WINE AND OIL PROCESSING AT ROMAN FARMS IN ITALY

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THE PROCESSES USED in the production of wine and olive oil were a central feature of agricultural practice in Roman Italy.[1] It is therefore not surprising that the facilities required for these processes were an important part of many Roman farm buildings. Structural remains excavated at numerous farm sites in Italy can be interpreted as belonging to buildings purposely constructed for the processing of wine or oil.[2] Yet the precise relationship of the excavated material to the different stages of the processing of these products has not always been clearly defined. Because both processes principally involve the extraction of a liquid from a fruit, they are sufficiently similar that scholars have even sometimes been uncertain whether excavated features should be related to the production of wine or of oil, or indeed of both.[3] Furthermore the application of certain technical terms used by the Roman agronomists to excavated features has not been consistent. We are fortunate that a number of ancient descriptions of these processes have survived but, although these have recently attracted several commentators,[4] there is

[1]General accounts of both processes can be found in K. D. White, *Roman Farming* (London 1970) 240–241, 425–426; *Farm Equipment of the Roman World* (Cambridge 1975) 112–115, 148–149, 165; C. Singer *et al.*, *A History of Technology* (Oxford 1956) 103–146; R. J. Forbes, *Studies in Ancient Technology* 3 (Leiden 1955) 131–154, 70 f. For accounts of wine-making: R. Billiard, *La Vigne dans l'Antiquité* (Lyons 1913) 423–536; G. Curtel, *La Vigne et le Vin chez les Romains* (Paris 1903) 104–124; A. Marescalchi and G. Dalmasso, *Storia della Vite e del Vino in Italia* 3 (Milan 1937) 165–369; W. F. Jashemsky, *The Gardens of Pompeii* (New York 1979) 219–232. On the processing of olive oil: H. Camps-Fabrer, *L'olivier et l'huile dans l'Afrique Romaine* (Algiers 1953); M. A. Cotton, *The Late Republican Villa at Posto, Francolise* (London 1979) 63–66; D. Oates, "The Tripolitanian Gebel: settlement of the Roman period around Gasr ed-Daun," *PBSR* 21 (1953) 81–113; H. A. Forbes and L. Foxhall, "The Queen of all Trees; preliminary notes on the archaeology of the olive," *Expedition* 21.1 (1978) 37–47. The most detailed account of Roman milling and pressing equipment is in A. G. Drachmann, *Ancient Oil Mills and Presses* (Copenhagen 1932). The works listed here and in notes 2 and 4 will be cited by author's name.

[2]Reports are scattered through numerous archaeological journals. A list of the sites discussed together with bibliographical references is given in the appendix to this paper. References in the text are to this list. For a preliminary classification of the excavated remains of press-rooms in Italy see my *Roman Farm Buildings in Italy* (B.A.R. Supp. 52, Oxford 1978) 49–55. There is also much relevant material in the recent collection of studies in K. S. Painter (ed.), *Roman Villas in Italy* (British Museum Occasional Papers No. 24, London 1980).

[3]For example T. Bertocchi, *Klearchos* 5 (1963) 141; M. Felletti Maj, *NSc* 1955, 215; L. Mercando, *NSc* 1979, 137; E. M. De Juliis, *Atti del XV Convegno di Studi sulla Magna Grecia* (Naples 1976) 651–652, Tav. LXI–LXII (probably for oil sedimentation).

[4]Recent commentaries include: R. Goujard, *Caton. De l'Agriculture* (Paris 1975);

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still need of a detailed comparative analysis of the literary accounts and the archaeological evidence, which viewed together may throw new light on the different stages of wine and oil production. It may then be possible to establish with more precision the functional nature of the different excavated features, to define more closely the material form of some of the pieces of equipment to which the Roman agronomists refer in their accounts of wine and oil production, and to determine what technological developments and procedural changes occurred.

WINE-MAKING

Pliny (*NH* 14) and Columella (*DRR* 12.18–40) provide the best technical accounts of wine-making. Shorter accounts appear in Cato (*DA* 23–26), Varro (*RR* 1.54), and Palladius (*Op Ag* 1.18). The earliest account, Cato's, although incomplete, specifies a number of the stages required for extraction and fermentation. Supplemented by references elsewhere in the *De Agricultura* it gives the following sequence: after the grapes had been sorted and selected (23.4), they were taken to the press-room for treading (25.1; 112.3). The must from the treading flowed either directly from the treading floor into large fermentation jars, coated with pitch (*dolia picata*), or into a reservoir (*lacus vinarius* 25.1), and thence into the jars (113.1). The grape pulp from the treading was next placed under a mechanical press to extract more must.[5] Cato also implies a second pressing, applied to the trimmings from the press-bed (23.4), that yielded an inferior quality must (*mustum tortivum*). The two stages of pressing are more clearly defined by Varro (1.54.2–3), who adds that the must from the second pressing was always kept separate.[6] Varro also explains that the residue from the pressings could be mixed with water to provide a beverage for the farm hands in winter. Varro's account of wine-making is consistent with Cato's in most respects. There is no indication, however, in Varro that the must from the treading could flow directly into the fermentation jars. The must from each stage of extraction flowed first into a reservoir and was then transferred to the jars. In both authors the periods prescribed for the fermentation and maturation of the must vary

R. Martin, *Palladius. Traité d'Agriculture* (Paris 1976); H. Plommer, *Vitruvius and Later Roman Building Manuals* (Cambridge 1973); J. Heurgon, *Varron. Economie Rurale* 1 (Paris 1978).

[5]It is not clear from the literary sources whether the must from the treading and that from the first pressing were mixed. Varro says only that the must from each process of extraction flowed *in eundem lacum* (*RR* 1.54.2). Curtel 106 supposes that the must from these stages was in fact mixed; cf. Billiard 442 "Le moût de mère goutte . . . était le plus ordinairement mélangé avec le vin de foulage, *mustum calcatum*, et celui de presse."

