CHAPTER SIXTEEN

# THE WATER SYSTEM
## Supply and drainage

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At Pompeii and Herculaneum great care was given to the water supply, sanitation and drainage.[1] Various methods accomplished the task—some simple, others more sophisticated. Different methods of providing water existed side by side: groundwater was hauled up from wells, and in houses rainwater was collected and stored. In addition, a network of lead pipes brought water to the baths, street fountains and private consumers. Sanitary provisions were abundant; in addition to the several public toilets, many toilets were built in private homes and shops. And finally, drainage accommodated the different kinds of material that had to be removed: urine and feces disappeared into cesspits; rainwater was led out of town along the sloping streets; and waste water from the baths was carried away in sewers.

This kaleidoscope of large and small, public and private, provisions functioned well and resulted in a good working system of water supply and disposal. This chapter presents the three types of water supply, sanitation, and different methods of disposal.

## WELLS

From an early period the inhabitants of Pompeii used wells. The geological substrata of the town consisted of alternating layers of porous volcanic material and hard lava banks. At a depth of 20 to 30 m was a 5 m-thick aquifer. Skill and perseverance were needed to reach this water as the porous walls of the well shaft collapsed easily. Furthermore, there was always the danger of deadly gas which even now can occur below a depth of 10 m. Due to these difficulties Pompeii had only a few wells. Some were in private houses; others were dug along the streets and served the general public.

In Herculaneum the groundwater could be found at a depth of only 8 to 10 m. Despite the fact that the substrata were formed out of hard tuff lava banks, many houses had their own private wells. Several windlasses with which water could be hauled up have been found in the houses.

In both towns a special kind of well was dug in establishments that needed a lot of water, such as the baths and *fullonicae*. Water was raised from the aquifer to a roof tank by a large water-lifting mechanism: a bucket-chain hung in the broad well shaft

operated by a man walking a tread-wheel.[2] In the roof tank the water was stored and later distributed over the building by lead pipes. With help of these devices one could be ensured of an abundant supply of daily water.

## RAINWATER CATCHMENT AND STORAGE

Besides drawing groundwater from wells, the inhabitants of Pompeii and Herculaneum collected rainwater on the roofs of their homes and led it into subterranean cisterns. Every house, or more accurately, every court was equipped with provisions for rainwater catchment. These were simple in design, but appropriate for collecting and storing rainwater and keeping it cool, clear and fresh.

In the *atrium*, rainwater was collected on the inward-sloping roof (Figures 8.19, 16.1 and 21.4) whose square opening, the *compluvium*, was decorated with waterspouts in form of dogs, bears or lions. These waterspouts directed the rainwater into a basin

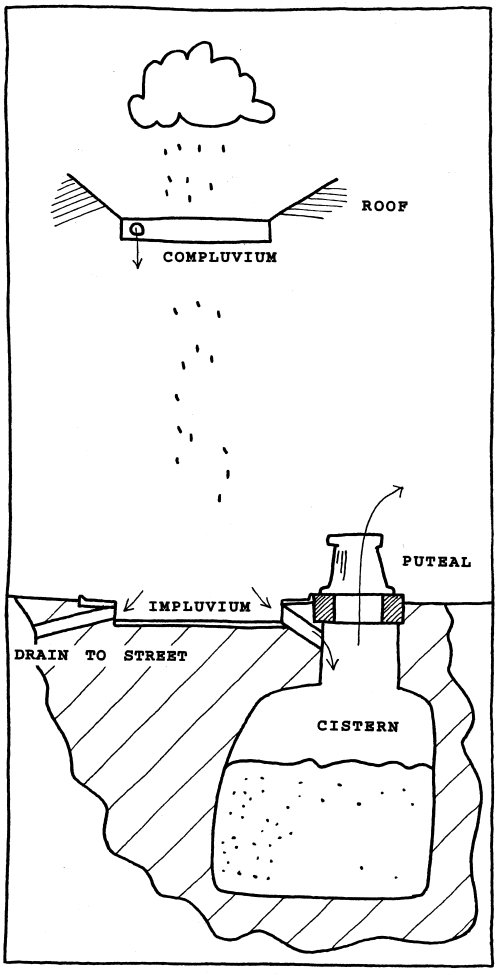


**Figure 16.1** Schematic presentation of a rainwater catchment system in an *atrium*.

**Figure 16.2** Settling box in peristyle gutter and perforated lead sheet in front of cistern entrance, both to prevent dirt from entering the cistern (Pompeii, I.9.11–12).

