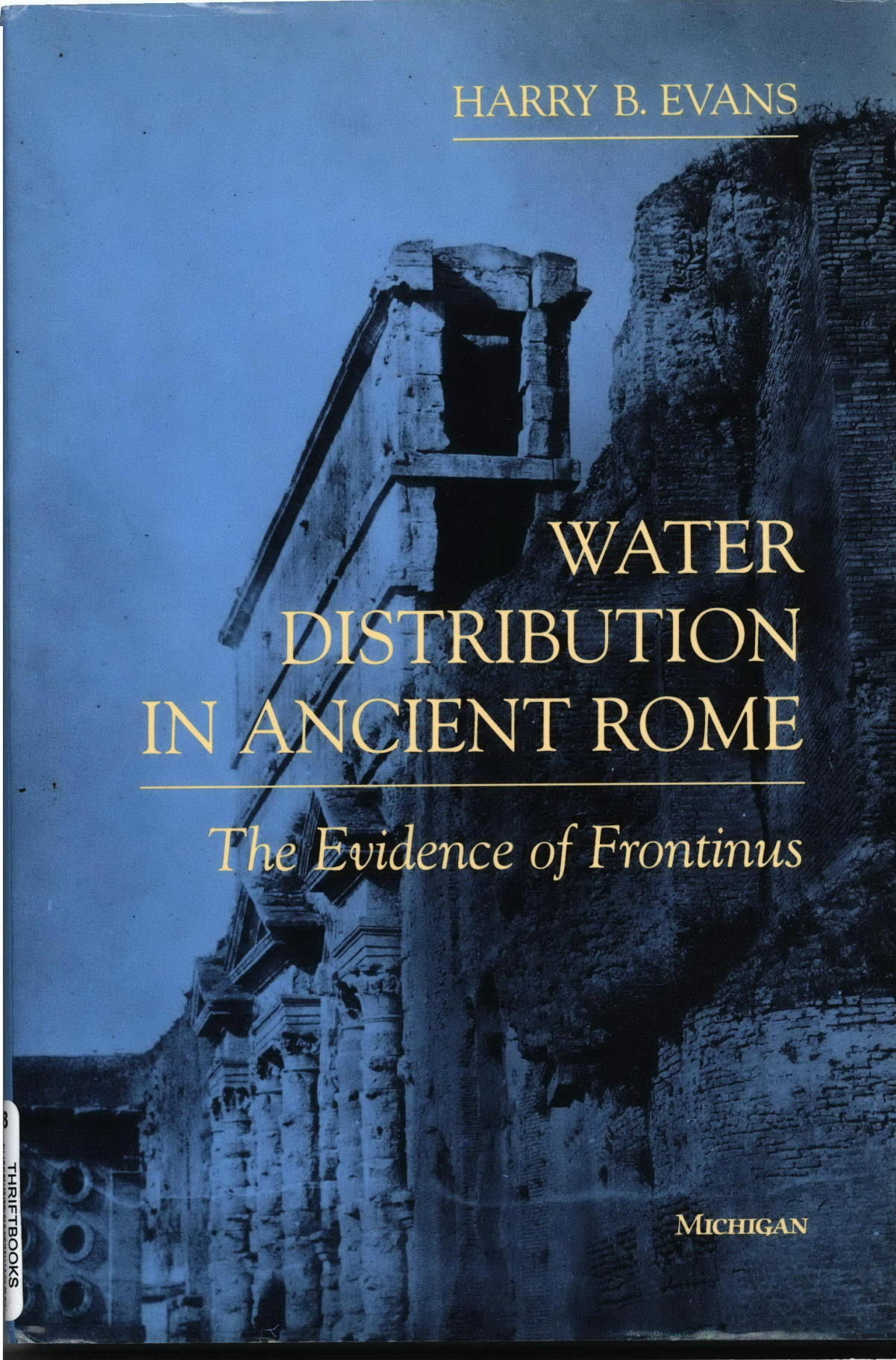




HARRY B. EVANS

WATER
DISTRIBUTION
IN ANCIENT ROME

The Evidence of Frontinus

MICHIGAN

THRIFTBOOKS

Water Distribution in Ancient Rome

Water Distribution
in Ancient Rome

The Evidence of Frontinus

Harry B. Evans

Ann Arbor

THE UNIVERSITY OF MICHIGAN PRESS

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Published in the United States of America by
The University of Michigan Press
Manufactured in the United States of America
1997 1996 1995 1994 4 3 2 1

A CIP catalogue record for this book is available from the British Library.

Library of Congress Cataloging-in-Publication Data

Evans, Harry B.

Water distribution in ancient Rome : the evidence of Frontinus /
Harry B. Evans.

p. cm.

Includes bibliographical references and index.

ISBN 0-472-10464-0 (alk. paper)

1. Water—Italy—Rome—Distribution—History. 2. Aqueducts—
Italy—Rome—History. 3. Water—Italy—Rome—Distribution—Early
works to 1800. 4. Aqueducts—Italy—Rome—History—Early works to
1800. 5. Frontinus, Sextus Julius. De aquis urbis Romae.

