

The Aqua Augusta and control of water resources in the Bay of Naples

Duncan Keenan-Jones, Macquarie University

This paper investigates the Aqua Augusta, one of the most difficult and costly aqueducts ever constructed by an ancient civilization. It focuses particularly on the control and use of the Augusta's water.¹

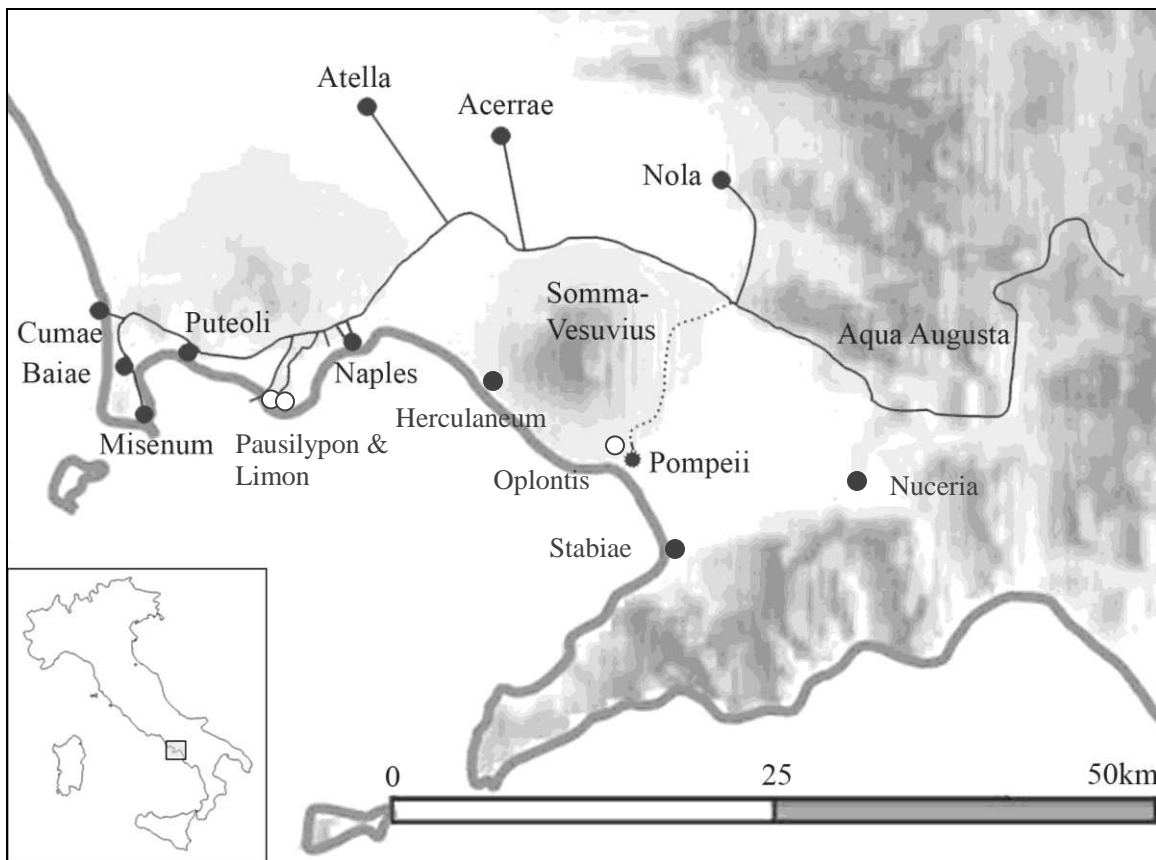


Figure 1 The Bay of Naples showing the Aqua Augusta. Villas are shown as open circles. Base map is Copyright 2001, Ancient World Mapping Center. Used with permission.

¹ I would like to thank the editor, Dr. Neil O'Sullivan, and an anonymous reviewer for their very helpful comments on this paper. Any remaining faults are, of course, my own. This paper presents findings from the author's PhD research.