situated underneath, the *impluvium*, which guaranteed that only clear water entered the cistern. As the *impluvium* had two drains, one to the street and one to the cistern, the water could be regulated by closing one of these drains. After long periods of drought the rainwater which fell into the *impluvium* was polluted with dust and dirt from the roofs. This rainwater was led directly to the streets by closing the drain to the cistern. When the water became clear, the drain to the street was closed and the water was allowed to enter the cistern.

Water from the cistern could be obtained from the cistern mouth, a stone slab with a hole in the middle for lowering buckets. The rims show signs of wear caused by ropes with which the buckets of water were hauled up. The cistern mouth was closed with a stone cover or decorative "well"-head, a so-called *puteal* (Figure 18.2). These protected the cistern water against sunlight and dirt. Moreover, in this way the cistern presented no danger to playing children or inattentive grown-ups.

In peristyles rainwater was collected on the portico roof. The water fell from these roofs in a stone gutter lying on the floor and it was from here conducted into the cistern. Because the water could not be manipulated here as in the *impluvium* one built in small settling boxes (Figure 16.2). A perforated lead sheet fixed in front of the cistern entrance prevented debris, such as twigs and leaves, from entering the cistern.

## WATER PIPE SYSTEM

At a still unknown time in the history of Pompeii and Herculaneum, a long-distance pipeline and an intra-urban pressure system was introduced.[3] This provision went beyond the capabilities of the individual citizen. For carrying out such a large-scale project it was imperative that there should be an adequate organizational structure, not only with regard to planning and construction but also regarding maintenance, supervision and repairs. These tasks were taken on by the municipal government

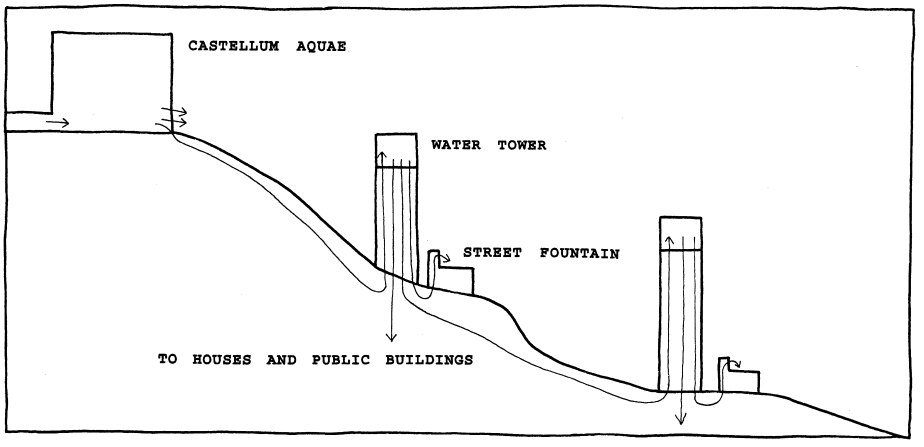


**Figure 16.3** Schematic presentation of the elements of the municipal water pipe system of Pompeii.

(Table 33.1). The introduction of this system was revolutionary for the water supply, as water was delivered to people's homes at a certain pressure. Of this advantage the inhabitants of both towns made grateful use by installing many fountains in their houses (Figures 14.5, 23.16 and 31.4).

In Augustan times a large aqueduct ran through Campania (Map 1). One of the assumptions is that Pompeii and Herculaneum were fed by branches of this aqueduct. However, the connection has not yet been found and the only thing known is the 90 m-long pipeline which has been excavated just north of Pompeii.[4] This is a typical Roman long-distance supply channel: U-shaped with a vaulted ceiling and large enough for a (small) man to walk through. In the excavated section two inspection shafts are still intact.

