begins early in the initial treading stage before alcoholic fermentation has begun and may continue for several hours or days (Ribéreau-Gayon, Dubourdieu, Donèche and Lonvaud 2006:327–395).

Polyphenols and tannins are found in the inner involucre of the plant cell vacuole. As alcoholic fermentation begins and the level of ethanol increases, their rate of dissolving in the alcohol increases. As fermentation proceeds, another process occurs when tannins from the seeds are solubilized as their cuticle begins to dissolve in the ethanol and augmenting those solubilized from the skins. This leads to the creation of unique polymers which enable the wine to mature and to maintain color quality, enhance its taste and prolong its shelf life (Ribéreau-Gayon, Glories, Maujean and Dubourdieu 2006:191–192).

It is noteworthy that when producing red wine, the whole mixture of skins, must and seeds remains together for some time before being separated to allow the completion of the process. This is the Rosetta Stone of understanding the technology of winemaking in antiquity.

The Production Process in the Winepresses

Wine is the product of a natural process that will also occur without any human intervention; however, the production of high-quality wine on an industrial scale requires optimal conditions. The grapes must first be trodden, cracked and crushed. Then, the mash is left to ferment for several days, or even months, whence the 'free-run' wine is drained and collected for secondary fermentation. The mash that still contains wine residue is further pressed, with impurities removed through precipitation and collected separately for secondary fermentation (Fig. 27). For millennia since the discovery of wine, many different installations have been constructed to control this natural process and produce large quantities of good-quality wine with consistent color, aroma and taste.

Wine Production in the Gat

The harvested grapes were transported to the *Gat* and placed on the uppermost part of the installation—a vat[8] with a plugged outlet—where they were trodden and left to ferment for

[8] Note that what usually survives in the field is only the hewn bottom of the vat, thus identified as a surface, but this is, in fact, the treading-fermenting vat.

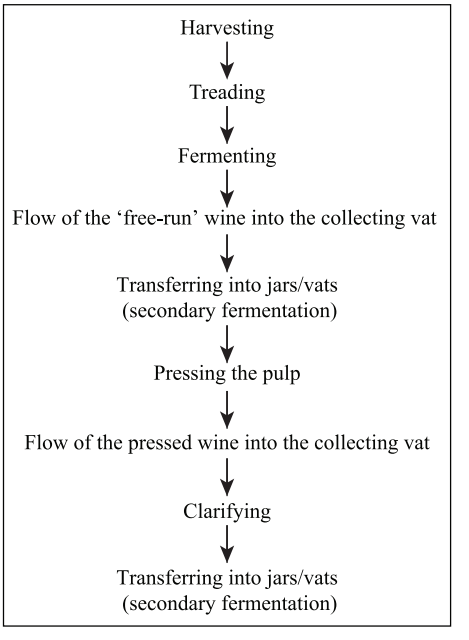


Fig. 27. Wine-production process
(graphics: Y. Dray).

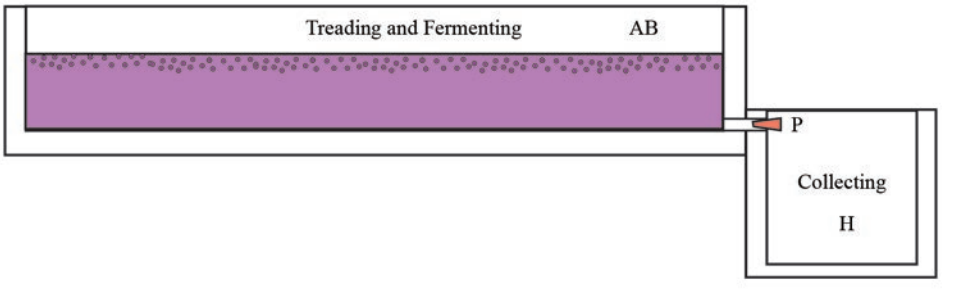


Fig. 28. Winemaking process in a typical *Gat*, schematic section: AB – treading and fermentation vat; P–drainage; H–collecting vat (graphics: Y. Dray).

the required time (Fig. 28). Following this initial fermentation, the stopper was removed from the outlet at the bottom of the vat (Fig. 28:P), allowing the 'free-run' wine to flow into the collecting vat (Fig. 28:H), the lowermost part of the installation, from where it was collected in jars for secondary fermentation. In the last stage, the mash remaining in the upper vat was pressed using a weighted beam or squeezed through a cloth sheet. This wine was drained into the collecting vat; once clarified, it was collected in jars for secondary fermentation.

Wine Production in the Bet-Gitot

The harvested grapes were transported to the *Bet-Gitot*, where they were placed on the uppermost element of the installation—the treading floors (Figs. 29; 30a; 30b:A). While trodden, the mixture of must and skins was transferred through a perforation (diam. 8–10 cm) to plugged fermentation vats beneath the treading floors, where they were stored and the fermentation process began, the liquid gradually turning into wine (Fig. 30b:B). The skins and seeds would then float atop the liquid, forming sort of a 'cap' that prevented the over-oxidation of the mixture, as the fermentation process released a large amount of carbon dioxide (CO_2). Once the initial fermentation had ended, the 'free-run' wine was drained and directed into one of two collecting vats.

The fermentation vats were arranged around a central paved working surface. They were filled to just below the level of their window-like opening (60 × 60 cm; Fig. 30b:C), 60–70 cm above the floor of the vat, through which the pulp was transferred after draining out the 'free-run' wine. The dimensions of the central working surface reflected the size and number of fermentation vats surrounding it (Fig. 30b:D). The central working surface has in the past been erroneously identified as the "treading surface" (for example, Seligman 1999:163; Frankel 2009:2; Avrutis 2015:56, Fig. 3.1; Dayan Barken and Radashkovsky 2020:298–301).

The pulp that remained in the fermentation vat after draining the 'free-run' wine contained 10–15% of the total amount of wine produced. This pulp was transferred to a press device,

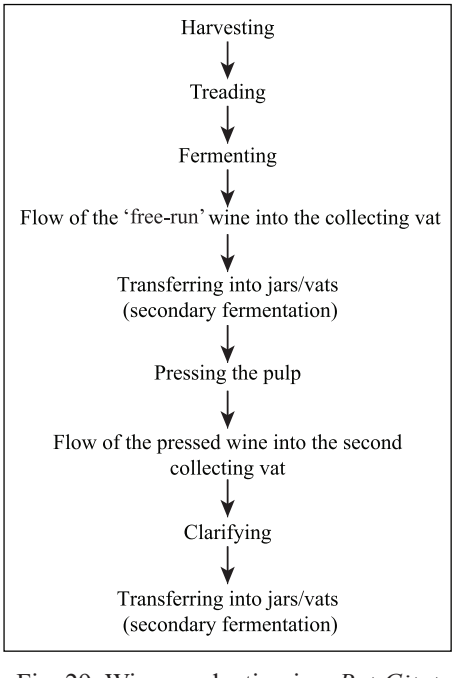


Fig. 29. Wine-production in a *Bet-Gitot* (graphics: Y. Dray).

