

THE TWO BOOKS ON THE WATER SUPPLY OF THE CITY OF ROME

By **SEXTUS JULIUS FRONTINUS (97 AD)**

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INASMUCH as every office conferred by the emperor demands especial attention; and inasmuch as I am moved not only to devote diligence, but even love to any matter confided to my care, be it on account of inborn zeal, or by reason of faithfulness in office; and inasmuch as Nerva Augustus, an emperor of whom it is difficult to say whether he devotes more love or more diligence to the common weal, has now conferred upon me the duties of water commissioner, (or water works superintendent, curator aquarum), duties contributing partly to the convenience, partly to the health, even to the safety of the city, and from olden time exercised by the most distinguished citizens; I therefore consider it to be the first and most important thing to be done, as has always been one of my fundamental principles in other affairs, to learn thoroughly what it is that I have undertaken.

2. There is indeed no better foundation for any business; nor can it in any other way be determined what is to be done, and what omitted; nor is there for a fair-minded man so debasing a course as to perform the duties of an office intrusted to him according to the directions of assistants: a course, however, which must be followed, whenever an inexperienced official takes refuge in the practical knowledge of his assistants; whose services though necessary for rendering help should nevertheless be only a sort of hand and tool of the principal in charge. . . . It is for this reason that I have set down in this commentary all that I could gather as bearing on the subject matter, after having arranged and codified it in accordance with my habit as already exemplified in other offices, so that I might consult it as a guide in the duties of this.

But my other commentaries were inspired by my own hard-earned practice and experience, and were intended for the benefit of my successors, and this commentary may also be of use to a successor; but, as it has been written at the beginning of my administration, it will serve more especially for my own instruction, and as a guide.

3. And that I may not by chance omit anything which is necessary for the understanding of the whole subject matter, I will first put down the names of the waters which are brought to the city of Rome; then by what persons, and under what consuls, and in what year since the founding of the city each of them was brought in; then at what places and at what mile-stones their aqueducts commence; how far they were carried in underground channels, how far on masonry substructures, and how far on arches; then the height of each of them, and the size and number of taps, and what uses are dependent upon them; how much each aqueduct brings to each ward without the city, and how much within the city; how many public delivery tanks there are, and how much is delivered from them to the places of public amusement, how much to the ornamental fountains (munera) - as the more educated call them - how much to the water basins, how much to the use of the State (in the name of Caesar), how much for private uses by grants from the emperor; what is the law with regard to the construction and maintenance of the aqueducts what penalties enforce it under the laws, votes of the Senate, and Imperial edicts that have been enacted.

BOOK I

4. From the foundation of the city for 441 years¹ the Romans were content with the use of the waters which they drew, either from the Tiber, or from wells, or from springs. Springs have held, down to the present day, the name of holy things, and are objects of veneration, having the repute of healing the sick; as for example, the springs of the Prophetic Nymphs (Camenae)², of Apollo, and of Juturna.³ But there now run into the city: the Appian aqueduct, Anio Vetus, Marcia, Tepula, Julia, Virgo, Alsietina, which is also called Augusta, Claudia, and Anio Novus

5. Under the consulate of M. Valerius Maximus and P. Decius Mus,⁴ in the thirtieth year after the beginning of the Samnite war,⁵ the Appian water was brought into the city by the censor Appius Claudius Crassus, who later received the surname Caecus,⁶ who also had charge of the construction of the Appian Way, from Porta Capena⁷ to the city of Capua. He had for his colleague C. Plautius, who received the name of Venox (the searcher of springs), on account of his search for the springs of this water; but since Plautius resigned the office of censor before the expiration of the eighteen months,⁸ as a result of the erroneous impression that his colleague would do the same, Appius alone enjoyed the honor of giving the aqueduct its name; and it is said of him, that by various contrivances he managed to extend the term of his office as censor until he had completed not only the aqueduct, but also the highway. The intake of the Appia is on the estate of Lucullus on the (Collatian) Praenestine⁹ Way, between the seventh and eighth mile-stones, on a cross-road, 780 paces¹⁰ to the left (going from Rome). The aqueduct from the intake to the Salinae at the Porta Trigemina has a length of 11,190 paces; of which 11,130 are in underground channels, and 60 paces above-ground on masonry substructures and on arches near the Porta Capena. With it connects a branch of the Augusta, at the Spes Vetus,¹¹ in the vicinity of the Torquatian and Plautian gardens, arranged thus as a supplementary supply by Augustus, who at the same time gave it the significant name of the Twins. This branch has its intake on the Praenestine Way, at the sixth mile-stone, on a cross-road, 980 paces to the left, very near the Collatiati Way, and the aqueduct extends in an underground channel 6,360 paces before joining the Twins. The distribution of Appia begins at the foot of the Publician steps (acclivity), near the Porta Trigemina, at the place called the Salinae.

6. Forty years after the construction of Appia, in the year 481¹² from the founding of the city, Manius Curius Dentatus, who was censor along with Lucius Papirius Cursor, contracted to have the waters of the river Anio (now called the Anio Vetus), brought into the city, for the sum realized by the sale of the spoils taken from Pyrrhus. This was in the second consulate of Spurius Carvilius, and of Lucius Papirius Cursor. Two years later the completion of this aqueduct was discussed in the Senate. . . . Upon which a board of two commissioners was elected by vote of the Senate, for the bringing in of the water, namely: Curius, who had let the (original) contract, and Fulvius Flaccus. Curius died within five days of his election as one of the board of commissioners: the honor of completing the work devolved on Fulvius. The intake of the Old Anio is up-stream from Tibur (Tivoli) at the twentieth mile-stone outside the Baranean Gate, where it gives a part of its water to them of Tivoli. Its conduit on account of necessary deviations is 43,000 paces long, of which there are 42,779 paces of underground channel, and 221 paces on substructures above-ground.¹³

7. Subsequently, 127 years from this time, that is in the year 608¹⁴ from the founding of the city, under the consulate of Servius Sulpicius Galba and L. Aurelius Cotta, when the Appia and Old Anio aqueducts had become leaky by reason of age, and water had also been diverted from them by unlawful takings, the Senate commissioned Marcius, who at that time administered the law as Praetor between the citizens, to restore these aqueducts to usefulness and to protect them.¹⁵ And because the growth of the city seemed to demand an increased water-supply, he was also empowered by the Senate to investigate whether he could bring other additional waters into the

city. This he did, by bringing to the Capitol by a conduit situated above-ground, the water which from the name of its builder is called Marcia. We read in Fenestella, that 180,000,000 sesterii¹⁶ had been appropriated for these works. But, because the term of office of the Praetor was not long enough to complete the commissioned work, the same was extended into the year following. During this time it is said that the Board of Ten¹⁷ found, on consulting the Sibylline Books¹⁸ for another purpose, that it was not right for the Marcian waters, or rather for those of the Anio-for the tradition more usually mentions the latter-to be brought to the Capitol. The matter is said to have been debated in the Senate in the consulship of Appius Claudius and Quintus Caecilius, Marcus Lepidus acting as spokesman (for the Board of Ten); and the question was even revived three years later under the consulship of C. Laelius and Q. Servilius; but the popularity of Marcius Rex carried the day; and thus the water was brought to the Capitol. The intake of Marcia is on the Valerian Way, at the thirty-sixth mile-stone, on a cross-road, 3,000 paces to the right as one comes from Rome. But on the Sublacensian Way, which was first paved under the Emperor Nero, at the thirty-eighth mile-stone, and to the left, it may be seen within a distance of 200 paces, at a place where numberless springs gush forth from caves in the rocks, immovable like unto a pool, and of a deep- green hue. The conduit has a length of 61,710 1/2 paces from the intake to the city; 54,247 1/2 paces of underground conduit; 7,463 on structures above-ground; of which, some distance from the city, and at several places where it crosses valleys, 463 paces on arches; nearer the city, and beginning at the seventh mile-stone, 528 paces on masonry substructure; on other arches, 6,472 paces.

8. The Censors, Cn. Servilius Caepio and L. Cassius Longinus, called Ravilla, in the year 627¹⁹ after the founding of the city, under the consulate of M. Plautius Hypsaeus and M. Fulvius Flaccus, caused the water which is called Tepula to be brought to Rome and to the Capitol from the estate of Lucullus, but which some hold to belong to Tusculum. The intake of Tepula is on the Latin Way, at the tenth milestone, 2,000 paces to the right as one comes from Rome; whence it was brought by its own conduit into the city.

9. Later than this, tinder the second consulate of the Emperor Caesar Augustus and of L. Volcatius, in the year 719²⁰ after the founding of the city, M. Agrippa, when he was Aedile subsequently to his first consulate, at the twelfth mile-stone from the city near the Latin Way, on a cross-road two miles to the right as you go from Rome, collected the sources of another spring, and tapped the conduit of Tepula. The new aqueduct was called Julia by the man who planned it, the supply, however, being so apportioned that the name of the Tepula was not lost. The conduit of Julia is 15,426 1/2, paces long, of which there are 7,000 on arches above-ground; quite near the city, beginning at the seventh mile-stone, 528 on masonry substructures; on other arches 6,472 paces.²¹

Near the intake of Julia, is a brook called Crabra. Agrippa disdained to take in this brook, either because he did not consider it of good quality, or because he thought he was under obligations to leave it for the use of the proprietors at Tusculum; for it is the same which is distributed by turns on fixed days and in determined quantities²² to the estates of that part of the country. But without the same moderation, our water-men constantly drew upon the greater part of it for increasing the flow in the Julian aqueduct, though not for the purpose of increasing the discharge of this aqueduct, which on the contrary they exhausted, by diverting its waters to their own profit. I therefore cut off the Crabra brook, and gave it again entire, upon the orders of the emperor, to them of Tusculum; who perhaps now get it with great astonishment on their part, and without knowing to what cause to ascribe the unusual abundance. The Julian aqueduct, on the other hand, has regained its normal quantity, and holds it even during notable droughts, by reason of the destruction of the branch pipes through which it was secretly despoiled. In the same year²³ Agrippa rebuilt the nearly ruined aqueducts of Appia, of Anio, and of Marcia; and with superior forethought supplied the city with a large number of ornamental fountains.

10. The same man, after his own third consulship, and under the consulate of C. Sentius and Q. Lucretius, thirteen years²⁴ after he had constructed the Julian aqueduct, also brought Virgo²⁵ to Rome, which is gathered on the estate of Lucullus. The day on which it first flowed into the city, is found to be the fifth before the Ides of June²⁶. The name Virgo was given to this aqueduct, because it was a young girl who showed its springs to some soldiers who were seeking to find water. Those who were digging having followed up these springs, found a great quantity of water. There may be seen in a little temple erected near the spring, a painting which represents this tradition.

The intake is on the Collatian Way, at the eighth milestone, in a swampy region. The spring is increased by being walled in with a wall of concrete, made of broken pottery and lime, so as to keep together the primary sources, as also by a number of other tributaries. The waters traverse a length of 14,105 paces; for 12,865 of which they are carried in an underground conduit, for 1,240 above-ground; of which, in a conduit built at several points on masonry substructure, 540 paces; on arches 700; the underground conduits of the tributaries measure 1,405 paces.

11. I do not rightly perceive the motives which caused Augustus, that most cautious ruler, to bring in the Alsietinian water, called Augusta, since it has nothing to commend it; and is, on the contrary, so unwholesome, that on this account it is delivered nowhere for the use of the people; unless it be that, when he undertook to construct his Naumachia,²⁷ he brought in this water to avoid drawing upon the better sources of supply, and left the surplus of the Naumachia for the adjacent gardens, and for the use of private parties for irrigation. It is customary, however, to draw from it in emergencies, and thus to eke out the supply of the public fountains in the ward beyond the Tiber, whenever the bridges are undergoing repairs and no water can be delivered from this side of the river. The intake is out of the Alsietinian Lake, on the Claudian Way, at the fourteenth mile-stone, on a cross-road, 6,500 paces to the right. Its conduit has a length of 22,172 paces; of which 358 paces are on arches.

12. Augustus also conducted another water of equal quality through an underground conduit to the channel of Marcia, for supplementing Marcia during droughts, which conduit is called Augusta after its designer. The intake is further away than that of Marcia; from the intake to its junction with Marcia is a distance of 800 paces.

13. After this, C. Caesar,²⁸ the successor of Tiberius, because the seven aqueducts did not seem to be sufficient to meet either the public needs or the demands of private luxury, commenced the construction of two aqueducts in the second year of his reign, under the consulate of M. Aquila Julianus, and P. Nonius Asprenas in the year 789²⁹ after the founding of the city. This work was completed in the most splendid manner by Claudius,³⁰ and was formally dedicated under, the consulate of Sulla and Titianus, in the year 803³¹ after the founding of the city, on the first of August. One water, which had its source in the Caerulean and Curtian springs, was called Claudia. This one most nearly equals Marcia in good quality. To the other was given the name of New Anio, so as to distinguish it the better, since now two aqueducts were in use, both called Anio. To the first Anio was given the surname Old.