I. Title.

TD280.R6E94 1993

628.1 '0937—dc20

93-33761

CIP

This book has been supported by a grant
from the National Endowment for the Humanities.

for Emmy and Larry

Acknowledgments

No one can write a book like this without incurring a great number of debts, and I would like to acknowledge them here. First I am grateful to Fred S. Kleiner, editor in chief of the *American Journal of Archaeology*, for kindly giving me permission to incorporate in chapters 6, 7, 8, and 10 material published in two earlier articles, "Agrippa's Water Plan," *AJA* 86 (1982): 192-204, and "Nero's *Arcus Caelimontani*," *AJA* 87 (1983): 393-99, and to Francis Cairns (Publications) Ltd. for similarly kind permission to incorporate in chapters 3 and 11 material in my paper "Water Distribution in Ancient Rome: *quorsum et cui bono?*" which appeared in A. Trevor Hodge, ed., *Future Currents in Aqueduct Studies* (Leeds, 1991).

Frontinus describes his predecessors in the office of water commissioner as *principes civitatis* (*Aq.* 1), and the same can be said for those scholars who have worked or are working on aqueduct studies; my debts to them are legion. Anyone interested in aqueducts must first acknowledge huge debts to the work of giants like Rodolfo Lanciani, Thomas Ashby, and Esther Van Deman, but I also owe much to contemporaries in the field. Robert H. Rodgers is a singular example here; he very generously made available to me the manuscript of his forthcoming text of and commentary on Frontinus' *De aquaeductu*, soon to be published by Cambridge University Press, thus making it possible for me to incorporate in this study the many contributions he has made to our understanding of an extremely difficult text. I have learned an extraordinary amount from conversations and correspondence with him over the past two years.

Italian scholars currently working on aqueducts have also assisted me greatly. I am most grateful to Giovanna Tedeschi Grisanti and Doriana Cattalini for taking the time to show me the "Trophies of Marius" during their work on its reconstruction, and particularly to Giovanna Tedeschi Grisanti for making available to me page proofs on her study of aqueduct levels at the "Trophies

of Marius" and Porta Maggiore, "Primo contributo ad una livellazione urbana sistematica," in *Atti del convegno "Gli antichi acquedotti di Roma."* I also learned quite a few things from Elvira Leone while visiting excavations in progress at the Meta Sudans and from Claudio Mocchegiano Carpano in a visit to the "Sette Sale." I have also gained much from conversations and correspondence with A. Trevor Hodge, Robert B. Lloyd, Christer Bruun, and Peter Aicher. Finally, I am grateful to Alexis Papadopoulos and Philippe Forét for their cartographic assistance in preparing the maps, to Karen Bull-Simonsen Einaudi and the Fototeca Unione at the American Academy in Rome for help in obtaining photographs, and to the Office of Research at Fordham University for its support.

My principal debts, however, are to the two scholars and friends to whom this study is affectionately dedicated. Emeline Hill Richardson introduced me to the study of Roman topography when I was a third-year graduate student at the University of North Carolina-Chapel Hill. Lawrence Richardson, jr, first encouraged me to apply for a Rome Prize Fellowship at the American Academy in Rome, where my year's study in 1972-73 and many subsequent returns changed my life and research interests. Larry's 1977 NEH Seminar for College Teachers at the American Academy, "Problems in the Topography of Ancient Rome," introduced me to the problems of water distribution in the ancient city, a topic with which I have dabbled off and on for the past fifteen years. He has also read more than one version of this study at various stages and has saved me from many errors of judgment and fact. Indeed without the Richardsons this book, such as it is, would have never become a reality. I am deeply grateful to them and others who have assisted me, *principes civitatis* all. The mistakes here, and there will be many, are entirely my own responsibility.

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Abbreviations in the Notes

Abbreviations in the Notes and *Bibliography* follow closely those given in the *Oxford Classical Dictionary*, 2d ed. (Oxford, 1970), ix-xxii, and "Editorial Policy, Notes for Contributors, and Abbreviations," *American Journal of Archaeology* 95 (1991): 1-16. After the first citation of an article or book in the Notes, all following references will be by author's name alone or by name and short title. All short titles can be readily identified in the *Bibliography*. Several works will be cited by special abbreviation as follows:

Ashby	T. Ashby, <i>The Aqueducts of Ancient Rome</i> (Oxford, 1935).
Bennett	C.E. Bennett, ed. and trans., <i>Frontinus, The Stratagems and the Aqueducts of Rome</i> (Cambridge, Mass., 1925).
Bruun	C. Bruun, <i>The Water Supply of Ancient Rome: A Study in Roman Imperial Administration</i> , <i>Commentationes Humanarum Litterarum</i> 93 (Helsinki, 1991).
CAR	<i>Carta Archeologica di Roma</i> (Florence, 1962-).
CIL	<i>Corpus Inscriptionum Latinarum</i> .
Currents	A.T. Hodge, ed., <i>Future Currents in Aqueduct Studies</i> (Leeds, 1991).
Grimal	P. Grimal, ed. and trans., <i>Frontin, les aqueducs de la ville de Rom</i> (Paris, 2d ed., 1961).
FUM	E. Rodriguez Almeida, <i>Forma urbis marmorea: aggiornamento generale</i> (Rome, 1980).
FUR	G. Carettoni, A.M. Colini, L. Cozza, and G. Gatti, <i>La pianta marmorea di Roma antica (Forma Urbis Romae)</i> , 2 vols. (Rome, 1960).