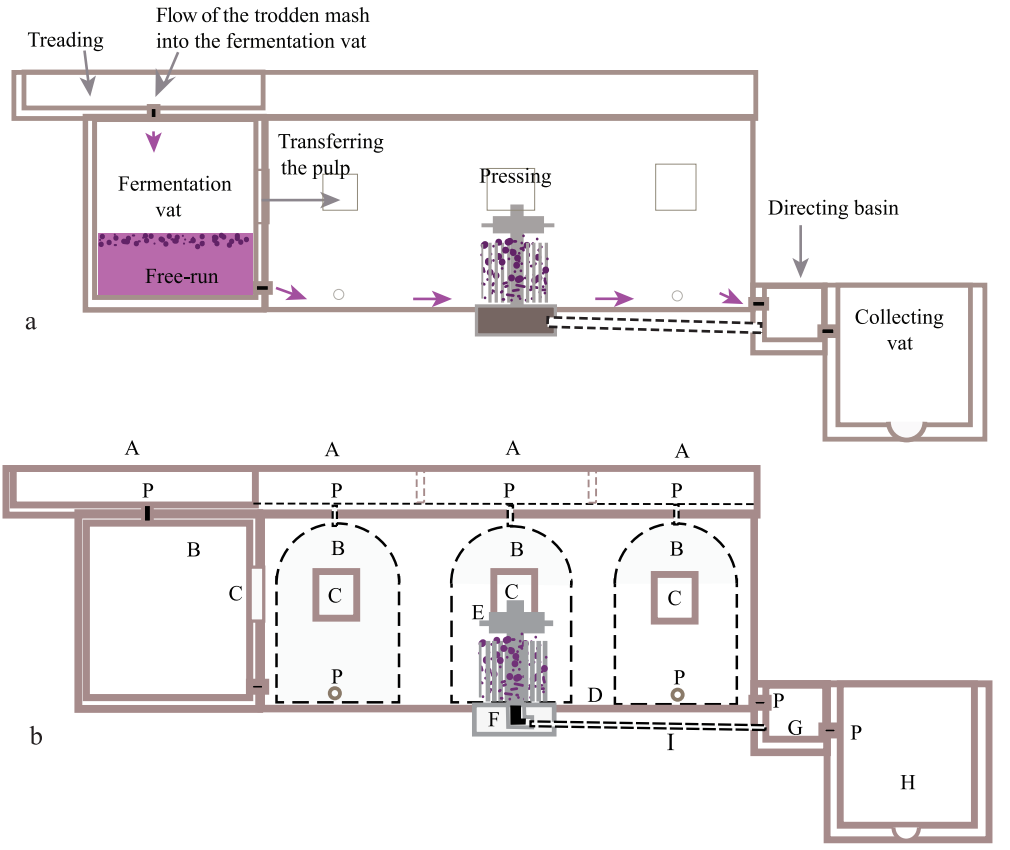


Fig. 30. (a) Winemaking process in a typical *Bet-Gitot*, schematic section; (b) schematic section of a typical *Bet-Gitot*: A–treading floors; B–fermentation vats; C–openings of vats; D–central working surface; E–screw-press; F–anchoring stone; G–directing basin; H–collecting vats; I–drainage of screw-press; P–drainage pipes (graphics: Y. Dray).

either a lever and screw-press[9] installed over the working surface, or a direct-pressure screw-press installed in the center of the working surface, while anchored to a monolith with a carved mortice and surrounded by a grille (Fig. 30b:E, F).[10] It made ergonomic sense for the press to be located in the center of this area as pressing was the most labor-intensive task, i.e., equal distances between the fermentation vats and the press facilitates the task. This rationale is well-illustrated in *Bet-Gitot* installations with a circular central working surface surrounded by fermentation vats.

[9] Earlier versions of *Bet-Gitot* installations were unearthed at el-Khirbe in the Nesher-Ramla quarry (Avrutis 2015:21–24, Figs. 2.20, 2.21, 2.22) and at Har Ḥoma in Jerusalem (Zelinger 2022:278–280, Plan 1, Fig. 27).

[10] Most of the *Bet-Gitot* installations comprise a drainage system in the form of a channel or a pipe beneath the central working surface, leading from the screw-press anchoring stone to one of the collecting vats, or into a basin (Figs. 30a; 30b:I). This system drained the fluid away from the wooden screw base to avoid expansion of the wood and consequently, the fracturing of the anchoring stone.

The lowermost part of the installation comprised large collecting vats for wine, built or carved into bedrock. There were usually two of these, one for the 'free-run' wine and another for the pressed wine (Fig. 30b:H). The volume of the two collecting vats reflects the scale of production and the amount of macerated mash in the fermentation vats.

Between the central working surface and the collecting vats was a directing basin, through which the wine was channeled to the desired collecting vat, one for the 'free-run' wine and the other for the pressed wine (Fig. 30b:G). As its name suggests, this basin was meant for directing and not for filtering (see below), as previously suggested (see, e.g., Seligman 1999:146; Avshalom-Gorni, Frankel and Getzov 2008:61; Dayan, Barken and Radashkovsky 2020:301; Seligman, Haddad and Nadav-Ziv 2022:249–253). 'Free-run' wine is clear once it flows into the collecting vat and does not require filtering. Pressed wine, however, contains suspended particles that cannot be subjected to rough mechanical filtration. Precipitation or clumping of the suspended particles was accomplished by the addition of marl, kaolin, or similar substances that attracted suspended particles and sank to the bottom of the collecting vat, thereby clarifying the pressed wine. Most of the collecting vats have a basal depression to accommodate this sediment, as well as to allow efficient collection of the liquid.

The combination of fermentation vats, a central working surface, collecting vats and the volume ratio between them define an installation as a *Bet-Gitot*. The absence of one or more components may indicate the need for an alternative identification of such finds in the field. Not every built or hewn surface with a vat next to it meets the definition of a winepress, *Gat* or *Bet-Gitot.*

Some *Bet-Gitot* installations had just a single collecting vat. In these instances, the 'free-run' wine was collected directly into jars in niches set below the fermentation vats (Figs. 31; 32a; 32b:N). The rest of the process was the same as in the other *Bet-Gitot* installations,

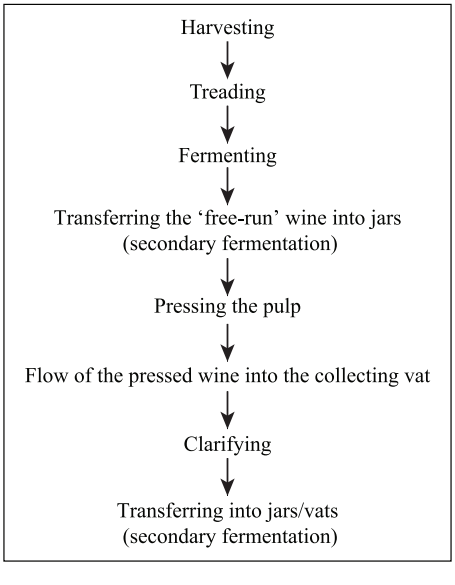


Fig. 31. Wine-production in a *Bet-Gitot* with niches (graphics: Y. Dray).