[6]In a different context altogether Varro provides an unusually full term for the Roman wine-press, which he refers to as *tocula vasa vindemiatoria* (*RR* 3.2.8).

according to the type of wine being produced and the kinds of seasoning and additives used.[7]

Columella describes the process of wine-making in great detail, with precise instructions for such preparatory tasks as the cleaning of the equipment and the coating of the fermentation jars with pitch (11.2.70–71; 12.18.1–6). In Columella's account the must from the treading flowed into a reservoir (*lacus musti* 12.27.1; cf., e.g., 12.19.3; 12.41.1). He also suggests, however, that the must may be transferred directly from the treading floor into the fermentation jars without passing through a collection reservoir (12.37.1). Like Varro, Columella indicates that the must extracted from the second stage of mechanical pressing should be stored separately and put to special use (12.36.1). Columella explains how boiled-down must, prepared in a special cauldron-room (*cortinale*), was used to fortify poorer quality wines (12.21.1); he also includes a number of specialized recipes for grape-based wines (12.27–29, 32–42). The jars used for fermentation were either embedded in the ground or free-standing (12.18.5). When fermentation was completed, the wine was racked into amphorae, which could be stored in a smoky atmosphere to accelerate the maturation of the wine (1.6.20).[8]

Pliny includes all the stages of production described by the earlier authors but provides more information on how the methods of fermentation and storage varied according to locality. In his account the must from the treading and pressing flowed into a reservoir (14.59, 83) whence it was transferred either into pottery fermentation vessels (14.133) or into wooden casks (14.132).[9] Pliny, like Varro, describes the process of using the residue from the press-bed to make a poorer quality drink for the farm hands (14.86). Pliny also recommends a great variety of additives that could be used to flavour and fortify wines (14.120–126).

The account of wine-making given by Palladius, writing probably in the 5th century A.D.,[10] differs in some important respects from those of his literary predecessors. He omits all reference to mechanical pressing.

[7]Cato *DA* 23–24; 104–105; 109; 112–115; 125; Varro *RR* 1.65.

[8]On this process see further Billiard 522; Curtel 136; White (1975) 115. The fermented wine was generally racked from the large fermentation jars into smaller jars within one year. Not all the wine, however, was moved; Billiard suggests that the "house wine" was left in the large jars and drawn off as required (514–517).

[9]Pliny refers to the use of wooden casks in the Alpine regions for storing wine during maturation. Strabo (1.5.8) speaks of wine being transported in wooden casks in the region of Aquileia. Curtel 112–113 suggests that the use of wooden casks for fermenting wine was practised in Italy "perhaps even in Cato's time." On the evidence for coopering and the use of stave-built wooden vessels for wine see Billiard 479–481; E. M. Wightman, *Roman Trier and the Treveri* (London 1970) 190–191; on surviving specimens White (1975) 143; G. C. Boon, *Silchester* (London 1974) 263–264; G. Ulbert, "Römische Holzfässer aus Regensburg," *Bayerische Vorgeschichtsblätter* 24 (1959) 6–29.

[10]On Palladius' date see most recently Martin i–xvi.

The use of presses, however, was by no means universal.[11] They were certainly not essential, since the best must was always produced by the treading process. Besides, presses were not cheap;[12] a farmer would probably have invested in a press only if he was making wine on a large commercial scale. Palladius describes an elevated treading platform, from which the must flowed into two reservoirs at a lower level and thence, by means of terracotta gutters or pipes, into the fermentation jars. If the capacity of the jars was insufficient, wooden barrels might be used as well (1.18).

The literary accounts raise some important questions which only an examination of the archaeological evidence can hope to answer. For example, how widespread was the use of mechanical presses in wine production? What kind of facilities existed for treading the grapes in a large processing plant? By what precise means was the must from the different stages of extraction collected and transferred to the fermentation jars? The first of these questions needs to be more closely defined. We can infer from numerous literary references that wine-making on a small scale could be carried out using a portable treading tub and no press.[13] Only medium or large-scale production would require permanent processing facilities; so what we need to ask is whether the archaeological evidence suggests that the use of presses was widespread in cases where production was being carried out on a scale large enough to necessitate permanent facilities. There is ample evidence from Roman Campania, largely from around Pompeii and therefore providing a convenient dating terminus, for wine processing plants built for commercial production. The well-known Villa della Pisanella at Boscoreale (Pasqui 1897), the Villa of the Mysteries (Maiuri 1947), another farmhouse at Boscoreale (Della Corte 1921), a farm at Gragnano (Della Corte 1923), and a plant in Regio II Insula 5 in Pompeii (Jashemsky 1970),[14] had elaborate pressing equipment. At other sites, however, we find evidence for purposely constructed wine processing facilities that did not include pressing equipment, i.e., for the kind of system described by Palladius. The central feature of Palladius' wine processing plant was a treading floor, clearly of a non-portable and permanent nature. Concrete floors apparently designed for this purpose have been found in excavated farm buildings at Guidonia (Caprino 1944–5), Granaraccio (Faccenna 1957), Pompeii Regio I Insula 20.1 (Jashemsky 1979), Stabiae (Ruggiero 1881, 325), and at

[11]Billiard 439; Curtel 107; White (1975) 165.

[12]Plommer 8. On Cato's figures for the cost of an olive mill see Drachmann 46–49; Goujard 187.

[13]References cited by Curtel 105; White (1975) 164.

[14]The recent excavation of a Roman farmhouse in the Contrada Regina-Sciusciello at Boscoreale near Pompeii has brought to light another impressive wine processing plant, as yet unpublished, which can now be added to this list: S. De Caro, *CronPomp* 4 (1978) 234.

