11

Planning Water Management: Corinth and Syracuse

Where water is in short supply—in El Paso—it costs 53 cents per gallon. Where it's plentiful—in Philadelphia—it costs $1.78 per gallon.

—*Fun with Facts*

The ancient Greeks could not afford inefficient and impractical cities. This one insight has guided my research ever since I attended the International Water Resources Association conference in Rome in 1986 and learned how concerned modern water engineers and policymakers are about careful utilization of water resources. We twentieth century Americans can afford waste, because we are both rich and spendthrift. But the ancients were living very close to the edge in an ecosystem that sustains human life only if it is carefully, respectfully managed. How successful they were in city site selection and in city building is evident from the fact that so many of their cities survived for such long times—Athens nearly 5000 years; the great capital Byzantium-Constantinople-Istanbul since the eighth century B.C., a lifespan of about 2800 years; and even obscure towns like Morgantina, Sicily, for 450 years.

Given a hot and semiarid Mediterranean climate with rain only in the winter months, careful attention to water supply and distribution was essential for a Greek city. As long ago as the second millennium B.C., the Mycenaeans who lived in mainland Greece and the Minoans of Crete took great care of the water supply and drainage of their sites, using cisterns, wells, pipelines, rock-cut channels, and so on (Evans, 1964 reprint, vol. I, 103–05, 141–43, 333–36, 378–84, 389–98; Broneer,1939, 317–433; Mylonas 1966; Knaus, Heinrich, and Kalcyk, 1980). Because of the gap in the archaeological record, we cannot be sure whether any of their knowledge about water management survived the collapse of these civilizations and the 400 years or so of the "Dark Ages" that followed. Some ideas such as cisterns seem to be both so basic and so easy for a single family to execute, that it is likely their use persisted no matter how primitive conditions became. Others, such as the use of pressure pipes, seem to require a fairly sophisticated society and probably the existence of a group of architect-engineers to carry out the building process, and therefore we would not expect them to survive but to be independently re-invented when later Greek society reached technological sophistication.

Highly developed urban water systems of classical and Hellenistic times were based on careful study of the behavior of water integrated with equally knowledgeable manipulation of human economic and political behavior. It is no accident that we look back to the Greeks who brought political interaction, discussion, and writing to a superior level, since in many ways they are still our models. The political maneuvering necessary to build a modern water system cannot be very different from the problems that surfaced when an ancient Greek town needed a water system, and similar negotiations were necessary to resolve the issues. During the eighth to first centuries B.C., the Greeks were building cities that were increasingly complicated. The water management system—that complex of physical objects, technological development, and human behaviors that supplied, used, and discarded waters—was one of the subsystems that made up a Greek city, ranking with the food supply system, the defense system, the municipal government system, and so on. The food system and the water system were the two basics that made urban life possible, and it is curious that until now the water management system has frequently been ignored completely in trying to understand the Greeks, or at best has been only partially acknowledged.[1]

When Greek society reappears as an organized and expanding entity, in the eighth century B.C., Corinth was a leader of the colonization process that was to characterize the next four centuries. [Corinth itself dates from the fourth millennium (H.S. Robinson,1965, 4).] As a city began to press too heavily on its economic base (particularly agriculture), a group of citizens, under the leadership usually of a younger son of an aristocratic family, set off to found a new city in the relatively empty lands adjacent to the Aegean region, either northeast toward the Black Sea or southwest to southern Italy and Sicily. Not until Alexander the Great, 400 years later, was there any attempt to unite all Greeks into one political entity, but during that whole time there were close cultural and often economic relations between mother cities and their colonies, as well as between the various unrelated polities of the Greek world. Frequently the sites chosen for new colonies had earlier been trading outposts (for details of locating sites for cities, see Chapter 9, Urban Location Determinants). Only those settlements survived that were endowed with the water they needed—a great success story in the history of the relationship between water management and Greek urbanization.

In the founding of Syracuse as a colony of Corinth, in 734 B.C., there was the usual transfer of culture—language, religion, governmental organization, customs of daily life, and traditional knowledge such as crafts, farming, and water management. In this chapter, I suggest that whatever elements of water system Corinth and Syracuse have in common after the eighth century are owing to three factors: their common culture with its backlog of traditional technological knowledge and openness to new technical developments; the fact that water is amazingly consistent in its behavior, thus calling for consistent solutions to the problems of managing it; and finally that the settlers deliberately chose sites where their water technology would work. The transfer of traditional knowledge about managing water was facilitated by the similarity of geology and climate between the two sites.

Traditional knowledge of finding and collecting water was coupled in the Greek world with increasing sophistication in the transport of both fresh and used water during the period studied (eighth to first century B.C.). (See Chapter 3 on traditional knowledge of finding water.) Fahlbusch (1982, 131–39) has studied the transport of water in long-distance water supply lines, noting that socioeconomic arrangements changed in parallel with other societal changes, and with the development of increasingly sophisticated technology. In the seventh century, for instance, the tyrant Theagenes at Megara kept firmly in his own hands the power to erect water system elements such as his famous fountainhouse. In sixth century Athens, Peisistratos gave this power to a board of commissioners, and in the fifth century, such individual engineers as Eupalinos of Megara took charge of the work and were held responsible for it. Eupalinos also built the tunnel at Samos. In the fourth century, we hear of building commissioners approving of the alignments for waterlines. At the same time, in Rome, the architect-engineer delegated responsibility for actual construction of the line to a businessman/contractor, as was the custom for other major construction projects. In the present state of knowledge, it is not possible to declare firmly that each of these examples stands for a consensus at that time on how water should be managed; rather, we may use them as illustrations of the possibilities at any given time. In general, it seems to me that newer ways of managing water were added to older ways rather than substituting for them.

These changes in who was responsible are paralleled by changes in what was built. The wondrous tunnel at Samos had clay pipes laid in a channel that sloped separately from the bed of the tunnel. Later, and at other places, cut and built channels followed the contours of the hills, while in major cities with a strong economic base and demographic demand there could be—as early as the third or perhaps even the fifth century—pressure pipe lines and siphons. Pressure pipelines at Syracuse, Akragas, and Pergamon, are discussed by Nerberger (1930, 422), and Forbes (1955, 151), but their documentation is weak. It could be a reflection of the wealth and sophistication of Syracuse that pressure pipelines are ascribed to it as early as the fifth century B.C. Greek cities were by the fifth century commonly supplied from waterlines based on gravity flow and on the natural geological pattern of the site. In Roman imperial times the engineers used a combination of tunnels, contour channels, bridges, and siphons, all developed in the preceding era.

CORINTH AND SYRACUSE (FIGS. 8.1, 8.4, 11.1, 11.2, 11.3, 11.4, 11.5. 11.6, 11.7, 11.8, 11.9)

Corinth and its very successful colony, Syracuse, may be compared as to natural resources, elements of water management—springs, fountains, cisterns, wells, pipes, and channels—and water use. For each aspect of the water system , we will examine first the example from Corinth and then that from Syracuse if there is a comparable one. This section continues by describing each water system as a whole and evaluating its effectiveness, and concludes by suggesting which elements of the Syracusan water system seem to take their intellectual or technological origin from Corinth. This comparison will be fairly easy for the major quasi-architectural features such as fountains, but difficult for pipes and channels, because of extreme differences in the way the different elements have or have not been published.

When we see how much water was available at both of these sites, and in what wide distribution, we can recognize that the abundance of water was a prime reason for selection of each for settlement, as it was for continued growth of the settlement. Water contributed markedly to the economic success of each site. The fact that each site was easily defensible was the other major factor in its choice.

Corinth

As H.S. Robinson (1965, 4–6) has written of Corinth:

> The ancient city grew up on the slopes of Acrocorinth because of the importance of the hill . . . on the north slope of the hill . . . there were good supplies of water combined with gently sloping terraces of fertile fields . . . Graves and some household deposits of the 10th, 9th and 8th centuries have appeared at isolated points throughout the central area of the later city, but we have no means as yet of estimating the size or economic status of the city in these years. That very period during which the city was achieving its greatest growth and when the Bacchiad kings were sending out colonies to Magna Graecia . . . is almost unknown to us from archaeological evidence.