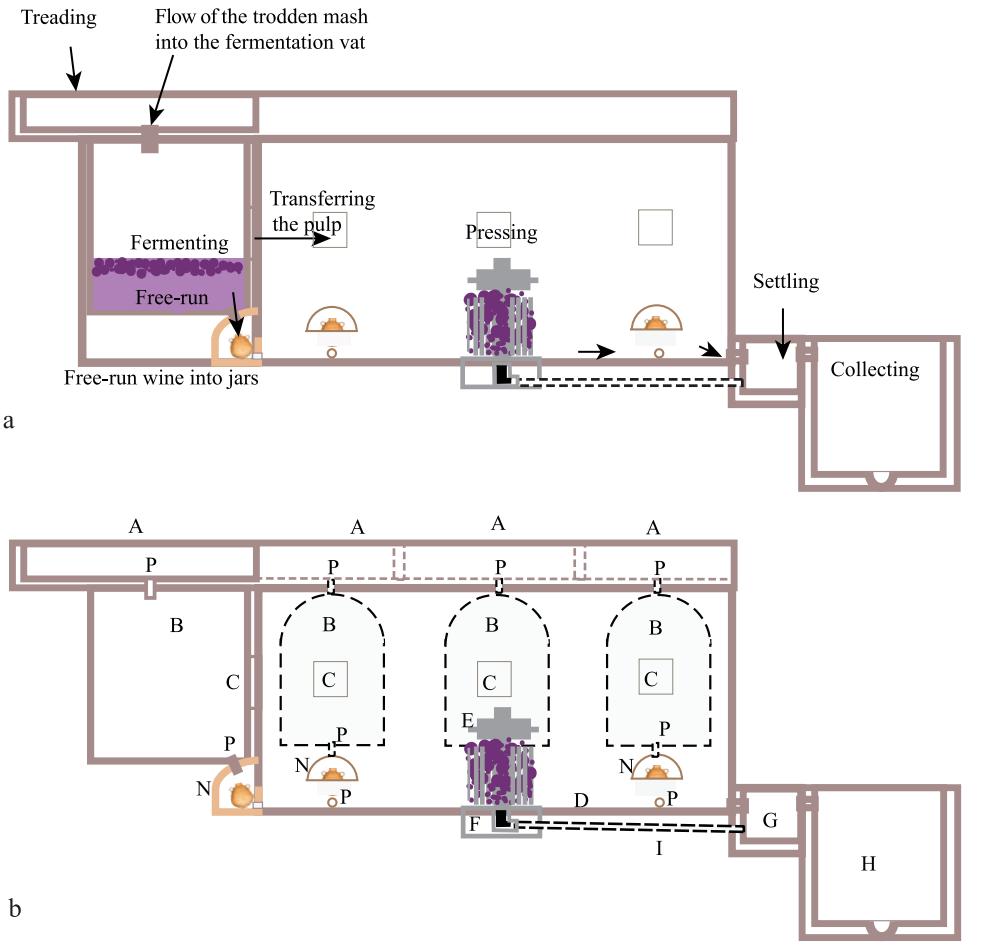


Fig. 32. (a) Winemaking process in a typical *Bet-Gitot* with niches, schematic section; (b) schematic section of a *Bet-Gitot* with niches: A–treading floors; B–fermentation vats; C–openings of vats; N–niches; D–central working surface; E–screw-press; F–anchoring stone; G–settling basin; H–collecting vat; I–drainage of screw-press; P–drainage pipes (graphics: Y. Dray).

where the pressed wine was drained into the single collecting vat. In such a case, sometimes, the directing basin was replaced by a settling basin designed for settlement of some of the suspended solids in the pressed wine on its way to the collecting vat. In accordance with their different functions, a directing basin would have an outlet pipe lower than the inlet pipe, whereas a settling basin would have its inlet and outlet pipes at approximately the same height (compare Fig. 32b:G with Fig. 30b:G).

This fixed formula implies that if a central working surface is discovered in the field, with remains of a central screw-press surrounded by niches in its peripheral walls, then the *Bet-Gitot* would comprise only one collecting vat. Also, it may be concluded that if a single

collecting vat is discovered next to a central working surface that includes remains of a central screw-press, even if the periphery of the installation is missing, one can confidently reconstruct niches along with fermentation vats above them.

As for the small basins, occasionally incorporated in the external walls of *Bet-Gitot* installations or outside them, the author considers that they were installed to bleed off some of the juice directly from the fermentation vats in the first stage of the process to obtain a more concentrated solution of color and tannin in the residual mash. By this, a fuller-bodied wine with more concentrated color and taste may be produced. The must that had been bled off was probably used to produce other products, such as *dibs* (Arabic; grape honey). In such cases, one can expect to uncover nearby *ṭabun*s (Arabic; ovens)[11] used to boil down the must and reduce the sugary liquid to concentrated grape honey. Another possibility is that small basins arranged outside the fermenting vats and connected to each of them directly, functioned as niches to collect the 'free-run' wine.

DISCUSSION

The argument set forth here is that the *Gat* and the *Bet-Gitot* illustrate the progress of wine production and technical improvements over the course of thousands of years. Winemaking in the Southern Levant began allegedly in the Chalcolithic period (see n. 5) in relatively small facilities, which developed during the Roman period, reaching a peak in the Byzantine period, with installations that demonstrate technical sophistication, allowing for a large-scale production. The set-up of treading floors above fermenting vats,[12] which in turn were set above the working surface located above the collecting vats, offers a new understanding of the novel technology and its influence on the development of the wine industry in the Byzantine Southern Levant to meet the increasing demand.

The origin of the new technology is indeed the *Gat*, where the treading surface doubled as a fermentation vat: the grapes were left to ferment where they were trodden. This was accomplished by raising low walls around the flat surface, transforming it into a vat with a plugged outlet (Figs. 33; 34). Once the fermenting process ended, the plug was removed from the outlet, allowing the wine to flow into the collecting vat.

To meet the growing demand for wine, the *Bet-Gitot* was designed to significantly boost the *Gat* production capacity. It comprises several *Gitot* arranged on three sides of a surface, forming a square, with a central screw-press. Instead of the relatively small collecting vat of

[11] At Bet Dagan, *ṭabun*s were found near a *Bet-Gitot* (Peilstöcker and Kapitaikin 1998:85). The excavators understood them to be related to a metal industry; this, however, seems to be of low probability as those installations cannot reach the temperature required for metal smelting.

[12] Other scholars had suggested to identify these surfaces as "waiting surfaces" (Avshalom-Gorni, Frankel and Getzov 2008:64), "auxiliary surfaces" (Frankel 2009:3) or "treading floors" (Avrutis 2015:203). Recently, these surfaces were interpreted as fermentation vats, but for the must itself (Dayan, Barken and Radashkovsky 2020:299).