14. The intake of Claudia is on the Sublacensian Way, at the thirty-eighth mile-stone, on a cross-road, three hundred paces to the left, taking in two very capacious and beautiful wells, the Caerulian (blue one), so called from its appearance, and the Curtian. Claudia also takes in a spring called Albulinus, which is of such purity that whenever there is need of supplementing Marcia, it answers so perfectly, that it in no wise changes the character of Marcia by mixing with it. The spring of Augusta was turned into Claudia, because Marcia seemed plainly to be of sufficient volume by itself; but Augusta remained, nevertheless, a reserve supply to Marcia, the understanding being that Augusta should run into Claudia only when the conduit of Marcia could not carry it. Claudia has a length of 46,406 paces; of which, 36,230 are underground conduit, 10,176 above-ground; of which at various points in the upper reaches 3,076 paces

are on arches, and near the city, beginning at the seventh mile-stone, 609 paces on masonry, substructure, and 6,491 on arches.³²

15. The intake of New Anio is on the Sublacensian Way, at the forty-second mile-stone, in the Simbruinum, and from the river; which flows muddy and discolored even without the effect of rainstorms, because it has rich and cultivated lands adjoining, and, as a result, loose banks; for this reason a settling reservoir was built upstream from the intake, so that in it and between the river and the conduit the water might come to rest and clarify itself. But in spite of this construction the water reaches the city in a discolored condition, whenever there are heavy rains. The Herculanean Brook, which has its source on the same Way, at the thirty-eighth mile-stone, opposite the springs of Claudia and beyond the river and the highway, joins it, being of itself exceedingly clear, but losing the charm of its purity by admixture. The conduit of New Anio measures 58,700 paces; of which 49,300 are underground, 9,400 above-ground; of which at various points in the upper reaches are 2,300 paces on masonry substructure or on arches; and nearer the city, beginning at the seventh mile-stone, 609 paces on masonry substructure, 6,491 paces on arches. These are the highest arches, and at some points are 109 feet high.

16. Will anybody compare the idle Pyramids, or those other useless though much renowned works of the Greeks with these aqueducts, with these many indispensable structures?

17. It has seemed to me not superfluous to examine consecutively the lengths of channel of each aqueduct in its several parts, and in detail;—this because the maintenance of the works is the most important part of the duties of this office, wherefore it is necessary that whoever is placed in charge of them should know which of them are in need of having money spent upon them. But my zeal was not satisfied by a mere personal examination in detail; I also had plans made of the aqueducts, from which it may be seen where there are valleys and how wide they are, and where rivers have been crossed; also where the conduits laid on the hillsides need an extended and continued care for their protection and maintenance. In this way we reap the advantage of having, as it were, the works referred to directly before us, and of being able to study them, as though we stood by their side.

18. The several aqueducts reach the city at different elevations. Whence it comes that some deliver water on higher grounds, while others cannot elevate themselves to the higher summits; for the hills have gradually grown higher on account of the accumulation of rubbish produced by the frequent fires. There are five aqueducts whose waters rise to all parts of the city, though some are forced up by a greater, others by a lesser head.

New Anio goes the highest; next to it comes Claudia; the third rank is taken by Julia, the fourth by Tepula; this is followed by Marcia, which equals in height at the intake even Claudia.

The ancients laid the lines of their aqueducts at a lower elevation, be it because the art of levelling had not been highly developed, or because they purposely sunk the aqueducts into the ground, in order that they might not readily be destroyed by the enemy, during the frequent wars with the Italians. But now, whenever an aqueduct has succumbed to old age, to save length, they are in certain parts either placed on a masonry substructure or on arches, at the same time avoiding the subterranean loops originally put around the heads of the valleys. The sixth rank in height is taken by Old Anio, which would likewise be able to supply the higher portions of the city if it were raised up on masonry substructures or on arches, wherever the situation of the valleys and low places made it necessary. Its elevation is followed by that of Virgo, then by that of Appia; both of which, since they were brought from points near the city, were unable to reach such high elevations. Lowest of all is Alsietina, which supplies the ward beyond the Tiber, and the very lowest districts.

19. Of these waters, six are drawn into covered catch-basins, this side of the seventh mile-stone on the Via Latina, in which, resting as it were from their run and taking a new breath, they deposit their sediment. Their volume is also determined by gauges setup in these basins. Thence onward, Julia, Marcia, and Tepula run on the same line; of which Tepula, which was turned, as has above been shown, into the same conduit with Julia, now leaves the basin of Julia and receives its volume from it, and flows in its own conduit and under its own name.

These three run on top of the same arches from the basins onward. The uppermost is Julia; next comes Tepula; then Marcia. These waters going underground at the elevation of the Viminal Hill, flow up to the Viminal Gate. There they again see the light of day. But first, a portion of Julia is distributed to the delivery tanks³³ of the Caelian Hill, having been diverted at Spes Vetus. But Marcia pours a portion of its waters into the so-called Herculean Channel, behind the Pallantian Gardens; and though this is conducted along the Caelian Hill, it fails to supply anything to this hill by reason of too low elevation, and ends over Porta Capena.

20. The New Anio and Claudia are carried on high arches from the basins, Anio being the higher of the two. Their arches end behind the Pallantian Gardens, and their waters are distributed thence to the city through pipes. But Claudia first delivers a portion of its waters over the so-called Neronian Arches, at Spes Vetus. These pass along the Caelian Hill and end near the temple of Divus Claudius. Both aqueducts deliver the water which they bring partly upon the Caelian Hill, partly upon the Palatine and Aventine, and to the ward over the Tiber.

21. Old Anio, this side of the fourth mile-stone, passes under the arches of New Anio, which crosses from the Latin Way to the Labican, and has there its catch-basin. It then delivers a part of its supply to the Octavian conduit this side of the second mile-stone, and reaches up to the Asinian Gardens in the vicinity of the New Way, whence it is distributed throughout the surrounding district. But the main conduit which passes Spes Vetus comes within the Esquiline Gate, whence it is distributed within the city in high-lying conduits.

22. Neither Virgo, nor Appia, nor Alsietina has a receiving reservoir or catch-basin. The arches of Virgo commence under the Lucullan Gardens, and end on the Field of Mars in front of the Voting Booths. The conduit of Appia, running along the base of the Caelian and the Aventine, emerges again into daylight, as we have said, under the Publician Steps (acclivity). The conduit of Alsietina ends behind the Naumachia, for the supply of which it seems to have been constructed.

23. Having now given the builders and the age of each aqueduct, also their sources, lengths of channel, and order of heights, it seems to me not out of keeping to go more into detail, and to demonstrate how large is the quantity of water which is allotted to public and to private uses, as well as for luxury; and through how many tanks it is conveyed, and in what wards these are located; how much water is distributed within the city walls, how much without, how much is used for water basins, how much for fountains, how much for public structures, how much on account of the State, how much by private consumers. But before I mention the names quinaria, centenaria, and those of the other ajutages by which water is gauged, I deem it expedient to state what is their origin, what their discharge, capacity, or value, and what each name means; and to show, after presenting the rules according to which their proportions and capacity are computed, how I discovered their discrepancies, and the way I set about to correct them.

24. The ajutages to measure water are arranged either according to digits or inches. Digits are used down to the present day in Campania, and in very many places in Italy; inches in Apulia and elsewhere. The digit, according to common agreement, is the one sixteenth part of a foot,³⁴ the inch the twelfth; but even as there is a difference between the inch and the digit, so also digits differ among themselves; some are

called square, others round. The square digit is greater than the round digit by three fourteenths of itself; the round digit is smaller than the square digit by three elevenths, obviously because the corners are lopped off.

25. At a later period, an ajutage called a *quinaria* came into use in the city, to the exclusion of the former measures; this had its origin neither in the inch, nor in either of the two digit measures named, but was introduced, as some say, by Agrippa, according to others by plumbers acting under the direction of the architect Vitruvius; it was so called, according to those who ascribe it to Agrippa, because five small ajutages or punctures of the old type, according to which water was formerly dealt out, when the supply was as yet insignificant, were united into one pipe; according to those who ascribe it to Vitruvius and the plumbers, it took its name from the circumstance that a flat sheet of lead five digits wide, made up into a round pipe, will form this ajutage. But this is indefinite; because the plate when made up into a round pipe will be extended on the exterior surface and contracted on the interior surface. The most probable explanation is, that the *quinaria* (or 5-pipe) received its name from the fact of its being five fourths (of a digit) in diameter, a method of designation which still applies in the case of the other ajutages up to the 20-pipe, each size being larger than its predecessor by a quarter; for example, a 6-pipe is six quarters in diameter; a 7-Pipe, seven quarters, and so on up to a 20-pipe.

26. But every ajutage is gauged either by its diameter or circumference, or by its area of clear cross-section; from any of which its capacity may be found. To appreciate readily the difference between the inch ajutage, the square digit, and the circular digit, and the *quinariae*, use must be made of the value of the *quinaria*, which ajutage is most accurately determined and best known. The inch ajutage is I digit plus $\frac{1}{3}$ of a digit in diameter; it contains slightly more than I *quinaria* plus $\frac{1}{8}$ *quinaria*; that is: I $\frac{1}{2}$ twelfths of a *quinaria* plus $\frac{3}{288}$ plus $\frac{8}{12}$ of $\frac{1}{288}$ more. The square digit converted into its equivalent circle is I digit plus I $\frac{1}{2}$ twelfths of a digit plus $\frac{1}{72}$ in diameter; it measures $\frac{10}{12}$ of a *quinaria*. The circular digit is one digit in diameter; and measures $\frac{7}{12}$ plus $\frac{1}{2}$ twelfth plus $\frac{1}{72}$ of a *quinaria* in area.³⁵

27. Now the ajutages which are derived from the *quinaria*, get their increase in two ways. The first way is by reason of the number of *quinaria* contained, that is by including several *quinaria* in one orifice, whose area increases according to the number of *quinaria* that are united.

This method is the same as the one ordinarily employed whenever several *quinaria* are delivered into the same delivery tank, out of which each customer then gets his share, this being done so as not to tap the pipes too often for branch pipes.

28. The second way is followed when the ajutages increase not by multiplication of *quinaria* contained, but by increase of the diameter of the pipe; according to which they get their names and measures of capacity. Thus by adding a quarter digit to the diameter of a *quinaria* we get a 6-pipe; but its capacity is not thereby increased proportionately; for it contains I *quinaria* plus $\frac{5}{12}$ plus $\frac{1}{48}$. And by adding quarter digits in the same way as has been shown, we get a 7-, 8-, up to a 20-pipe.

29. For the higher numbers is used the method of gauging by the number of square digits contained in the cross-section that is in the orifice of each ajutage, from which the pipes also received their names; for those which in cross-section, that is, in their circular orifice, have twenty-five square digits, are called 25-pipes; upon the like gauging depends the name of the 30-pipes, and so on progressing by five square digits, up to the 120-pipe.

30. In the 20-pipe, which is on the dividing line between the two methods of gauging, the two methods almost coincide. Because, according to the method to be used in the first-named set of ajutages, it is 20

quarter digits in diameter; and according to the method of computation to be applied to the *ajutages* that follow these,³⁶ it has 20 square digits less a fraction.

31. The gauging of all the *ajutages* from the 5-pipe up to the 120-pipe is made as we have stated; and is applicable to them all; and conforms to the *ajutages* as recorded and confirmed in the records of the most puissant and patriotic of emperors.³⁷ Whether, therefore, we follow computation or authority, the *ajutages* of the records are entitled to the greater weight. But the water-men have ventured to make deviations in the case of four of the *ajutages*, namely, in the 12-, 20-, 100-, and 120-pipe, although they generally conform to the rules.

32. In case of the 12-pipe, the error is not great, nor is its use frequent; they have added $1/24$ plus $1/48$ of a digit to the diameter, and $3/12$ of a *quinaria* to its capacity. But a greater discrepancy exists in case of the other three *ajutages*. They diminish the 20-pipe by $1/2$ of a digit plus $1/24$, its capacity by 3 *quinariae* plus $1/4$ plus $1/24$; and common use is made of this *ajutage* for delivery. But in case of the 100-pipe, and the 120-pipe, through which they regularly receive water, they do not diminish their capacity, but increase it. For they add to the diameter of the 100-pipe $2/3$ plus a half-twelfth of a digit, and to the capacity, 10 *quinariae* plus $1/2$ plus $1/24$ [plus $1/48$]. To the diameter of the 120-pipe they add 3 digits plus $7/12$ plus $1/24$ plus $1/48$; to its capacity, 66 *quinariae* plus $1/6$.