Grotta del Malconsiglio, room 41 (Galli 1929); a sloping concrete floor that formed part of the industrial area of a late phase of the early villa at San Giovanni di Ruoti (Small 1980) may also have served such a function.[15] At Granaraccio the treading floor, in fact a rectangular tank measuring 2.25 × 1.40 m. with a smooth concrete lining, was apparently used in conjunction with a nearby mechanical press. In the case of the treading floors at Pompeii and Stabiae, however, and at Ruoti and Grotta del Malconsiglio, there was no indication of an accompanying press. Caprino suggests that at Guidonia the press found near the treading floor was in fact a later addition and that originally the room may have contained only the treading floor, connected by means of a terracotta conduit to a reservoir at a lower level. Thus at these sites there is evidence for wine production on a scale involving the construction of permanent facilities but without the use of mechanical processing equipment.[16] Caprino places the Guidonia farmhouse not later than the 2nd century A.D., while the latest phase of the farm at Grotta del Malconsiglio was ascribed by Galli to the 1st century A.D. The concrete floor and collection tank at Ruoti have provisionally been dated to the 2nd century A.D.[17] All these features, therefore, pre-date the account of wine-making in Palladius and suggest that the system he describes was in common use over a long period, at farms where production was substantial, though probably not on a large commercial scale.

As to our second question, Cato remarks that the grapes were trodden in the press-room (*in torculario* 112.3). Curtel (107) thought that Cato had here confused the processes of treading and pressing. But at many of the

[15]This interpretation of the industrial features of the early Imperial villa at San Giovanni di Ruoti is tentative; cf. A. M. Small, "San Giovanni di Ruoti: some problems in the interpretation of the structures," in Painter, 91–109, where it is suggested that the concrete floor (*ibid.* Fig. 2.c) may rather have been used in the process of fulling cloth. Its precise function is at present uncertain but it is hoped that this will be clarified by the analysis of soil samples taken from the drain leading from the adjacent tank (Fig. 2.d). The site is currently being excavated by a team from the University of Alberta and I should like to thank Professor Small for permission to mention these features in advance of final publication.

[16]To this list of treading floors can perhaps be added a feature of the working farm of the rural villa at Russi in Emilia-Romagna; D. C. Scagliarini in G. Susini (ed.), *Russi. La Villa Romana, la Città* (Faenza 1975). This was a large mosaic-lined tank fitted with an outlet into a smaller reservoir (Susini Plate A.3). Scagliarini offers no interpretation of these features but it seems possible that they were used for grape treading. The same function may perhaps be ascribed to an enigmatic group of brick pavements found in the region of Bologna; L. Ruggini, *Economia e Società nell'Italia Annonaria* (Milan 1961) 530–533; M. E. Blake, *MAAR* 8 (1930) 149–150; P. Ducati, *Storia di Bologna* 1 (Bologna 1974) 422–423. Many of these pavements slope towards small catchment tanks which were clearly designed to collect liquid. Their precise function, however, has not been satisfactorily explained.

[17]Small (above, note 15) 92.

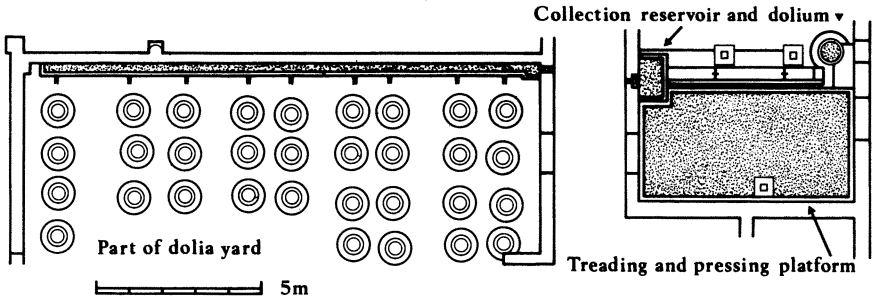

FIG. 1. Wine press and fermentation yard in the Villa della Pisanella, Boscoreale (after Pasqui, *MonAnt* 7 [1897] Fig. 14).

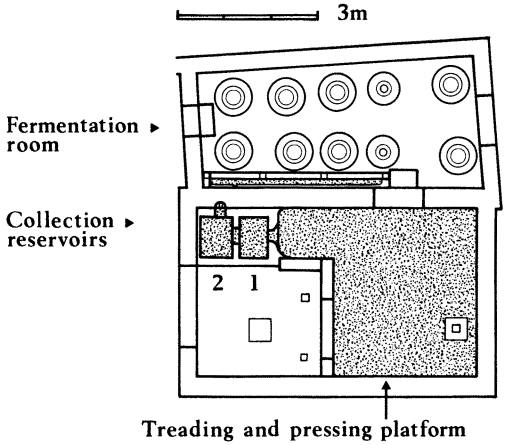

FIG. 2. Wine press with double collection reservoir and fermentation room, Pompeii Reg.II Insula 5.

plantation farms in the region of Pompeii, the treading of the grapes evidently took place, as Drachmann (86) has suggested, on the concrete-faced platforms over which the presses were mounted. The raised curbs of these platforms formed a rectangular basin which was used both for treading and for pressing (Fig. 1–3). It is to this feature of the press-room that Varro (1.54.2) and Columella (11.2.71) would seem to refer by their use of the word *forum*.[18] Where the press was mounted over a circular

[18]A. Pasqui, *MonAnt* 7 (1897) 469–470; A. Maiuri, *La Villa dei Misteri* (Rome 1947) 98. Billiard (450) is wrong, however, in applying the word *lacus* to the treading and pressing platform. White ([1975] 132) defines the word *forum* as "a large quadrangular basin made of stone," used for treading grapes, but misses the point that this can be equated with the concrete pressing platform with its raised curbs, making the *forum* a structural feature of the press-room. Cato (*DA* 18.3) uses the word *forum* in a different sense, to refer to the anchor-stone of the vertical timbers of the press; cf. Goujard 193.