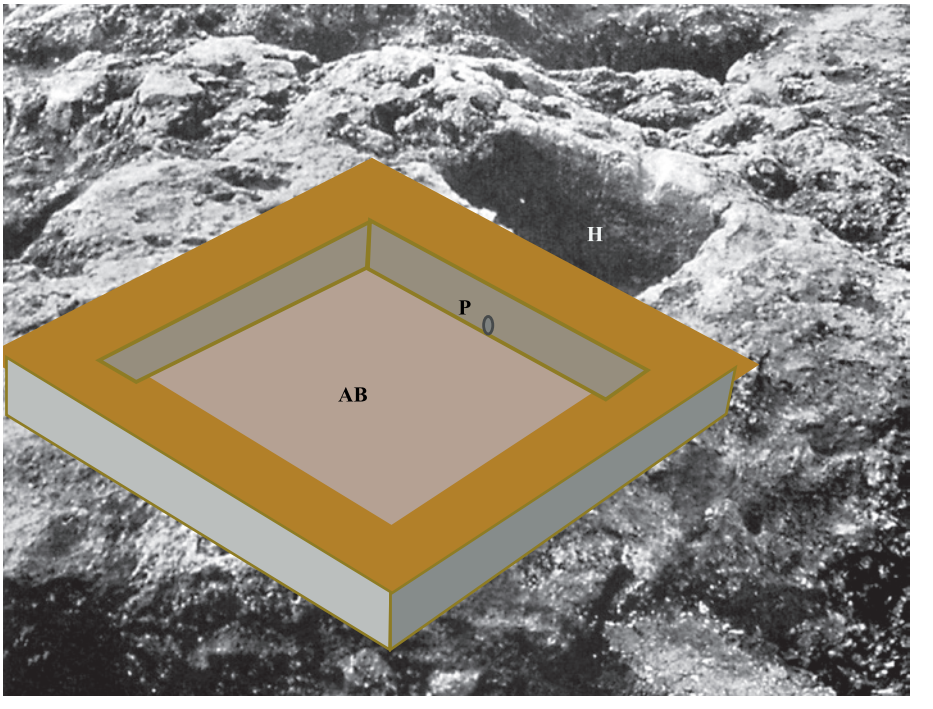


Fig. 33. The author's reconstruction of Ḥorbat Tittora: AB–treading and fermentation vat; P–drainage; H–collecting vat (graphics: Y. Dray; after Lass 1998: Fig. 136).

the *Gat*, rock-cut or built large-sized vats were constructed on the fourth side of the formed square to collect the production of the total volume capacity of fermentation vats. Coupled together, the treading floors constructed above each fermenting vat, the working surface with the central screw-press, the collecting vats and the drainage system between them—all comprise a *Bet-Gitot*, which is an upgraded version of the *Gat* (Fig. 35). This upgrade turned the winepress into a 'factory' operating within one roofed[13] complex to produce large quantities of wine for export. The area of the working surface, previously and mistakenly called a "treading floor," reflects the number and the size of the fermenting vats.

The layout of the *Bet-Gitot* best attests to the significance of gravity in the winemaking process, which was heretofore overlooked by previous researchers. All the components of the *Gat* and the *Bet-Gitot* conform to the physio-technical aspect of the production process, in which the first phase takes place in the highest part of the installation and the last phase, in the lowermost one. Thus, the winepress is an installation that works on the principle of gravity: simple, smart, efficient and logical.

[13] Seligman (1999:163) suggested, following Rahmani (1991:105), that the "auxiliary floors" above the vaulted "collecting compartments" that surrounded the "main treading floor" were roofed. He failed, however, to explain their funtion, idenifying them as waiting/storage elements. These should be understood as fermentation vats above vaulted niches in a *Bet-Gitot* with one collecting vat.

Fig. 34. The author's reconstruction of a Ta'anakh-type *Gat* operation: raising walls and combining the Egyptian wall painting from the Middle Kingdom period with the winepress from Gan-Ner: AB–treading and fermentation vat; H–collecting vat (photography and graphics: Y. Dray).

A note concerning the small version of the *Bet-Gitot* is in place here. This installation should also be reconstructed with fermentation vats around the working surface with treading floors above them. The winemaking process carried out in the small *Bet-Gitot* is the same, but with a different pressing device.[14] In the past, the treading action was considered an activity aimed at extracting the must from the grapes. It should be emphasized, however, that many other installations are known from different periods in antiquity to have been used to extract liquids, reflecting ingenuity and efforts to improve and optimize their operation over time, such as laying heavy stones on a wooden board, using heavy wooden beams as

[14] The find of a 'lever and screw-press' at el-Khirbe in the Nesher-Ramla quarry and at Har-Ḥoma in Jerusalem is so rare that one of the excavators erroneously posited that the winepress was converted into an Early Islamic olive-oil press (Avrutis 2015:24). In my opinion, such an installation cannot be transformed into an olive-oil press, mainly because it lacks a crushing device but also because of the volume of the collecting vat, as only 10% of oil can be produced from olives, whereas from wine, 90%. Therefore, the dating should be reevaluated.

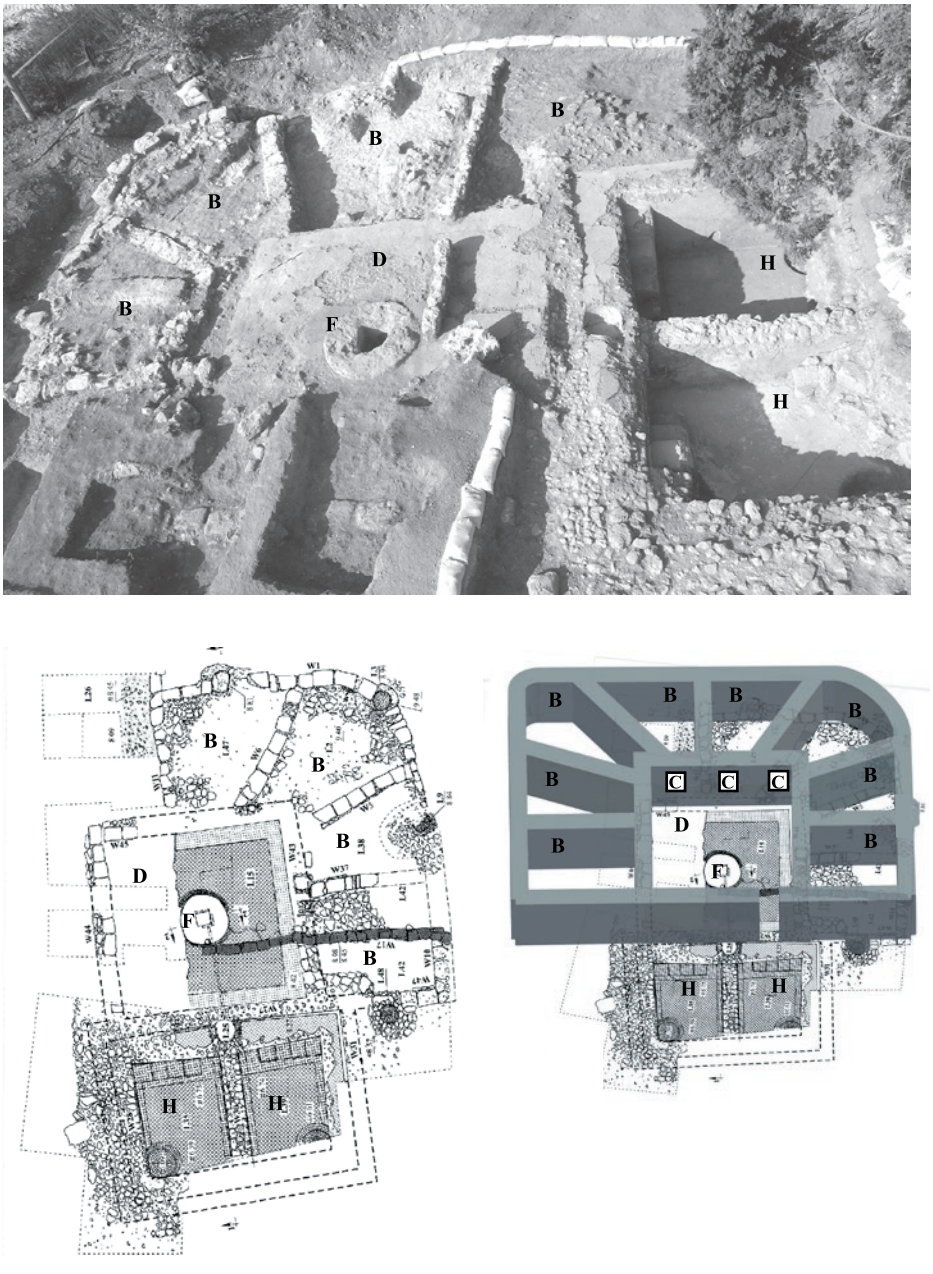


Fig. 35. The author's reconstruction of the Mishmar Ha-'Emeq winepress: B–fermentation vats; C–fermentation vats' openings; D–central working surface; F–screw-press anchoring stone; H–collecting vats (photograph and plan after Avshalon-Gorni, Frankel and Getzov 2008: Fig. 1, Plan 1; graphics: Y. Dray).