33. Thus by subtracting on the one hand from the 20-pipe, with which they generally deliver, and by adding, on the other hand, to the 100- or the 120-pipe, through which they always receive, they intercept (take unlawfully) in case of the 100-pipe, 27 *quinariae*; and in case of the 120-pipe, 86 [$1/12$] *quinariae*.³⁸ Which maybe proven by computation, although manifest of itself. For out of the 16 *quinariae* allotted by Caesar to the 20-pipe, they do not deliver more than 13; and it is equally certain that of the discharge of the 100- and the 120-pipe which they have expanded, they deliver only a part, inasmuch as Caesar has made delivery according to his grant when out of a 100-pipe he gives 81 *quinariae* plus $1/2$, and similarly out of a 120-pipe 98.

34. In all there are twenty-five *ajutages*. They all conform to their computed and recorded capacities, excepting those four, which the water-men altered. But everything that is computed and arranged by mensuration should be in harmony in all its parts, the one with the other; for thus only will the results of computation be consistent. And as, for example, a *cyathus*³⁹ has a fixed relation to a *sextarius*⁴⁰, and similarly a *modius*⁴¹ to both a *cyathus* and a *sextarius*⁴², so must the multiplication of the *quinariae* in case of the larger *ajutages* proceed in regular order. However, when it is found that the delivery *ajutages* vent less, and the receiving *ajutages* vent more than they should, it is plain that this is due not to error, but to fraud.

35. Let us not forget in this connection that every stream of water whenever it comes from a higher point and flows into a delivery tank through a short length of pipe, not only comes up to its measure, but yields, moreover, a surplus; but whenever it comes from a low point, that is, under a less head, and is conducted a tolerably long distance, it will actually shrink in measure by the resistance of its own conduit; so that on these accounts, either an aid or a check is needed for the discharge.

36. But the position of the calix also has an effect. Placed at right angles and level, it maintains its proper measure; set against the current of the water and sloping down, it will consume more; set sloping to one side, so that the water flows by, and inclined with the current, that is, placed less favorably for swallowing the water, it will receive the water slowly, and in a scant quantity. The calix is a bronze *ajutage* which is tapped into a conduit or delivery tank, and to it the pipes are attached. Its length must be not less than 12 digits; its area of orifice, that is, its capacity, as much as ordered. Bronze seems to have been selected on account of its hardness; difficult to bend and not easily extended or contracted.

37. I have described below all the 25 ajutages that there are, although only 15 of them are in use; gauging them according to the method of computation spoken of, and correcting the four which the water-men have altered. According to which principle all ajutages which shall be in use ought to conform, or if those four shall remain in use, they ought to be gauged by the number of *quinariae* that the orifice contains in area. Those that are not in use, are so referred to.

38. The inch ajutage is 1 digit plus $\frac{1}{3}$ of a digit in diameter; it contains more than a *quinaria* by $1\frac{1}{2}$ twelfths of a *quinaria* plus $\frac{3}{288}$ plus $\frac{2}{3}$ of $\frac{1}{288}$. The square digit has the same height as breadth. The square digit converted into its equivalent circle is 1 digit plus $1\frac{1}{2}$ twelfths of a digit plus $\frac{1}{72}$ in diameter; it measures $\frac{10}{12}$ of a *quinaria*. The circular digit is 1 digit in diameter; and measures $\frac{7}{12}$ plus a half twelfth plus $\frac{1}{72}$ of a *quinaria* in area.

39.⁴³ The *quinaria*: 1 digit plus $\frac{3}{12}$ in diameter; 3 digits plus $\frac{1}{2}$ plus $\frac{5}{12}$ plus $\frac{3}{288}$ in circumference; it has a capacity of 1 *quinaria*.

40. The 6-pipe: 1 digit and a half in diameter; 4 digits plus $\frac{1}{2}$ plus $\frac{2}{12}$ plus $\frac{1}{24}$ plus $\frac{2}{288}$ in circumference; it has a capacity of 1 *quinaria* plus $\frac{5}{12}$ plus $\frac{7}{288}$.

41. The 7-pipe: 1 digit plus $\frac{1}{2}$ plus $\frac{3}{12}$ in diameter; 5 digits plus a half in circumference; it has a capacity of 1 *quinaria*, plus a half plus $\frac{5}{12}$ plus $\frac{1}{24}$; is not in use.

42. The 8-pipe: 2 digits in diameter; 6 digits plus $\frac{3}{12}$ plus $\frac{10}{288}$ in circumference; it has a capacity of 2 *quinariae* plus a half plus $\frac{1}{24}$ plus $\frac{5}{288}$.

43. The 10-pipe: 2 digits and a half in diameter; 7 digits plus $\frac{1}{2}$ plus $\frac{4}{12}$ plus $\frac{7}{288}$ in circumference; it has a capacity of 4 *quinariae*.

44. The 12-pipe: 3 digits in diameter; 9 digits plus $\frac{5}{12}$ plus $\frac{3}{288}$ in circumference; it has a capacity of 5 *quinariae* plus a half, plus $\frac{3}{12}$ plus $\frac{3}{288}$; is not in use. But with the water-men it measures 3 digits plus $\frac{1}{24}$ plus $\frac{6}{288}$ in diameter, containing six *quinariae*.

45. The 15-pipe: 3 digits plus a half plus $\frac{3}{12}$ in diameter; 11 digits plus a half plus $\frac{3}{12}$ plus $\frac{10}{288}$ in circumference; it has a capacity of nine *quinariae*.

46. The 20-pipe: 5 digits plus $\frac{1}{24}$ plus $\frac{1}{288}$ in diameter; 15 digits plus a half plus $\frac{4}{12}$ plus $\frac{6}{288}$ in circumference; it has a capacity of 16 *quinariae* plus $\frac{3}{12}$ plus $\frac{1}{24}$. With the water-men it measures 4 digits plus a half in diameter, holding 13 *quinariae*.

47. The 25-pipe: five digits plus a half plus $\frac{1}{12}$ plus $\frac{1}{24}$ plus $\frac{5}{288}$ in diameter; 17 digits plus a half plus $\frac{2}{12}$ plus $\frac{1}{24}$ plus $\frac{7}{288}$ in circumference; it has a capacity of 20 *quinariae* plus $\frac{4}{12}$ plus $\frac{9}{288}$; is not in use.

48. The 30-pipe: six digits plus $\frac{2}{12}$ plus $\frac{3}{288}$ in diameter; 19 digits plus $\frac{5}{12}$ in circumference; it has a capacity of 24 *quinariae* plus $\frac{5}{12}$ plus five 288ths.

49. The 35-pipe: six digits, plus a half plus $\frac{2}{12}$ plus $\frac{2}{288}$ in diameter; 20 digits plus a half plus $\frac{5}{12}$ plus $\frac{1}{24}$ plus $\frac{4}{288}$ in circumference; it has a capacity of 28 *quinariae* plus a half plus $\frac{3}{288}$; is not in use.

50. The 40-pipe: seven digits plus $1/12$ plus $1/24$ plus $3/288$ in diameter; 22 digits plus $5/12$ in circumference; it has a capacity of 32 *quinariae* plus $1/2$ plus $1/12$.
51. The 45-pipe: seven digits plus $1/2$ plus $1/24$ plus eight 288ths in diameter; 23 digits plus $1/2$ plus $3/12$ plus $1/24$ in circumference; it has a capacity of 36 *quinariae* plus $1/2$ plus $1/12$ plus $1/24$ plus eight 288ths; is not in use.
52. The 50-pipe: seven digits plus $1/2$ plus $5/12$ plus $1/24$, plus five 288ths in diameter; 25 digits plus $1/24$ plus $7/288$ in circumference; it has a capacity of 40 *quinariae* plus $1/2$ plus $2/12$ plus $1/24$ plus $5/288$.
53. The 55-pipe: eight digits plus $4/12$ plus ten 288ths in diameter; 26 digits plus $3/12$ plus $1/24$ in circumference; it has a capacity of 44 *quinariae* plus $1/2$ plus $3/12$ plus $1/24$ plus $2/288$; is not in use.
54. The 60-pipe: 8 digits plus $1/2$ plus $2/12$ plus $1/24$ plus eight 288ths in diameter; 27 digits plus $5/12$ plus $1/24$ in circumference; it has a capacity of 40 and eight *quinariae* plus $1/2$ plus $4/12$ plus $11/288$.
55. The 65-pipe: nine digits plus $1/12$ plus $3/288$ in diameter; 20 and eight digits plus $1/2$ plus $1/12$ in circumference; it has a capacity of fifty-two *quinariae* plus $1/2$ plus $3/12$ plus $1/24$ plus eight 288ths; is not in use.
56. The 70-pipe: nine digits plus $5/12$ plus six 288ths in diameter; 29 digits plus $1/2$ plus $2/12$ in circumference; it has a capacity of 57 *quinariae* plus $5/288$.
57. The 75-pipe: nine digits plus $1/2$ plus $3/12$ plus six 288ths in diameter; 30 digits plus $1/2$ plus $2/12$ plus $7/288$ in circumference; it has a capacity of 61 *quinariae* plus $1/12$ plus $2/288$; is not in use.
58. The 80-pipe: ten digits plus $1/12$ plus $2/288$ in diameter; 31 digits plus $1/2$ plus $2/12$ plus $1/24$ in circumference; it has a capacity of 65 *quinariae* plus $2/12$.
59. The 85-pipe: ten digits plus $4/12$ plus $1/24$ plus seven 288ths in diameter; 32 digits plus $1/2$ plus $2/12$ plus $4/288$ in circumference; it has a capacity of 69 *quinariae* plus $3/12$; is not in use.
60. The 90-pipe: ten digits plus $1/2$ plus $2/12$ plus $10/288$ in diameter; thirty-three digits plus $1/2$ plus $1/12$ plus $1/24$ plus $2/288$ in circumference; it has a capacity of seventy-three *quinariae* plus $3/12$ plus $1/24$ plus $5/288$.
61. The 95-Pipe: 10 digits plus $1/2$ plus $5/12$ plus $1/24$ plus $9/288$ in diameter; 34 digits plus $1/2$ plus $1/24$ in circumference; it has a capacity of 77 *quinariae* plus $4/12$ plus $1/24$ plus $2/288$; is not in use.
62. The 100-pipe: 11 digit plus $3/12$ plus $9/288$ in diameter; 35 digits plus $5/12$ plus $1/24$ in circumference; it has a capacity of eighty-one *quinariae* plus $5/12$ plus $10/288$. With the water-men it has a diameter of 12 digits; having a capacity of ninety and 2 *quinariae*.
63. The 120-pipe: twelve digits plus $4/12$ plus $6/288$ in diameter; 38 digits plus $1/2$ plus $4/12$ in circumference; it has a capacity of 97 *quinariae* plus $1/2$ plus $3/12$. With the water-men it has a diameter of 16 digits, having a capacity of one hundred and sixty-three *quinariae* plus $1/2$ plus $5/12$, which is the measure of two 100-pipes.

BOOK II

64. Going on from what it has been necessary to say with regard to the *ajutages*, I will now give the discharge which each aqueduct was thought to have had, up to my term of office, according to the imperial records, and how much it did deliver; then the discharge, which I found by careful investigation, acting on the prudent suggestion of that best and most active ruler, Nerva (Trajanus).⁴⁴ There were, be it noted, in the aggregate twelve thousand seven hundred and fifty-five *quinariae* recorded, fourteen thousand and eighteen discharging water; that is, 1,263 more were reported as delivering water than had been received. Astonished at this, I felt it to be no small part of my duty to investigate, so as to arrive at reliable data concerning the aqueducts and their discharge, and to see how it could come about that more was being delivered than belonged, so to speak, to the estate. So, before doing anything else, I set about measuring the intakes of the conduits; but I found a much greater measure,- that is, one exceeding the recorded figures by about 10,000 *quinariae*, - as I shall show in detail.

65. Appia is credited in the records with 841 *quinariae*. This aqueduct could not be gauged at the intake, because it there consists of two channels; but at the Twins, which is below Spes Vetus, where it joins the branch of the Augusta, I found a depth of water of 5 feet, and a width of one foot plus $\frac{3}{4}$, making $8\frac{3}{4}$ square feet of area, twenty-two 100-pipes plus one 40-pipe, which makes 1,825 *quinariae*; more than the records have it by 984 *quinariae*. It was discharging 704 *quinariae*; less than credited in the records by 137 *quinariae*, and, furthermore, less than given by the gauging at the Twins by 1,121 *quinariae*. But a considerable quantity of water is lost through leaks in the conduit, which is not readily seen on account of the depth at which the conduit is located, but whose existence may be inferred from the circumstance that in many wards of the city excellent water is met with, which is the water that leaks from the conduits. But we have also found illicit pipes within the city. Outside the city, on the other hand, on account of the water level, which at the intake is fifty feet under ground, the conduit has suffered nothing unlawful.