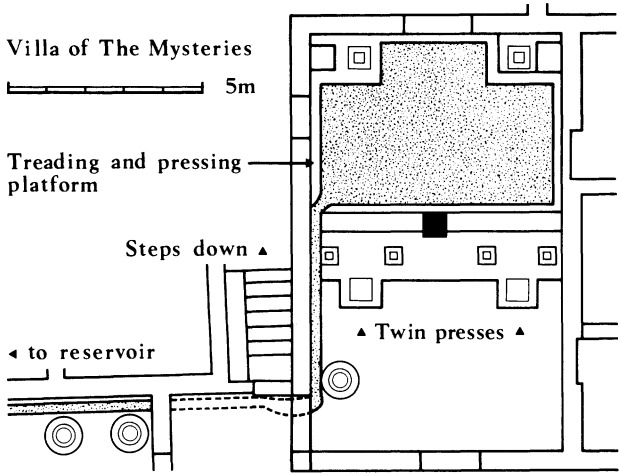

FIG. 3. Twin wine presses in The Villa of The Mysteries, Pompeii. Phase 5, second half of the 1st century A.D. (after Maiuri, *La Villa dei Misteri* [Rome 1947]).

press-bed rather than a rectangular concrete platform, as at Granaraccio, treading evidently still took place in the press-room, in this case in the tank built next to the forward anchor stone of the press. Similarly in the large press-room of the "Sette Finestre" villa (Carandini and Tatton-Brown 1980) it has been suggested that the treading of the grapes took place in the brick-paved basin immediately to the north of the three circular press-beds.[19]

The third question concerns the way in which the must from the treading and pressing processes was collected and transferred to the fermentation jars. A number of mosaics and reliefs show the treading tank fitted with outlets that allowed the must to flow directly into jars placed around the outside (the best-known are on the 4th-century vault mosaic from S. Costanza in Rome and the Seasons mosaic from Vienne).[20] It has already been noted that this system of direct flow from treading-floor to jar is referred to by both Cato and Columella. In all the literary accounts, however, the main system described involved the flow of the must from the treading and pressing into a reservoir (*lacus*) and thence into jars. The reservoir provided a single point of collection for the run-off

[19]Carandini and Tatton-Brown in Painter, 15; cf. A. Carandini and S. Settis, *Schiavi e Padroni nell'Etruria Romana* (Bari 1979) 70.

[20]The former is discussed by H. Stern, "Les mosaiques de l'église de Sainte-Constance à Rome," *DOPapers* 12 (1958) 157–218; the latter reproduced in White (1970) 254 Plate 59. To these may be compared the vintaging scenes on a mid 3rd century A.D. mosaic from Cherchel; J. Lassus, "Mosaïque de la vendage à Cherchel, Tennis Club," *Lybica* 7 (1958) 257–269.

and also served to trap some of the impurities in the must. Several farm sites in Italy show this system in practice. In the Villa della Pisanella at Boscoreale (Fig. 1) the reservoir was a rectangular concrete-lined tank located beside one of the press platforms. Into the reservoir flowed the must from both press platforms, that in the opposite end of the room being connected to the reservoir by means of an underground lead pipe. The platforms also had alternative outlet pipes leading to large dolia embedded in the press-room floor, which Pasqui suggested were used to drain off the poorer quality must extracted by the initial impact of the press.[21] Such a precaution is not mentioned in any of the literary accounts. Varro and Columella do, however, say that the must from the pressing of the trimmings should be kept separate from the main flow and the jars may have been used for this purpose. A little above its floor the reservoir was fitted with an outlet pipe which was plugged until the lees had settled below this level. The must could then be channeled into the nearby yard, where it was fed into a large number of sunken jars for fermentation. A similar arrangement existed in the press-room in the corner of the vineyard in Regio II Insula 5 in Pompeii (Fig. 2) where the must from the press platform flowed first into a rectangular collection reservoir ($0.90 \times 0.65 \times 0.36$ m.), connected by an overflow to a second reservoir, and from there into a roofed gutter along the wall of an adjoining fermentation room.[22] Partial parallels for this kind of system have been found at other sites in Italy. In the middle of room 41 of the farm at Grotta del Malconsiglio was a sunken rectangular concrete-lined reservoir ($1.35 \times 1.35 \times 0.30$ m.) fitted with terracotta inlet and outlet pipes. In the "Sette Finestre" villa the floor of the reservoir had a central plug-hole, over which a filter was presumably placed to trap the lees. The collection tank next to the concrete floor in the villa at San Giovanni di Ruoti was also drained from the base. At Guidonia a concrete-lined reservoir was originally located at a short distance from the treading floor, to which it was connected by means of a covered terracotta conduit. The Villa della Pisanella is the only site where the complete system of distribution is both preserved and well-documented. In the Villa of the Mysteries outside Pompeii, while the treading and pressing platform and its run-off channel have been excavated (Fig. 3), the existence of a collection reservoir and the extent of the dolia yard have not been established.

[21] A. Pasqui, *MonAnt* 7 (1897) 470–472, followed by Mau-Kelsey 355 f. and White (1975) 422–427. Mau-Kelsey and White accordingly refer to the reservoir as "the receptacle for the product of the second pressing."

[22] I should like to thank Professor F. Zevi, Archaeological Superintendent for the Provinces of Naples and Caserta, and Dr. S. De Caro, Director of excavations at Pompeii, for giving me authorization to examine this facility during a recent visit to Pompeii; also to Professor W. Jashemsky, director of the vineyard excavations, who has kindly allowed me to make this press-room the subject of a separate detailed study.

It is clear from the literary sources that wine was most commonly fermented in large free-standing or sunken jars and extensive magazines of sunken dolia have been found at several farm sites: Casalotto (Romanelli 1933), Gragnano-Carità (Della Corte 1923), Gragnano-Messigno (Della Corte 1923), Oplontis (Malandrino 1977), Scafati-Spinelli (Della Corte 1923), Villa Magliano (Santarelli 1883), and Vittimose (Holloway 1971). In most cases these magazines can probably be associated with the production of wine at the site.