Hodge	A.T. Hodge, <i>Roman Aqueducts and Water Supply</i> (London, 1992).
Jordan	H. Jordan, <i>Topographie der Stadt Rom im Alterthum</i> , 2 vols. in 4 (Berlin, 1871–85; repr. Rome, 1970).
Kunderewicz	C. Kunderewicz, ed., <i>Sex. Iulii Frontini, De Aquaeductu Urbis Romae</i> (Leipzig, 1973).
Lanciani	R. Lanciani, <i>I commentarii di Frontino intorno le acque e gli acquedotti</i> , <i>MemLinc</i> ser. 3.4 (1881; repr. Rome, 1975).
LFUR	R. Lanciani, <i>Forma Urbis Romae</i> (Milan, 1893–1901; repr. Rome, 1990).
Lugli	G. Lugli, <i>I monumenti antichi di Roma e suburbio</i> , 3 vols. (Rome, 1930–38).
Nash	E. Nash, <i>Pictorial Dictionary of Ancient Rome</i> , 2d ed. (New York, 1967).
Pace	P. Pace, <i>Gli acquedotti di Roma e il “De Aquaeductu” di Frontino. Contesto critico, versione, e commento</i> (Rome, 1983).
Platner-Ashby	S.B. Platner and T. Ashby, <i>A Topographical Dictionary of Ancient Rome</i> (Oxford, 1929; repr. London, 1950; Rome, 1965).
RE	A. Pauly, G. Wissowa, and W. Kroll, eds., <i>Real-Encyclopädie der classischen Altertumswissenschaft</i> .
Richardson	L. Richardson, jr, <i>A New Topographical Dictionary of Ancient Rome</i> (Baltimore and London, 1992).
Roma sotterranea	R. Luciani, ed., <i>Roma sotterranea</i> , Exhibition Catalog (Rome, 1984).
Trionfo	G. Pisani Sartorio and A. Liberati Silverio, eds., <i>Il trionfo dell' acqua: acque e acquedotti a Roma, IV sec. a.C.–XX sec.</i> , Exhibition Catalog (Rome, 1986).
Van Deman	E.B. Van Deman, <i>The Building of the Roman Aqueducts</i> (Washington, D.C., 1934).
Wasserversorgung	Frontinus-Gesellschaft e.V., <i>Wasserversorgung im antiken Rom</i> (Munich, 1982).

Introduction

One of the long-standing problems in Roman topography is that of water distribution in the ancient city, specifically how water brought into Rome by its aqueducts was delivered to its neighborhoods and districts. Rome's aqueducts have long fascinated visitors to the city, and its water system has been the subject of intense scholarly interest since the publication of Rodolfo Lanciani's monumental commentary on Frontinus' treatise *De aquaeductu urbis Romae*, a study that has been aptly described as "the starting point of modern topographical work."¹ Scholars such as Thomas Ashby and Esther Van Deman have produced magisterial studies on the courses of the aqueducts outside the city,² and the imperial administration of Rome's water supply has most recently been extensively examined by Christer Bruun.³

In addition, aqueduct systems throughout the Roman world are now receiving fresh attention through publications of the Frontinus-Gesellschaft in Germany⁴ and the ongoing work of scholars in Italy, North America, and

1. Ashby, 9 (see Abbreviations).

2. Ashby; Van Deman. The contributions of these two scholars will never be superseded, because much of the physical evidence documented by them has now been lost as a result of Rome's rapid expansion into the countryside following World War II.

3. Bruun, 393-419, also provides a full bibliography of work to date. Cf. also O.F. Robinson, "The Water Supply of Ancient Rome," *Studia et Documenta Historiae e Iuris* 46 (1980): 61-78; id., *Ancient Rome: City Planning and Administration* (London, 1992) 95-105; and C. D'Amato, "L'Amministrazione delle acque in età romana," in *Trionfo*, 176-87.

4. Three volumes have now appeared in its "Geschichte der Wasserversorgung": *Die Wasserversorgung im antiken Rom* (Munich, 1982) includes a German translation of Frontinus, photographs, and plans; *Die Wasserversorgung antiker Städte: Geschichte der Wasserversorgung* vols. 2 and 3 (Mainz, 1987-88) focus on ancient Pergamum, the structural elements of water systems, their administration, and fountains, as well as

elsewhere.⁵ Very little, however, has been done to determine what happened to Rome's water after it reached the city. Its final distribution remains essentially an unsolved problem, a fact observed by Giuseppe Lugli more than fifty years ago,⁶ indeed one that is even now regarded as insoluble.⁷

Our ignorance about water delivery in ancient Rome is in many ways not surprising, given the state of the evidence available. Frontinus' treatise on Rome's water system, our primary source, survives only in a faulty manuscript tradition, and it furnishes statistics that are at times conflicting on the volume and delivery of individual aqueduct lines. As a text of crucial importance to ancient historians and students of technology, *De aquaeductu urbis Romae* has attracted new scholarly attention in the last twenty years; the most recent Teubner edition, that of Cezary Kunderewicz published in 1973, has received both generally favorable reviews and critical comment.⁸ Its appearance has prompted further textual study and scholarly work, activity that no doubt will continue and needs to continue.⁹

To be sure, Frontinus' statistics on water distribution in the ancient city are

water systems in northern Europe. See also K. Grewe, *Planung und Trassierung römischer Wasserleitungen* (Wiesbaden, 1985); and R. Tölle-Kastenbein, *Antike Wasserkultur* (Munich, 1990).