66. Anio Vetus is credited in the records with the quantity, 1,441 *quinariae*. At the intake I found 4,398, exclusive of the quantity which is drawn into the conduit which belongs to them of Tivoli; more than is recorded by 2,957 *quinariae*. There were discharged, before reaching the settling reservoir, 262 *quinariae*; the quantity at the reservoir, determined from the gauges placed there, was 2,362 *quinariae*; so that 1,774 *quinariae* were lost between the intake and the reservoir. Downstream from the reservoir 1,348 *quinariae* were discharged; more than we have stated to be the capacity according to the records by 169⁴⁵ *quinariae*; less than we have shown was received into the conduit from the settling reservoir by 1,014 *quinariae*. The total that was lost between the intake and the reservoir and down stream from the reservoir amounted to 2,788⁴⁶ *quinariae*, which I should have ascribed to error in measurement, had I not found where it was diverted.

67. Marcia is credited in the records with the quantity, 2,162 *quinariae*. Gauging it at the intake, I found 4,690 *quinariae*; more than is in the records by 2,528 *quinariae*. There were discharged before Marcia reaches the settling reservoir 95 *quinariae*, and 92 *quinariae* are given to supplement Tepula, likewise 164 *quinariae* to Anio; the aggregate discharged before reaching the reservoir is 351 *quinariae*. The quantity at the catch basins computed from the gauges placed there, along with that which is conducted around the basins and is carried upon arches, is 2,944 *quinariae*. The aggregate of what is either discharged upstream from the reservoir or received on the arches is 3,295 *quinariae*; more than is set down in the schedule of the records by 1,133 *quinariae*; less than the gaugings taken at the intake by 1,395 *quinariae*. Eighteen hundred and forty *quinariae* were discharged after passing the reservoir; less than we have said was set down in the records by 227⁴⁷ *quinariae*; less than is taken from the reservoir upon the arches by 1, 104 *quinariae*. The aggregate of what was lost either between the intake and the reservoir or downstream from the reservoir was 2,499⁴⁸ *quinariae*, the diversion of which, as in case of the other aqueducts, we discovered at several places. For, that there is no lack of such is manifest also

from the fact that at the intake, besides the volume that we found in the conduit, over 300 *quinariae* are wasted.

68. Tepula is credited in the records with 400 *quinariae*. This aqueduct has no springs to supply it; it consists only of some veins of water taken from Julia. Its intake is therefore to be set down as beginning with the Julian reservoir, for from this it first receives 190 *quinariae*; then immediately thereafter 92 *quinariae* from Marcia, and further from Anio Novus at the Epaphroditian Gardens 163 *quinariae*. This makes in all 445 *quinariae*; more than in the records by 45 *quinariae*; but they appear in its delivery.

69. Julia is credited in the records with a measure of 649 *quinariae*. At the intake the gaugings could not be made, because the intake is composed of several tributaries. But at the sixth mile-stone from the city Julia is wholly taken into the settling reservoir, at which place its measure, according to the plainly visible gauges, amounts to 1,206 *quinariae*; more than set down in the records by 557 *quinariae*; besides this, it receives, near to the city, behind the Pallantian Gardens, from Claudia 162 *quinariae*, making the whole of the *quinariae* received by Julia 1,368. From this it discharges 190 into Tepula, and delivers on its own account 803 *quinariae*; from this we get a total of 993 *quinariae* which it delivers; more than it has in the records by 344 *quinariae*; less than we set it down as having in the reservoir by 213, which is precisely the amount we found was being used by those who had seized upon it without grant from the sovereign.

70. Virgo is credited in the records with a measure Of 752 *quinariae*. The gauging could not be made at the intake, because Virgo is made up of several tributaries, and enters its channel with too slow a current. Near to the city, however, at the seventh mile-stone, on the land which now belongs to Cejonius Commodus, and where Virgo has a greater velocity, I made the gauging, and it amounted to 2,504 *quinariae*, being 1,752⁴⁹ *quinariae* more than was set down in the records. But proof of the correctness of our gauging is at hand; for Virgo discharges all the *quinariae* we found at the point of gauging, that is, 2,504.

71. The measure of Asietina is not set down in the records, nor could it be accurately arrived at under present conditions, because it receives from Lake Alsietinus, and afterwards in the vicinity of Careiae from Sabatinus, * * * as much water as pleases the water-men Alsietina discharges 392 *quinariae*.

72. Claudia, flowing more abundantly than the others, is especially exposed to depredation. In the records it is credited with not more than 2,855 *quinariae*, although I found at the intake 4,607 *quinariae*; more than recorded by 1,752 *quinariae*; but our gauging is all the surer, inasmuch as at the seventh mile-stone from the city, at the settling reservoir, where the gauging is without question, we found 3,312 *quinariae*; more than recorded by 457; although it not only discharges before reaching the reservoir to satisfy private grants, but also, as we detected, is deprived of a great deal secretly, and therefore carries 1,295 *quinariae* less than it actually should carry. It is manifest that there has been fraud somewhere before the delivery of the water, if the amount actually delivered does not agree either with the statements of the records or with the gaugings made by us at the intake, or even with those made at the settling basins, which last were made downstream from the points of leakage that have been named. For there are only 1,750 *quinariae* delivered; less than the computation given in the records by 1,105 *quinariae*; also less than the gauging made at the intake by 2,857 *quinariae*; less also than was found at the reservoir by 1,562 *quinariae*; for which reason, although it arrived in the city perfectly clear in its own conduit, it was mixed within the city with the New Anio, so that by this mixing of the waters their measure as well as their discharge was obscured. But should any one think that I have exaggerated the measure of the sources of Claudia., it should be remembered that the Caerulean and Curtian springs alone suffice to deliver to the conduit the 4,607 *quinariae* above given by me, and that there are 1,600 besides to spare. But at the same time I do not deny that that which is to spare does not really belong to these springs, for it comes from Augusta,

which was constructed to supplement Marcia, but is turned into the sources of Claudia as long as Marcia does not need it, though not even the conduit of Claudia itself can carry all this water.

73. New Anio is credited in the records with the quantity 3,263 *quinariae*. Gauging at the intake I found 4,738 *quinariae*; more than the quantity given in the records by 1,475 *quinariae*. In what way could I more clearly show that I have not exaggerated this measure of the total *quinariae* carried than by showing that in the records of delivery most of this water is actually accounted for? For it is stated that 4,200 *quinariae* are delivered; although in the same records the amount carried is given as not more than 3,263; besides this, I have discovered that not only 538, the difference between our gauging and the recorded delivery, is stolen, but a far greater quantity. Whence it appears that the amount measured by me is none too large; the explanation of this is, that the more impetuous stream of water increases the supply, since it comes from a large and rapidly flowing river.

74. I do not doubt that many will be surprised that according to our gaugings, the quantity of water was found much greater than that given in the imperial records; but it should be observed that this error comes from the fault of those who originally failed to measure each of these waters with sufficient exactness. I do not even believe that it was from fear of droughts in the summer that they deviated so far from the truth, for my experience is the other way, since the quantity of each of the aqueducts which is above given results from gaugings taken in the month of July, and from then on the supply remains the same throughout the entire remainder of the summer; but whatever the reason of the above may be, it has been discovered that 10,000 *quinariae* were intercepted; while the amounts granted by the sovereign are limited to the quantities set down in the records.

75. Another variance consists in this: that there is one measure at the intake; another, and by no means smaller one, at the settling reservoir; and the smallest at the distribution. The cause of this is the fraud of the water-men, whom we have detected diverting water from the public conduits for private use; but a large number of proprietors of land also, whose fields border on the aqueducts, tap the conduits; whence it comes that the public water-courses are brought to a standstill by private citizens, yea, for the watering of their gardens.

76. Concerning misdemeanors of this sort, nothing more nor better needs to be said than was said by Caelius Rufus,⁵⁰ in his speech, which is entitled "Concerning Waters." And would that we were not having daily experience by actual infringement of the law that all these misdemeanors are committed just as flagrantly now as then. Irrigated fields, shops, garrets, even; lastly, disorderly houses have we found fitted up with constantly flowing fixtures. For that some waters should be delivered under a forged name in place of other waters belongs to the lesser misdemeanors. But among the frauds that should be rectified is to be mentioned what took place in the vicinity of the Caelian and Aventine Hills. These bills were supplied before the construction of Claudia by the waters of Marcia and Julia; but after the Emperor Nero led Claudia over the arches at Spes Vetus to the temple of Divus Claudius in order to distribute it from here, the first-named waters were not accredited to new accounts but were quietly ignored; for he did not build new delivery tanks for Claudia, but used those that already existed; and the old name of these remained, although the water had become a new one.

77. With this enough has been said about the measure of each water; and if I may so express it, about a new way of acquiring water; about frauds and about offences committed in connection with all this. It remains to account for the supply, which we found given in a lump sum, so to speak, and recorded, moreover, in false entries, stating how much is to be allotted to each aqueduct, and to what wards of the city. I know very well that such a statement will appear not only tedious but also complicated; nevertheless, I will make it as short as possible that nothing may be lacking to the data of (this) office. Those who will be satisfied with knowing, the main facts, can skip the details.

78. In enumerating the distribution of the 14,018 *quinariae*, the 771 *quinariae*⁵¹ which are transferred from certain aqueducts to supplement others and are set down twice in exhibiting the distribution, figure only once in the reckoning. Out of this quantity there are delivered outside of the city 4,063 *quinariae*: of which, in the name of Caesar, 1,718 *quinariae*; to private parties, 2,345. The remaining 9,955 are distributed within the city out of 247 delivery tanks; out of these are delivered, in the name of Caesar, 1,707 1/2 *quinariae*; to private parties, 3,847 *quinariae*; for public uses, 4,401 *quinariae*; namely: to . . . camps, 279 *quinariae*; to seventy-five public structures, 2,301 *quinariae*; to thirty-nine ornamental fountains, 386 *quinariae*; to five hundred and ninety-one water-basins, 1,335 *quinariae*. But this schedule must be made to apply to the several aqueducts and to the several wards of the city.

79. Of the 14,018 *quinariae*, which sum have stated to be the discharge of all the aqueducts, only five *quinariae* are given from Appia without the city because (its source is so low). The remaining 699 *quinariae* are distributed within the city throughout the second, eighth, ninth, eleventh, twelfth, thirteenth, and fourteenth wards, out of twenty delivery tanks; of these there are furnished in the name of Caesar 151 *quinariae*; to private parties 194 *quinariae*; for public uses 354 *quinariae*; namely: to one camp four *quinariae*; to fourteen public structures 123 *quinariae*; to one ornamental fountain two *quinariae*; to ninety-two water-basins 226 *quinariae*.

80. Out of the Anio Vetus are delivered, outside the city, in the name of Caesar, 169 *quinariae*; to private parties 404 *quinariae*. The remaining 1,508 1/2 *quinariae* are to be distributed within the city through the first, third, fourth, fifth, sixth, seventh, eighth, ninth, twelfth, and fourteenth wards, out of thirty-five delivery tanks: of which there are furnished in the name of Caesar 66 1/2 *quinariae*; for the use of private parties 490 *quinariae*; for public uses 503 *quinariae*; to one camp 50 *quinariae*; to nineteen public structures 196 *quinariae*; to nine ornamental fountains 88 *quinariae*; to ninety-four water-basins 218 *quinariae*.

81. Out of Marcia are delivered, outside the city, in the name of Caesar 261 1/2 *quinariae*. The remaining 1,472 *quinariae* are distributed within the city through the first, third, fourth, fifth, sixth, seventh, eighth, ninth, tenth, and fourteenth wards, out of fifty-one delivery tanks; of these there are furnished in the name of Caesar 116 *quinariae*; to private parties 543 *quinariae*; for public uses⁵² * * * *quinariae*; namely: to four camps 42 1/2 *quinariae*; to fifteen public structures 15 *quinariae*; to twelve ornamental fountains 104 *quinariae*; to 113 water-basins 256 *quinariae*.

82. Out of Tepula are delivered outside the city, in the name of Caesar, 58 *quinariae*; to private parties 56 *quinariae*. The remaining 331 *quinariae* are distributed within the city through the fourth, fifth, sixth, and seventh wards, out of fourteen delivery tanks: of which there are furnished in the name of Caesar 42 *quinariae*; to private parties 237 *quinariae*; for public uses fifty *quinariae*; namely: to one camp twelve *quinariae*; to three public structures seven *quinariae*; to thirteen basins 32 *quinariae*.