OIL PROCESSING

The same authors whose accounts of wine-making have been discussed also provide the best literary evidence for the processes involved in the production of olive oil. Cato outlines the stages of production: as soon after harvesting as possible (3.4; 64.1) the olives were crushed to a paste in a rotary mill, then packed into baskets and put under a mechanical press; the extracted liquid was channeled off into a sunken tank from which, Cato seems to imply, it was collected in a lead vessel.[23] The oil was then ladled by means of a shell or a shell-shaped scoop from one container to another until finally the pure oil was put into jars for storage (66.2). The ladling process served to refine the oil, since in each container the *amurca* was allowed to settle out of the oil. Cato recommends that throughout the processing the press-room be kept as warm as possible both by maintaining a fire (65.2 with 67.1) and by restricting the traffic of personnel (66.1). Varro adds little to Cato's account except to remind his readers that the *amurca* can serve a useful purpose and should not be discarded (1.64).[24]

Columella's account, written around the middle of the 1st century A.D., not only is more detailed than Cato's but differs in some important respects, indicating developments in processing technique since his time. According to Columella the olives usually had to be stored after harvesting to await processing; for this they were put in bins in a store-room which, he says, resembled a granary (12.52.3.). The *amurca* which seeped

[23]The precise function of the lead vessel is not clear. It may have been used to "ladle off" the surface oil from the liquid in the tank, but it is difficult to see how it could have served "to remove the harmful dregs" as White suggests (1975) 134–135. Cato perhaps means that the lead vessel was placed in the tank as a receptacle for the run-off from the press-bed; cf. Columella 12.52.10 for the similar collection of the run-off in a lead container.

[24]The *amurca* is a highly organic watery liquid obtained as a by-product of the pressing (the oil yield of the olive is around 20–25%). It is liable to rapid fermentation and has to be run off as soon as sedimentation is complete to avoid spoilage of the oil. It had a number of potential uses: as a fertilizer, for seasoning wood or leather, or even as a consolidating agent for earth floors; White (1975) 7–8, Camps-Fabrer 40.

from the stored fruit was drained away by means of a sloping floor (12.52.4). Like Cato, however, he recommends that this period of storage be avoided if possible and that processing be carried out immediately after harvesting (12.52.3, 17–18). From storage the olives were cleaned, then placed under a press, and given a gentle preliminary squeezing (12.52.10) to extract some of the *amurca*; Columella warns that some farmers thought this process undesirable since some of the precious oil was bound to escape (12.52.13). The olives were then crushed in a mill,[25] and the paste pressed. The extracted oleaginous liquid flowed into a round container (*rotundum labrum*), or else into a squared lead tank (*plumbeum quadratum*) or into some sort of constructed container with twin compartments (*structile gemellar*) (12.52.10).[26] Columella shows less enthusiasm for these latter two devices; perhaps one may detect here the suspicions of an elderly conservative farmer against certain new technological developments. Columella's account of sedimentation is similar to Cato's: the oil was ladled from one pottery container to another (12.52.10–14), being allowed to stand in each and finally stored in jars. Unlike Cato, Columella discourages the use of a fire in the press-room, to remove the risk of pollution by smoke or soot (12.52.13).

Pliny (15.20–22) quotes Cato's account, but also describes a sequence similar to Columella's, adding that the olives might be soaked in boiling water before the first pressing (15.23).[27] Pliny recommends that the period of storage after harvesting should not exceed three days (15.21). With regard to the heating of the press-room, he produces a compromise solution; the olive stones, which were less polluting than wood, could be used to fuel the fire (15.22). Palladius (1.20) suggests constructing the whole processing plant over a hypocaust,[28] a more elaborate and expensive solution.

The literary accounts indicate some variation in the processes for making oil and raise several questions that the archaeological material may help to answer. What sort of provision was made for storing the olives prior to processing? What kinds of containers were used to receive

[25]Columella mentions various types of mill (12.52.6–7). The best discussion is in Drachmann Part I.1 and 2; cf. White (1975) 226–229; Forbes 101–104, 146–148.

[26]White (1975) 149–150.

[27]A treatment corresponding to the modern practice of using hot water or steam to heat the malaxator (mixing machine) in which the olive paste is mixed after milling in order to unite the dispersed drops of oil and achieve a higher yield. The use of very hot water, however, causes a deterioration in the quality of the oil; for details see M. Moreno *et al. Manual of Olive Oil Technology* (Rome 1975, F.A.O.) 28–29. Pliny quotes the use of hot water as an additional process to the first light pressing, not as White suggests (1975) 226, as an alternative process.

[28]Martin 132 n.7. The oil press-room of the "Sette Finestre" villa was located next to the *caldarium* of a bath-suite; Carandini and Tatton-Brown 15, Fig. 8.

the liquid flowing from the press and for purifying the oil? How, finally, was the processed oil stored?

The likely need to store the olives for a few days before processing them is mentioned in all the literary accounts. According to modern practice in rural olive mills the olives should be laid out on a non-porous surface in thin layers, allowing them to be well aired.[29] Thus "wooden and tile floors should not be used but rather a cement-covered stone floor, provided it is absolutely smooth so as to make it easy to wash."[30] If the press-room pavement, therefore, were made of a suitable material, such as that of the concrete floors of the press-rooms found at Salapia (Marin 1964), Camerelle (Bertocchi 1963), and Guidonia, or that of the mosaic floor at Scalea (Pesce 1936), the olives could presumably have been stored on this surface while awaiting processing. In a rural villa excavated near the Via Tiberina (Felletti Maj 1956) a concrete-faced platform built at one end of the press-room was probably used for the same purpose (Fig. 4).[31] Columella's description of a complex storage facility has foiled commentators and certainly nothing corresponding to it has ever been found by excavation. White suggests that Columella's store-house was in fact designed for storing the olives *after* their initial light pressing. It seems probable, however, that Columella is indeed referring to the normal practice of pre-processing storage. Olives stored in bins become soft and watery after a while and it was presumably to deal with seepage at this stage that Columella recommended his system of drainage.[32]

Next came milling and pressing. Drachmann and Forbes have discussed

[29]A good account of modern techniques is contained in G. Frezzotti and M. Manni, *Olive Oil Processing in Rural Mills* (Rome 1956, F.A.O.) 30–33. This includes a valuable discussion of "traditional" (pre-industrial) methods of processing. A traditional Sicilian olive processing plant is illustrated in Marescalchi and Dalmasso 3. 281–288, Fig. 274, 289, 293.