The urban system started at the main distribution center where the water, brought to the city by this aqueduct, was discharged. This water distribution center, called a *castellum aquae*, was a small building in which the water flow was divided and distributed among three large lead pipes.[5] As the building was situated at the highest point of the town, water was easily conducted to the several districts through pressurized pipelines. Because of the steep slope of the hill on which the city was built and, consequently, the difference in elevation between different parts of the town, the pressure in the main pipes varied considerably. Especially in lower parts of the town, the pressure must have been unacceptably high, necessitating the construction of towers up to 6 m high as minor distribution centers at street crossings (Figures 16.3 and 16.4). To release pressure, the main pipe was led in a groove up the side of the tower to a small and open basin at the top. That the water sometimes overflowed this basin can be deduced from the heavy calcium incrustations on some of the towers. In this way the water was depressurized and the downstream head of pressure was reduced to the height of the tower above the final destination. From the top of the tower small consumer pipes descended. These were smaller than the mains and attached to the tower with lead strips and iron nails.

Through the pipes, which ran down from the towers and under the sidewalks, water was led to its destinations: the baths, some urban reservoirs, street fountains and private consumers. People with no adequate water supply of their own could turn to the street fountains, a common feature in Pompeii and according to Eschebach's map not further away from one's house than 50 m (Figure 16.4).[6] Most of the street fountains were equipped with a basin, so it was possible for more than one person at a time to draw water and at the same time to create a reserve.

A private water pipe entered the house near the front or side door and headed immediately for the *impluvium* in the *atrium*.[7] Here the pipe was connected to a lead box to which several other pipes were fitted (Figure 16.5). These pipes were connected to fountains in and around the *impluvium* and could be closed by stopcocks, set between the lead box and each of the pipes. The most striking feature is the fact that it was not possible to close off the entire system within the house with one master valve. It was only possible to close each fountain independently.

In domestic settings water was mainly used for fountains whose overflow was drained into cisterns. Pipes leading to private baths and toilets were more rare.

The advent of piped water from the aqueduct introduced certain changes. Wells and rainwater catchment became supplementary. Public wells were replaced by street fountains and baths were no longer supplied with groundwater, but were converted to the pipe system. Some wells in private houses remained functional and rainwater catchment systems remained in use with the small change that the surplus from the fountains was now also stored in the cisterns.

**Figure 16.4** Water tower and street fountain at the intersection of the via Stabiana and the via dell'Abbondanza at Pompeii; view from the south.

**Figure 16.5** Lead distribution box with four pipes and four stopcocks, House of the Hanging Balcony, Pompeii (VII.12.28).

## SANITATION

On several walls in Pompeii inscriptions, such as *cacator cave malu(m) aut contempseris habeas Iove iratum* and *cacator sic valeas ut tu hoc locum trasea(s)* can be read.[8] From these it can be concluded that some relieved themselves in the street, and also that others took offence at this habit. This did not mean that there were not enough toilets in the town. On the contrary, both towns had several large and small public toilets and nearly every household had its own private one (cf. Jones and Robinson, Ch. 25).[9] In all these toilets water was needed, both to rinse the sponges, the Roman equivalent of our toilet paper, and to flush the toilet. Households that were not connected to the water pipe system or apartments on upper floors had toilets built in niches in the wall (Figure 16.6). In this way one could sit right above the drainpipe which was let into the wall and not much water was required for flushing. More water was needed in flush toilets, which mostly occur in kitchen areas. To flush the toilet with a bucket of water a small plateau of tiles was built in front of the toilet seat which slanted slightly towards the drain underneath the seat (Figure 16.7).

The porous and permeable subsoil of Pompeii made it possible to connect toilets to well-functioning cesspits. A cesspit was a kind of leach field: liquid material seeped into the ground and solid material remained in the pit. This result was achieved by constructing the pit's walls in such a way that liquids could get out through the seams between the bricks. The cesspits were round or square and the upper part was built of bricks. They could be up to 11 m deep. The opening through which a cesspit had to be emptied was often situated in the sidewalk of a nearby street or in an adjoining garden. In this way the pit could be emptied without causing a mess in the house. It is possible that the contents of the pits were used as a fertilizer on the fields outside the city or gardens within.