That the archaeological evidence from the earliest period is scanty forces us to examine very carefully whatever evidence is available. Robinson continues: "Wells of the late 8th and 7th centuries which have been found in and around the area of the later market-place indicate the presence of houses or civic buildings . . . the Potters' Quarter, west of the town, . . . flourished from the late 8th through the 4th century B.C.

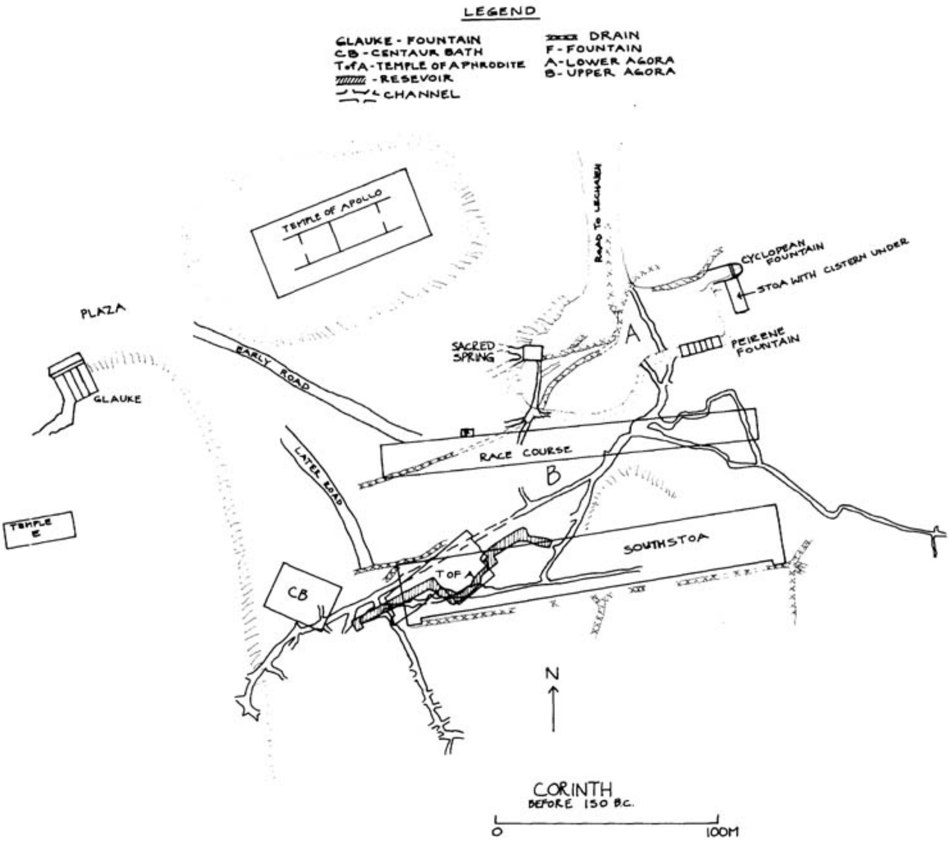


Figure 11.1. Corinth. Central district in Greek times, before 150 B.C., with special reference to the water system elements.

. . . produced the pottery carried in Corinthian ships all around the Mediterranean world."

In appearance, the site of Syracuse is somewhat different from that of Corinth. The latter is some 3 to 5 kilometers inland but had ports at Lechaeum and Isthmia (to the west and east of the Isthmus, respectively), while Syracuse was founded as a port of trade on the island/peninsula of Ortygia and grew gradually inland and uphill. Corinth lay at the foot of the abrupt peak of Acrocorinth, while Syracuse's uphill termination was the fortress of Euryalus, perhaps as tall as Acrocorinth, but reached by gradually sloping land on the east, southeast, and south, where the city lay. The climate in both is essentially Mediterranean, although one must allow for the differences that occur because one city (Corinth) slopes downward to the north and lies near a large bay (the Gulf of

Corinth) and the other (Syracuse) slopes downward to the southeast, and lies on the open sea. Hydrogeologically, the sites are similar in that layers of permeable rock and impervious clay collected water in quite similar fashions and made it available to human use. Natural channels through the rock seem at both sites to have been amplified and directed to behave as underground aqueducts.

We will better understand these features by examining details of the water system in each place, beginning with the fountains at Corinth. The "compact, whitish clay—the typical light-colored clay used in the archaic period by the famed potters of Corinth" (H.S. Robinson, 1965, 9) was a crucial stratum in the layers of rock that collected the rainfall and made it available for human needs. Under a 1.5 or 2 meter thick layer of porous conglomerate lay the impervious clay. Water trickled down through the rock and spread out along the surface of the clay, from whence it could easily be collected. At least by the sixth century, the Corinthians had learned to improve upon nature, making a spring house by cutting back the clay so that an outlet was shielded from the sun by overhanging conglomerate, and then cutting tunnels back into the clay just under the stone, to tap the water-bearing seam.

Three fountains are known in the Corinthian agora area that date from the earliest period—the Cyclopean Spring, Peirene, and the Sacred Spring. There is question as to whether the Glauke Fountain (not a spring), set apart from the others at the opposite end of the archaic temple, belongs to this early period also. Let us consider them in that order.

The Cyclopean Spring was located to the east of the road that led from the coast and the agricultural terraces up to the area of the Agora and the early race track. This spring stood at right angles to the fountain of Peirene, both located on the left as one mounts the street. As its name suggests, the appearance of the Cyclopean Spring alluded to great antiquity with its masonry of rough-hewn stones forming the walls of a "natural" grotto of irregular hexagonal shape, its street-side end a parapet toward the user. Thus in appearance this fountain was an enhanced natural object reminding users of a very early period in Corinthian history (Mycenaean times). Both the Cyclopean Spring and Peirene were tucked in under the conglomerate that formed the surface of the upper agora. Originally, a natural spring just to the east of Peirene may have supplied both fountains, with the water stored in two holding tanks immediately south of Peirene and in a cistern immediately south of the Cyclopean fountain. Probably by the end of the fifth century B.C. the flow of this spring was supplemented by a common water supply tunnel for the two fountains. The chronology may have been:

- Discovery of a group of springs at the head of the valley leading up from the coast to Acrocorinth—major reason for locating the center of Corinth where the agora still is

Figure 11.2. View into Peirene Spring at Corinth, past one bay of the Hellenistic colonnaded facade to the collection basin behind. This facade was pierced by the hole at lower right, probably in Roman times, to allow the waters to fill a new series of collection basins between the later outer facade and the one shown here. The Hellenistic columns, about 1.6 meters tall, stand on the outer wall of one of four reservoir basins of that period.

- Formalization of Cyclopean and other springs as fountainhouses
  - Cyclopean fountain in "natural" grotto fed by water from spring that also fed Peirene
  - Cistern built to hold water for Cyclopean Spring
  - Earliest monumentalization of Peirene fountain
  - The two fountains and their holding tanks supplied later (fifth to fourth centuries B.C.) from the long channels that tapped the karst channels from Acrocorinth
  - In the Hellenistic era, Peirene was developed further and at the

same time, new construction began to squeeze against the site of the Cyclopean Spring

- Destruction of the city ca. 150 B.C.
- City rebuilt as a Roman town
- Refurbishing and expansion of Peirene completely concealed old Cyclopean Spring
- In Byzantine times, the Cyclopean Spring was opened up again (Hill, 1964, 47 n.1) perhaps because constriction of the channels elsewhere had caused the water to erupt here again

Most famous and long-lived of the Corinthian springs was Peirene, first mentioned by Herodotus in the sixth century B.C., and by Pindar in the fifth century; Euripides also alluded to the spring in *Medea*, agreeing with the other two authors that Peirene was the center of Corinthian life (cited in Hill, 1964, 1). If the fountain was so famous in the sixth century, it is likely to have been already in place even earlier, by the seventh century at least. The Roman author Pausanias said that Peirene was just outside the agora of his day (Hill, 1964, 23); actually it is located at the lower level where the main road entered the agora (Figs. 11.1 and 11.2). (See Part IX, Amenity and Necessity, for fuller discussion of the locations of public fountains.)