[30]Frezzotti and Manni 31.

[31]We can perhaps infer a similar additional function for the large concrete pressing platforms in the double press-room of the Casa di Miri at Stabiae. Drachmann supposed that they were used for treading grapes (86) but the presence of an olive mill between the platforms makes this an awkward interpretation. For the excavation see M. Ruggiero, *Degli Scavi di Stabiae* (Naples 1881) 333, Fig. XII. For modern parallels illustrating traditional methods of pre-processing storage in small rural mills: A. Louis, *Tunisie du Sud* (Paris 1975) 165, Fig. 49; Marescalchi and Dalmasso 3. 281, Fig. 274 No. 1.

[32]White (1975) 160. It has been suggested that two of the concrete-lined basins found in the press-room of a farmhouse recently excavated near the Via Gabina outside Rome may have been designed for the pre-processing storage of the olives. The basins were built to allow for drainage into a smaller, lower tank; W. M. Widrig, "Two sites on the ancient Via Gabina," in Painter, 119–140. The olives could not, however, have been stored for long in such conditions; Frezzotti and Manni (above, note 29) 31 "the worst way of storing olives is to put them in chambers or vats .... In these conditions the olives quickly become fermented and, if stored for too long, they have the appearance of manure." Cf. Pliny *HN* 15.21 on this process of deterioration.

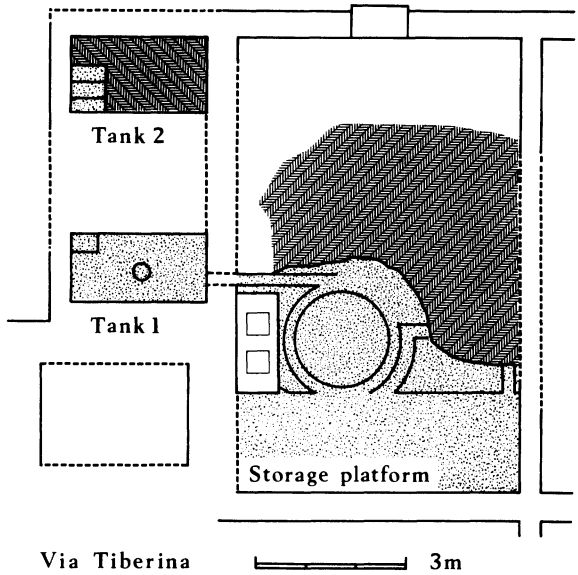

FIG. 4. Olive press and tanks found in a rural villa at Valle Lungha near the Via Tiberina (based on Felletti Maj, *NSc* 1956, 207).

the various types of mills and presses used for these operations. The extracted oil then had to be purified and stored. These processes, which have received considerably less attention, may be illustrated from many sites in Italy. A farm at Stabiae (Ruggiero 1881 tav.xii) provides evidence for a system whereby the run-off from the press-bed flowed directly into a large dolium embedded in the press-room floor beside the press.[33] More usually the oil was channeled into a sunken rectangular tank such as we see in the excavated farms at Posta Crusta (De Boe 1975) (Fig. 5), Vicovaro, room G (Lugli 1926), Monte Canino (Pallottino 1937), and Scalea.[34] The oil separated above the *amurca* in the tank and could then be ladled off for further purifying in portable containers. At Camerelle, room W, and Pareti (Dyson 1972) the remains of large dolia were found standing inside the collection tanks beside some of the presses, and these may have been put there to collect the run-off from the press-bed, perhaps serving the function of the lead container mentioned by Cato (66.1). Placed in a tank the dolium was at a convenient level below the press-bed and easily accessible.

[33]Casa di Miri, Ruggiero (above, note 31); cf. Drachmann 89–91; Rich, *Dic.Ant.* 676, Figs. 1–4.

[34]The surface dimensions of these tanks range from 1.00 × 0.50 m. (Scalea) to 3.70 × 2.40 m. (Vicovaro). The capacity of the tanks cannot always be calculated owing to the omission in some of the excavation reports of the measurement of the depth of the tank; the maximum capacity at Scalea was 500 litres, at Montecanino, 1,280 litres.

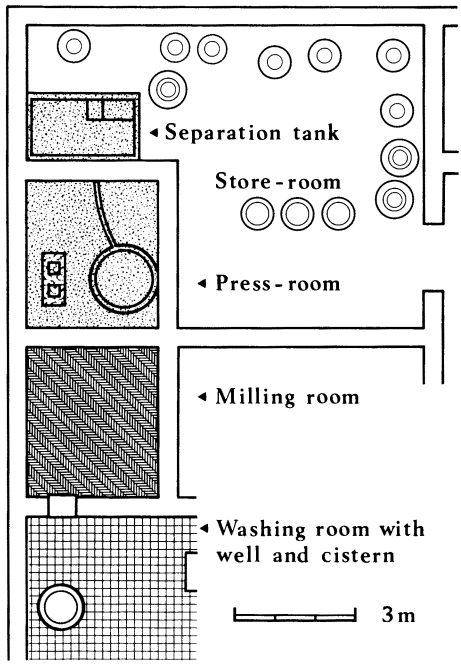

FIG. 5. Oil processing plant at Posta Crusta, Foggia. Phase 2, 1st century A.D. (after De Boe, *NSc* 1975, 520).

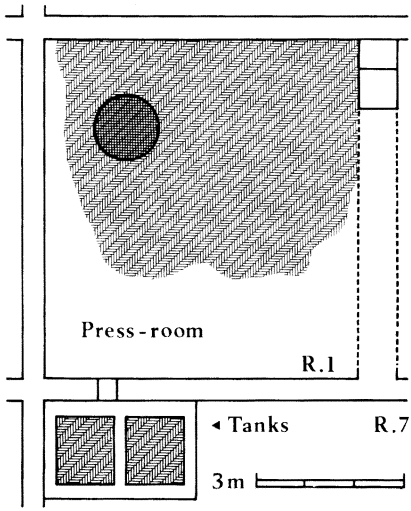

FIG. 6. Olive press and twin sedimentation tanks at Grotta del Malconsiglio, Sybaris. Phase 3, 1st century A.D. (based on Galli, *AttiMGrecia* 1929, Fig. 26).