The Aqua Augusta

It is likely that at least a promise of the Augusta was made during Augustus' confrontation with Sextus Pompey and construction was probably completed early in Augustus' reign as princeps.² Despite its size and complexity, the Augusta has been largely neglected by historians of ancient water technology, of ancient Campania and of the Augustan period. The route of the aqueduct (Figure 1) is well known via the writings of two Italian engineers who were contracted to assess the feasibility of bringing it back into use as the water supply of Naples in the 16th and 19th centuries.³ It started at the Acquaro and Pelosi springs in the Apennine mountains, at 371m above sea level, and ended at the western tip of the Bay of Naples not far above sea level. Unlike other Roman aqueducts, which were almost all focused on one urban centre, the Augusta was a regional network supplying eight or nine towns, as well as numerous villas, through ten branches: Nola, perhaps Pompeii, Acerrae, Atella, Naples, then three branches supplying villas, Puteoli, Cumae, Baiae and Misenum. The total length of the aqueduct, including its branches, was approximately 140km, making it the longest single Roman aqueduct until the construction of the long distance channel at Constantinople in the fifth century AD.

The Augusta also contained numerous technically difficult sections. The need to transfer water from an Apennine basin to basins around the Bay of Naples necessitated a 6km long tunnel to cross the watershed. In the mountainous upstream reaches of the Augusta, there were many complex decisions to be made regarding route, gradient and the use of tunnels, such as the 2km long tunnel to cross into the Sarno plain. Once the Augusta reached the Campanian plains, there were fewer possible route permutations but still numerous technical difficulties, such as the building of a 3.5km long arcade near Pomigliano d'Arco, two kilometer-long tunnels, a sea crossing to an island, the

² There is no explicit reference to the construction date of the Augusta in the surviving historical record. A terminus ante quem of AD 10 is given by the first inscription mentioned below. For a discussion of the probable period of construction, see Keenan-Jones 2010.

³ Lettieri 1560, Abate 1840, Abate 1842, Abate 1862, Abate 1864.

construction of an enormous reservoir at the aqueduct's terminus and ground movement related to volcanism.

Due to its length and technical difficulty, the Augusta probably took a decade to plan and build at a cost of 140-450 million sesterces, equal to 1-2 years of non-military state expenditure.⁴ It was one of the costliest of Augustus' undertakings. This huge amount of money and labour was expended to help secure the strategic but potentially restive region of Campania during a critical time: the establishment of the Principate. The purpose of the Augusta was to supply water for major ports (one naval at Misenum and one mercantile at Puteoli) and to bring Campania and its influential inhabitants onside by providing towns, coloniae and villas (including Augustus' own) with water.

Scarcity, control and use of the Augusta's water

The diversion of the majority of the water of the Acquaro and Pelosi springs out of the Sabato river basin via the Augusta, combined with the use of another larger spring just downstream for an aqueduct, would have reduced the river's flow rate by more than half in its upper reaches.⁵ This would have negatively impacted the river's health, particularly in summer. Irrigation in the centuriated area along the river⁶ would have been affected. Likewise, fish stocks would have been reduced, removing a source of income and/or dietary protein from those who could least afford to lose it.⁷

Despite the Augusta's massive expense and the large scale removal of water from the Sabato river basin, the towns it supplied could not all have received a plentiful water supply throughout the year. Reconstructions of ancient climate suggest that temperatures, and hence rainfall and Serino spring discharge, in Campania when the Augusta began

⁴ Estimate of annual non-military state expenditure is based on Duncan-Jones 1994: 34, 46.

⁵ Calculated from the figures provided in Provincia di Avellino 2009: 39-40, 48.

⁶ Spadea 1998: 35.

⁷ Bunn, et al. 2002, Squatriti 2002: 98-101, Richter, et al. 2003.

operating were probably comparable to those in the 20th century.⁸ As time went on, it seems that discharge probably diminished and stayed at levels below modern ones until the mid 5th century.

The current seasonal minimum and maximum flow of the Acquaro & Pelosi springs, equivalent to the amount of water available to the Augusta at its source, are shown at the right of Figure 2. Not all of this amount would have been used by the Augusta. The minimum value, applicable in November each year or when the capacity of the Augusta was reduced by the clogging of even a small amount of mineral deposits on its channel walls,⁹ is only equivalent to that of a larger aqueduct supplying just one town. At these times, one town's worth of water would have had to have been shared between seven or eight towns. Furthermore, droughts could have been expected every 70 years or so¹⁰ and would have badly affected those towns (like Pompeii) that depended on the aqueduct and rainwater to the exclusion of groundwater. Both of these water supply issues would have deteriorated as the flow of the Augusta decreased over its lifetime due to climate change and, periodically, lack of maintenance. Hence, it is very likely there was some competition for the water of the Augusta

Some of the Augusta's water was publicly available from fountains or in baths. Public fountains dating to the period of the Augusta's operation are known at Puteoli (8)

⁸ Dragoni 1998: 250, Fig. 11.3. Dragoni's research is based on several different types of palaeoclimate proxy data from Northern and Central Italy, which accord well with ice cap data. The dating for these data has an error of around +/- 50 years (Dragoni 1998: 249). A similar succession of wet, dry and wet periods has recently emerged from analysis of lake sediments in Spain (Martín-Puertas, et al. 2009: 108). Recent temperature estimations from speleothems from the Italian alps and Ireland (Frisia, et al. 2005:451-2) confirms that these two temperatures were equivalent, while at the same time suggesting a transition in the opposite direction, ie from warm to cool.