5. Hodge presents the most recent comprehensive study of Roman aqueducts and water systems, with a full bibliography, 359–88. Cf. also the comprehensive bibliography in Bruun, 393–419. The 1986 Exhibition Catalog *Il trionfo dell' acqua* contains many articles of value on aqueducts of ancient, Renaissance, and modern Rome. Two recent general studies focusing on the aqueducts of Rome itself have also appeared: that of G. Panimolle, *Gli acquedotti di Roma antica* (Rome, 1963); and that of Pace, which focuses primarily on engineering but also gives a text and Italian translation of Frontinus. L. Quilici, "Gli acquedotti di Roma," *Archeo. attualità del passato* 53 (July, 1989): 50–97, provides a general review of the Roman aqueducts, with photographs and maps. In addition, the 1987 Annual Meeting of the Archaeological Institute of America included a special colloquium on ancient water systems, the papers from which were published in 1991 (*Currents*).

6. G. Lugli, review of the books by Van Deman and Ashby, *Gnomon* 13 (1937): 98.

7. Bruun, 117 and n. 7, describes any attempt to deal exhaustively with the question as "quite futile," "respectfully" doubting Lanciani's comment in 1880 that "con un poco di pazienza" the distribution of the Claudian aqueducts could be traced within the city (Lanciani, 363).

8. C. Kunderewicz, ed., *Sex. Iulii Frontini, De aquaeductu urbis Romae* (Leipzig, 1973). Cf. the reviews by M. Lenoir, *REL* 53 (1975): 453–54; O.A.W. Dilke, *JRS* 67 (1977): 247–48; L. Callebat, *RPhil* 49 (1975): 326–27; and P. Grimal, *Gnomon* 47 (1975): 624–25.

9. R.H. Rodgers is currently preparing a new text and scholarly commentary on the work. Cf. R.H. Rodgers, "The Textual Tradition of Frontinus' *De Aquaeductu Urbis Romae*: Preliminary Remarks," *BICS* 25 (1978): 101–6; id., "Frontinus on Aqueducts: Textual Temptations," *BICS* 30 (1983): 131–36; and Bruun, 381–84.

partial and limited; in addition, because he wrote his treatise in A.D. 97, shortly after he assumed the post of *curator aquarum* or water commissioner under Nerva (*Aq.* 1–2, 102.17, hereafter cited without title), Frontinus gives no information at all on the two aqueducts introduced at later dates, the Aqua Traiana of A.D. 109 and Aqua Alexandriana of the early third century.

Moreover, although most of Rome's aqueducts can be traced to terminal reservoirs within the city, there is almost a total lack of archaeological evidence as to what happened to their water after that point. Most of the lead pipes used to convey it no longer survive, having been stolen and used for other purposes in medieval and modern Rome,¹⁰ and excavation reports have been rightly described as old and "generally quite casual," making it difficult to draw convincing conclusions about watercourses within the city.¹¹ In addition, the full extent of terracotta pipes and free-flow channels in Rome remains largely unknown.¹²

The problem is still worth attention, because much more can be done with the evidence we have: Frontinus and other literary sources; archaeological remains, however meager; and our understanding of ancient Rome, which has been significantly advanced by the work of many archaeologists and topographers during the last fifty years, since the studies of Ashby and Van Deman were published. Recent investigations of specific aqueducts and branch lines have indeed shown that careful examination of all the evidence—literary, archaeological, and topographical—can yield significant results.¹³ This study seeks to advance on these contributions.

Our starting point is the evidence of Frontinus, a treatise indispensable for serious study of Rome's water supply. Because this source will be cited throughout, chapter 1 presents a translation of *De aquaeductu urbis Romae* based primarily on R.H. Rodgers' forthcoming critical edition and commentary.¹⁴ Since

10. For the loss of these conduits see Lanciani, 414–15, who also included in his commentary a "Silloge Epigrafica Aquaria" (423–502) cataloging 596 pipes found in and around Rome. This work is long superseded by that of H. Dressel, *CIL* 15.2.1, 906–93; and, most recently, by that of Bruun, 207–380.

11. Bruun, 117, points out that only three of nine planned volumes of the *Carta Archeologica di Roma* have been published to date.

12. On free-flow channels see Bruun, 118–23; on open conduits in other distribution systems, see Hodge, 315–17. On terracotta piping, recommended by the Roman architect Vitruvius (*De arch.* 8.6.1–8), see Bruun, 125–39; and Hodge, 113–17.

13. Cf. R.B. Lloyd, "The Aqua Virgo, Euripus and Pons Agrippae," *AJA* 83 (1979): 193–204; H.B. Evans, "Agrippa's Water Plan," *AJA* 86 (1982): 401–11; id., "Nero's Arcus Caelimontani," *AJA* 87 (1983): 392–99; F. Coarelli, "L'urbs e il suburbium," in A. Giardina, ed., *Società romana e impero tardoantico*, 2 vols. (Bari, 1986), 2:43–45.

14. The only other English version is that of C.E. Bennett's Loeb edition (Cambridge, Mass., 1925), based on the earlier translation of C. Herschel, *The Two Books on the*

the Latin text of Frontinus is not well preserved, any English version of it will not be without problems and disputed passages. I have cited these, when appropriate, in the notes. The translation is included mainly as an aid to the reader, who will need ready access to pertinent sections of *De aquaeductu*.

While this study begins with a complete translation of Frontinus' treatise, it is not intended to be a comprehensive commentary on *De aquaeductu*. Indeed the recent work of Bruun and the contributions of scholars within the Frontinus-Gesellschaft have done much to fill that need, not to mention Rodgers' forthcoming text and commentary. Preliminary remarks are therefore in order concerning aims and methodology.