83. Out of the Julia flow outside the city, in the name of Caesar, 85 *quinariae*; to private parties 121 *quinariae*. The remaining 548 *quinariae* are distributed within the city to the second, third, fifth, sixth, eighth, tenth, and twelfth wards, out of seventeen delivery tanks: of which there are furnished in the name of Caesar 18 *quinariae*; to private parties * * * *quinariae*; for public uses 383 *quinariae*; namely: to * * * camps 69 *quinariae*; to * * * public structures, 181 *quinariae*; to three ornamental fountains 67 *quinariae*; to twenty-eight basins, 65 *quinariae*.

84. Virgo delivers outside the city 200 *quinariae*. The remaining 2,304 *quinariae* are distributed within the city to the seventh, ninth, and fourteenth wards, out of eighteen delivery tanks: of which there are furnished in the name of Caesar 509 *quinariae*; to private parties 338 *quinariae*; for public uses 1,167 *quinariae*; namely: to two ornamental fountains 26 *quinariae*; to twenty-five basins, 51 *quinariae*; to

sixteen public structures, 1,380 *quinariae*. Among the public structures are included 460 *quinariae* for the Euripus⁵³ alone, to which *virgo* gave its name.⁵⁴

85. Alesietina has 392 *quinariae*. These were all used outside the city: of which, there are furnished in the name of Caesar 354 *quinariae*; and to private parties 138 *quinariae*.

86. Outside the city Claudia and Anio Novus deliver each from its own channel; within the city they are mixed together. Claudia discharges outside the city, in the name of Caesar, 246 *quinariae*; to private parties 439 *quinariae*; to Anio Novus in the name of Caesar 728 *quinariae*. The remaining 3,498 *quinariae* of the two are distributed within the city through all the 14 wards out of ninety-two delivery tanks: of these, there are furnished in the name of Caesar 819 *quinariae*; to private parties 1,067 *quinariae*; for public uses 1,012 *quinariae*; namely: to nine camps 149 *quinariae*; to eighteen public structures⁵⁵ 374 *quinariae*; to twelve ornamental fountains 107 *quinariae*; to 226 basins, 481 *quinariae*⁵⁶

87. This is the schedule of the amounts of water distributed or available down to the time of the Emperor Nerva (Trajanus).⁵⁷ But now, by the foresight of the most painstaking of sovereigns, whatever had been unlawfully drawn by the water-men, or had been wasted as the result of official negligence, has been recovered; this was practically equivalent to the finding of new sources of supply. And in the fact the supply was almost doubled, and was distributed so carefully thereafter, that wards which had previously been supplied by only one aqueduct now received the water of several; as, for example, the Caelian and Aventine hills, to which Claudia alone had been brought on the arches of Nero, whence it often happened, that whenever this aqueduct had to be repaired, these densely inhabited hills suffered a drought. These are now supplied by several aqueducts, above all, by Marcia, which has been rebuilt and carried on conspicuous structures from Spes (Vetus) to the Aventine. In all parts of the city also, the basins, new and old, have been connected for the greater part with two pipes of different aqueducts, so that if by any accident the supply of one or the other should fail, they will get water from the other and the use of the basins be thus kept up.

88. The effect of this care displayed by the Emperor Nerva,⁵⁷ most patriotic of rulers, is felt from day to day by the present queen and empress of the world; and will be felt from day to day by the present queen and empress of the world; and will be felt still more in the improved health of the city, as a result of the increase in the number of the tanks, reservoirs, fountains, and water-basins. No little advantage accrues also to private consumers from the increase in number of private grants; and those who with fear drew water unlawfully, draw their supply now free from care, by grant from the sovereign. Not even the waste water is lost; the cleanliness of the city, too, is greatly improved; the air is purer; and the causes of the pestilence, which gave the air of the city so bad a name with the ancients, are now removed.⁵⁸ I am well aware that I ought to indicate in detail the manner of the new distribution; but this I will add when the works are done; it must be understood that no account ought to be given until they are complete.

89. What shall we say of the fact that painstaking interest which our Emperor evinces for his subjects, could not rest satisfied with what I have already described, but that he though he would be contributing too little to our needs and gratification merely by such increase in the supply of water, unless he should also increase its purity and its palatableness? It is worth while to examine in detail how he endeavored to enhance the usefulness of all these waters while correcting the defects of only a few of them. For when has our city ever been without muddy or turbid water, even though there had been moderate rainstorms? And this, not because all the waters are thus affected at their sources, or because this defect ought to be felt in those which are taken from springs; especially not in the case of Marcia and Claudia and the rest, whose purity is perfect at their sources, and which are not, or hardly at all, troubled by rains, if well-basins are built and these are covered over.

90. The two Anios are less limpid, for they are drawn from a river, and are often muddy even in good weather; because the Anio, although running from a lake whose waters are very pure, is nevertheless made turbid by carrying away portions of its loose banks, before it enters the conduits; a defect which it suffers not only in the rainstorms of winter and spring, but also in the showers of summer; at which time of the year a more agreeable state of the water is demanded.

91. Of the two Anios, one, namely Anio Vetus, runs in a lower channel than most of the others, and keeps this muddiness therefore to itself. But the New Anio spoiled all the others, because, coming from a higher position and flowing more abundantly, it was used to eke out the supply of the others; but by the unskilfulness of the water-men, who let it flow into the other conduits oftener than there was any need, it spoiled also the waters of those aqueducts that had a plentiful supply; especially Clauida, which, flowing within the city in its own conduit many thousand paces, finally lost its own qualities, as a result of its mixture with Anio, - at least it did until recently. And so far were the supplementary waters from doing any good that many were brought in heedlessly, by those who had charge of the distribution and who did not give it the proper care. So that we have found even Marcia, so charming in its purity and coldness, used for baths, fulling-mills, and I may not say what vile appointments.

92. It was therefore determined to separate them all and then to arrange so that Marcia should serve wholly for drinking purposes, and that the others should be used for purposes adapted to their special qualities. For example, it was ordered for several reasons, that Old Anio should be used for watering the gardens, and for the more dirty uses of the city; because the further from its source its waters are drawn, the less wholesome they are.

93. But it was not sufficient for our ruler to have restored the volume and attractiveness of the other waters; he also recognized the possibility of remedying the defects of the New Anio, and he gave the order to stop drawing directly from the river and to take from the lake lying above the Cublacensian Villa of Nero, there where the Anio is clearest; for inasmuch as the source of Anio is above Treba Augusta, it reaches this lake in a very cold and clear condition, be it because it runs between rocky hills and because there is but little cultivated land around the hamlet, or because it drops its sediment in the deep lakes into which it is taken; partly also through the effect of the shade of the forests that surround it. These so excellent qualities of the water, which cause it to equal Marcia in all points, and in quantity to exceed it, are now to supersede its former unsightliness and impurity; and the inscription will proclaim as its new founder, Emperor Caesar Nerva Trajanus Augustus.

94. We have further to indicate what is the law with regard to conducting and maintaining the waters; the first treats of the limitation of private parties to the measure of their grants, and the second of the maintenance of the conduits themselves. In examining in ancient writings what was said in detail in these matters in the laws that had been enacted, I found some things different with our forefathers. With them all water was held for public use, and the law was as follows: *No private person shall conduct other water than that which flows from the basins onto the ground.* For these are the words of the law referring to water which overflows from the troughs, - we call it lapsed water⁵⁹; and even this was not granted for any other use than for bathing establishments and for fulling-mills; and it was subject to a tax, for a consideration had to be paid for it, which was turned into the public treasury. Some water was conceded to the houses of the principal citizens, in case the others made no objection.

95. To which authorities belonged the right to grant water or to sell it is variously given in those laws, for at times I found it was left to the aediles, at other times to the censors; but it seems that as often as there were censors in the government these grants were sought from them; if there were none, then the aediles had the power referred to. It is plain from this how much more our forefathers cared for the general good

than for private luxury, inasmuch as they caused the State to derive profit even from that water which was conducted to private parties.

96. The maintenance of the several aqueducts, as I found, was let out to contractors, and they were to employ a definite number of workmen on the aqueducts outside the city, and another definite number within the city; in doing this they had to enter in the public records the names of those whom they intended to employ in the service for each ward of the city; and the duty of inspecting their work devolved at times on the aediles and censors, and at times on the quaestors,⁶⁰ as may be seen from the vote of the Senate which was passed in the consulate of C. Licinius and Q. Fabius.

97. How much care was taken that no one should injure the conduits, and that no one should draw water that had not been granted, may be seen, among other ways, from the fact that the Circus Maximus could not be watered, even on the days of the Circensian Games, except with the permission of the aediles or censors; which regulation, as may be read in the writings of Ateius Capito, was still in force even after the care of the waters had passed, under Augustus, to commissioners; but lands of which it could be proven that they had been irrigated unlawfully from the public supply were confiscated. A tenant, one of whose slaves infringed the law, even without the knowledge of his master, was punished by a fine. By the same laws it is also enacted as follows: *No one shall with malice pollute the waters where they issue publicly. Should any one pollute them, his fine shall be ten thousand sestertii.*⁶¹ Therefore the order was given to the Curule aediles to appoint two men in each district from the number of those who lived in it, or owned property in it, in whose care the public fountains should be placed.

98. The first permanent water commissioner was M. Agrippa. He, as one might say, was commissioner mainly of works which he himself had called into existence. This was after his aedileship; and before his aedileship had come his consulship. Inasmuch as the amount of water now available warranted it, he determined how much should be allotted to the public structures, how much to the basins, and how much to private parties. He also kept his own private gang of slaves for the maintenance of the aqueducts and delivery tanks and basins. This gang was given to the State as its property by Augustus, who had received it in inheritance from Agrippa.

99. Following him under the consulate of Q. Aelius Tubero and Paulus Fabius Maximus, votes of the Senate were passed and a law was promulgated in these matters, which until that time had been managed at the option of officials, and had lacked definite rules of law. Augustus also determined by an edict the rights of those who were enjoying the use of water according to Agrippa's records, and made the entire supply dependent upon his own grants. The ajutages, also, of which I have above spoken, were established by him; and for the maintenance and operation of the whole system he named Messala Corvinus commissioner, and gave him as assistants Postuminus Sulpicius, ex-praetor, and Lucius Cominius, a junior senator. They were allowed to wear regalia, as though magistrates; and concerning their duties a vote of the Senate was passed, which is here given:-

100. (Vote of the Senate.) *The consuls, Q. Aelius Tubero and Paulus Fabius Maximus, having made a report relating to the duties and privileges of the water commissioners appointed with the advice of the Senate by Caesar Augustus,⁶² have inquired of the Senate what it would please to order upon the subject; upon which it has been ordered: that those who have the care of the administration of the waters, when they go outside of the city in the discharge of their duties, shall have two lictors, three public servants, and an architect for each of them, and the same number of writers, clerks, assistants, and criers as those have who divide the grain among the people; and when they have business within the city on the same duties, they shall content themselves with the same attendants, omitting the lictors; and, further, that the list of servants granted to the water commissioner by this vote of the Senate shall be by them presented to the public treasurer within ten days from its promulgation, and to those whose names shall be thus*

reported the praetors of the treasury shall give as compensation food by the year, as much as the food commissioners are wont to give, and they shall be authorized to take money for that purpose pose without prejudice to themselves. Further, there shall be furnished to the commissioners tablets, paper, and everything else necessary for the exercise of their functions. To this effect, the consuls, Q. Aelinus and Paulus Fabius, are both requested, or either in default of the other, to consult with the praetors of the treasury in contracting for these supplies.

101. *Further, that the water commissioners, inasmuch as it will take one quarter of the year to fulfill their Slate duties by attending also to the superintendence of streets and of grain distribution, shall be free from adjudicating in private or Slate causes.* Although the treasury has continued down to the present to pay for these attendants and servants, they have, as far as appearance goes, ceased to do any work on account of the laziness and negligence of the commissioners, who do not attend to their duties. But when the commissioners went out of the city, provided it was on official business, the lictors had to accompany them according to the commands of the Senate. In my examination of the aqueducts, my self-reliance and the authority given me by the sovereign will stand in place of the lictors.