⁹ According to the flow rate calculations of Morretta 1990: 62-68.

¹⁰ Fiorillo, et al. 2006, Fiorillo, et al. 2007.

Pompeii (more than 40), and at Cumae (2).¹¹ Several at Puteoli and the two at Cumae were conspicuous benefactions by influential individuals. While baths were present before the Augusta, there was a sustained surge in the construction of new bath complexes during the first two centuries of the Augusta's existence.¹² Questions of cause and effect are complicated by the general increase in the popularity of bathing occurring all over Italy at this time.¹³

The water was also piped to the homes of influential individuals. The Augusta allowed greater flexibility in the use of water in private houses, such as bathing, water display and thirstier gardens. Another use was for industrial purposes, such as fulling or dyeing.¹⁴

¹¹ Puteoli: Sommella 1978: 26 (#12) & #39; Gialanella 1993b: 89; De Caro 1999: 651; De Caro and Gialanella 2002:19; De Caro 2003: 593-4. Pompeii: Jansen 2000b: 113; Eschebach 1983: 90, 104 Tafel 2. Cumae: Capaldi 2007:168-172.

¹² Keenan-Jones 2010.

¹³ Fagan 2002: 40-74.

¹⁴ Dybkjaer Larsen 1982:43, Jansen 2001.

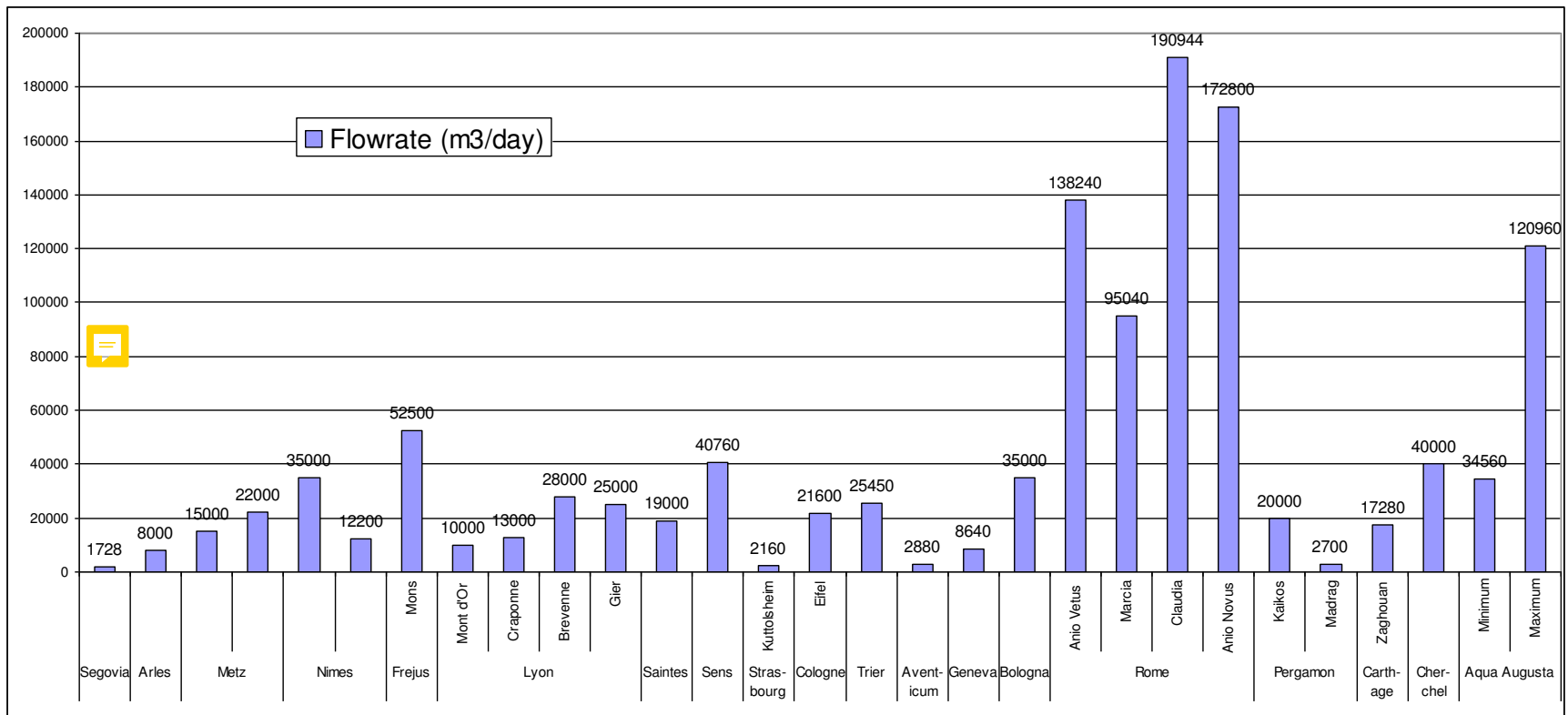


Figure 2 Estimated flow rates of some Roman aqueducts. Data from Blackman 1978; Hodge 1992: 347-8; Chanson 2002: Tab. 1

Municipal Control

Initially, the Augusta seems to have been administered by a curator aquae Augustae. Curatores aquae appeared in several towns in Italy around this time and were modeled on the curator aquarum of Rome.¹⁵ That of the Augusta is the best attested, appearing in three inscriptions. The earliest was found in an underground tunnel near Baiae above an entrance to a side tunnel.

HAVSTVS•ADAPERT(us)
PERM[i]S(su) AC [cu]R(a)? D(ecimi)•SAT[ri] RA[g]O
NIANI•CVRATORIS•AQVAE
AVGVSTAE III K(alendas) IANVARIAS
IVNIO BLAESIO SER(vio) LEN[tulo co(n)s(ulibus)]¹⁶