Fig. 36. Various presses in ancient descriptions: (a) twisted fabric on an Egyptian wall painting from the Middle Kingdom period (see Tchernia and Brun 1999: Fig. 108); (b) beam and weights on a sixth-century BCE pottery vessel (see Tchernia and Brun 1999: Fig. 84); (c) beam press on a third-century CE mosaic floor (see Tchernia and Brun 1999: Fig. 92); (d) screw-press on a sixth-century CE mosaic floor at Mt. Nebo (see Piccirillo 1992: Fig. 206).

levers to increase the extraction pressure, and pressing with a screw device (Fig. 36). Why then would the ancient winemaker opt to press the grapes with his bare feet? The treading action was meant not simply to extract the juice but to crack open the grapes and allow an interaction between the skins and pulp. The later mechanical pressing stage was designed only to extract the relatively small amount of wine from the skins after fermentation and the draining off of the 'free-run' wine.

The ancient mosaics depicting workers treading the grapes around a screw-press (see Piccirillo 1992:158; Tchernia and Brun 1999:76) should not be viewed as a detailed technical description of the installation and the work performed at each stage of the process, but rather as a symbolic rendering of the winepress' operation.[15]

[15] On the concept of "a whole process in one frame" in ancient art, see Gersht 2001.

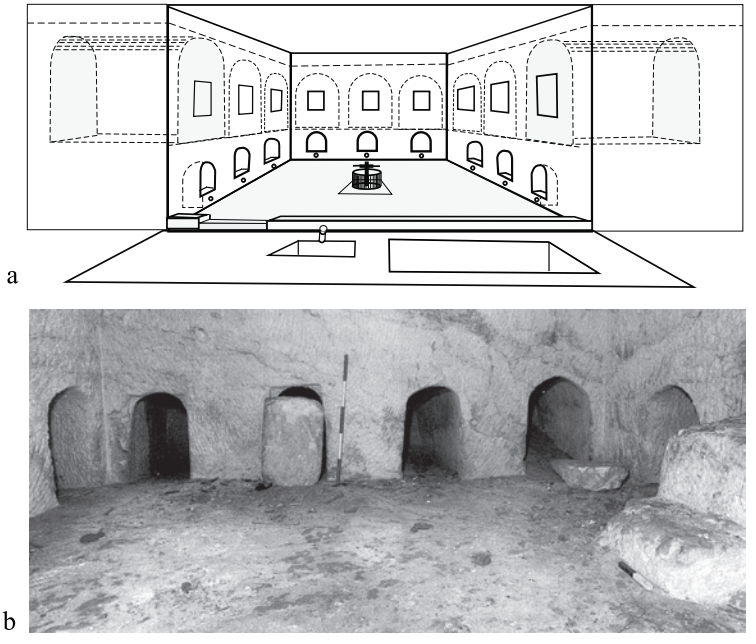


Fig. 37. (a) Inner view of a *Bet-Gitot* based on the author's reconstruction (graphics: Y. Dray); (b) Cave 1, Chamber C, in the Akeldama tombs (see Avni and Greenhut 1996: Fig. 1.11).

The rationale behind the Hebrew terminology, i.e., *Bet-Gitot* (Tosefta, *Terumot* 3:7), is elucidated by its being the plural form of *Gat*. The *Gat* features a vat designed to serve both functions, treading and fermentation, while plugged. This is a stage in the winemaking process described in the Jewish literature as *Gat Peqwqa*, i.e., a 'stoppered *Gat*' (BT, *'Avoda Zara* 55b). In the *Bet-Gitot*, being the plural of *Gat*, treading and fermentation were separated. These were allocated to different components, one atop the other, i.e., treading and then draining the mash into a plugged fermenting vat. Several such fermenting vats surrounded a working surface featuring a central screw-press. Removing the plug during the wine collection was carried out in a vat situated below the treading and fermentation vat in the *Gat*, and in the same way, in the *Bet-Gitot*, where the collection of wine from all fermenting vats was merged into one or two collecting vats. Further substantiation for the layout of the *Bet-Gitot* would be the illustrative description in the Tosefta (*Oholot* 15:7): ואיזה הוא חצר הקבר? זו הגת שהמערות פתוחות לתוכו, "And what is the courtyard of the tomb? That is the *floor* to the midst of which the caves open". Neusner (1977:121) translated *gat* as "floor" (Fig. 37). While some Jews were prohibited by halachic purity laws from entering cemeteries, they nevertheless could envisage a tomb complex through its similarity to the *Bet-Gitot* with its central working surface surrounded by fermentation compartments.

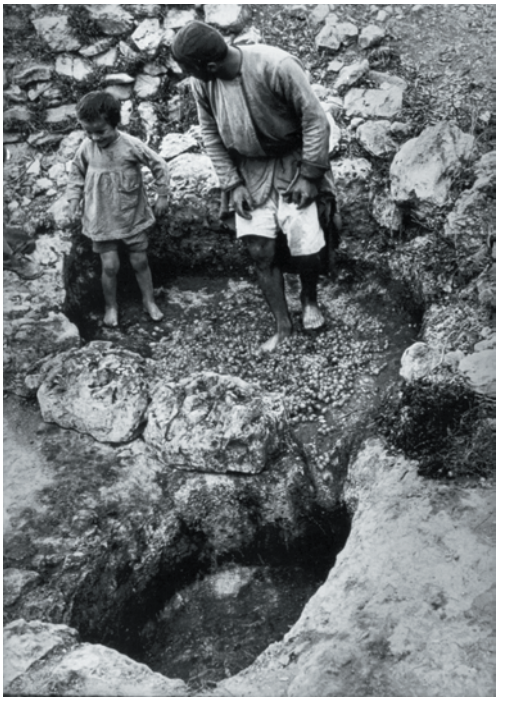


Fig. 38. Villagers treading grapes in an ancient winepress in Hebron, 1980s (photography: Y. Ben Ya'akov; see Ayalon, Frankel and Kloner 2012: article cover).

The study of ancient production processes is frequently accomplished based on a comparison with ethnographic parallels. This comparison, however, must be restricted to the production process of the same product. In this regard, the reference to a late twentieth-century photograph (Fig. 38; see, e.g., Ayalon, Frankel and Kloner 2012:15),[16] or a nineteenth-century illustration (Fig. 39; see, e.g., Frankel and Ayalon 1988: Fig. 93), which show villagers treading grapes in ancient winepresses in Hebron and collecting the must, is misleading and irrelevant, as the product of this process is grape honey (*dibs*), not wine.