102. As I have followed the matter down to the introduction of the commissioners, it will not be out of place now to name those who followed Messala⁶³ in this office up to my incumbency:- To Messala succeeded, under the consulate of Silius and Plancus, Ateius Capito.⁶⁴

To Capito, under the consulate of C. Asinius Pollio and C. Antistius Vetus, Tarius Rufus. [A.D. 23]
To Tarius, under the consulate of Servius Cornelius Cethegus and L. Visellius Varro, [A.D. 24] M. Cocceius Nerva, the grandfather of Divus Nerva, who was also noted as learned in the science of law.
To him succeeded, under the consulate of Fabius Persicus and L. Vitellius [A.D. 34], C. Octavius Laenas.
To Laenas, under the consulate of Aquila Julianus and Nonius Asprenas [A.D. 38], M. Porcius Cato.
To him succeeded, after a month, under the consulate of Servius Asinius Celer and A. Nonius Quintilianus, A. Didius Gallus.
To Gallus, under the consulate of Q. Veranius and Pompeius Longus [A.D. 49], Cn. Domitius Afer.
To Afer, under the fourth consulate of Nero Claudius Caesar, and that of Cossus, the son of Cossus [A.D. 60], L. Piso.
To Piso, under the consulate of Verginius Rufus and Memmius Regulus [A.D. 63], Petronius Turpilianus.
To Turpilianus, under the consulate of Crassus Frugi and Lecanius Bassus [A.D. 64], P. Marius.
To Marius, under the consulate of Lucius Telesinus and Suetonius Paulinus [A.D. 66], Fonteius Agrippa.
To Agrippa, under the consulate of Silius and Galerius Trachalus [A.D. 68], Albius Crispus.
To Crispus, under the third consulate of Vespasian, and that of Cocceius Nerva [A.D. 71], Pompeius Silvanus.
To Silvanus, under the second consulate of Domitian and that of Valerius Messalinus [A.D. 73], Tampius Flavianus.
To Flavianus, under the fifth consulate of Vespasian, and the third of Titus [A.D. 74], Acilius Aviola.
After whom, under the third consulate of the Emperor Nerva, and the third of Verginius Rufus [A.D. 97], the office was transferred to me.

103. I will now set down what the water commissioner must observe, being the laws and Senate enactments which serve for his guidance. As concerns the draft of water by private consumers, there is to be noted: *that no one shall draw water without a writing from Caesar, that is, that no one shall draw water from the public supply, without a license, and no one shall draw more than has been granted.* By this means, we propose to make it possible that the quantity of water, concerning whose recovery we have spoken, may be distributed to new fountains and may be used for new grants from the sovereign. But in both cases must a great zeal in the service be opposed to manifold forms of fraud. The channels of the aqueducts without the city must be carefully examined, one after the other, to review the granted

quantities; the same must be done in case of the delivery tanks and fountains, that the water may flow without interruption, day and night, which the commissioner has been directed to see to, by vote of the Senate, whose words are as follows:-

104. *The consuls, Q. Aelius Tubero and Paulus Fabius Maximus, having made a report upon the number of fountains established by M. Agrippa in the city and adjacent to the city, have inquired of the Senate what it would please to order upon the subject; upon which it has been ordered: That the number of public jet fountains which exist at present, according to the report of those who were ordered by the Senate to examine the public aqueducts and to take account of the number of public jet fountains, shall be neither increased nor diminished. Further, that the water commissioners, who have been appointed by Caesar Augustus, according to vote of the Senate, shall take pains that the public jet fountains may as continuously as possible deliver water for the use of the people day and night.* In this vote of the Senate is to be noted the prohibition by the Senate to increase or diminish the number of public jet fountains. I think this was done because the quantity of water, which at that time came into the city, before Claudia and Anio Novus had been brought in, did not seem to permit of a greater distribution of water.

105. Whoever wishes to draw water for private use must seek for a grant and bring to the commissioner a writing from the sovereign; the commissioner must then immediately carry out the grant of Caesar, and appoint one of Caesar's freedmen as his deputy commissioner. Ti. Claudius appears to have been the first man to appoint a deputy commissioner, after he introduced Claudia and Anio Novus. The overseers must also be acquainted with the contents of the writing, so that they cannot excuse themselves for negligence or fraud on the ground of ignorance. The deputy commissioner must attend to having the levellers employed in the business stamp the calix which conforms to the deeded quantity, and for this it will be necessary that he consult what we have above said about the size and position of these ajutages, so as to know how to select them and not to leave to the caprice of the levellers the liberty to adopt a calix of sometimes greater or sometimes smaller interior area, according as they interest themselves in the parties. It must also not be left optional to attach any kind of lead pipe to the ajutages; but there must rather be attached for a length of fifty feet one of the same interior area as that which the ajutage has been certified to have, as has been ordained by a vote of the Senate which follows:-

106. *The consuls, Q. Aelius Tubero and Paulus Fabius Maximus having made a report that some private parties take water directly from the public conduits, have inquired of the Senate what it would please to order upon the subject; upon which it has been ordered: It shall not be permitted to any private party to draw water from the public conduits; and all those to whom the right to draw water shall have been granted, shall draw it from the delivery tanks, the water commissioners to direct at what points, within and without the city, private parties may erect suitable delivery tanks for the purpose of drawing water from them, under grants, which in common with others, the water commissioners have located; and no one to whom a right to draw water from the public conduits has been granted, shall have the right to use a larger pipe than a quinary for a space of fifty feet from the delivery tank out of which he is to draw the water.* In this vote of the Senate is to be noted, that it is only permitted to draw water from the delivery tanks, so that the conduits or the public pipes shall not frequently be cut into.

107. The right to granted water does not pass either to the heirs, or to the buyer, or to any new occupant of the land. The public bathing establishments had from old times the privilege that water once granted to them should remain theirs forever. We know this from old votes of the Senate, of which I give one below. Nowadays every grant of water is renewed to the new owner.

108. *The consuls, Q. Aelius Tubero and Paulus Fabius Maximus having made a report upon the necessity of fixing the extent of the right of those to whom it has been permitted to conduct water both within and without the city, have inquired of the Senate what it would please to order upon the subject; upon which it*

has been ordered: That a grant of water, with the exception of those which have been granted for the use of bathing establishments, or in the name of Augustus,⁶⁵ shall remain in force as long as the land remains in the ownership of him to whom the water was granted.

109. As soon as any water becomes free it is announced, and entered in the records, which are consulted to see what vacant water rights may be given to petitioners. These waters were formerly cut off immediately, so that between grants they were sold to the occupants of the land, or to outsiders even. It seemed less harsh to our ruler not to deprive estates of water suddenly, but to give thirty days' grace, within which the proper officers could dispose of the water.

I did not find anything set down about the water granted to an estate belonging to a syndicate. Nevertheless the following practice is observed, just as though prescribed by law, *that as long as one of those who have received a grant of water remains among the living, the full amount of granted water shall flow upon the land, and the grant shall be renewable only when every one of those who received it shall have ceased to remain in possession of the property.*

That granted water cannot be carried elsewhere than upon the premises to which it has been made appurtenant, or taken from another delivery tank than the one designated in the writing of the sovereign, is self-evident, but this is also forbidden by ordinance.

110. Those waters also that I have called lapsed, namely, those that come from the leakage out of the cisterns or the pipes, are subject to grants; but these are only rarely given by the sovereign. But they are exposed to thefts by the water-men; and with how much care it should be prohibited may be seen from a paragraph of an ordinance, which I append:-

111. I desire that no one shall draw lapsed water except those who have had permission to do so by grants from me or preceding sovereigns; for there must necessarily be some overflow from the delivery tanks, this being proper not only for the health of our city, but also for use in the flushing of the sewers.

112. Having now explained those things that relate to the administration of water for the use of private parties, it will not be foreign to the subject to say something, and to give examples, of how we have detected some in the act of contravening these most wholesome ordinances. In a great number of delivery tanks I found ajutages of a larger size than had been granted, and among them some that had not even been stamped. But whenever a stamped ajutage is larger than its legitimate measure it reveals an endeavor to curry favor on the part of the deputy commissioner (*procurator*) who stamped it; but when it is not even stamped it reveals the fault of all, especially of the grantee, also of the overseer. In some of the tanks, though their ajutages were stamped in conformity to their lawful admeasurements, it was found that pipes of a greater diameter were attached to them. As a consequence, the water not being held together for the lawful distance, and being on the contrary forced through the short restricted distance, easily filled the adjoining larger pipe. Care should therefore be taken, as often as an ajutage is stamped, to stamp also the adjoining pipe over the length prescribed by the vote of the Senate which we have quoted. For thus only is the overseer relieved of every excuse he could make, when he knows that none but stamped pipes are allowed to be set in place.

113. In setting ajutages, care must be taken to set them on a level, and not place the one higher and the other lower down. The lower one will take in more; the higher one will suck in less, because the current of water is drawn in by the lower one. To some pipes no ajutages were attached. Such pipes are called uncontrolled, and are expanded or contracted as pleases the watermen.

114. The following method of cheating practised by the watermen is, further, unbearable; when a water-right is transferred to a new owner, they will insert a new ajutage in the delivery tank; the old one they leave in the tank and draw water from it which they sell. Most especially, therefore, as I believe, should the commissioner have in mind to stop this; for thus he will maintain not only the measure of the water itself, but also the good condition of the tanks, which get to be leaky when they are so often and unnecessarily tapped into.

115. This mode of gaining money, practiced by the water-men, is also to be abolished: the one called "tapping." Far away, and in all directions, run the pipes under the city pavements. I discovered that these pipes were furnishing water by special branches to all whom they passed and who had been able to arrange for it; being bored for that purpose here and there, by the so-called tappers; whence it came, that only a small quantity of water reached the places of public supply. The amount of water gained in consequence of our abatement of this evil, I measure by means of the fact that we have gathered a large quantity of lead by the removal of that kind of branch pipes.

116. It remains to speak of the maintenance of the conduits; but before I say anything about this, a little should be explained about the gangs of slaves employed upon them. There are two of those gangs; one belongs to the State, the other to Caesar. The one belonging to the State is the older, which, as we have said, was left by Agrippa to Augustus, and was by him made over to the State. It numbers about 240 men. The number in Caesar's gang is 460; it was instituted by Claudius at the time he brought his aqueduct into the city.

117. Both gangs are divided into several classes of workmen: overseers, reservoir-keepers, line-walkers, pavers, plasterers, and other workmen; of these, some must be outside the city for purposes which do not require any great amount of work, but demand prompt attention; the men within the city at their stations at the reservoirs and fountains will devote their energies to the several works, especially in case of sudden emergencies, in order that a plentiful supply of water may be turned from several wards of the city to those which are threatened with deprivation. Both these large gangs, which occasionally were taken by exercise of favoritism or by negligence of their foremen for employment on private work, I resolved to bring back to some discipline and to the service of the State, by writing down the day before what each one was to do, and by putting in the records what it had done each day.

118. The wages of the State gang are paid from the State treasury, which expense is made easier for the treasury by the receipt of the rentals from water-rights, which are received from places or buildings situated on and about the conduits, reservoirs, public fountains, or watering basins. This income of nearly 250,000 *sestertii*,⁶⁶ formerly lost through loose management, was turned in recent times into the pocket of Domitian; but with a due sense of right the revered (*divus*) Nerva restored it to the people; I took pains to bring it under fixed rules in order that it might be clear what were the places which fell under this tax. The gang of Caesar gets its wages from the emperor's privy purse; from which are also drawn all expenses for lead and for pipes, delivery tanks, and basins.

119. As I have now explained what related to the slave-gangs, I shall now, agreeably to my promise, explain the maintenance of the conduits; a thing which is worthy of special care, as it gives the best testimony to the greatness of the Roman Empire. These numerous and extensive works have a natural tendency to fall into decay, and they must be attended to before they call for large appropriations. As a rule, however, they are only to be taken hold of after due consideration; because those who urge the construction or extension of works cannot always be trusted. The water commissioner therefore ought not only to be provided with advisers, but ought also to be armed with self-acquired practical experience of his own. He must consult not only the builders in the employ of the office, but must seek aid from the trustworthy and thorough knowledge of outsiders, in order to judge what must be taken in hand forthwith,

and what postponed; again, what is to be carried, on by public contractors and what done by his own regular workmen.

120. The necessity of repairs arises from the following reasons: by lawlessness of the owners of fields traversed, by age, by the weather, or by poor workmanship in the original construction, which has happened frequently in the case of recent work.

121. As a rule, those parts of the aqueducts which are carried on arches, or are placed on side-hills, and of those on arches, the parts that cross rivers, suffer most from the effects of age or of the elements. Therefore must these be built with special diligence. The underground portions not being subjected to either heat or frost, are less liable to injury. Repairs are either of the sort that can be made without stopping the flow of the water, or such as cannot be made without emptying the conduit; as for example, those which have to be made in the channel itself.

122. These latter become necessary from two causes: either by increase of deposit, which sometimes hardens into a crust and thus diminishes the size of the channel; or by destruction of the concrete lining, causing leaks, which of course do injury to the side walls of the channel and to the substructure. Sometimes even the piers, which are built of "tufa," yield under their great load. Repairs to the sides of the channel should not be made in the summer time, in order not to stop the flow of water at a time when the demand for it is the greatest, but should be made in the spring or autumn, and, moreover, with the greatest speed possible, in order that, when all preparations for hurrying the work have been made, the flow of water may be interrupted as few days as possible. As every one can see, one aqueduct must be taken at a time, for if several were cut off at once, the supply would prove inadequate for the city's needs.