Like the Cyclopean and Sacred Springs, Peirene began as a point of natural outflow of waters collected along the seam between conglomerate and clay. In appearance, it was probably a cave (Hill, 1964, 23). Several building periods are in evidence, from the earliest channels barely 0.25 meters below the conglomerate surface, through many deepenings and extensions of the channels back toward Acrocorinth. Some tunnels eventually ran more than 3000 meters back into the rock (Hill, 1964, Fig. 4, p.16 ; H.S. Robinson, 1969,1–35). Remodelings in the levels of the early spouts and in the parapets for the later drawbasins culminated in the Roman period in the elaboration of the courtyard into one with a central pool flanked laterally by two large semicircular exedrae and entered on either side of a third exedra of the same pattern, set opposite the new colonnaded facade that stood in front of the large old drawbasins. Behind the Roman columns, the inner facade was the old Hellenistic one with small Ionic columns and well-worn parapets. Farther in were the four long basins of the archaic reservoir, filled from the channels leading back into the hill. Hill states that the system was essentially unchanged throughout the Greek era (Hill, 1964, 15–45). However, it seems that to keep the spring flowing copiously it was necessary from time to time to extend and deepen the channels corresponding to the natural tendency of the water to cut deeper beds for itself. So, also, the facade of the fountain was refurbished or rebuilt every few centuries.

The Sacred Spring, third of these very early fountains, stood on the west side of the main street, near the southeast corner of the hill on which stood the archaic temple. The relationship between that temple, the Sacred Spring, Peirene, and the Cyclopean Fountain (called simply Fountain House) is shown in figure 5 of Williams and Fisher (1971, 12). Beginning as a natural grotto-like spring, this fountain had to be rebuilt later after the conglomerate roof collapsed. Today one unlocks the iron gate and goes down several steps below the present ground level, where can still be seen the fine ashlar wall of the rebuilding, screening the channels cut in clay and rock that brought water to this place. Bronze lion heads were found in situ on the wall, and the gutter into which their water poured lay at the base of the wall—a small gutter, indicating that the flow of the spring by the time of the sixth century rebuilding was meager. The water came originally from a small natural spring. Because of the sacred nature of this spring, it was worth amplifying that source later and supplying the spring from deeper channels. However, as the level of the agora became higher, this spring was entered less and less frequently, and the final phase of water use at this spot (end of third to middle of second century B.C.) directed the water from the channels to a square basin on the agora surface above the old reservoir, which had been carefully buried (Hill, 1964, 116–96).

The last fountain we will look at is Glauke, which stands 80 meters southwest of the archaic temple, and is of the same rough native rock as the temple (Hill, 1964, 200–24). It is evident that an adjacent hill was quarried for blocks to build the temple and possibly other buildings, and that this 15 by 14 meter cube was left in place. Someone had the inspiration to use the quarry trenches as reservoirs, and to fit the big block as a fountainhouse, with draw-basins, access stairs, and supply pipes. At first the excavators assumed that the fountain block dated to the sixth century B.C. like the temple (H.S. Robinson, 1965, 11), but more recent studies have disclosed the Roman type of terra-cotta pipes bringing the water to the fountain and other evidence to indicate that the whole fountain may date from the later period (Williams and Zervos, 1984, 97–101). One of the arguments for the Roman date of the fountain is the vaulting cut into the rock; however, Williams and Fisher write (1971,12; cf. Wiseman, 1970, p.13 n.43), that the Greeks had used vaults since the sixth century B.C. It is very difficult to date rock cuttings.

This careful reading of the evidence, however, fails to solve the question of what the cube of stone was used for if it were not a fountain? Why was it left there—in a very busy part of the city center—from archaic times until after the middle of the second century B.C. when the Romans rebuilt the area, and then through the Roman period until today, if it were not a useful object? What was its function during this interval? Because Glauke stands on top of the layer of conglomerate rather than under it like the three fountains discussed previously, it could not tap into the underground karst network. Rather, it was supplied by pipelines that were perforce at a higher level than the channels that fed the other fountains. The pipelines were liable to accidents and deliberate attack, and would therefore have needed replacement in a more overt and easily

Figure 11.3. Glauke Fountainhouse, Corinth. Sculpted from a huge block of stone that remained after the Temple of Apollo was constructed in archaic times, this fountainhouse seems never to have been a spring, but rather to have been supplied by pipes bringing water from uphill. The arched openings cut in the rock are approximately 4 meters tall.

dateable fashion than the underground clay-cut channels. Therefore I speculate that the fountain is indeed archaic, but refitted with pipes, possibly "modernized" with rock-cut vaults, and given a newly paved setting in Roman times. This scenario accounts for the fact that its cubic mass has always occupied the same location in what was a very congested part of the city. As suggested in Chapter 8, temples of Apollo are associated with springs, so that a functioning fountain near the entry to this precinct of Apollo would be appropriate and worth the trouble of fitting Glauke with a long-distance supply line.

Although this account by no means exhausts the list of fountains at Corinth, it is sufficient to give a sense of the provision of water in copious amounts at the center of the commercial, political, and religious focus of the city. Would that it were as easy to describe the fountains at the center of Syracuse!

Syracuse

City founders and architect-engineers, as was customary, selected the site of Syracuse for its inherently positive base, including water supply, and then located public buildings and private shops and houses according to the customs of daily life. Because of the geology of the site, with its earlier and later limestone layers above clay, there was an abundance of water. Many of the same processes were at work here as at home in Corinth, with the water cutting its own channels through the rock and even etching out access shafts, so that the ancient engineers had rather to manage the water than to find or even import it, and this for many years (eighth to fifth centuries B.C.).

Archaeological knowledge of the site of Syracuse has been hampered by the fact that the medieval and baroque city overlies the most ancient settlement on the island of Ortygia, while the Hellenistic city, long rural, now feels the forces of modern urban development. Still, we can make a few comparisons with Corinth that may be illuminating.

The most diligent scholar of the water lines of Syracuse was J. Schubring, who published his detailed account in 1865. Schubring also wrote on the water channels of Akragas.[2] He followed every trace of every line, both within and outside of the city, counting the shaft openings (pozzi) as he did so, and examining reservoirs, as well as the remains of fountains, wells, and so forth. More recently, Alfred Burns (who had the advantage of being an industrial engineer as well as a classicist) has examined the water supplies of Syracuse and of Akragas, and published a sketch map (1974). One would give a great deal for a unified map that displayed all the currently known features of ancient Syracuse superimposed on the faint traces of the modern city and well captioned, but it does not apparently exist. Maps 14 and 15 of the Hellenistic quarters of Syracuse and of Ortygia, respectively, in *Storia della Sicilia* (1979) were useful sources for Figures 8.4 and 11.4 here, which attempt to bring together what is known from many sources about the geography and urban plan of ancient Syracuse.