Although I am primarily concerned with water delivery, I shall not attempt to make sense in modern terms of the volumes that Frontinus reports as *quinariae*, a measurement based on the capacity of the *fistula quinaria*, a pipe one and a quarter Roman digits in diameter (25.1-2). The problem has been much debated, and modern estimates of the total water delivery within the ancient city vary greatly, from more than a million cubic meters a day to five hundred thousand to six hundred thousand cubic meters. Such estimates are, of course, of limited value, since there is no sure way to determine the population of ancient Rome at any given time, and therefore no means to establish an average daily volume per inhabitant.¹⁵

Several investigations have been made on the capacity and volume delivered by the Roman aqueduct system: a study by Claudio di Fenizio almost eighty years ago focused on investigations of the *quinaria* measurements given by Frontinus,¹⁶ and a second, much more recent, by Deane Blackman based its findings on extensive measurement of channel widths and flow depths of extant water conduits of four major aqueducts.¹⁷ Both studies through independent methodologies have resulted in a "modest agreement" concerning the total volume of water delivered by the four major aqueducts of imperial Rome. Such "agreement" does not resolve the problems connected with determining the

Water Supply of the City Rome (Boston, 1899; repr. 1973). There is a French translation in P. Grimal's Budé edition (Paris, 1961), and German versions of the Kunderewicz text can be found in *Wasserversorgung*, 81-120, and M. Hainzmann, *Wasser für Rom: Die Wasserversorgung durch Aquädukte* (Zurich, 1979). Pace, 235-314, gives an Italian version.

15. Bruun, 98-100.

16. C. di Fenizio, "Sulla portata degli antichi acquedotti romani," *Giornale del Genio Civile* 14 (1916): 227-331, followed by Hodge, 299-300; and, with slight modifications, by Pace, 61-70. Bruun, 385-87, gives a summary of di Fenizio's methods and conclusions.

17. D.R. Blackman, "The Volume of Water Delivered by the Four Great Aqueducts of Rome," *PBSR* 46 (1978): 52-72.

volumes of water distributed, much less establish this delivery in modern units of measurement,¹⁸ but it does strengthen the credibility of Frontinus' figures.

The last few years have seen further investigation into Frontinus' treatise and its statistics, specifically whether he could measure the *quinaria* by scientifically accurate methods, and, if so, how such measurements were taken.¹⁹ These studies confirm that while the *quinaria* cannot be converted into modern units of measurement, Frontinus regarded it as an accepted unit internally consistent and applicable to the statistics he reports in *De aquaeductu* (34.2–3). We can therefore use his data to determine the relative capacities and delivery of individual lines within Rome's water system as a whole.²⁰ Moreover, even if exact deliveries cannot be determined for individual aqueducts, given the faulty state of the MS tradition and possible variations in the size of the *quinaria* from line to line, Frontinus' statistics do reflect administrative practices in effect when he assumed office and therefore tell us much about hydraulic planning for the city.²¹

In any case, we must recognize that the statistics of *De aquaeductu urbis Romae* are not only data supplied by a knowledgeable source (albeit in a sometimes faulty text), but also, and more important, the primary statistics available to us. Lacking others, we must use Frontinus' *quinariae* figures in any attempt to make sense of the distribution of water within the ancient city. Our problem then is how each aqueduct delivered its water and what areas of the city each line served. How much water within the total supply did each aqueduct distribute? What needs did it supply? What role did each line play within the overall hydraulic system of Rome, both at the time of its introduction and at the end of the first century A.D., when Frontinus wrote his treatise?

Frontinus' data indicate that approximately one-third of the total delivery of Rome's aqueducts was distributed outside the city, 4,063 *quinariae* from a total of 14,018 (78.2). This study will not, however, address directly the problem

18. R.H. Rodgers, "Copia Aquarum: Frontinus' Measurements and the Perspective of Capacity," *TAPA* 116 (1986): 353–60, 357 n. 19, rightly observes that "modest agreement" does not establish overall certainty and that di Fenizio's calculations were presented to give only a minimal value for the *quinaria*.

19. A.T. Hodge, "How did Frontinus Measure the *Quinaria*?" *AJA* 88 (1984): 205–16; Rodgers, "Copia Aquarum," 353–60.

20. Cf. Bruun, 372, in discussing the volume of water delivered in ancient Rome: "Since the Romans themselves were not able to calculate exactly the volume of flowing water, there is not much point in relying on the figures of Frontinus. Moreover, these figures are sometimes contradictory...." Such observations are certainly valid in attempts to determine the actual volume of delivery in modern terms, but that is not the purpose of this study.

21. Bruun, 100 n. 19.

of supplies to the *suburbium*, a subject which merits full examination on its own, except where such deliveries *extra urbem* are relevant to distribution of individual lines within Rome itself.²² In addition, since Frontinus' *De aquaeductu* is a treatise on the history and organization of Rome's water system, and not a manual on Roman hydraulics,²³ any study of water distribution based primarily on its evidence must be limited in focus. We shall not attempt to investigate the technology of the aqueduct system or to explore problems of Roman hydraulic engineering, such as the operation of aqueduct lines, siphon systems, and distribution tanks, all topics covered in standard introductory works on ancient engineering.²⁴ However, we must begin with a few observations on Roman water distribution, to explain terms found throughout Frontinus' text and in subsequent chapters.