123. Repairs that can be carried on without cutting off the water of the aqueducts consist principally of masonry work, which should be executed at the right time, and conscientiously. The proper time for masonry work is from the 1st of April to the 1st of November; but with this restriction: that the work be interrupted during the hottest part of the summer; because moderate weather is necessary for the masonry properly to absorb the mortar,⁶⁷ and to solidify into one compact mass; for the heat of the sun is no less destructive to masonry than is too violent frost. Nor is greater care required upon any works than upon such as are to withstand the action of water; for this reason, all parts of the work need to be done exactly according to the rules of the art, which all the workmen know, but few observe.

124. No one probably will doubt that the greatest care should be taken with the aqueducts nearest to the city, namely: those within the seventh mile-stone, which consist entirely of block-stone masonry; because, in the first place, they are of such great extent, and because each one carries several conduits; for should it once be necessary to interrupt these, the greater part of the water of the city would be diverted. But there are methods for meeting even these difficulties; a foundation is built up to the level of the defective conduit, and the channel is continued over the length of the destroyed portion in troughs made of lead. Inasmuch as all the aqueducts were built through the fields of private parties and it seemed difficult to provide for future works of construction without the help of some constituted law; also, in order that proprietors might not be able to prohibit the contractors from access to the conduits needing to be repaired, a vote of the Senate was passed, which I give below: -

125. *The consuls, Q. Aelius Tubero and Paulus Fabius Maximus, having made a report relating to the restoration of the canals, conduits, and arches of Julia, Marcia, Appia, Tepula, and Anio, have inquired of the Senate what it would please to order upon the subject; upon which it has been ordered. That when the canals, the conduits, and the arches, which Augustus Caesar has promised to the Senate should be repaired at his cost, shall be repaired, the earth, clay, stone, potsherds, sand, wood, &c. and whatever is*

necessary for the work in hand, and, from whatever source each of these things may most conveniently and without prejudice to private parties be brought, obtained, taken, they shall be brought, obtained, and taken upon the estimate of a good man as arbitrator ; and that rights of way through the lands of private parties without injury to them shall remain open and permitted, as often as it is necessary for the transportation of all these things for the purposes of repairing these works.

126. But generally damages occur by reason of the lawlessness of private owners, who injure the canals in numerous ways. In the first place, they occupy the space around the aqueducts, which according to the vote of the Senate should remain open, with structures or with trees. The trees do the most damage, because their roots burst asunder the top coverings as well as the sides; they also lay out neighborhood roads and field roads over the aqueducts; finally, they hinder the repair of the works by stopping access to them. All this has been provided for in the vote of the Senate, which follows: -

127. The consuls Q. Aelius Tubero and Paulus Fabius Maximus having made a report that the rights of way of the aqueducts coming to the city are occupied with tombs and edifices and planted with trees, have inquired of the Senate what it would please to order upon the subject; upon which it has been ordered: That for the purposes of repairing the channels and masonry conduits, and generally all public structures that might be destroyed, it is decreed that there shall be kept a space clear and unoccupied of fifteen feet on each side of the springs, arches, and walls; and that about the subterranean conduits and channels, both within the city and adjoining the city, if there be buildings near, there shall be a vacant space of five feet; and it shall not be permitted to erect a tomb at these places after this time, nor any structures, nor to plant trees. If there be any trees within this space at the present time they shall be taken out by the roots except when they are connected with country seats or enclosed in buildings. Whoever shall contravene these provisions shall pay the penalty, for each contravention, 10,000 sesterii, of which one half shall be given as a reward to the accuser through whose especial endeavors the violator of this vote of the Senate shall have been convicted; the other half shall be paid into the public treasury. About these matters the water commissioners shall judge and take cognizance.⁶⁸

128. This vote of the Senate would appear perfectly just even if this ground were claimed solely in view of the public advantage; the more so because our forefathers with their admirable equity did not take away even those lands from private parties which were necessary adjuncts to the lands requisite for the public needs, but in the construction of the waterworks paid for the whole field in those cases in which the proprietors made any difficulty in the sale of a portion of the field, and after enclosing the needed portion again sold the fields, with the understanding that each one within his boundaries, the public as well as private parties, should have his legal rights. But many have not been content to assume control up to the boundaries, but have laid hands on the aqueducts by diverting, here and there, some of the water to their own use through the side walls of the punctured channels; this having been done not only by those who have a right to draw water, but also by those who misuse the least favor given them, by attacking the walls of the conduits. What more would not be done, were they not held in restraint by a carefully drawn law, and were not the transgressors threatened with a serious penalty? The words of the law are given below:-

129. The consul T. Quinctius Crispinus duly called together the people, and the people duly passed a vote in the Forum, near the rostra of the temple of Divus Julius the day preceding the Ides of July. The tribe Sergia, which was to vote first, chose Sextus Varro, the son of Lucius Varro, to propose as follows: Whoever, after the promulgation of this law, shall maliciously and knowingly pierce, break, or attempt to pierce or break, the canals, conduits, arches, pipes, rains, reservoirs, basins of the public water supply, or who shall do damage with intent to diminish the water-courses, or portions of them, so as to prevent them from going, reaching, being conducted into the City of Rome; or so as to prevent the flow, distribution, allotment, discharge into delivery tanks or basins of any water in buildings at Rome and in

those appurtenant to the city, or in the gardens, the properties, or estates of those to whom the water is now or in future shall be given or granted, shall be condemned to pay a fine of 100,000 sesterii⁶⁹ to the Roman people; and in addition, whoever shall have knowingly and maliciously done any of these things, shall be condemned to repair, restore, re-establish, reconstruct, replace, what he has deranged, and quickly demolish what he has built, - all in good faith. Further, whoever is or shall be water commissioner, or in default of such officer, whoever is praetor charged to judge between the citizens and strangers, is authorized to fine, bind over by bail, or constrain, shall belong to every water commissioner, or in his absence to the praetor. If a slave shall do any such damage, his master is to pay 100,000 sesterii to the people. If any enclosure has been made or shall be made near the canals, conduits, arches, pipes, drains, reservoirs, or basins, of the public waters, which now are or in future shall be conducted into the City of Rome, no one shall, after the passage of this law, put in the way, construct, obstruct, plant, establish, set up, place, plough, sow anything, or admit anything in that space unless for the purpose of doing those things and making those repairs which shall be lawful and obligatory under this law. If any one contravenes these provisions, against him shall apply and ought to apply the same law, the same statute, and the same procedure in every particular as against him who in contravention of this statute shall cut or pierce the channel of an aqueduct. Nothing in this law shall revoke the privilege of pasturing cattle, cutting grass or hay, or gathering brambles. The water commissioners, present or future, in any place which either now is or in future shall be enclosed about any springs, arches, walls, canals, or conduits, are authorized to remove, pull out, uproot any trees, vines, bushes, hedges, banks, fences, willows, or reeds, while remaining within the equity of the text of the law, which gives them the right and the power to fine, to bind over bail, or order personal constraint. As for the vines and trees enclosed in bounds or within structures or fences, nothing is enacted by this law to prevent their remaining, if the water commissioners have decided that they are not to be demolished, and if the names of the commissioners who have so ordered be inscribed and engraved thereon.

Nor shall anything, in this law revoke the permits that have been given by the water commissioners to any one, to take or draw water from springs, canals, conduits, vaults, provided that neither wheel, calix, nor machine be used, that no well be dug, and that no new tap be made.

130. I should call the transgressor of so beneficent a law not unworthy of the threatened punishment. But those who have lived in an atmosphere of delusion, and to whom a violation of the law had become second nature in the course of time, had to be brought back to the right way of thinking by gentle means. I therefore endeavored with diligence that as far as possible the erring ones should remain unknown. Those who sought the Emperor's pardon, after due warning received, may thank me for the pardon granted. But for the future, I would wish that it might not be necessary to invoke the law, for it will be necessary to maintain the honor of my office even at the risk of giving offence.

Table I.

| Names of the Aqueducts | Height of the water in Rome above the Tiber wharves | Wards within the city receiving water | Taps in actual use | Outside the City | | | No. of Density Tanks | Within the City | | | |
|------------------------|---|---------------------------------------|--------------------|------------------|-----------------------|--------------------|----------------------|-----------------|-----------------------|--------------------|-----------------|
| | | | | Total | In the name of Caesar | By private parties | | Total | In the name of Caesar | By private parties | For public uses |
| | Rondelet in ft. Eng. | | Quinariae | | | | | Quinariae | | | |
| Appia | 28 | 2, 8, 9, 11, 12, 13, 14 | 704 | 5 | 0 | 5 | 20 | 699 | 151 | 194 | 354 |
| Anio Vetus | 84 | 1, 3, 4, 5, 6, 7, 8, 9, 12, 14 | 1,610 | 508 | 104 | 404 | 35 | 1,102 | 60 | 490 | 552 |
| Marcia | 125 | 1, 3, 4, 5, 6, 7, 8, 9, 10, 14 | 1,935 | 837 | 269 | 568 | 51 | 1,098 | 116 | 543 | 439 |
| Tepula | 128 | 4, 5, 6, 7 | 445 | 114 | 58 | 56 | 14 | 331 | 34 | 247 | 50 |
| Julia | 133 | 2, 3, 5, 6, 8, 10, 12 | 803 | 206 | 85 | 121 | 17 | 597 | 18 | 196 | 383 |
| Virgo | 35 | 7, 9, 14 | 2,504 | 200 | ... | 200 | 18 | 2,304 | 549 | 338 | 1,417 |
| Alsietina | (?) | Outside the city | 392 | 392 | 254 | 138 | ... | 0 | ... | ... | ... |
| Claudia | 158 | In all the 14 wards | 5,625 | 1,801 | 217 | 439 | 92 | 3,824 | 779 | 1,839 | 1,206 |
| Anio Novus | 158 | | | | 731 | 414 | | | | | |
| Totals | | | 14,018 | 4,063 | 1,718 | 2,345 | 247 | 9,955 | 1,707 | 3,847 | 4,401 |

Remark – These figures are as adjusted by Poleni and others so as to conform to the rules of arithmetic.

Table II.

| Names of the Aqueducts | For public uses within the city | For camps | | For public structures | | For ornamental fountains | | For water basins | |
|------------------------|---------------------------------|-----------|-----------|-----------------------|-----------|--------------------------|-----------|------------------|-----------|
| | Quinariae | Number | Quinariae | Number | Quinariae | Number | Quinariae | Number | Quinariae |
| Appia | 354 | 1 | 3 | 14 | 123 | 1 | 2 | 92 | 226 |
| Anio Vetus | 552 | 1 | 50 | 18 | 196 | 9 | 88 | 94 | 218 |
| Marcia | 439 | 4 | 41 | 15 | 51 | 12 | 104 | 113 | 253 |
| Tepula | 50 | 1 | 12 | 3 | 7 | .. | ... | 13 | 31 |
| Julia | 383 | 3 | 69 | 10 | 182 | 3 | 67 | 28 | 65 |
| Virgo | 1,417 | .. | ... | 16 | 1,330 | 2 | 26 | 25 | 61 |
| Alsietina | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| Claudia | 1,206 | 9 | 104 | 18 | 552 | 12 | 99 | 226 | 481 |
| Anio Novus | | | | | | | | | |
| Totals | 4,401 | 19 | 279 | 94 | 2,401 | 39 | 386 | 591 | 1,335 |

Remark – These figures are as adjusted by Poleni and others so as to conform to the rules of arithmetic.