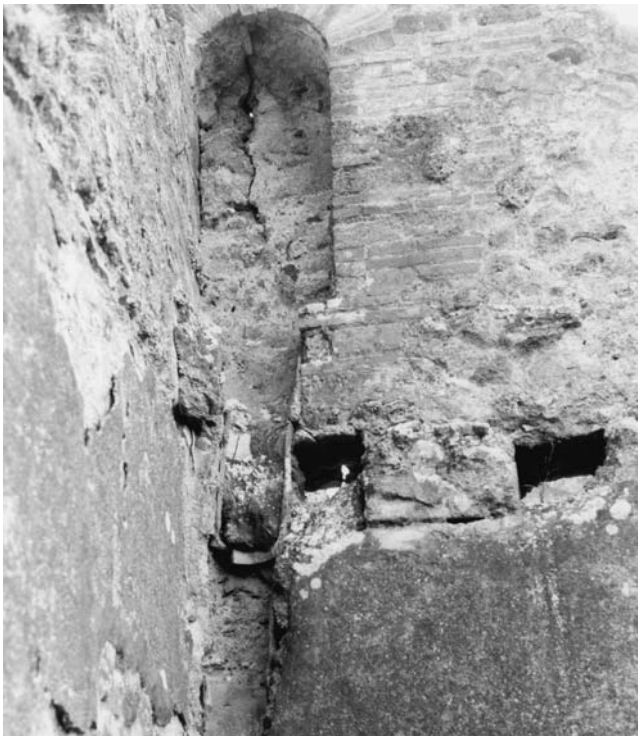

**Figure 16.6** Niche toilet on an upper floor with drainpipe in the wall, Pompeii (V.1.30).

**Figure 16.7** Flush toilet with raised tile floor in kitchen, House of Apollo (VI.7.23), Pompeii.

## DISPOSAL OF RAIN AND WASTE WATER

Rainwater, the overflow from the fountains, and waste water had to be removed. Because of the sloping streets of both Pompeii and Herculaneum the rainwater automatically flowed downwards and left through the city gates. Even now, after a shower of rain the streets of Pompeii change into fast-flowing brooklets. At such times the high sidewalks and stepping stones prove to be no superfluous luxury. The Pompeians did not just sit back and watch the water leave their city; they tried to manipulate it to prevent the flooding of some streets and to reduce the flow in others.[10] One method of manipulating the water was to construct a small elevation at the entrance to a side street, to prevent the rainwater from flowing into it. Another method was to raise the pavement slightly and thus force the water to change direction. In this way the water was manipulated without obstructing the traffic. Special measures were taken at the city gates. Since the gates were closed at night, the rainwater was led into a large drain beside the gate. This drain passed through the city's walls. Although it cannot be seen where the water went after it left the gates, it seems safe to assume that it was directed to the river Sarno or to the sea.

Because excreta were disposed of in cesspits and rainwater was carried away by the streets it seems that Pompeii did not need a sewer. But Pompeii had a sewer anyway. It was not a complete network but it consisted of different and separate branches, built to solve specific problems. One branch was specially designed to drain the forum. Other branches were connected to buildings where large amounts of water had to be disposed of, such as the baths and the Great Palaestra. The toilets of the baths and the *palaestra* were connected to the sewer as well.

As soon as branches of a sewer were laid out, they started to be used to get rid of other waste as well. In places where there was a lot of rainwater in the streets, a connection was made to the sewer to remove the excess. Toilets could then be connected to the sewer as well.

In contrast to Pompeii, Herculaneum had a rather systematic sewer system. Underneath all of the streets a sewer was installed. Inhabitants of Herculaneum were forced to do so, as cesspits did not work very well in the compact tuff substrata. Most of the toilets were, therefore, connected to this extensive sewer network.