A notable source of water on Ortygia, the first site of settlement at Syracuse, was the spring named after the nymph Arethusa. Located just at the edge of the sea, this pool has since baroque times been framed with an architectural setting, but seems always to have had wild papyrus plants growing in it, giving rise to the myth that the fleeing nymph, after whom the spring was named, was trying to escape from the amorous attentions of the god of the River Nile—since papyrus grows wild elsewhere only in Egypt. The nymph dove into the Mediterranean, and came up here on Ortygia. Actually, this spring is one of a series that used to be visible in both the Great and Little Harbors flanking the island, originally fresh water but of salty taste since an earthquake in the twelfth century (Schubring, 1865; Sweeting, 1973, 212). In the traditional literature, these fresh intrusions into the salt water are variously explained as natural springs or as breaks in an undersea aqueduct. When I visited Syracuse in 1985, I looked in vain for them. Since then, I have searched in the literature and found the answer to the mysteries of their appearance and disappearance with the other material on karst phenomena: The water-bearing karstified limestone formation is overlaid by an imperme-

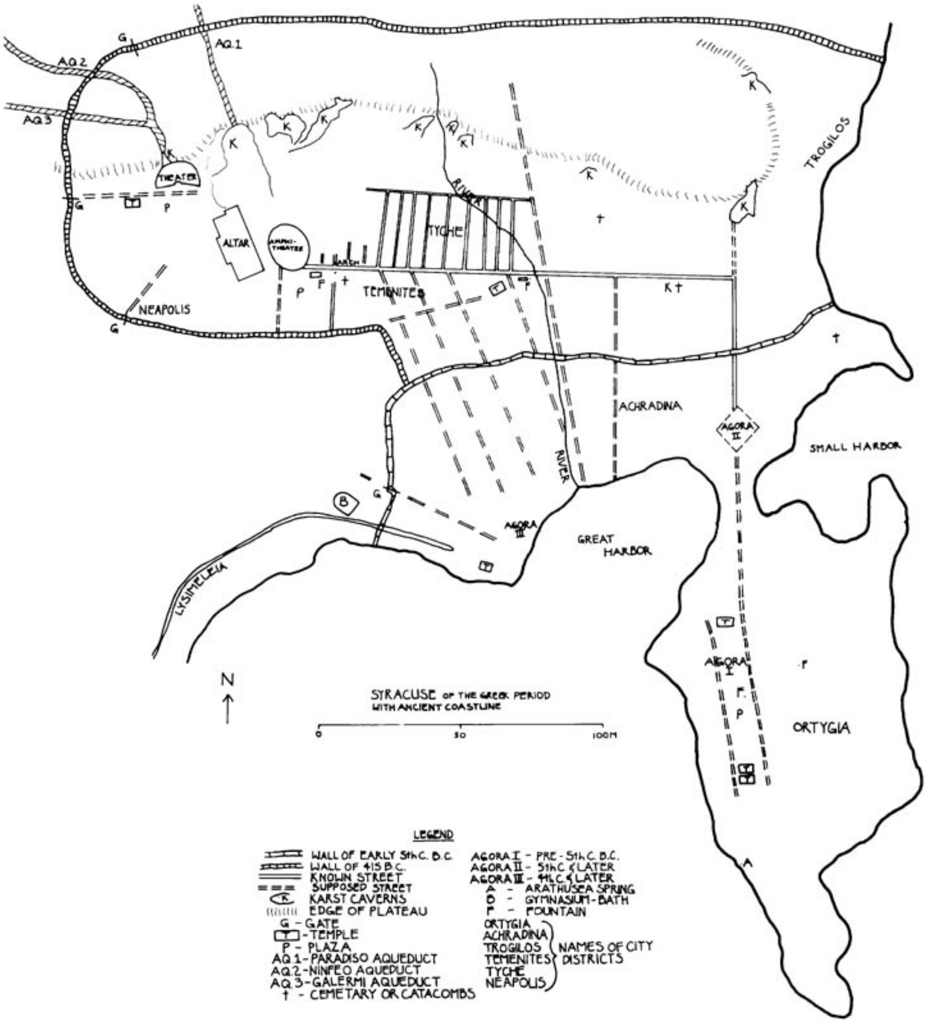


Figure 11.4. Map of Syracuse in Greek times. The shoreline is that of Greek and Roman times. Note numerous karst caverns, today known as quarries or latomia. All streets and public spaces shown are taken from archaeological reports on the site.

able layer, together sloping downward in a great disk shape from the fortress of Euryalus northwest of the city, down and under the city, coming to the surface again on the island. The water seeps along the bedding planes in the limestone, but tries to come up to the surface through shafts that form along upright cracks in the rock. From time to time, the top of one of these shafts collapses, allowing the fresh water to flow out under pressure, and forming an artesian spring on land or in the sea as the case may be. So much for the appearance of springs in the sea. That these springs are not now flowing may be due to two separate factors, or to a combination of them. The easiest explanation is that the shaft collapsed and was plugged up, preventing the water from flowing out. Given the recent surge of urban development at Syracuse, an equally likely explanation is that the groundwater table on the slope went down because of many uphill demands, reducing the pressure (head) that had previously forced the spring water out to the surface of the harbor.

Since the earliest temples of the city have been found on Ortygia, and the area is still the focus of urban life, we can deduce that the earliest agora and other municipal functions were there. They would have needed the usual complements of public fountains, drains, etc., but these have not been systematically located, and may prove irrecoverable because of the density and persistence of later use of the site. To tap for public use the water flowing in bedding planes but fairly near the surface of the island, there were three or four water lines crossing it, as reported by Schubring. He lists one waterline as opening near the cathedral, one in the cloister of S. Lucia, two near the spring of Arethusa, and one line on the coast of the Great Harbor. One plaza on Ortygia is called "Ronco del Pozzo"(area around the well).

Other visible features of the water system at Syracuse are located on the mainland, in what became first the suburbs and then intrinsic parts of the city: Acradina, Neapolis, Tyche, and Epipolae. A major focus of development in this region was the series of grottoes above the theater, where water still collects and is disbursed for further use (Fig. 11.5). Water naturally forms caverns in limestone, and it is common for the pressure of water farther uphill to drive springs out into the open wherever such caverns intersect the surface. Thus the early Greeks found water naturally flowing here. Over time (two or three centuries), two things happened: The water found a new path, farther down the hill, and the increase of population increased demand for water. Since settlement had originally taken place in this immediate area because of the springs, it was reasonable to continue to use these outlets, but to re-supply them with long-distance lines bringing additional water from farther uphill and from the west. Both the Ninfeo Aqueduct from the northwest (uphill) and the Galermi Aqueduct from the west converge at these grottoes. (We will discuss these supply lines later.) The grottoes make a handsome frame for the theater, lying in a gentle arc along the uphill side of the street that edges the top of the cavea. They were a favorite site for burials during later centuries, so that both the face of the rock and the walls of each cave are pocked with niches now. The dates for all of this activity are hard to ascertain, but I will hazard the following chronology:

- Water with CO_2 in solution carves out channels in the limestone, a process beginning eons ago and still continuing
- Natural springs in caves draw settlers

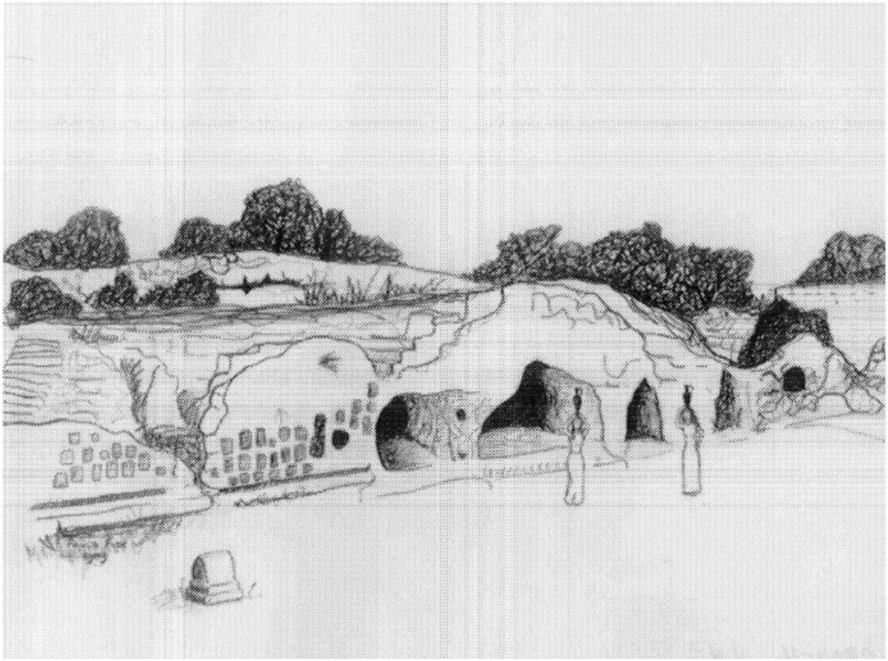


Figure 11.5. Reconstruction of fountain grottoes above theater, Syracuse. A series of natural grottoes that received the outfall of karst channels were amplified over time, receiving waters from the Galermi aqueduct and other long-distance water supply lines. The area also served as a cemetery or sanctuary during some times in its history, as is indicated by the many niches and inscriptions cut into the face of the stone, at left.