Table III.

| Names of the Aqueducts | Height of the water in Rome above the Tiber <small>in metres</small> | Wards within the city receiving water | Taps in actual use | Outside the City | | | No. of Density Tanks | Within the City | | | |
|---|--|---------------------------------------|--------------------|------------------|-----------------------|--------------------|----------------------|-----------------|-----------------------|--------------------|-----------------|
| | | | | Total | In the name of Caesar | By private parties | | Total | In the name of Caesar | By private parties | For public uses |
| | Rondelet in ft. Eng. | | Quinariae | | | | | Quinariae | | | |
| Appia | 28 | 2, 8, 9, 11, 12, 13,14 | 704 | 5 | 0 | 5 | 20 | 699 | 151 | 194 | 354 |
| Anio Vetus | 84 | 1, 3, 4, 5, 6, 7, 8, 9, 12, 14 | 262 1,348 | .. | 169 | 404 | 35 | 1,508.5 | 66.5 | 490 | 503 |
| Marcia | 125 | 1, 3, 4, 5, 6, 7, 8, 9, 10, 14 | 95 1,840 | .. | 261.5 | ... | 51 | 1,472 | 116 | 543 | (?) |
| Tepula | 128 | 4, 5, 6, 7 | 92 190 163 | .. | 58 | 56 | 14 | 331 | 42 | 237 | 50 |
| Julia | 133 | 2, 3, 5, 6, 8, 10, 12 | 803 | .. | 85 | 212 | 17 | 548 | 18 | (?) | 383 |
| Virgo | 35 | 7, 9, 14 | 2,504 | 200 | ... | ... | 18 | 2,304 | 509 | 338 | 1,167 |
| Alsietina | (?) | Outside the city | 392 | 392 | 354 | 138 | ... | 0 | ... | ... | ... |
| Claudia | 158 | In all the 14 wards | (1,588) | 1,801 | 246 | 439 | 92 | 3,498 | 819 | 1,067 | 1,012 |
| Anio Novus | 158 | | (4,037) | | 728 | ... | | | | | |
| Totals | | | 14,018 | 4,063 | 1,718 | 2,345 | 247 | 9,955 | 1,707 | 3,847 | 4,401 |
| Remark – These figures are given in the original Montecassino codex. (?) means an omission due to a defect in the manuscript. | | | | | | | | | | | |

Table IV.

| Names of the Aqueducts | For public uses within the city | For camps | | For public structures | | For ornamental fountains | | For water basins | |
|---|---------------------------------|-----------|-----------|-----------------------|-----------|--------------------------|-----------|------------------|-----------|
| | Quinariae | Number | Quinariae | Number | Quinariae | Number | Quinariae | Number | Quinariae |
| Appia | 354 | 1 | 4 | 14 | 123 | 1 | 2 | 92 | 226 |
| Anio Vetus | 503 | 1 | 50 | 19 | 196 | 9 | 88 | 94 | 218 |
| Marcia | (?) | 4 | 42.5 | 15 | 15 | 12 | 104 | 113 | 256 |
| Tepula | 50 | 1 | 12 | 3 | 7 | .. | ... | 13 | 32 |
| Julia | 383 | (?) | 69 | (?) | 181 | 3 | 67 | 28 | 65 |
| Virgo | 1,167 | .. | ... | 16 | 1,380 | 2 | 26 | 25 | 51 |
| Alsietina | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| Claudia | 1,012 | 9 | 149 | 18 | 374 | 12 | 107 | 226 | 481 |
| Anio Novus | | | | | | | | | |
| Totals | 4,401 | 19 | 279 | 94 | 2,401 | 39 | 386 | 591 | 1,335 |
| Remark – These figures are given in the original Montecassino codex. (?) means an omission due to a defect in the manuscript. | | | | | | | | | |

Notes

- 1 Until 313 B. C.
- 2 Livy, i. 21, 3, etc. See Kiepert and Hiilsen.
- 3 Near it was the Temple of Castor and Pollux, who were reputed to have watered their horses there, after the battle of Lake Regillus.
- 4 313 B. C.; Middleton, ii. 335
- 5 The Samnite war referred to is the one of 343 B.C.
- 6 Livy, iX. 29; Diod. Sic. xx. 36. is meant.
- 7 Martial, iii. 47, and Kiepert and Hulsen.
- 8 The normal term of office.
- 9 Lanciani says this should be Collatian. See also Middleton, ii. 336.
- 10 The Roman double pace, about 5 feet long, is meant.
- 11 Middleton, ii. 198; Livy, xi. Si.
- 12 273 B. C.
- 13 Lanciani. Com. di Frontino, Plate iv.;
- 14 145 B. C.
- 15 Dion. Cass., xlix. 42; Pliny, Nat. Hist., xxxi. 41; xxxvi. 121; Middleton, ii. 337.
- 16 The sestertius was between 4 and 5 cents in value.
- 17 This board was specially charged with the custody of the Sibylline Books.
- 18 See Hermes, 4, 248.
- 19 127 B. C.
- 20 35 B. C.
- 21 Middleton, ii. 325; Trochner, Med. Rom. 169; Castellum of Aqua Julia; medallion of Severus Alexander. Trophies of Marius on it. Shown in Du Perac's etchings, Vestigi di Roma.
- 22 Cicero, De leg. agr. iii. 2, 9. See ancient stone map, Fabretti, De aquis, etc., Rome, 1738, P. 151.
- 23 Pliny, Nat. HiSt., xxxvi. 121 ; Middleton, ii. 342.
- 24 20 B.C. Pliny, Nat. Hist., xxxi. 42; Dion. Cass. xi. 7
- 25 Ovid F. i 464; Pont. Epis. i. 8, 38.
- 26 June 9th.
- 27 A naumachia (from the Greek word for "sea-fight") was the name given to the artificial lakes prepared for exhibitions of sham naval battles; the same name was also applied to the exhibitions themselves. See Middleton, Reiliatis of Ancient Rome, i. 386 and ii. 343. Also Martial. i. 24, and i. 28. Tacitus, 4 iii. xiv. 15; xxxii. 56. Also Ramsay's Manual of Roman Antiquities.
- 28 Caligula.
- 29 A.D. 36.
- 30 The successor of Caligula.
- 31 A. D. 50.
- 32 Pliny, Nat. Hist., xxxvi. 122; Middleton, ii. 344
- 33 I make out fiiscinae to have been catch-basins, and castellae small distributing reservoirs or tanks.
- 34 The Roman foot measured 11.653 ins., U. S. standard; =0.296 m.
- 35 Frontinus' fractions are as follows: - Dodrans, $\frac{3}{4}$, S= - Uncia, $\frac{1}{12}$, - Quincunx, $\frac{5}{12}$, = = - Dextans, $\frac{10}{12}$, S= = Sextans, $\frac{1}{6}$, = or Z Semissis, $\frac{1}{2}$, S Deunx, $\frac{11}{12}$, S= = - Quadrans, $\frac{1}{4}$, = or Septunx, $\frac{7}{12}$, s Semuncia, $\frac{1}{2}$ "/12, S or Z Triens, $\frac{1}{\sim 3}$, = or Bes, $\frac{2}{3}$, S Scripulus, $\frac{1}{288}$, 3
He also uses Sescuncia, $\frac{1}{2}$ - $\frac{1}{12}$, (or $\frac{1}{8}$); Duella, $\frac{1}{36}$; Sicilicus, $\frac{1}{48}$; and Sextula, $\frac{1}{72}$; and depends on combinations of these to express exact terms. As an illustration, we can modernize the computations of 26, as follows: A pipe, one inch in diameter, is the same as $\frac{1}{3}$ sixteenths (digits) in diameter; it measures 0.7854 square inches, while a *quinaria* = 0.69026 square inches (being $\frac{5}{64}$ of a foot in diameter). Therefore, one inch diam. = somewhat more than $\frac{1}{8}$ *quinaria*. The square digit, reduced to a circle = $\frac{3}{4}$ inch square so reduced = $\frac{9}{16}$ square inches = 0.5625 square inches = 0.846 inches diam. = about 0.8 *quinaria* . The round digit has a diameter of one digit or $\frac{3}{4}$ inch ; and measures 0.4418 square inches = 0.64 *quinaria*. It is useless to try to test the computations of Frontinus himself from the data now

available; for in nothing would the various copyists have been so likely to differ as in these matters of arithmetic. Everybody that ever had anything to do with the book, seems to have delighted in tinkering at these chapters, so as to exhibit his arithmetical skill.

36 1 square digit = 9/16 square inch. One 20-pipe = 16. *quinaria* = 16 X .69 square inch = 11.04 square ins. = 19.6 square digits.

37 The Emperor Trajan is meant.

38 The various texts are a hopeless confusion of figures (See J. Assoc. Eng'g. Soc., June, 1909, M. L. Holman). I have followed Bucheler's Latin edition of Frontinus, but Heaven only knows what Frontinus originally computed and wrote, what changes have been made in the course of centuries of the copyists' dabbling in arithmetic, and of twirling of the pen, and what final errors have been laid on, in the way of surplusage, by the practical part of modern typography. Thus it comes, that the stated figures do not agree with the rules of arithmetic.

Frontinus computes discharges by areas of cross-section only. Then, if the gain by *selling* by *short* measure in a 20-pipe was $3 \frac{1}{24}$, *quinariae*, it will have been $15 \frac{5}{24}$ *quinariae* for five 20-pipes, or for the amount of one lawful 100-pipe; and will have been $18 \frac{6}{24}$ *quinariae*, in the same way, for the amount of one lawful 120-pipe. But by reason of *long* measure in *receiving* water, the gain was stated to have been $10 \frac{1}{12} + \frac{1}{24}$ [+ 1/48], and $66 \frac{1}{6}$, in case of the 100- and 120-pipes respectively; so that adding these gains made at both ends of the bargain, we arrive at an aggregate gain to the water-men of $25 + \frac{9}{12}$ [+1/48]; and of $84 + \frac{10}{24}$ *quinariae*, in case of the 100- and the 120-pipe respectively.

Of course discharges depended then, as now, on the laws of practical hydraulics; on the head acting to produce the discharge ; on the precise form and position of the inlet; on the length of pipe, etc. See Chapter V. of the Explanatory Chapters.

39 About a gill.

40 The Roman pint.

41 The Roman peck.

42 12 *cyathi* made 1 *sextarius*; 16 *sextarii*, 1 *modius*.

43 I follow the text of Bucheler's Latin edition of Frontinus in all these admeasurements; and in the choice of words, of numerals, and of fractions have endeavored to reproduce the Latin text, so as to make it possible, mayhap, to trace the ancient mode of reckoning. The Latin text uses symbols, however, instead of vulgar fractions as now written; and Bucheler's had not the advantage of being able to study the Montecassino manuscript, or any exact reproduction of it. Nor have I much confidence in the integrity of even the Montecassino manuscript in reproducing the original text of these arithmetical chapters. What some paleographic student may nevertheless yet accomplish in elucidating this and other portions of the *De Aquis*, remains to be experienced.

44 Trajan is no doubt meant here. In Book I. Frontinus speaks of "Nerva Augustus;" in Book II. he says "Divus Nerva," the sainted Nerva; whence the argument that Book I. was begun under Nerva, and Book II. finished under Trajan.

45 $1,441 - 262 = 1,179$. And $1,348 = 1,179 + 169$.

46 $1,774 + 1,014 = 2,788$.

47 $2,162 - 1,840 - 95 = 227$.

48 $4,690 - (1,840 + 351) = 2,499$.

49 The Montecassino manuscript credits Virgo with 652 *quinariae*, and says the gauging gave the quantity 1,852 *quinariae* greater than recorded; either it is wrong in this, or it is wrong in adding up the quantities recorded as running in all the aqueducts.

50 B.C. 85-48. Cicero: Letters ad. Fam., 8,6,4. Epist., 242. Date, abt. 50 B.C.

51 These 771 *quinariae* are made up as follows: 92 from Marcia to Tepula, 164 from Marcia to Anio (Vetus), 190 from Julia to Tepula, 163 from Anio Novus to Tepula, 162 from Claudia to Julia = 771 *quinariae* .

52 A branch of Marcia supplied the baths of Caracalla, (built A.D. 206). Middleton, ii. 172.

- 53** This word means a channel or canal, and is here supposed by Rondelet to have meant the canal of running water built opposite the seats of the Flaminian Circus, situated in the ninth ward. See also Middleton, ii. 51; Suet., *J. Caesar*, 39.
- 54** Virgo also supplied the quantity required by the Thermae of Agrippa; Middleton, ii. 142.
- 55** Among them the Baths of Nero; see Middleton, ii. 147. Finished A.D. 69.
- 56** Note to Chapters 78 to 86. - The original Ms. of *De Aquis* is a hopeless confusion of figures as regards the statistics given in Chapters 78 to 86. The quantities, as they have come down to us in the Montecassino manuscript, contain a great many errors, and it would be impossible to affirm what are errors, and what is the truth. Poleni seems to have endeavored to reconcile these various figures, so as to make them at least arithmetically consistent. His adjustment of them may perhaps now do as well as any other that can be made, and I give it in the two first of the following tables. The figures contained in Bucheler's Latin edition of Frontinus, taken from those of the original text, are given in the second set of two tables, and it will be evident at once that these last named tables could be adjusted into consistency in an infinite number of ways.
- 57** The Emperor Trajan is meant.
- 58** See H. Jordan, in *Hermes*, 14 (1879), 269. Also, the same in *Topogr.* i. 1,149, note 45.
- 59** That is, water the private right to which has become void.
- 60** Jordan, i. I, 408. The quaestor Aemilius built the first stone bridge. There is a *denarius* showing it. Cohen, *T. I Aem.* 3.
- 61** At that time about two hundred and ninety-two dollars of coin.
- 62** 10 B.C.
- 63** Messala succeeded to Agrippa, under the consulate of Q. Aelius Tubero and Paulus Fabius Maximus, according to Varro, 10 B.C.
- 64** A.D. 13.
- 65** A probable emendation. The manuscript has *haustus*.
- 66** Equivalent at this time to about \$10,000 or \$12,000 coin.
- 67** Vitruvius, ii. 3, 2, says the same.
- 68** Bruns, *Fontes*, page 185, *S. C. de aquaeductibus*. B. C. II.
- 69** About \$4,600 of coin.