In contrast to these illustrations, a relevant parallel is the technology applied by the Jewish settlers in Palestine at the end of the nineteenth century, supported by the famous Baron Edmond James de Rothchild, which testifies to a renaissance of the Byzantine wine production process. The wineries that the Baron founded in Palestine operated on principles

[16] For the reader's attention, in the remains of the ancient *Gat*, where the villager produces grape honey, the original walls of the treading and fermenting vat have been preserved.

Fig. 39. Treading grapes, Hebron Mountains, nineteenth century
(Illustration: A.H. Harper; see Geike 1890:288).

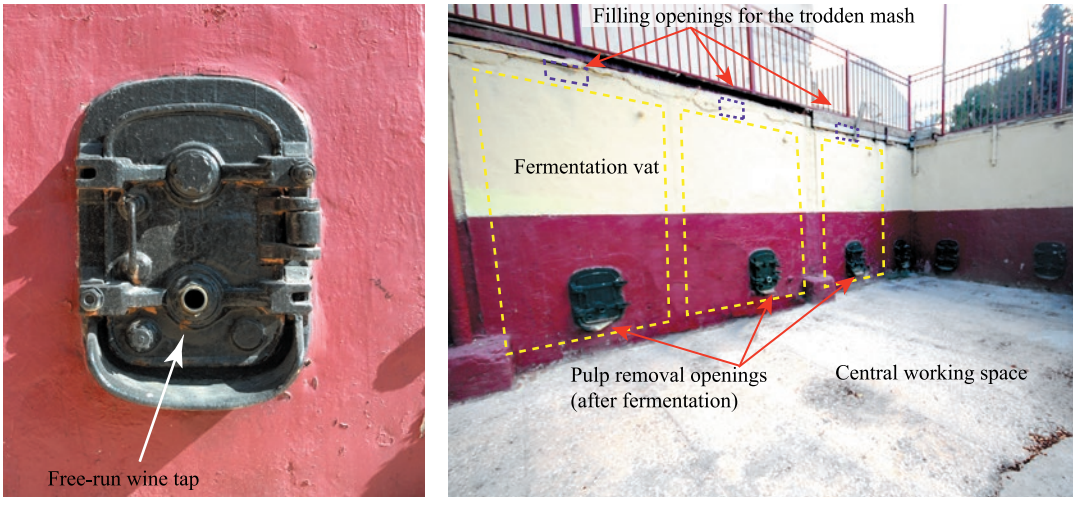


Fig. 40. Carmel-Mizrachi winery in Zikhron Ya‘aqov (photography and graphics: Y. Dray).

similar to those of the *Bet-Gitot*, albeit with some minor differences, such as mechanical crushing instead of treading, the use of a portable press instead of a fixed one, and pumps rather than gravity to transfer the wine for secondary (malolactic) fermentation (Fig. 40). Even in rural Europe today, families with a winemaking tradition use the same ancient

method, where the grapes are first crushed into fermenting vats (Fig. 41), then the mash is suspended for several days to ferment (Fig. 42), allowing the 'free-run' wine to drain off and be collected (Fig. 43), and finally, the remaining mash is subjected to screw pressing to extract any remaining liquid (Figs. 44, 45).

Fig. 41. Cylinder crusher, Cyprus (photography: Y. Dray).

Fig. 42. Fermentation vats in a domestic winepress in Monte-Laterone, Tuscany, Italy: B–vats, C–vats' openings (photography: Y. Dray).

Fig. 43. Draining 'free-run' wine from a fermentation container in a domestic winepress in Monte-Laterone, Tuscany, Italy (photography: Y. Dray).

Fig. 44. Retrieving the pulp from the fermentation container in a domestic winepress in Monte-Laterone, Tuscany, Italy (photography: Y. Dray).

Fig. 45. Pressing in a portable screw-press in a domestic winepress in Monte-Laterone, Tuscany, Italy (photography: Y. Dray).

As for the reliance on ancient texts, these can be useful as long as they reflect on the era in which they have been written. The first-century CE texts of Pliny the Elder and of Columella have been used to substantiate theories for understanding the winemaking installations in the Byzantine period, i.e., centuries later, in the Southern Levant (Avshalom-Gorni, Frankel and Getzov 2008:57; Ayalon, Frankel and Kloner 2012:31; Frankel and Eisenberg 2018:61). This extrapolation cannot be substantiated as *Bet-Gitot* installations have not been invented yet.

Another issue that scholars have debated over is where the wine was stored for secondary fermentation and ageing. In some *Bet-Gitot* installations, the openings leading from the bottom of the niches to the working surface were found blocked with mortar. Moreover, the mosaic tesserae in the fermentation vats above them were more deeply and severely eroded than the other mosaics in the same *Bet-Gitot* (Fig. 46). In my opinion, these vats above the niches should be identified as containers for secondary fermentation and ageing, during which the limestone tesserae were eroded by the acidity of the wine. Furthermore, the external basins in the *Bet-Gitot* installations, which were connected through outlets directly to these vats, may have served as a selling point of the matured wine, without the need of

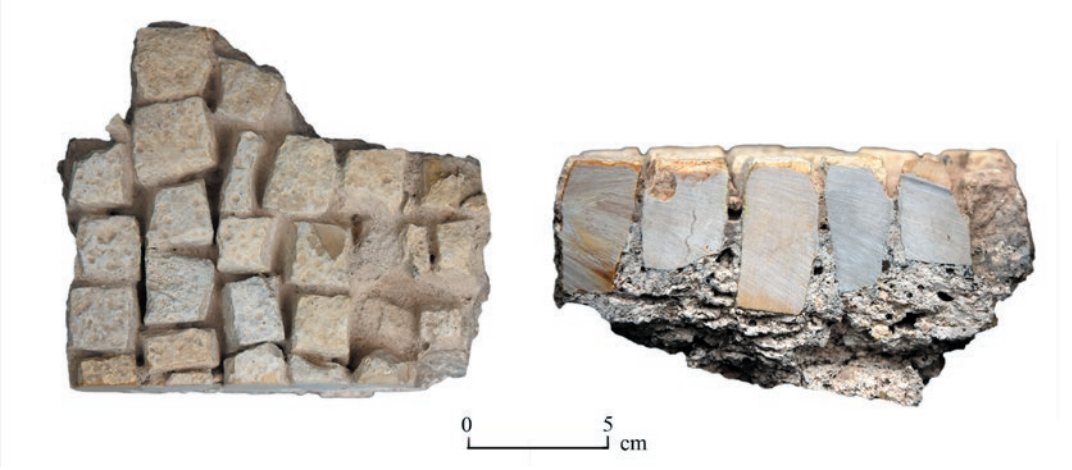


Fig. 46. Top view and a cross-section of the fermentation vat's mosaic floor from the *Bet-Gitot* of el-Khirbe in the Nesher-Ramla quarry (photography: Y. Dray).

buyers to enter the facility. In any case, it must be borne in mind that these installations were designed solely to produce wine, as no other product, or operation, could be performed in them, primarily due to the risk of contamination.