- Greeks of the archaic and classical periods utilize these little caves and channels to serve as aqueducts, enlarging them as necessary, no later than early fifth century

Schubring suggests that old cemetery areas near the quarries and springs, for a long time outside the city, were in Gelon's time incorporated into the expanded urban fabric. In this scenario, the widening of channels for catacombs would already have begun in the fifth century or earlier. During the reign of Gelon, in the first quarter of the fifth century, settlers were brought in from Kamarina, Gela, Megara Hyblea, and Euboia. To provide for these new settlers, he built aqueducts for the Tyche, Achradina, and Ortygia areas (Schubring, 1865, 618–20, 625).

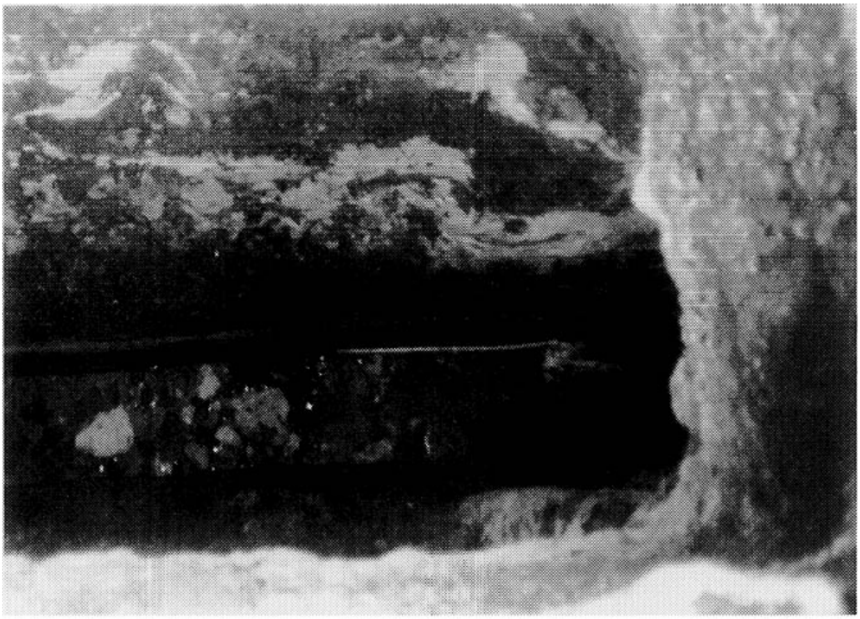
- The earliest aqueduct here dates from 491 to 477 B.C.
- The theater is built, in the quarry area below the road and springs, late fifth century, after the war with Athens, using Athenian prisoners as quarry slaves. It has the normal drainage system for a classical theater.

- To maintain fountains and waterlines at uphill locations, water must be brought in from farther away and from higher sources (late classical and Hellenistic eras), necessitating the construction of long-distance water supply lines, possibly including pressure pipe lines, and quite possibly tapping karst channels.
- Water table drops because of large demand; Greeks increase supply (as would modern engineers) by waterproofing tunnels, diverting streams, and using parts of old tunnels as reservoirs
- Dwindling flow of water at the grottoes and other outlets while the population increases requiring long-distance water supply so the Aqueduct of the Nymphs and the Galermi Aqueduct are built to supply grottoes, etc., no later than third century B.C.

In *Storia della Sicilia*, (1979) plate LXXXIX, figures 92 and 93 show the interior of Galermi, and date it as "classical" which should mean fifth to fourth centuries, in contrast to the Tindari line which is termed "Hellenistic."

- Romans conquer Sicily in late third century, bringing into existence an early Greco-Roman society.
- Gradual reduction of population parallels gradual down-cutting of

Figure 11.6. View down into stone shaft of Galermi Aqueduct at Syracuse, towards water still flowing in a channel at the bottom. The narrow dimension of the shaft is .5 to .7 meter.



underground water, and population moves downhill to utilize lower outlets, and to be closer to continuing commercial center.

- During the Roman period, new water system elements are added to compensate for old ones going out of use, and to provide for normal Roman activities such as bath-gymnasiums and other needs of the new and possibly enlarged population.
- After centuries of use as waterlines, abandoned grottoes and underground tunnels are pressed into service as tomb sites perhaps as early as the last century B.C., but increasingly in the third and fourth centuries A.D. The Greeks and Romans rarely buried their dead within the city limits, but often reused cemetery areas after a lapse of time. The reuse and probable enlargement of the aqueduct channels as catacombs speaks strongly of an era when no water flowed in the tunnels. They certainly would not have contaminated an active and important water source with dead bodies.
- By the second or third century A.D., the water system had continued to change as maintenance had been deferred or nonexistent.
- After a gap of centuries, the modern population finds new sources of water (e.g., deep pumping in the plains west and especially southwest of the city), and renovates the old Galermi aqueduct.[3] Professor Aurelio Aureli of the Geology Department of the University of Catania (personal communication) reports that the springs in the harbor were fed from the west, by the same aquifer that gave rise to the Rivers Kyane and Anapos; the disappearance of the harbor springs may be due to massive pumping in this western plain.

Thus in the case of the grottoes above the theater and the lines that supplied them, the continuum spring-fountain-waterline exhibits all the complexity that is possible, given centuries of change in both the location of the vein of water and the preferences of the human users.

There are other fountains from ancient times in the Hellenistic parts of Syracuse, but none are ancient enough to be relevant to our investigation of Corinthian influence in the development of the water system of Syracuse. Largest of these later fountains is one to the immediate southeast of the amphitheater, at the west end of the major east-west street. It stands on a level 10 or 15 feet below the arch that terminated the street, suggesting that it predates the arch and that its location depended upon where a vein of water came to the surface. At least one of the water lines that honeycomb this hill was made to supply this fountain in Roman times, but I think (because of its awkward relationship to the street system here and to the amphitheater) that the water line is much earlier than the amphitheater.[4] It is interesting to note that one practice described by Fahlbusch (1982, Abb. 4), that of stuffing an ooze gallery with stones to facilitate the collection of the water, is visible in the third and fourth niches from the right end of this fountain.

Turning from fountains to the waterlines that supplied them, we must admit that we have no evidence for long-distance supply lines in the Greek world as early as the eighth century when the colonization of Syracuse was taking place from Corinth; however, by the seventh century or early sixth, the line supplying the Megara Fountainhouse was built. If we find similar waterlines in Syracuse and Corinth, it must be the result of two factors coinciding: First, both cities seem to have imported the water technology that had been developed originally in the kingdom of Urartu (modern Armenia), then adopted and promulgated by the Persians, and used in Greek lands initially on islands like Samos and Lemnos very near to the Persian possessions in western Asia Minor (discussed in Chapter 6). Second, the geology of the two sites was similar enough that the same technology worked well at both places. This new long-distance waterline technology was easily adapted to their own purposes by a people who had centuries of observation and experimentation behind them, as well as a pressing need for ample water supply for growing urban centers. Here I would like to add that the colonists from Corinth were, it seems likely, explicitly looking for a site on which it would be possible to apply what they knew of water management, farming, trade, and so on. Similarly, it was the Scandinavians who found it possible to colonize Iceland and Greenland, as well as Vineland on the North American continent, and it was the Spanish from Mexico and their Indian allies who found it possible to colonize New Mexico. In each of these three cases, the similarities of terrain and climate between base and colony are not accidental (Tuan, 1974, 66–70).[5] With these caveats in mind, let us consider the evidence for long-distance water supply at Corinth and then at Syracuse (Figs. 8.4, 11.1, 11.6, 11.7, 15.5, 15.6).