Access (to water) opened by permission and under the supervision (?) of Decimus Satrius Ragonianus, curator Aquae Augustae, on the third day before the Kalends of January, while Junius Blaesus and Servius Lentulus were consuls.¹⁷

Decimus Satrius Ragonianus¹⁸ was curator Aquae Augustae in late AD 10 and clearly controlled access to the water of the Augusta. By analogy with others in Italy, this officer's duties would have also included assigning contracts to build or maintain aqueducts and fountains and checking of completed work.¹⁹ He was probably from Cumae judging from his nomen, although the family is also attested at Puteoli in the second century AD.²⁰ There are several reasons why Cumae might have provided the first curator Aquae Augustae. Augustus seems to have had a close relationship with Cumae.²¹ At this time, the area administered by Cumae probably included Baiae and Misenum²² and thus the base of the Imperial fleet. This

¹⁵ Corbier 1984: 238, 254.

¹⁶ Camodeca 1997: 192.

¹⁷ This and all other translations are my own.

¹⁸ Or possibly Paconianus, judging from the inscription at Mergellina discussed below.

¹⁹ Digest 50.4.1.2, 50.4.18.6, Corbier 1984: 266-70.

²⁰ PIR S 204, E 33. Camodeca 1997: 197.

²¹ Porph. Ad Hor, Sat 1.2.36, AE 1927.148, Lomas 1993: 159; McKay 1998: 226, Verg. Aen. 6.1-155.

²² Livy 24.3, Beloch 1890: 190.

being the last area supplied by the Augusta, Cumae had the greatest vested interest in the maintenance of the entire main line.

As well as having the first curator, Cumae was also the first town known to have built public fountains and private connections utilizing the Augusta's water.²³ No further *curatores Aquae Augustae* are known from Cumae, however. Misenum was removed from Cumae's jurisdiction in the early Imperial period,²⁴ which may have caused Cumae to lose significance in regard to the administration of the Augusta.