The walls and floors of the collection tanks were commonly lined with concrete, as at Monte Canino, Posta Crusta, and Vicovaro, but frequently the lining did not extend over the brick floor of the tank, as for example at Cesano di Senigallia (Mercando 1979), Grotta del Malconsiglio, room 7, and Valle Pilella (Reggiani 1978). This is not surprising if it is remembered that only the *amurca*, which sank below the oil in the tank, would come into contact with the floor and that it was precisely this *amurca* that was used to proof the pottery jars in which the oil was eventually stored (Cato 69; 100).

Sometimes there was a second tank next to the collection tank, as we find at Posto (Cotton 1979) and Via Tiberina (Fig. 4), or else the tank had a central partition, forming twin compartments—Columella's *structile gemellar* (12.52.10)?[35]—as at Vicovaro, room D, Castelfidardo (Mercando 1979), Salapia, Grotta del Malconsiglio, room 7, and a farm near Luceria (McDonald 1966). The purpose of having two tanks or compartments was to facilitate the process of sedimentation. After separating above the watery *amurca* in one part, the oil was then ladled to the other where it was again left to settle. Meanwhile the *amurca* could be cleaned out of the first part. No datable double tank is earlier than the second half of the 1st century B.C., so perhaps the device was still a relatively recent innovation at the time when Columella was writing.[36]

A further innovation seems to have occurred around this time in the process of sedimentation. Ladling the oil from one container to another must have been laborious and it is therefore not surprising to find that a more automated system was developed. At a number of farms including Cesano di Senigallia, San Rocco (Blanckenhagen 1965) and Granaraccio near Tivoli (Fig. 7), we find a series of tanks fitted with outlet pipes or sluices through which part of the liquid could be drawn off after the oil and the *amurca* had separated.[37] At Granaraccio an outlet near the base of Tank 1 was presumably used to drain off the heavier *amurca* into the

[35]Cf. White (1975) 150 for an apparently similar system at another Apulian farm. Although the term *structile gemellar* seems applicable to these twin brick-built tanks, Pasqui is probably also right in applying it to the freestanding partitioned pottery container found next to the olive press in room T of the Villa della Pisanella at Boscoreale (Pasqui 1897, 498).

[36]On the date of the *DRR*, White (1970) 26. The twin tanks at the Posto villa were built ca mid-1st century A.D., Cotton 46 f; suggested dates at other sites: Via Tiberina, 1st century A.D.; Camerelle, late 1st century B.C.; Grotta del Malconsiglio, 1st century A.D.

[37]This multiple-tank system was evidently also in use in the south press-room of the "Sette Finestre" villa; Carandini and Tatton-Brown in Painter, 15 f. The oil processing plant at San Rocco incorporated a number of different sedimentation systems which were used in sequence to obtain oil of varying quality. The pure edible oil was drawn off by means of an interconnecting sink and basin located near the press-bed, while larger separating tanks, fitted with compartments and sluices, were used to extract

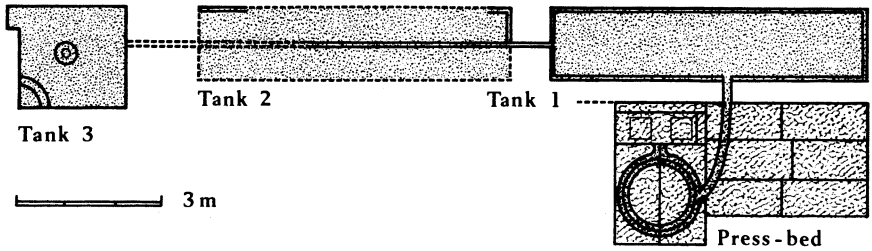

FIG. 7. Olive press and sedimentation tanks at Granaraccio near Tivoli (after Faccenna, *NSc* 1957, 149).

adjacent Tank 2, from which it could then be removed while Tank 1 continued to be filled from the press-bed. The separated oil was finally drained into Tank 3 where it could be further purified by standing for a while before being drawn off for storage.

For storage the oil was transferred to jars.[38] The process of ladling the oil from the settling tank to the jars was often facilitated by the construction of a small platform or series of steps inside the tank, as for example at Cesano di Senigallia (tank 5), Granaraccio (tank 3), Guidonia, Grotta del Malconsiglio (room 37), Posto, Posta Crusta (Fig. 5), San Rocco, Scalea, and Via Gabina (Widrig 1980). It would appear that the jars used for oil storage were not commonly embedded in the ground like the dolia used for fermenting wine.[39] For at most of the sites where oil settling tanks have been found, either singly or in series, there has been no recorded trace of large magazines of sunken jars of the kind known from a number of wine processing plants. It would seem probable, therefore, that at these oil processing plants the jars into which the oil was finally ladled were portable.[40]

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residual oil. For this information I am most grateful to Dr. M. A. Cotton, who has kindly allowed me to read a draft copy of the report on the San Rocco *oletum* before its publication.

[38]Cato (*DA* 10.4) recommends 100 such jars (*dolia olearia*) for a 240 iugera estate. The oil was certainly not stored in the concrete settling tanks, where it would have deteriorated rapidly; Frezzotti and Manni (above, note 29) 89.

[39]The main reason for embedding the wine jars was to create stable temperature conditions, first by insulating the jars against undue heat loss during fermentation and then by providing a steady and cool temperature (optimum 10°C.) for maturing the wine over the winter months until the summer racking. Such temperature control was not essential for stored oil and the presence of *dolia defossa* should probably be seen as indicating the storage of wine rather than oil; cf. White (1975) Plate 10a; R. Meiggs, *Roman Ostia* (Oxford 1973) 274–275; G. Rickman, *Roman Granaries and Store Buildings* (Cambridge 1971) 73–76.