In Corinth, Peirene deserved its name of perennial spring since it still (in the early 1960s) gave 4.2 to 8.1 cubic meters per hour depending on the season and the year (Hill, 1964, 29). The water arrived at Reservoir 4 and from there filled the other three reservoirs and three draw basins. This reservoir was filled by the east tunnel, tall enough to walk in and with its ceiling formed by the bottom of the conglomerate level. The east tunnel was followed by the excavators for 175 meters and the west one for 260 meters. The west tunnel was "used for 1800 years as a reservoir, filled up to within .75 m[eters] of the top" (Hill, 1964, 57). Hill's theory is that the west tunnel was begun "to strengthen and direct the flow, [to] collect water from several small streams [i.e., karst channels] as its line crossed theirs." In order to collect the waters from the seam between clay and rock, the west tunnel branches many times; two branches, for instance, serving the water system of the South Stoa, upstream from which was an underground reservoir. This tunnel is typical of those used at Corinth, in that each channel has short branches for collecting water, tapping not only those important flows that we call springs, but also seeps and various sorts of oozing. The west tunnel taps two springs nearest Acrocorinth, as well as the small spring only 8 meters north of Peirene—this one finished with very carefully cut masonry, as if to call attention to its role as a shrine (Hill, 1964, 61, and fig. 31d). Apparently this spring was the original supply for the Cyclopean Spring and Peirene. The tunnel system is furnished throughout with well-shafts, which facilitated both cutting the tunnel and maintaining it. Twenty of them are visible from below, four from above. One row of openings lies about 15 meters away from the foundations of the South Stoa, spaced at regular intervals to serve the shops; the shafts seem to have been built at the same time as the South Stoa. Others date from as early as the sixth century B.C. to as late as the Byzantine period (ca. sixth century A.D.), judging from their fill—all of which tells us that maintenance of this system was a constant requirement, and change in the system inevitable as the human population changed its habits and needs. In the agora area, cross tunnels ran between the major lines, which followed the slope of the agora from up in the southwest corner to down in the northeast corner (Morgan, 1939, 256) (see Fig. 11.1). The ultimate extent of the channels may have been 2200 or even 3500 meters back toward the great "sponge" that was Acrocorinth.

A second set of important water tunnels and cisterns was found in 1962 about 1000 meters southwest of the old agora (Robinson, 1969, fig. 1) The main tunnel was traced for more than 600 meters and seemed to run in the general direction of a spring at the foot of Acrocorinth (now called by its Turkish name, Hadji Mustapha). The water seemed destined to supply a small valley west of the city, and on the way there to serve both the domestic and the industrial needs of the persons living and working in this quarter. As usual, the tunnel was interrupted every 60 meters or so by manholes, many of them oval, which is not uncommon at Corinth. Already in the fourth century B.C. part of the system went out of use. Almost 200 meters of the tunnel (the branch to the southeast) was used in Roman times, if not before, as a reservoir.

The length of 3500 meters of channels attested for Corinth was far outstripped by the longest of the waterlines at Syracuse: the Galermi Aqueduct, which ran some 25 kilometers from the west into the city, and which still flows although its waters are no longer serious contributors to the water supply of the city. It was extremely interesting, however, to see in 1985 that a modern waterline of large size is being built that runs from very near the source of Galermi, on Crimiti Mountain, and follows much of the course of the ancient line. Schubring traced the entire line of Galermi (ca. 1860), reporting that in some places it was visible by the line of pozzi and in others by the line of brambles growing with their roots in the leakage from the line. Both kinds of evidence are still appar-

Figure 11.7. Galermi Aqueduct at Syracuse. Line of aqueduct channel, covered here by pointed roof, and leading to stone shaft in middle distance.

ent (1985), as well as stretches where one sees the line's arched or gabled roof rising through the grass and brush (Fig. 11.7). As it approaches the city, the waterline branches many times. Within Syracuse, Galermi is less easy to trace, but eventually it filled a large reservoir somewhat northwest (uphill) of the theater grotto area. A line led southeast that fed the grottoes, then in turn branched left and right past the theater and downhill to the sea in both easterly and south-southeasterly directions. Cavallari reported that Galermi surfaced above the theater, between the Ninfeo and Paradiso Aqueducts, at the height of 60 to 70 meters above sea level, having originated at about 187 meters on the mountain above Belevedere (Cavallari, 1887, esp. pl. 15).

Without attempting to describe the remaining waterlines of the city in the exhaustive detail of Schubring, let me list them here and then go on to some general remarks about the method of supplying the city with water in this way.

GROUP ONE

1. From the mountains to the west, the "water supply for the city" runs under the north wing of the fortress Euryalus through Epipolae and Tyche, with many important branches (Schubring, 1865, 586). Schubring states (p. 629) that because the Athenians had attacked the city from this area, Dionysus decided to fortify it and incorporate the aqueduct in the rampart system so that enemies could not ruin the water supply lines of the city (Diodorus, 14,18).
2. One branch, which is built in a different fashion and so may not be Greek, crosses under the Anapos River to the west of the city and runs at a lower level through Neapolis.
3. Another line, found a few steps from the "prison of Dionysus" was set in a fold of the city wall, was made of "beautiful early stonework," and had many lead channels associated with it (Schrubring, 1965, 588). Lead should indicate Roman intervention into an earlier Greek system. Roman lead pipes are known at Morgantina, for instance, in the late second and first centuries B.C. (Crouch, 1984, 358).
4. From the waterline nearest the top of the hill in Epipolae and Tyche, at the right in Schubring's "Plan von Syrakus," branched off the aqueduct called Tremiglia because of its destination; from this juncture it may have run approximately parallel to the main line much farther uphill, until it turned and ran into the bay of Trigilos, part of the Great Harbor (Schrubring, 1865, 599–600).
5. Ninfeo.
6. Targietta.
7. Paradiso, which ran on to the amphitheater area.
8. Zappala.
9. And finally the high line turned south and ran through Achradina, although today the link between the two lines is missing [because of the continued erosion of the valley head above the bay called Tonnara?]
10. Aqueduct under the sea of the Little Harbor. [I am highly skeptical of this as a built waterline, but can easily imagine a karst channel in this area.]
11. Waterlines on Ortygia, near temples, and near spring of Arethusa (Schrubring, p. 608, quoting Diodorus V,13, who writes that Arethusa was the end point of the Crimiti aqueduct, serving as a reservoir for it in the Greek times. This would mean that the present baroque walling around Arethusa replaces much older reservoir walls).

GROUP TWO

12. A line that taps mountain springs and feeds the Anapos River.[6] This line runs for part of its way perpendicular to the river and part of the way parallel to the river (Schubring, 1965, 611). These channels may be a complicated system for handling flood waters and providing for irrigation. (They need modern study by hydraulic engineers and archaeologists together.)
13. Part of this line runs parallel to the Ninfeo line and appears between the theater and the Ear of Dionysus (one of the quarries), as a new arrangement in a district that had earlier been served by Crimiti water only. Schubring comments several times on the bitter taste of the Crimiti water so the provision of an alternate supply may have been to overcome this drawback (see, e.g., p.594). Note that there may have been a deliberate decision to import waters of different tastes and hence of different chemical compositions, in order to mix them and thereby remove sinter deposits from pipes and channels. I suggest that the well-known but hard-to-explain importation of bitter waters in an aqueduct of Rome could have been to achieve the same effect. If so, this is another example of Sicilian ideas influencing the Romans.
14. A pond and river fed from the spring Kyane and called by its name. [Although there may originally have been a spring here in the plain west of the city, this place seems now to be fed from the same Anapos line that comes from the mountains, and to be part of the same effort to control flooding, etc. (personal observation, 1985.)]

Schubring also gives his estimates of dates for each of the lines (pp. 617–38). Burns (1974, 390) does not always agree with Schubring on number or dates of lines, but he urges the particular usefulness of studying Syracuse as a typical case for many Greek cities in the matter of water management. I would say that Syracuse is a model rather than a typical case.

Thus for the springs and fountains of Syracuse, we have some evidence, and for the long-distance water supply lines a great deal more. From the evidence of the extensive development of long-distance water supply lines—even if there were no references in the ancient literature—we can see that Syracuse was a very large and wealthy city. Money was frequently reinvested here in the water supply system so that it could continue to function well to provide for the needs of residents and visitors.