The two other *curatores Aquae Augustae* were from the very highest ranks of the elite of Puteoli, the dominant town in the region. Each is known from one inscription found in Puteoli. The first, of late Julio-Claudian date judging from the lettering, has suffered from *damnatio memoriae*, but has been reconstructed as follows:

[L(ucio) C]ASSIO•L(uci)•F(ilio)•PAL(atina tribu)•CEREA[li praef(ecto)]
 [f]ABRVM•AVG(uri)•Q(uaestori)•CVRATORI O[perum]
 PVBLICOR(um)•ET LOCORVM•PRIM[o facto]
 II•VIR(o)•Q(uinquiens)•QVINQ(uennali)•CVRATORI•AQ[uae Aug(ustae)]
 [[hunc]] VNIVERSA PLEPS CVM [ludos fec(erit) Neroni]
 [Claudio] CAESARI AVG(usto)•IN AMPHITEA[t(ro) acclamavit]
 CASSIA•CALE•CER[ea]LI•F(ilio)•PISSIMO²⁵

For Lucius Cassius Cerealis, son of Lucius, of the Palatine tribe, praefectus fabrum, augur, quaestor, curator operum publicorum et locorum, elected first duumvir five times, quinquennalis, curator Aquae Augustae. Here the entire plebs acclaimed him when he held games for Nero Claudius Caesar Augustus in the amphitheatre. Cassia Cale for her most dutiful son Cerealis.

²³ The early uses of the Augusta's water are published in CIL 10.3713, Capaldi 2007, Capaldi 2007.

²⁴ Beloch 1890: 190 (Augustan), Keppie 1983: 150 (Claudian).

²⁵ Originally published by D'Arms (1975), the reconstruction presented here contains an emendation, from *curatori aq[uarum]* to *curatori aq[uae Aug(ustae)]*, suggested by Corbier (1984: 260). There have been other reconstructions (e.g. *AE* 1983.193, *AE* 1980.236) and that of D'Arms does have clear deficiencies (e.g. "hunc") but the differences are not important for the current purposes.

The second inscription, which has been dated between the mid-third and mid-fourth centuries AD, runs thus:

MA[---]
V(iro)•E(gregio)
SACERDOTI•D(ei)•P(atrii)•IMMVNI
OMNIBVS•HON(oribus)•ONERIBVS
MVNERIBVS•PERFVNCTO
ET•CVR(atori)•AQVAE•AVG(ustae)•PER•ANNOS
[---]OMNI•SVMPTV•PROPIO[administratae]²⁶

To Marcus A[?...], vir egregius, priest of the deus patrius, tax exempt, all public offices, burdens and duties performed and curator Aquae Augustae for ? years...all carried out at his own cost

In both cases at Puteoli, the position of curator Aquae Augustae is listed as the peak of the holder's career. The high local status of the curatores accords with the situation in the rest of Italy, where curatores aquae were locals of great influence who had climbed to the highest rung on the municipal cursus honorum.²⁷ Both L. Cassius Cerialis and D. Satrius Ragonianus, the first curator, are not otherwise known and have no known links to Rome. Thus, it seems that the populi of Cumae and then Puteoli were choosing the curator Aquae Augustae from among their own. If not directly elected by the populus, he was chosen from a pool of those who had been elected duoviri by the populus. Despite the unusual regional nature of the Augusta, the appointment of its curator appears to have been a local exercise.

It is not known whether this resulted in preferential treatment, although Cumae (including Baiae) and Puteoli dominate the pipe stamps that signify public and private use of the Augusta's water (Figure 3). It is possible, however, that other towns chose to stamp pipes only occasionally, or not at all.

²⁶ CIL 10, 1805, with emendation in CIL 10, vol. 2, p1009.

²⁷ Corbier 1984: 238, 260.