Water Distribution: The Hydraulics

Aqueducts in the Roman world worked basically on the principle of gravity flow, quite different from the closed pipe systems used today. Water was carried through an enclosed conduit (*specus* or *rivus*), which usually ran underground, from its source to its terminus or distribution tank (*castellum*). Above ground the line could be carried on a raised embankment (*substructio*) or on an arcade or bridge. Along the line could be incorporated any number of settling tanks (*piscinae*) to remove foreign matter or sediment between its source and *castellum*. At points along the course a subsidiary line (*ramus*) could be introduced to supply additional water, in order to augment the capacity of the line. In addition, a subsidiary or branch line (also designated a *ramus*) could begin from a main conduit before it reached its *castellum*.

At its distribution point the water was divided for delivery through pipes (*fistulae*), either tile or lead, which were attached to the *castellum* by a delivery

22. For a brief but informative discussion of suburban distribution southeast of Rome see Coarelli, "Suburbium," 43-45. On distribution in Tiburtine territory see Z. Mari, *Tibur, pars quarta, Forma Italiae* 35 (Florence, 1991), 40; and H.B. Evans, "In Tiburtium usum: Special Arrangements in the Roman Water System," *AJA* 97 (1993): 447-55.

23. This point, already made by Grimal, xiv; Bruun, 17-18, 369-70; and Hodge, 16-18, will be explored further in chapter 2.

24. Hodge, 67-331, gives a comprehensive treatment of the technology involved; for a summary, cf. Hodge, 1-3. See also R.J. Forbes, *Studies in Ancient Technology*, 9 vols., 2d ed. (Leiden, 1964-72), 1:149-94; G. Garbrecht, "Wasserversorgungstechnik in römischer Zeit," in *Wasserversorgung*, 9-31; J.G. Landels, *Engineering in the Ancient World* (Berkeley and Los Angeles, 1981), 34-57; Robinson, "Water Supply," 44-46; and P. Pace, "Tecniche di conduzione e distribuzione dell' acqua in epoca romana," in *Trionfo*, 138-51.

fitting or nozzle (*calix*), then laid, usually below ground level, along major streets. For our understanding of how an aqueduct *castellum* worked we are indebted in part to a chapter of Vitruvius' treatise on architecture (*De arch.* 8.6.1–2):²⁵

When it [the water] has reached the city, build a reservoir with a distribution tank in three compartments connected with the reservoir to receive the water, and let the reservoir have three pipes, one for each of the connecting tanks, so that when the water runs over from the tanks at the ends, it may run into the one between them. From this central tank, pipes will be laid to all the basins and fountains; from the second tank, to baths, so that they may yield an annual income to the state; and from the third, to private houses, so that water for public use will not run short; for people will be unable to divert it if they have only their own supplies from headquarters. This is the reason why I have made these divisions, and also in order that individuals who take water into their houses may by their taxes help to maintain the conducting of the water by the contractors.

Vitruvius' description of tripartite division for basins and fountains (*lacus et salientes*), baths (*balneae*), and private houses (*privatae domus*) is generally repeated in standard works on Roman hydraulics and is indeed even accepted by many scholars as a canonical arrangement.²⁶ It does not, however, agree with the analysis of distribution given by Frontinus in *De aquaeductu*, to be discussed below. Such disagreement is not an insurmountable problem, since Frontinus wrote a good 100 years after Vitruvius, and distribution plans within Rome may well have been modified during the first century A.D. Moreover, Vitruvius' treatise, highly theoretical in nature, is frequently in conflict with what we know of actual practice in the Roman world.²⁷

The archaeological evidence on Roman *castella* available to us makes the problem even more complicated: remains of *castella* that survive at Pompeii and Nîmes indicate that these tanks distributed their water, not strictly according

25. I follow the translation of M.H. Morgan, *Vitruvius, The Ten Books on Architecture* (Cambridge, Mass., 1914).

26. Two examples are M. Hainzmann, *Untersuchungen zur Geschichte und Verwaltung der stadtrömischen Wasserleitungen* (Ph.D. diss., Universität Graz, 1973), 20–21; and G. Tedeschi Grisanti, *I "Trofei" di Mario: il ninfeo dell' Acqua Giulia sull' Esquilino* (Rome, 1977), 36–38; Hodge, 13–16, 280–82, comments critically on such acceptance of Vitruvius.

27. Bruun, 16 n. 16; Hodge, 15–16.

to function or subsequent use, but rather according to the geography of the areas served: pipes from the *castellum* carried water along main streets to designated neighborhoods, and the same branch lines supplied both public basins and private homes.²⁸ From main reservoirs a number of branch lines were laid which themselves terminated in their own *castella*, whence the water was distributed further.²⁹ We cannot assume that the relatively simple distribution net in Pompeii paralleled arrangements in Rome itself,³⁰ but the large number of *castella* that Frontinus records in the city at his time, 247 in all (78.3), suggests that geographical distribution in individual regions or neighborhoods was a standard arrangement followed there.

Water Distribution: Frontinus' Data

Frontinus provides statistics on water distribution (78–86) both outside (*extra*) and inside (*intra*) Rome,³¹ before he assumed responsibility for his office (77.1–2). He also gives a division of volumes in *quinariae* for each line according to function or supply: waters were furnished *nomine Caesaris*, to *privati*, and for *usus publici*,³² a category that he further divides into four areas, *castra*, *opera*

28. For the distribution system at Pompeii see L. Richardson, jr, *Pompeii: An Architectural History* (Baltimore and London, 1988), 51–63; Hodge, 282–84; and H. Eschebach, "Die innerstädtische Gebrauchwasserversorgung, dargestellt am Beispiel Pompejis," in J.-P. Boucher, ed., *Journées d'études sur les aqueducs romains* (Paris, 1983), 79–132; for that of Nîmes cf. A. Grenier, *Manuel d'archéologie gallo-romaine*. Vol. 4.1, *Les monuments des eaux* (Paris, 1959), 97–98; and Hodge, 284–89.