Comparison of Water Elements

Other elements of the water system contributed equally, although not so dramatically, to the supply and use of this vital liquid. In both Syracuse and Corinth there are archaeological data to support a brief discussion of the other water system elements. In both cities, public bath buildings served the large population. At Corinth (Figs. 8.1, 11.1), these were from the Greek period:

- The Centaur Bath west of the South Stoa, 425–400 B.C., rebuilt and then abandoned in 325–300. Buildings and water were heated (Williams, 1976, 109–15; 1977, 40–53).
- The possible Greek bath between the North Market and the archaic temple, from no later than 300 B.C.[7]
- The bath at the Asklepion. It was customary for sanctuaries of Asklepios to be equipped with baths. This sanctuary at Corinth was located where it could tap extensive water channels, and included its own formal bath. This location enabled it to appeal to the foot traffic climbing up to Corinth from the port below.
- The underground bath west of the Lerna area, adjacent to the Asklepion. This structure was published as the Fountain of the Lamps.
- It should be noted also that the Roman gymnasium just south of the Asklepion replaced the Hellenistic and earlier Greek gymnasium on the same site, and is assumed to have included bathing facilities (*Wiseman*, 1972, 9).
- Perhaps further investigation will reveal a Greek bath under the Roman one on the Lechaion Road that was recently reported by Biers (1985). There was also another Roman bath north of the new excavations near the theater, dating from the Hadrianic period. Both of these baths are located where I would expect Hellenistic baths to have preceded them, and possibly classical era baths as well.

Thus by archaeological evidence we know of five major bathing facilities within the Greek city, and tradition adds another at the "Baths of Aphrodite" on the scarp just above the coast, directly north of the city (see the map "Water Sources," fig. 43, in Sakellariou and Faraklas, 1972). (Williams is also skeptical of this water outlet as a bath.) Their map also notes several "sources" (numbers 3–8, 10, 15, 16) with Greek and Turkish names that I take to be outlets of underground water lines.

At Syracuse, a population of nearly a quarter of a million needed to be provided with bathing facilities. Pace (1935–38, II, 463) says there were 240,000 people in 4800 square kilometers, thus a density of 50 per kilometer. It seems likely, then, that further excavations will uncover more bathing facilities. Those that can be listed today are of varying degrees of visibility:

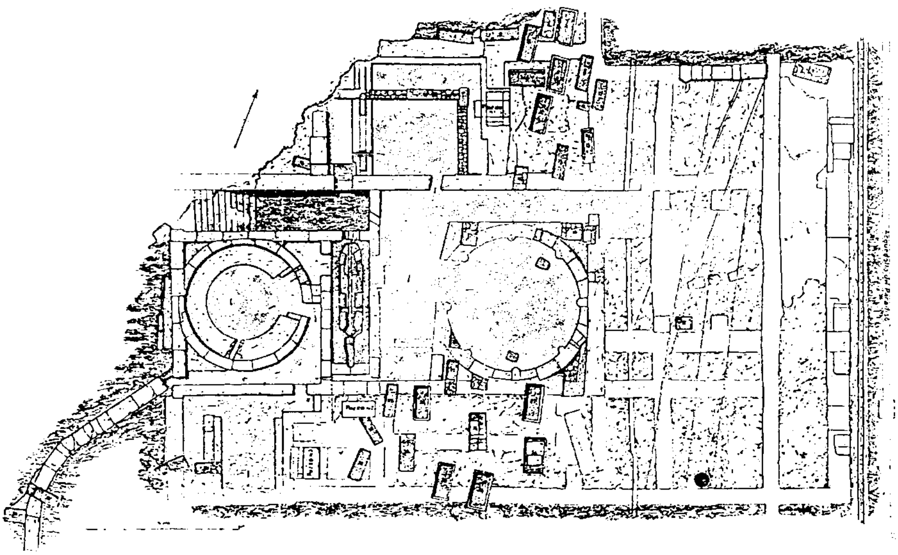
- One in Tyche.
- One in Achradina with a large rectangular cistern, part of a gymnasium in this area (both in Orsi, 1900, 207–08).
- One near the present railroad station, which Schubring said had a

Greek plan but Roman workmanship (Schrubring, 1865). Excavation has been hampered by the very high water table so that trenches and other declivities immediately fill up with water. This bath was also part of a gymnasium in Roman times. It seems likely that an earlier Greek bath stood here.

- One described by Ginouves as having two rotundas and a sauna, and dating from no later than the third century B.C. One rotunda had basins on stands, and the other had columns. Water was supplied by both wells and an aqueduct. Lines from the aqueduct came into the building under the vestibule. This bath was located just north of the Paradiso Latomia (quarry/karst outfall). One would like to know where the waste waters went from this bath, and why if it was as late as the third century it was so primitive as to have only three rooms (Ginouves,1959; Delorme, 1960)? (Fig. 11.8).

Even though this list is incomplete, we can assert that both the locations and the variations in the types of baths known at Syracuse indicate that new and up-to-date baths were added as the city grew. These were supplied by the same waterlines that supplied the fountains, although we would expect that special spur lines had to be constructed to divert the necessary water supply from the main aqueduct line to the bathing establishment. For economy, we would expect that baths were located as close as possible to the waterlines. Certainly the close connection between

Figure 11.8. Greek bath found north of the Paradiso Latomia, Syracuse. Reprinted by permission from G. Cutrera, "Rovine di un antice stabilimento idraulico in contrada Zappala," *Notiizie degli Scavi di Antichicta,* 16(1938), plate XXI.



waterlines and baths has been proved at Pergamon, where the West and East Baths of the Gymnasium were located directly below the Roman Madradag channel which probably replaced the Hellenistic twin pipeline (Fahlbusch, personal communication). It would be interesting to check the bath locations at Syracuse with this in mind.

Domestically and strategically, the importance of wells and cisterns for assuring the water supply for residences and industry is demonstrated at both Corinth and Syracuse, even though the evidence was not gathered in order to prove this point. In Corinth, for example, wells and cisterns in the area of the Asklepion and gymnasium show that these edifices replaced houses of the sixth and fifth centuries (Roebuck, 1951, 14, 26, 46, 74–76, 96, 102–06), while the wells and cisterns east of the theater give evidence of occupation since Early Neolithic times (Williams and Zervos, 1982, 116–22, pl. 37) We have already mentioned the wells and cisterns of the Agora from the tenth to the eighth centuries, and can note here those of the fifth and fourth centuries west of the Agora (H.S. Robinson, 1969, 2, 38) and the sixth and fifth century ones under and around the South Stoa (Broneer, 1954, 95), as well as the same date for wells and channels from houses south of the Sacred Spring. Perhaps the most interesting shaft near the Sacred Spring is the one with a rectangular well head over a circular well later enlarged to an oval shaft, which was used during the sixth and fifth century and then went out of use. From inspection of the shaft, I suggest that these differences in form indicate at least three periods of use. The area immediately east of the museum at Corinth has wells and cisterns whose contents give a capsule history of the area, wherein one can read the construction, use, filling, clearing out and reuse, and refilling of both wells and cisterns for domestic and industrial use, as the fortunes of the city changed (Weinberg, 1948, 198–241).

One unchanging feature in the life of Corinth from very early through Late Roman times was the worship ("participatory ritual"?) of Aphrodite on the top of Acrocorinth. To accommodate throngs of worshippers and to safeguard the garrison in time of siege, the Acropolis was supplied with many cisterns as well as having its own spring (Upper Peirene). There is one cistern only 20 or 30 meters from the peak, still containing water in 1985. I counted 16 along the path from the top to the level of the spring, which is 350 meters lower than the crest. Additional cisterns are scattered over the Acropolis in many places. Larger public reservoirs were noted in sections of the channel system under the Agora, remodeled as reservoirs, such as the long reservoir of the fifth century under the South Stoa, that went out of use in the fourth century (Broneer, 1954, 95).