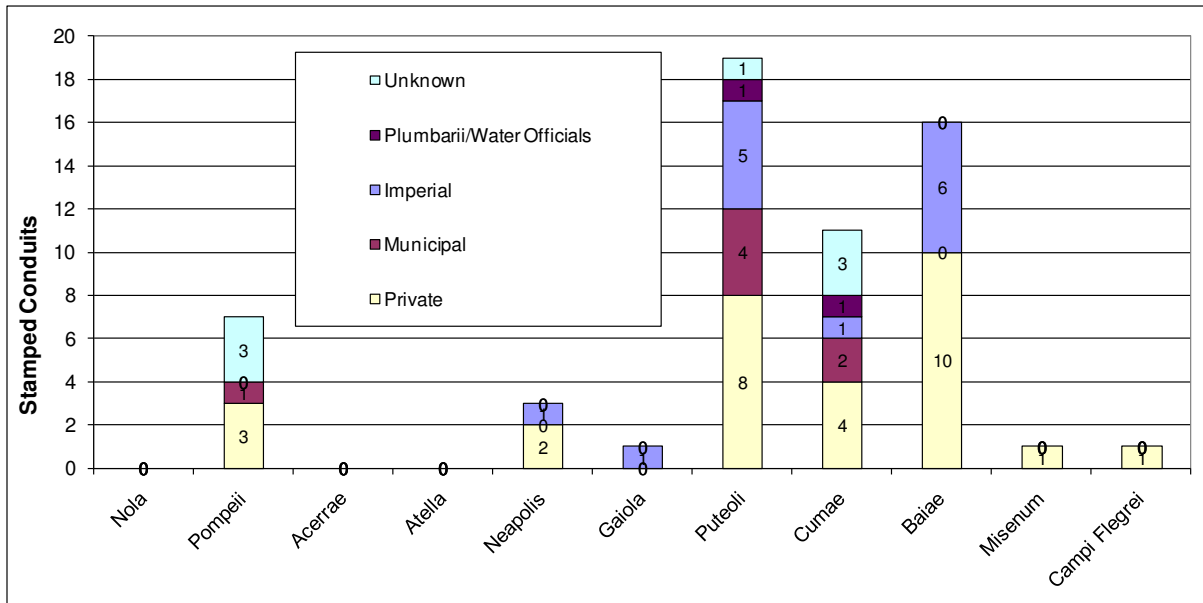


Figure 3 The findspots of different types of stamped lead conduits (which can be made up of more than one surviving length of pipe).

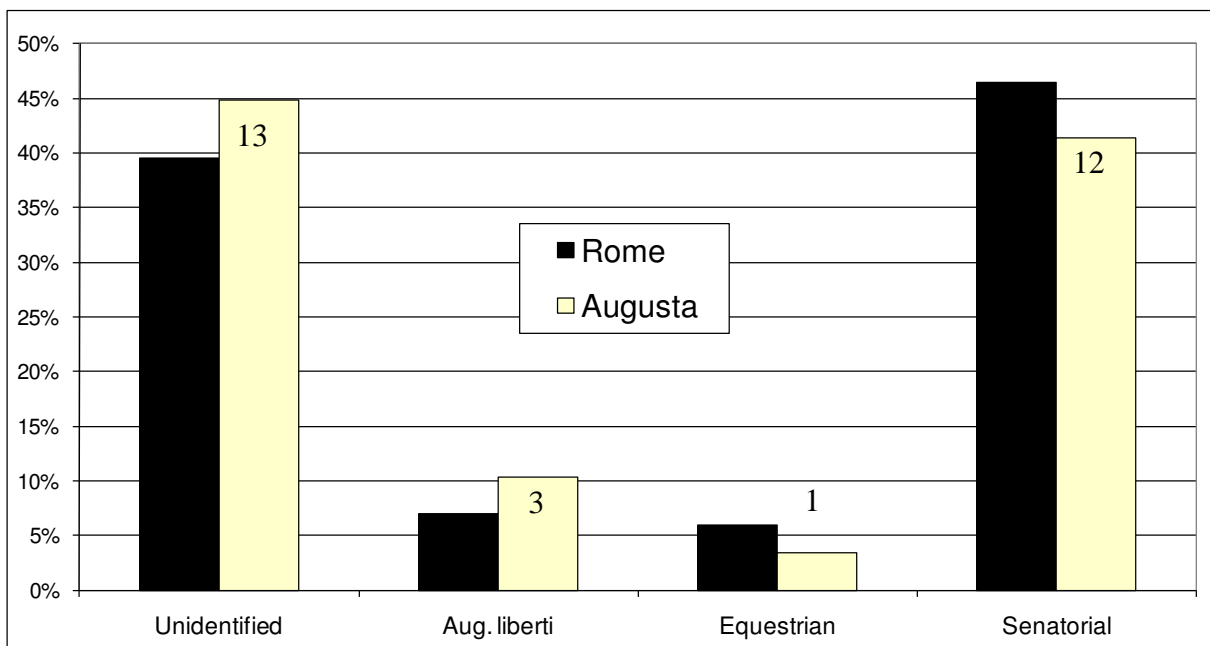


Figure 4 Distribution of private stamped conduits from the Augusta and the aqueducts of Rome amongst social classes.²⁸ Absolute numbers of stamped conduits are shown for the Augusta.

²⁸ Rome data are from Eck 1982: 203. The Rome data have been quantified by name rather than stamped conduit. The difference would be minor, as most stamped conduits in both samples contain a single private name (Eck 1982: 201, only 4 of the 29 private stamped conduits in this study contain two names). The effect of measuring the Bay of Naples data in this way would be to increase the proportion of senatorial recipients as 3 of the 4 conduits containing two private names have two senatorial names.