Another major agricultural product of the Southern Levant was olive oil. While both wine and olive-oil production were widespread in the region, especially in the Roman and Byzantine periods, and primarily involved liquid extraction, they are substantially different: olive oil was extracted mechanically, while wine was produced in a natural chemical-biomechanical process. Furthermore, the production of olive oil requires just a few hours, while several months are required to produce wine. When assessing installations exposed in the field, it is important to understand the basic and very different principles involved in producing each commodity and in the design of the structures where these processes were carried out. Not every installation comprising a surface and a vat is a winepress, and the ratio of surface area to size of collecting vat is important.[17]

The discovery of a complete installation at Khirbat Mulabbis in Petaḥ Tikwa,[18] dating from the Byzantine period, which was remarkably well-preserved up to the height of its uppermost level (Gudovitch 2009:203–211), allowed for the first time to determine the function of each and every one of its components. Notwithstanding the evidence, some

[17] Examples of installations comprising surfaces and vats, which were wrongly identified as winepresses, were unearthed at Akhziv (Syon 1998) and Ramla (South), north of Moshav Mazliaḥ (Gorzalczany and Marcus 2010).

[18] I wish to thank Shlomo Gudovitch, for allowing me to elaborate on his excavation at the site of Khirbat Mulabbis in Petaḥ Tiqwa.

Fig. 47. Aerial view of the *Bet-Gitot* installations at Yavne (photography: A. Peretz, courtesy of the Israel Antiquity Authority).

researchers may have been hidebound by their acceptance of old theories, not internalizing the magnitude of this discovery. As a result, the structure, its components and its technology were misinterpreted (see, for example, Ayalon, Frankel and Kloner 2012:32, n. 60). As a consequence, the expertise of the ancient winemakers has been undervalued.

The recent discovery of the Byzantine *Bet-Gitot* installations in ancient Yavne (Viezel and Torge 2022:205–213; Fig. 47), whose plans parallel that of the *Bet-Gitot* at Khirbat Mulabbis, reinforces the new concepts elaborated on in this article. Yavne's industrial-scale complex of winepresses consists of several *Bet-Gitot* installations, one of which was preserved to the height of its upper treading floor (Fig. 48). Furthermore, at the bottom of the fermentation vat, underneath the outlets from the upper floor, marble tiles were set into the mosaic at the point where cascading liquid from the trodden mash would fall so as to prevent damage to the mosaic floor (Fig. 49).[19]

Every *Bet-Gitot* had treading floors and fermentation vats for the wine-production process. In excavations where these were reported missing, they had apparently been destroyed, since they were the uppermost element of the installation and thus, most vulnerable to damage through erosion and human activity. A good example of this is the recently excavated *Bet-Gitot* at Moẓa, which in photographs from 1942 still had niches, walls and mosaic floors of the fermentation vats (Fig. 50), much of which was subsequently

[19] I wish to thank the Israel Antiquities Authority team who excavated the winepresses complex in Yavne, for letting me use information and photographs of the site: Elie Haddad, Liat Nadav-Ziv, Jon Seligman, Hagit Torge and Mor Viezel.

Fig. 48. Upper treading floor remains on top of a fermentation vat in one of the *Bet-Gitot* installations at Yavne (photography: A. Peretz, courtesy of the Israel Antiquity Authority).

Fig. 49. A marble tile within the mosaic floor of a fermentation vat in one of the *Bet-Gitot* installations at Yavne (photography: A. Peretz, courtesy of the Israel Antiquity Authority).

a

b

Fig. 50. The *Bet-Gitot* at Moẓa: (a) photograph from 1942 (IAA Archives, 1919–1948); (b) snapshot from photogrammetry model, 2020 (preparation: A. Wiegmann, courtesy of the Israel Antiquity Authority).

lost in the intervening period.[20] It is also the case that when uncovering winepresses in archaeological sites, archaeologists who have in mind a mistaken premise may not identify all elements of the installation. In several sites where the fermentation vats were reported as missing, such as Ḥorbat Ḥermeshit, a reexamination of the remains found that they did in fact exist (compare Greenhut 1998:149 with Greenhut and Yron-Lubin 2009:249).

[20] I wish to thank the excavator, Uzi Ad, for his permission to use the photogrammetry model of the excavation at Moẓa, courtesy of the Israel Antiquities Authority.

Summary

This article offers a full comprehension of the *Gat* and the *Bet-Gitot* installations, and their role in the winemaking process, facilitating the interpretation of the archaeological remains of such installations, even when poorly preserved.

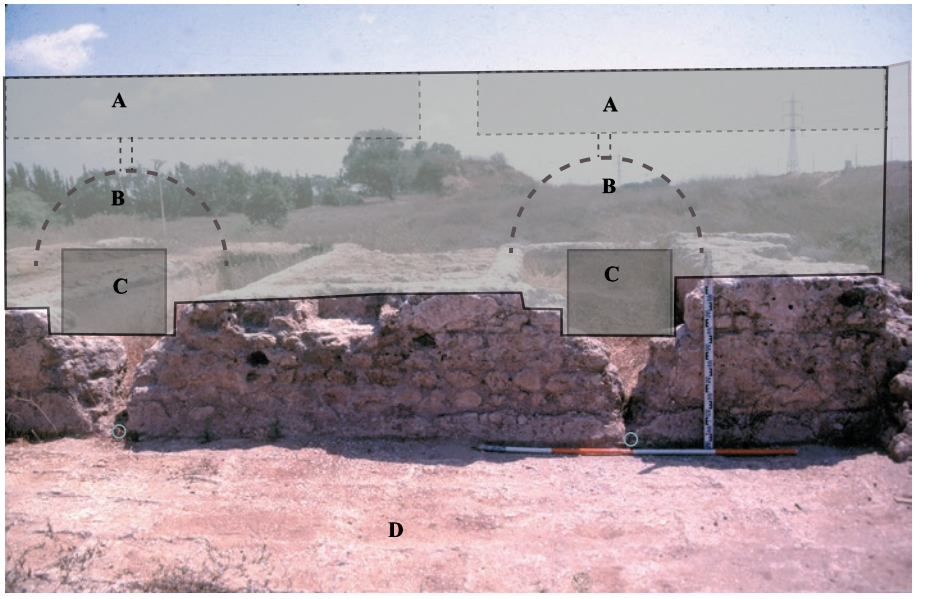
It is important that scholars refrain from rigid thinking and a blind adherence to past theories, as this may result in discoveries in the field being overlooked, misinterpreted or ignored. In the publication of Yavne's exceptional winemaking installations, for example, the excavators failed to identify the profound significance of their discovery, which provides the missing evidence to finally reconstruct the entire winemaking process in one installation, which produced quality wine on a commercial level with a long shelf life. In essence, the Yavne installations provide a crucial piece of the puzzle, advancing our comprehension of ancient viticulture.

Archaeology is a comparative field of study that often has to infer from only a tiny fragment of the complete find. Just as one can identify a ceramic vessel based on a rim fragment, one may reconstruct fragmentary and damaged winepresses based on the best-preserved and most complete installations, such as the *Bet-Gitot* installations at Khirbat Mulabbis (Petaḥ Tiqwa) and Yavne, which may serve as a template for reconstructing the missing elements of other such installations, such as the *Bet-Gitot* at Mazor and 'The Third Mile Estate,' Ashqelon (Fig. 51); el-Khirbe (Fig. 52); Kefar Sirqin (Fig. 53); Mishmar Ha-'Emeq (Avshalom-Gorni et al. 2008); Hame Yo'av (Avner 2022); Gan Ha-Darom (Dayan, Barken and Radashkovsky 2020); Mt. Gerizim (Magen 2000); Ḥorbat Qasṭra (Yeivin and Finkielsztejn 2009); and 'Avedat, Shivṭa and Ḥaluẓa in the Negev (Seligman 2020).