Only a few cisterns have been described in the archaeological literature from Syracuse, and these are entirely from the late Hellenistic period, with some early imperial Roman examples also. Largest of these is a tank 6 meters long, placed between the walls of two neighboring houses

(Gentile, 1951, 285–87, 294). The size of this does not begin to compare with the 200–foot-long cistern related to the South Stoa in Corinth. The paucity of domestic data here suggests that excavators have been unable to look for residential quarters because they had to concentrate on saving and understanding the major monuments threatened by modern urban expansion, a problem the site of ancient Corinth is fortunately free from. Although a few house walls from the eighth and seventh centuries have been found at both sites, there are not enough examples to allow us to get a sense of what was common provision for domestic water use in the centuries when Corinth founded Syracuse.

The evidence does enable us, however, to assert that both mother city and colony had mixed systems of water supply, in which the oldest methods of wells and cisterns and tapping natural springs were gradually supplemented by methods relying on more advanced technology. Thus in classical and Hellenistic times, the engineers of the city could provide the amplification of the waters of a spring by directing to it flows and seepages from farther uphill, and by erecting completely artificial fountains such as Glauke or its small neighborhood equivalents. Enough water was available for ordinary domestic use, for industry, for ritual ablutions, and for the public baths that were so important an amenity of everyday life.

Pipes, channels, and drains cannot be described at either Corinth or Syracuse, because they have not been explicitly published. Still, we can conclude on the basis of the information available that every feature of the fully developed water system contributed to both survival and amenity, from the "insurance" of private wells and cisterns multiplied by the public water lines, to the sophistication of reusing waste waters for irrigation to ensure a continuous crop of trees (for fuel and building materials) near the city. (See Chapter 15 on the variety of elements making up the typical water system; the issue of water as amenity is discussed further in Part IX.) Greek tradition emphasized the prudence of having a multiplicity of supply sources, each a safeguard against failure of the others. The water management tradition evolved in response to the real risks of urbanization in this climatological niche. Weighed in the ancient cost-benefit analysis was the prudence of reuse and extended use (also discussed in Chapters 3 and 4). Every potential water decision was evaluated as to its cost in human effort and in community wealth. I have mentioned already the decisions to locate bathing establishments near waterlines with ample flow. Fahlbusch (1982, 131–39) has discussed the general question of cost-benefit analysis, reading the ancient decisions from the waterlines as built, by a modern hydraulic engineer trained to make exactly the same kinds of analyses.

It is not coincidental that Gelon, who moved the populations of several towns to Syracuse, also built several aqueducts for them in the newly settled quarters. One can interpolate a public works program that con-

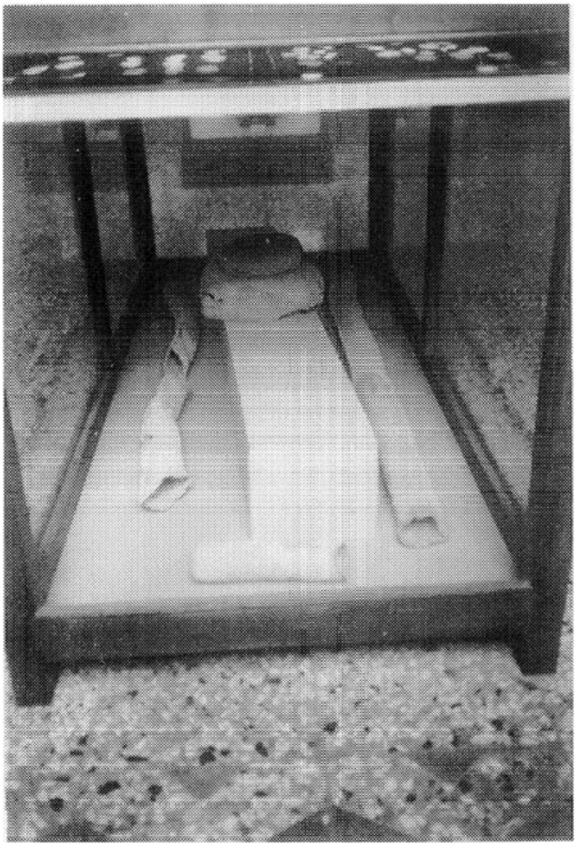


Figure 11.9. Lead pipe in Syracuse Museum, probably from after 200 B.C. These pipes are 5 to 7 centimeters in diameter.

structed not only aqueducts but also roads, houses, and public buildings, redistributing some of the wealth that Gelon had won in taking over Syracuse, and binding the new residents to him as their patron and benefactor so that they sided with him in any altercations with the earlier residents of the city. Similarly, some Roman governmental money must have gone into refurbishing the water system when it was decided to rebuild the city of Corinth and turn it over to army veterans. That story takes us beyond the period of this study, however.

These two cities provide powerful examples of water in the urban landscape and water as the sine qua non of urban ecosystems. Colonists from Corinth were aware of how important water was in the flourishing condition of their home city, and I believe that they deliberately sought not only a new site with a positive resource base, but specifically a site where the customary technical knowledge that they carried with them was appropriate to handle the new situation: same geology, same climate, so that the same flora and fauna could flourish, and especially humans and all their works. Those who settled Syracuse seem also to have carried a mind-set that accepted new ideas and mechanisms for water management, so that as water technology changed at home in Corinth, the same new ideas found acceptance in Syracuse. We know that Plato, for instance, was equally at home in Syracuse as in Athens, which is an indication of the level of intellectual life in Syracuse in the fourth century.

PLANNING

The kinds of information and political processes necessary to plan and implement such an ancient water system are clarified for us by comparative data from modern water planning. In both cases, interactions between humans, their culture, and their environment can lead to misuse or abuse that affect hydrology (adapted from Lindh and Berthelot, 1979, 4–5):

1. Alteration or destruction of the natural hydrological balance
2. Modification of the runoff pattern
3. Degradation of the environment
4. Failure to know or understand the interrelations between people and the environment
5. Unfair allocation of costs and benefits at least partly because it is hard to tell who benefits
6. Inadequate allocation of money to hydrological problems
7. Conflicts of interest between user or supplier groups, and between them and the government
8. Selfishness about contributions to solutions
9. Lack of planning and fragmented services

Not only hydraulic engineering factors but also social and economic factors must be considered in water management planning. Planning for water management, involving multiple objectives and expert input from several disciplines, is complicated. Because of the constraints of multiple objectives (both then and now!) and the need for many kinds of expert input, the study of water management among the ancient Greeks is far from being straightforward, simple, and clear. Even the term *water management* needs clarification. Lindh points out that water management is a loose term, used on two levels: the formulation of strategic goals and policies, and the tactical administration of the chosen means of implementation (Lindh and Berthelot, 1979, 6). The term is used here precisely because of this double level of meaning.

In the next chapter, I turn to one aspect of water management, the use of waters of different qualities, as an example of the careful thought that went into ancient Greek water management.

NOTES

1. My articles on "The Water System of Palmyra" (1975) and "The Hellenistic Water System of Morgantina, Sicily" (1984) remain highly unusual attempts in the literature of classical archeology to portray complete water systems.

2. I have felt a true camaraderie with this 19th-century German whose work encouraged me in the lonely years when I could find no one else to share my fascination with the topic of ancient water supply.

3. Modern aqueduct construction and repair I learned about in an interview with Mr. Davi of the Ufficio Technico of Syracuse, facilitated by V. Castanza of the Archaeological Service in Syracuse; they both have my thanks.

4. I am grateful to Mr. A. LaMesa, head gardener of the archaeological park that contains the Theater and the Latomia at Syracuse, who showed me the water system elements of his domain and shared both his knowledge and his enthusiasm with me.

5. I expect to deal with colonization in the Old and New Worlds, specifically comparing Roman and Spanish practices, in a future work. Meanwhile, see Crouch, 1991.

6. I saw this connection, thanks to G. Aresco, who showed me the Galermi line.

7. I could never "read" these ruins as a bath, and was relieved when Dr. Williams told me in 1988 that it is not a bath, although it was so published.