Early imperial control?

Alongside this evidence for control by important local towns, there are also hints that the imperial administration exercised some control over the Augusta in this period. Where the status of the names of private users on the stamps can be determined, they are overwhelmingly members of the Rome-based senatorial class (Figure 4). The senator/equestrian/imperial freedperson ratio of the pipe stamps relating to the Augusta is very similar to that of the pipe stamps at Rome, which suggests that similar forces were at work in determining who could gain a private connection to the Augusta. At Rome, a letter from the emperor was required to gain a private connection and it would appear that imperial favour was also a factor in accessing the Augusta's water.

Around the same time as L. Cassius Cerealis was curator Aquae Augustae, it seems likely that an imperial freedman procurator a rationibus, Diadumenus Antonianus, was responsible for repairs at both Mergellina and Misenum carried out after the earthquakes of AD 62-64. This is clear evidence of the use of funds from the emperor's fiscus for the repairs in two different locations. At Mergellina (near the beginning of the second branch downstream of Naples, Figure 1), three graffiti were found scratched into the mortar lining of the aqueduct channel while it was still wet. The following inscription is representative of the other two:

MACRINVS•DIADVMINI•AVG(ustae)•L(iberti)•PROC(uratoris)•ANTONIANI•DI
SP(ensator)•HIC•AMBVLAVIT•A•VILLA•POLLI•FIILICIS•QVAII•IIST•IIPILIMO
NIIS•VSQVII•AD•IIMISSARIVM•PACONIANVM•NIIRVA•IIT•VIISTINO•CO(n)
S(ulibus)²⁹

Macrinus, dispensator of the imperial freedman and procurator Diadumenus Antonianus, walked here from the villa of Pollius Felix which is epilimones to the Paconian outlet during the consulship of Nerva and Vestinus (65 AD).

It seems that Macrinus scratched this text as he was checking recent repairs on the aqueduct for Diadumenus, his procurator.

²⁹ Mommsen 1883, Ruggiero 1883: 21.

At Misenum (Figure 1), among remains of some form of water system, the following fragmentary monumental inscription was found:

DIADVMENVS A[ug(ustae/i) lib(ertus)...]
A RATIONIB[us...]³⁰

The Mergellina inscription, at least, is clear evidence of imperial repairs to the Augusta. The inscription from Misenum is less clear, however, but probably to be linked with the Mergellina inscription.

High-ranking imperial appointees in charge of the port of Puteoli and the fleet at Misenum would have also had an interest in the Augusta's continued supply of their harbours.

Imperial control in late antiquity

Campania became a province, with imperially appointed governors, in the late third century AD.³¹ After this time, there is no further evidence for municipal administration but clear evidence for imperial involvement. An inscription found at the source of the Augusta shows it was administered by a praepositus who probably reported to the consularis Campaniae. Imperial funds had been used for the aqueduct's repair once more.

DD(omini)•NN(ostri)•FL(avius)•CONSTAN
TINVS•MAX(imus)•PIVS•
FELIX•VICTOR•AVG(ustus)•
ET FL(avius) IVL(ius) CRISPVS•ET
FL(avius)•CL(audius) CONSTANTINVS
NOBB(ilissimi) CAESS(ares)
FONTIS AVGVSTEI
AQVAEDVCTVM
LONGA INCVRIA

³⁰ The other reading given in CIL 10.3347 does not have the A at the end of the first line. The reconstruction is from Bassett 1920: 12. It seems reasonable considering that the department a rationibus was largely staffed by imperial freedmen or slaves (who would be styled Caesaris servus). It is also possible that the end of the first line should be reconstructed A(ntoninianus).

³¹ Savino 2005:18, 255; D'Arms 2003:109.

ET VETVSTATE CONRVPTVM
PRO MAGNIFICENTIA•
LIBERALITATIS CONSvETAE
SVA•PECVNIA•REfICI IVSSERVNT
ET•VSVI•CIVITATIVM INFRA
SCRIPTARVM REDDIDERVNT
DEDICANTE•CEIONIO IVLIANO V(iro) C(larissimo)
CONS(ulare)•CAMP(aniae)•CVRANTE
PONTIANO•V(iro)• P(erfectissimo)•
PRAEP(osito)•EIVSDEM
AQVAEDVCTVS
NOMINA CIVITATIVM
PVTEOLANA•NEAPOLITANA•NOLANA
ATELLANA•CVMANA•ACERRANA
BAIANA•MISENVM•

R³²

Our lords Flavius Constantinus Maximus Pius Felix Victor Augustus and Flavius Julius Crispus and Flavius Claudius Constantinus, most noble Caesars, on account of the greatness of their habitual generosity, ordered the Aqueduct of the Augustan Spring, ruined by long neglect and age, remade out of their own funds and returned it to the use of the communities listed below. Dedicated by Ceionius Julianus, vir clarissimus, consularis of Campania. Overseen by Pontianus, vir perfectissimus, praepositus of the same aqueduct. Names of the communities: Puteoli, Neapolis, Nola, Atella, Cumae, Acerrae, Baiae, Misenum.