[40]cf. Columella *DRR* 12.53.3, where he gives instructions to the farmer making gleucine oil to "put the jar in the sun." In the farmstead at Posta Crusta (Fig. 5) the impressed beds of a series of round-bottomed jars used for storing the oil could be detected in the store-room floor; G. De Boe, *NSc* 1975, 521–523.

From the archaeological evidence which has been presented here it is possible to make a clear distinction between features used in wine-making and features used in oil production. Wine production required special facilities for the treading and pressing of the grapes and for the collection and distribution of the must to the fermentation jars. Oil production required mills and presses and specially designed sedimentation tanks. Although the presses used in each process were mechanically similar, it is very unlikely that the same facilities were used for both wine and oil processing, since press remains have usually be found in conjunction with other processing features whose distinctive design indicates their specific agricultural function.[41]

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APPENDIX

A bibliographical catalogue of Roman farms and villas in Italy which have produced evidence for wine or oil production.

A. Wine

Boscoreale, Villa Regina. S. De Caro, *CronPomp* 4 (1978) 234.
Boscoreale, Villa Della Pisanella. A. Pasqui, *MonAnt* 7 (1897) 467–475.
Boscoreale, Villa of Popidius Florus. M. Della Corte, *NSc* 1921, 442 f.
Boscoreale, Villa of Publius Fannius Synistor. F. Barnabei, *La Villa pompeiana di P. Fannio Sinistore* (Rome 1901).
Casalotto, Lazio. P. Romanelli, *NSc* 1933, 246–248.
Cosa, Ager Cosanus. F. E. Brown, *Cosa* (Ann Arbor 1980) 71.
Gragnano-Carità, Campania. M. Della Corte, *NSc* 1923, 275–280.
Gragnano-Messigno, Campania. M. Della Corte, *NSc* 1923, 271–274.
Granaraccio, Ager Tiburtinus. D. Faccenna, *NSc* 1957, 148–153.
Grotta del Malconsiglio, Sybaris. E. Galli, *AttiMGrecia* 1929, 46–98.
Guidonia, Lazio. C. Caprino, *NSc* 1944–5, 39–51.
Oplontis, Villa of L. Crassius Tertius. C. Malandrino, *Oplontis* (Naples 1977) 81–82.
Pompeii, Regio II Insula 5. W. F. Jashemsky, *AJA* 74 (1970) 62–67.
Pompeii, Regio I Insula 20.1. Jashemsky (1979) 227.
Pompeii, Villa of the Mysteries. A. Maiuri, *La Villa dei Misteri* (Rome 1947) 96–104.
San Giovanni di Ruoti, Basilicata. A. M. Small in Painter, 91–109; *idem*, *CNV* 24.1 (1980) 28–30 (?wine).

[41]I wish to thank Professor A. M. Small and Professor T. N. Ballin and two anonymous referees for their helpful criticism of an earlier draft of this article.

San Sebastiano al Vesuvio, Campania. G. C. Irelli, *NSc* 1965 Supp., 161–178.
Scafati-Spinelli, Campania. M. Della Corte, *NSc* 1923, 280–284.
Sette Finestre, Ager Cosanus. A. Carandini and T. Tatton-Brown in Painter 9–43.
Stabiae. M. Ruggiero, *Degli Scavi di Stabiae* (Naples 1881) 325.
Villa Magliano, Emilia-Romagna. A. Santarelli, *NSc* 1883, 159–161.
Vittimose, Buccino. R. Holloway and S. Dyson, *AJA* 75 (1971) 151/154.

B. Oil

Boscoreale, Villa della Pisanella (Room T). Pasqui *op.cit.*
Camerelle, Castrovillari. T. Bertocchi, *Klearchos* 5 (1963) 135–152.
Casali di Mentana, Mentana. C. Pala, *Forma Italiae I. XII* (Rome 1976) 75.
Castelfidardo, Ancona. L. Mercando, *NSc* 1979, 132–165.
Cesano di Senigallia, Ancona. L. Mercando, *NSc* 1979, 110–131.
Gallignano, Ancona. L. Mercando, *Atti XIII Conv. Studi Maceratesi* (1980) 39.
Granaraccio, Ager Tiburtinus. Faccenna *op.cit.*
Grotta del Malconsiglio, Sybaris. Galli *op.cit.*
Guidonia, Ager Tiburtinus. Caprino *op.cit.*
Luceria, Puglia. A. H. McDonald, *Republican Rome* (London 1966) 132, plate 73.
Mattinata, Foggia. E. M. De Juliis, *Atti del XV Convegno di Studi sulla Magna Grecia* (Naples 1976) 651–652.
Monte Canino, Ager Capenas. M. Pallottino, *NSc* 1937, 7–28.
Pareti, Buccino. S. L. Dyson, *AJA* 76 (1972) 161–163.
Ponte di Nona, Collazia. L. Quilici, *Forma Italiae I.X* (Rome 1974) 363 f.
Posta Crusta, Foggia. G. De Boe, *NSc* 1975, 516–530.
Posto, Francolise. Cotton 47–48, 63–66.
Salapia, Puglia. M. D. Marin, *Archivio Storico Pugliese* 1964, 171 f.
San Rocco, Francolise. P. Von Blanckenhagen *et al.*, *NSc* 1965, 237–252.
Scalea, Calabria. G. Pesce, *NSc* 1936, 67–74.
Sette Finestre, Ager Cosanus. A. Carandini and T. Tatton-Brown *op.cit.*
Stabiae, Casa di Miri. M. Ruggiero, *Degli Scavi di Stabiae* (Naples 1881) 333.
Valle Pilella, Ager Tiburtinus. A. M. Reggiani, *ArchCl* 30 (1978) 219–225.
Via Gabina, Lazio. W. M. Widrig in Painter, 119–140.
Via Tiberina, Lazio. M. Felletti Maj, *NSc* 1955, 206–216.
Vicovaro, Lazio. G. Lugli, *MonAnt* 31 (1926) 512 f.