A complex typology of *Gat* and *Bet-Gitot* installations based on their layout (squared, rounded, octagonal, etc.), or the various definitions ('simple winepress', 'basic winepress', 'improved winepress', 'elaborate winepress', etc.), is unnecessary. There are *Gat* installations and *Bet-Gitot* installations, and attempts to further classify them are confusing and misleading (see, e.g., Frankel 1999:149–153; Hadas 2007:100–101; Avrutis 2015:55–71). The *Bet-Gitot* developed from the *Gat*, and any additional component, element or other nuance (each one with a functional explanation) does nothing to change the fundamental nature of the installation and the winemaking process carried out within them. The wine produced in the *Bet-Gitot* installations of the Byzantine period in the Southern Levant, which is likely to have pleased the modern palate, owes its good reputation to its high quality and long shelf life, attested in contemporary historical sources, such as Gregory of Tours, who in the sixth century CE extolled the wines of Gaza and Ascalon (*The History of the Franks*:103, 306; *Glory of the Confessors*:70). With this in mind, these long-misunderstood ancient winemakers should now regain the credit which they rightly deserve.

On a final note, a fundamental principle of archaeological, as well as other fields, is a willingness to test and challenge long-established research and novel hypotheses. This process allows for existing concepts to be validated or refuted. Thus, maintaining academic thinking is crucial, whereas conservative academic groupthink may prevent the introduction of new interpretations and innovative insights supported by concrete data evidence.

a



b

Fig. 51. Proposed reconstruction of the upper parts that were not preserved in the *Bet-Gitot*: (a) at Mazor; (b) at 'The Third Mile Estate' in Ashqelon; A–treading floors; B–fermentation vats; C–openings of vats; D–central working surface; F–screw-press anchoring stone; N–niches (photography and graphics: Y. Dray).

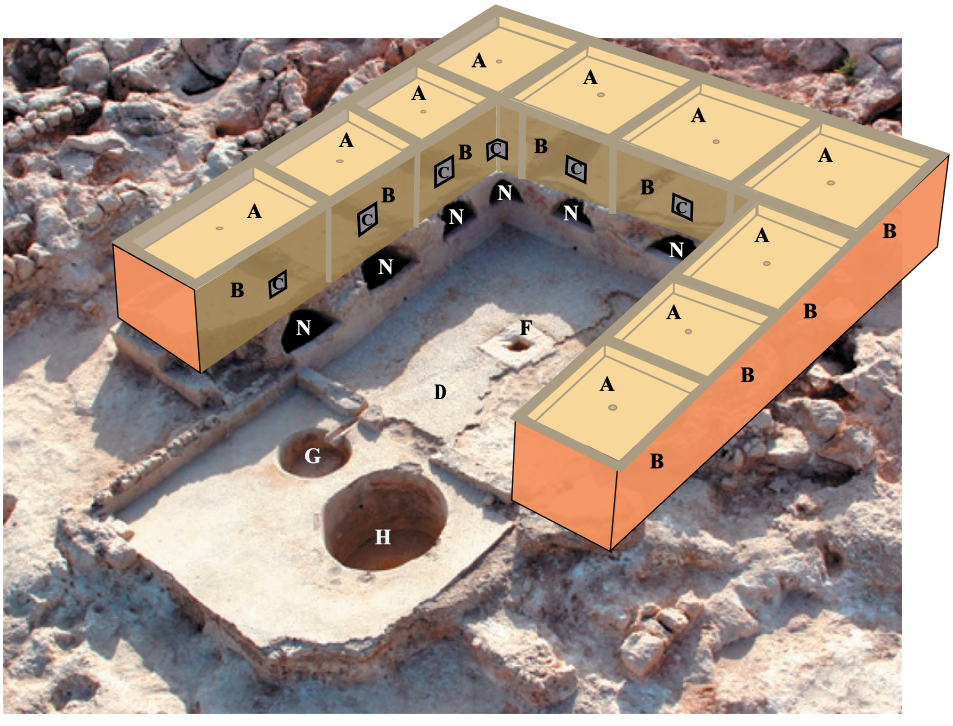


Fig. 52. Proposed reconstruction of the lost upper parts in the *Bet-Gitot* at el-Khirbe in the Nesher-Ramla quarry; A–treading floors; B–fermentation vats; C–openings of vats; D–central working surface; F–screw-press anchoring stone; N–niches; G–settling basin; H–collecting vat (photography: D. Silberman, courtesy of V.W. Avrutis, the Zinman Institute of Archaeology, University of Haifa; graphics: Y. Dray).

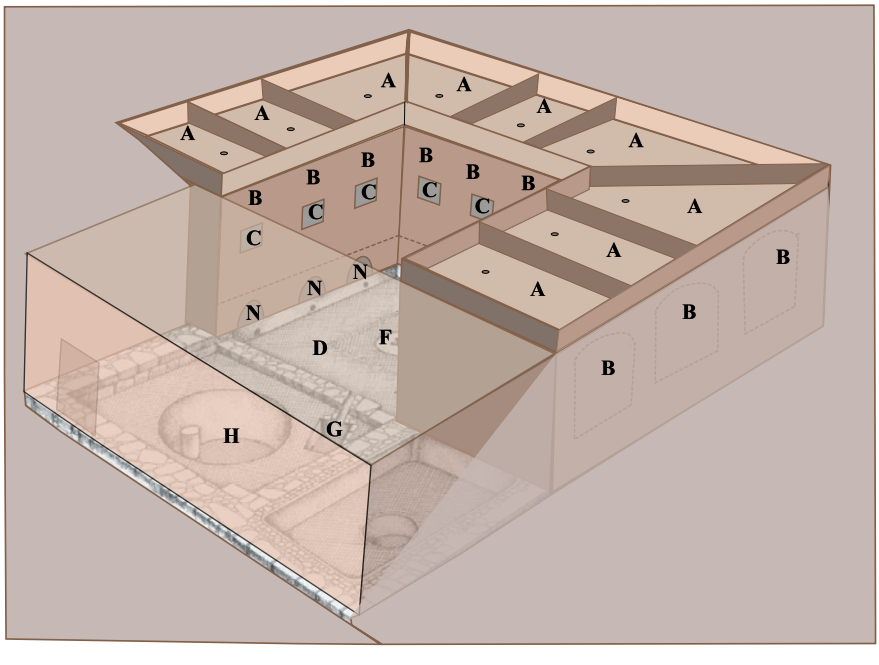


Fig. 53. Proposed reconstruction of the lost upper parts in the *Bet-Gitot* at Kefar Sirqin; A–treading floors; B–fermentation vats; C–openings of vats; D–central working surface; F–screw-press anchoring stone; N–niches; G–settling basin; H–collecting vat (isometric reconstruction after Sidi, Amit and Ad 2003: Fig. 3; graphics: Y. Dray).

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