³² Sgobbo 1938. The relative sizes of the lettering match those on the inscription. The “R” is located away from the rest of the text towards the bottom right-hand corner of the block.

Further evidence is provided by a constitution from the Codex Theodosianus (15.2.8), which shows that in AD 399, the imperial administration in Milan, via the praetorian prefect, had again funded repairs and was making important decisions regarding the use of the Augusta's water.

IDEM AA³³. MESSALAE P(RAEFECTO) P(RAETORI)O. Ex forma, cui nomen Augusta est, quae in Campania sumptu publico reparata est, nihil privatim singulorum usurpatio praesumat neque cuiquam posthac derivandae aquae copia tribuatur. Si quis autem meatum aquae ausus fuerit avertere, quinque libras auri aerario nostro inferre cogatur. Quidquid etiam ob eam fraudem ex rescripto fuerit elicatum vel qualibet arte temptatum, inritum habeatur. DAT. V KAL. IAN. MED(IOLANO) THEODORO V.C. CONS.

The same Augusti³⁴ to Messala, Praetorian Prefect. From the aqueduct, whose name is the Augusta, which has been repaired in Campania at public expense, let no individual use in a private capacity appropriate anything, nor should a supply³⁵ of its water be diverted henceforth for anyone. If, however, anyone dares to subvert the path of the water in the future, they must pay five pounds of gold into our treasury. In addition, anything obtained for this type of fraud from a rescript or by any form of deception shall be deemed invalid. Dated the fifth day before the kalends of January, in Milan, Theodorus, vir clarissimus, being consul.

The imperial administration, having taken financial responsibility for the upkeep of the Augusta, seems also to now have, in theory at least, complete control of the use of its water, being able to ban all private connections. It is hard to imagine the curator aquae Augustae, himself a member of the local elite with relationships with many of these private water users, making such a decision.

³³ Arcadius and Honorius (Cod. Theod. 15.2.6).

³⁴ See note 1 above.

³⁵ That copia means a supply of water is supported by Cod. Theod. 15.2.5.

Conclusion

During the AD 79 eruption of Vesuvius, the Augusta had been spared the worst of the damage and burial by ash due to the direction of the wind and the shielding effect of Monte Somma.³⁶ During the next major explosive (or Plinian) eruption in AD 472, the wind direction resulted in the Augusta being buried under the worst of the ash fall.³⁷ It seems that the 3.5km long Pomigliano d'Arco arcade had collapsed even before the eruption,³⁸ cutting off supply to all towns except Nola and Acerrae. The poor administrative and economic situation in Campania, and Italy in general, at this time³⁹ would have prevented major repairs to the Augusta. **Contrary to previous scholarship, it seems that the Augusta ceased to supply any of its towns in the fifth century,** and written references to an aqueduct in Naples after this time refer to other aqueducts, either the Bolla aqueduct or other, smaller aqueducts.

Despite the enormous size and cost of the Augusta, the considerable water it took from an Apennine catchment could not have abundantly supplied all eight or nine towns, plus numerous villas. Hence it is likely there was some competition for the water of the Augusta. Glimpses in the surviving historical record suggest that control of the Aqua Augusta and its water was a complex interplay between local and imperial interests that mirrored the changes occurring in Italy more broadly during the Principate. Imperial control eventually eclipsed that of major local towns, but neither group was willing and/or able to repair the Augusta when it again broke down in the fifth century AD.

³⁶ Rosi, et al. 1986: 25-6, Fig. 14, Mastrolorenzo, et al. 2002: 20.

³⁷ Mastrolorenzo, et al. 2002: 21, Fig. 1.

³⁸ De Caro 2000: 633, De Caro 2001: 880, Mastrolorenzo, et al. 2002: 19.

³⁹ Mastrolorenzo, et al. 2002: 32, Nixon 2002: 66, Savino 2005: 79-86.

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