29. Cf. Richardson, *Pompeii*, 55: "the main purpose of the castellum was to direct water to different quarters at different times." Frontinus himself describes such distribution in the case of the Aqua Crabra outside Rome (9.5).

30. Bruun, 124–25; Hodge, 291–93, 300.

31. Bruun, 147–48, notes that Frontinus uses these phrases without specification but argues that the *urbs* in the first century A.D. may well have extended beyond the line of the later Aurelian Wall. He suggests that the seventh milestone, where several aqueducts had their settling tanks (19.1), may have marked for Frontinus the limit between the *urbs* and surrounding *ager*. The distinction itself between city and *suburbium* in antiquity was an ambiguous one; see E. Champlin, "The Suburbium of Rome," *AJAH* 7 (1982): 97–98.

32. G. Tedeschi Grisanti, "I terminali degli acquedotti," in *Trionfo*, 151, considers this tripartite division as roughly parallel to that given by Vitruvius (cited above, n. 25), arguing that water distributed *nomine Caesaris* in Frontinus' statistics includes that assigned to *balneae* by Vitruvius a century earlier: by Frontinus' time, she suggests, the emperor would have assumed responsibility for the supply to baths. This is a tidy way of resolving the discrepancy between the two authors, but *balneae* would seem more likely to be included among either *opera publica* or grants to *privati*, not the category of installations supplied *nomine Caesaris*. Frontinus cites the special status of grants to *balneae* (107–8), a provision that would be unnecessary if they were part of distribution *nomine Caesaris*, and also singles out the Euripus Virginis, part of Agrippa's bath

publica, *munera*, and *lacus*. To make sense of his statistics we must explore the meaning of these terms. Interpretation of them is far from secure, and is further complicated by the failure of Frontinus' categories to correspond to inscriptional evidence from extant *fistulae*. Indeed very few pipe stamps indicate the purpose or destination of the water the *fistulae* carried.³³

Water distributed *nomine Caesaris* appears to have been that delivered at the emperor's disposition to supply the imperial palace and buildings directly under his control, to include staff headquarters and offices.³⁴ It is worth noting that Frontinus includes in this category the delivery of 254 *quinariae* to the *naumachia Augusti* in Region XIV (85); distribution *nomine Caesaris* could therefore include delivery to large structures under imperial control, even if constructed for public benefit or entertainment.³⁵

That distributed to *privati* went to citizens granted water for private use by favor of the emperor (*beneficio principis*, 3.2, 69.6, 74.4), an arrangement that seems to have been instituted by Marcus Agrippa, who first published *commentarii* fixing distribution to private parties (98.2). According to Frontinus, in the early republic (*apud antiquos*) almost all water had been used for public purposes (94.3). In his time, however, *privati* received water through written authorization (*epistula a principe*, 105.1) and were subject to a water tax (118.1–3; cf. Vitruvius 8.6.2, cited above).³⁶

Usus publici are best discussed according to the four subcategories listed by Frontinus. *Opera publica* or public works appear to be not only public buildings but all structures or monuments erected for public use, benefit, or amusement that were not directly the property of the emperor or his *fiscus*: these include baths, meeting places, theaters and amphitheaters, circuses, markets, and porticoes.³⁷ Among the bath complexes were, of course, the great imperial *thermae*, but this category may have also included smaller bathing establishments or *balneae*, which existed in great numbers, from the evidence of the fourth century Regionary Catalogs.³⁸ Although there is very limited

complex in the Campus Martius, as one of the *opera publica* supplied by the Aqua Virgo (84.3).

33. Bruun, 256.

34. Cf. Lanciani, 581; Hainzmann, *Untersuchungen*, 28 n. 1; Grimal, 39 n. 1; Robinson, "Water Supply," 78.

35. We might expect the *naumachia* to be one of the 95 *opera publica* supplied in the city (78.3), but Frontinus' statistics indicate otherwise.

36. Cf. Hainzmann, *Untersuchungen*, 60–61.

37. Lanciani, 581, followed by Grimal, 39 n. 2; Hainzmann, *Untersuchungen*, 28 n. 1; and Bruun, 102 n. 25.

38. A. Nordh, *Libellus de Regionibus Urbis Romae*, *SkrRom* ser. II, iii (Rome, 1949), 105. The Breviarium of the Regionaries gives a total of 856 *balneae* within the city, a figure that is suspiciously high, perhaps concocted to conform to a predetermined scheme

evidence for supply to *balneae* in extant *fistulae* inscriptions,³⁹ such establishments certainly received aqueduct water. Frontinus himself indicates that they had once enjoyed special status among water grants (107-8), and Martial (6.42.18) describes the *thermulae* of Claudius Etruscus as an installation providing water of both the Aqua Marcia and Aqua Virgo to its patrons. *Balneae* are also to be included in Frontinus' category of distribution to *privati*, since many of the complexes were privately owned. Frontinus cites only ninety-five *opera publica* in the city at his time (78.3), and parallels of density from Pompeii and Ostia would indicate that several hundred bathing establishments must have existed in imperial Rome.⁴⁰ Also worth noting is that Frontinus specifically cites among *opera publica* the Euripus Virginis, a monumental stream of running water constructed by Agrippa in the Campus Martius (84.3).⁴¹