## NOTES

1 For a general introduction into the water supply systems of Pompeii see H. Eschebach, "Die Gebrauchswasserversorgung des antiken Pompeji," *Antike Welt*, 1979, vol. 10, pp. 3–24; and N. de Haan and G. C. M. Jansen (eds), *Cura Aquarum in Campania: proceedings of the Ninth International Congress on the History of Water Management and Hydraulic Engineering in the Mediterranean Region* (Pompeii, 1–8 October 1994), *Bulletin Antieke Beschaving–Annual Papers on Classical Archaeology*, 1996, Supplement 4. For an introduction into the systems of water supply, sanitation and wastewater disposal of Herculaneum see A. Maiuri, *Ercolano, I Nuovi Scavi 1927–1958*, Rome, 1958, pp. 51–3, 49–51, 467–9 and G. Jansen, "Water systems and sanitation in the houses of Herculaneum," *Mededelingen van het Nederlands Instituut te Rome*, 1991, vol. 50, pp. 145–66. See also Koloski-Ostrow, Ch. 15.

2 J. P. Oleson, *Greek and Roman Mechanical Waterlifting Technology*, Toronto, 1984, pp. 213–15, 241–8 and J. P. Oleson, "Waterlifting devices at Herculaneum and Pompeii in the context of Roman technology," in N. de Haan and G. Jansen (eds), *Cura Aquarum*, pp. 67–77.

3 For this discussion see Eschebach, "Die Gebrauchswasserversorgung des antiken Pompeji," p. 7; Chr. Ohlig, "DE AQUIS POMPEIANORUM, Das Castellum Aquae in Pompeji: Herkunft, Zuleitung und Verteilung des Wassers," diss. Nijmegen, 2001, pp. 49–83.

4 As the eastern and highest part of Herculaneum is not excavated yet, a substantial part of the water pipe system is still missing: the aqueduct remains hidden underneath modern Herculaneum together with the main distribution center.

5 For recent research into this main distribution center see Chr. Ohlig, "Vitruvs 'castellum aquae' und die Wasserverteiling in antiken Pompeji," *Sftenreihe der Fronchritinusgesellschaft*, 1995, vol. 19, pp. 124–47 and idem, "Anmerkungen zum Funktionsmodell des Castellum Aquae im antiken Pompeji," in N. de Haan and G. Jansen (eds), *Cura Aquarum*, pp. 19–27; idem, "DE AQUIS POMPEIANORUM." [For concerns about lead piping affecting the health of the population, cf. Lazer, Ch. 38. Calcium deposits from the hard water (see below) would have helped insulate the water from lead contamination.—Eds]

6 Eschebach, "Die Gebrauchswasserversorgung des antiken Pompeji," fig. 11.

7 G. Jansen, "Water pipe systems in the houses of Pompeii: distribution and use," in A. O. Koloski-Ostrow (ed.), *Water Use and Hydraulics in the Roman City*, *AIA Colloquia and Conference Papers*, no. 3, Boston, 2001, pp. 27–40.

8 *CIL IV*, 7716, found in a passage leading to a latrine in IX.7.22, and 6641, from a roadside shrine (in V.6): "Shitter beware: if you ignore (this warning), may you endure the wrath of Jove" and "Shitter: you can hold it long enough to pass this place by." Transl. P. Foss.

9 A. O. Koloski-Ostrow, "Finding social meaning in the public latrines of Pompeii," in N. de Haan and G. Jansen (eds), *Cura Aquarum*, pp. 79–86 for public toilets, and G. Jansen, "Private toilets at Pompeii: appearance and operation," in S. E. Bon and R. Jones (eds), *Sequence and Space in Pompeii*, Oxford, 1997, pp. 121–34 for private ones.

10 M. Koga, "The surface drainage system of Pompeii," in *Opuscula Pompeiana*, 1992, vol. II, pp. 57–72; G. Jansen, "Systems for the disposal of waste and excreta in Roman cities. The situation at Pompeii, Herculaneum and Ostia," in X. Dupré Raventos and J.-A. Remolà (eds), *Sordes Urbis, La eliminación de residuos en la ciudad romana*, Rome, 2000, pp. 37–49.

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