Castra would normally indicate military camps and installations, but the number Frontinus lists for them in the city, eighteen in all (78.3), and the wide range in volumes of *quinariae* distributed to them suggest that the term should also be applied to paramilitary or even nonmilitary posts or stations with dormitory arrangements, such as barracks of the *vigiles* or fire brigade, installations like the *Castra Leticariorum* and *Tabellariorum*, and offices of various sizes.⁴² Recent studies have shown that such installations had no fixed form or size; those of the *vigiles* were sometimes situated in houses or earlier buildings specifically adapted for the functions accommodated.⁴³ By Frontinus' time *castra* seem to have been considered a distinct type of public building; otherwise we might expect him to list distribution to them under the category *nomine Caesaris*. Certainly individual *castra* varied in size and water needs because of the wide discrepancies in delivery to individual installations: the Aqua Appia supplied four *quinariae* to one (79.2), the Anio Vetus fifty to another (80.2), the Marcia forty-two *quinariae* to four (81.2), and so forth.⁴⁴

of two *balneae* and four *lacus* for each *vicus* within the individual regions. On the difficulties of using the Regionaries as a topographical source see Nordh, 58-67; and G. Hermansen, "The Population of Imperial Rome: the Regionaries," *Historia* 27 (1978): 131-45, 165-69.

39. Bruun, 75-76.

40. Bruun, 74 n. 48.

41. Lloyd, 196-97; Hainzmann, *Untersuchungen*, 28 n. 1. The number 95 is an emendation by Poleni adopted by most editors to make sense of the arithmetic in chapters 79-86.

42. For the mysterious *Castra Leticariorum*, *Tabellariorum*, and *Victimariorum*, cited only in the Breviarium of the Regionary Catalogs (Nordh, 106), see Jordan, 2:71-72.

43. For the *castra* of the *vigiles* see J.S. Rainbird, "The Fire Stations of Imperial Rome," *PBSR* 54 (1986): 147-69.

44. Cf. Bruun, 245-56, who suggests that *castra* may refer to another category of

The interpretation of *munera* is more problematic. In the text they appear to be ornamental fountains giving a display of their water (3.2), a definition accepted by most commentators on the passage.⁴⁵ Frontinus' notice that the staff of the *cura aquarum* were stationed at *munera* as well as at *castella* throughout the city (117.3) indicates that they could also serve as a reserve supply of water in case of emergencies.⁴⁶ Moreover, common citizens may well have been able to draw water from the *munera*, given the quantity of water supplied to them.⁴⁷ The large number of *munera* listed, thirty-nine in all (78.3), and the varying volumes supplied to them suggest a wide range of size; they should not necessarily be thought of as fountain displays on a scale like that of the "Trophies of Marius," the one example usually cited within Rome. *Munera* could also serve a double function as distribution *castella*: recent excavations have confirmed that the "Trophies of Marius" channeled its water into a delivery system after its monumental display.⁴⁸

Finally Frontinus gives distribution figures for *lacus*, public basins located throughout the city, 591 in all (78.3). That the term indicates open basins is clear from another reference (94.3), describing *aqua caduca*, the overflow from *lacus* taxed for use in baths and fullers' establishments (94.3). Closely associated, indeed inseparable, from the *lacus* were the *salientes* or water outlets supplying the basins located underneath the taps (87.5). The text of a senatorial decree of 11 B.C. quoted by Frontinus (104.2-3) also connects the functioning of *publici salientes*, which fed the public basins, with the constant delivery of water in Rome.⁴⁹

Rome's aqueduct system evolved on a piecemeal basis over a period of five hundred years, as new lines were added to meet existing demands. We must

"public water post" or "local cistern" and that Frontinus "presumably" included supplies to military camps under the category *nomine Caesaris*. This, however, seems unlikely; we would expect a much greater uniformity of volume if *castra* were cisterns or storage facilities. Moreover, we would also expect Frontinus to gloss this unusual meaning of the word, in much the same way he glosses his technical use of *munera* (3.2). Even more problematic is the use of the term to indicate a "local cistern," if *castra* were supplied through *castella*: we would expect the diminutive form to indicate the smaller reservoir or tank, not the larger one within the distribution net.

45. Lanciani, 581; Grimal, 65-66. Cf. P. Grimal, review of F.W. Shipley, *Agrippa's Building Activities in Rome*, REL 12 (1934): 240, followed by Robinson, "Water Supply," 77: *munera* are a euphemism for public latrines.

46. Cf. Grimal, 66 n. 3.

47. Bruun, 102-3.

48. G. Tedeschi Grisanti, "Le mostre degli antichi acquedotti: i 'Trofei di Mario'," in *Trionfo*, 126-35; cf. Lanciani, 581; Grimal, 65-66.

49. Pliny HN 36.121, in discussing Agrippan improvements to the water system, appears to distinguish *salientes* from *lacus*. For a discussion of the problem cf. Bruun, 105-6 n. 43; Jordan, 2:61; Lanciani, 581; and Hainzmann, *Untersuchungen*, 28 n. 2.

therefore examine each line separately, according to the chronology of its introduction. Our discussion will focus on what is known about the route of the line within the city, the position of its terminal *castellum*, and the distribution it carried out, both at the time of its introduction and when Frontinus wrote his treatise. We turn first to the text of *De aquaeductu*, and then will review the organization of Frontinus' treatise and the reasons for its publication.