

**Source: The Ten Books on Architecture
by Vitruvius
(Translated by Morris Hicky Morgan 1914)**

BOOK IX

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INTRODUCTION

1. THE ancestors of the Greeks have appointed such great honours for the famous athletes who are victorious at the Olympian, Pythian, Isthmian, and Nemean games, that they are not only greeted with applause as they stand with palm and crown at the meeting itself, but even on returning to their several states in the triumph of victory, they ride into their cities and to their fathers' houses in four-horse chariots, and enjoy fixed revenues for life at the public expense. When I think of this, I am amazed that the same honours and even greater are not bestowed upon those authors whose boundless services are performed for all time and for all nations. This would have been a practice all the more worth establishing, because in the case of athletes it is merely their own bodily frame that is strengthened by their training, whereas in the case of authors it is the mind, and not only their own but also man's in general, by the doctrines laid down in their books for the acquiring of knowledge and the sharpening of the intellect.

2. What does it signify to mankind that Milo of Croton and other victors of his class were invincible? Nothing, save that in their lifetime they were famous among their countrymen. But the doctrines of Pythagoras, Democritus, Plato, and Aristotle, and the daily life of other learned men, spent in constant industry, yield fresh and rich fruit, not only to their own countrymen, but also to all nations. And they who from their tender years are filled with the plenteous learning which this fruit affords, attain to the highest capacity of knowledge, and can introduce into their states civilized ways, impartial justice, and laws, things without which no state can be sound.

3. Since, therefore, these great benefits to individuals and to communities are due to the wisdom of authors, I think that not

only should palms and crowns be bestowed upon them, but that they should even be granted triumphs, and judged worthy of being consecrated in the dwellings of the gods.

Of their many discoveries which have been useful for the development of human life, I will cite a few examples. On reviewing these, people will admit that honours ought of necessity to be bestowed upon them.

4. First of all, among the many very useful theorems of Plato, I will cite one as demonstrated by him. Suppose there is a place or a field in the form of a square and we are required to double it. This has to be effected by means of lines correctly drawn, for it will take a kind of calculation not to be made by means of mere multiplication. The following is the demonstration. A square place ten feet long and ten feet wide gives an area of one hundred feet. Now if it is required to double the square, and to make one of two hundred feet, we must ask how long will be the side of that square so as to get from this the two hundred feet corresponding to the doubling of the area. Nobody can find this by means of arithmetic. For if we take fourteen, multiplication will give one hundred and ninety-six feet; if fifteen, two hundred and twenty-five feet.

5. Therefore, since this is inexplicable by arithmetic, let a diagonal line be drawn from angle to angle of that square of ten feet in length and width, dividing it into two triangles of equal size, each fifty feet in area. Taking this diagonal line as the length, describe another square. Thus we shall have in the larger square four triangles of the same size and the same number of feet as the two of fifty feet each which were formed by the diagonal line in the smaller square. In this way Plato demonstrated the doubling by means of lines, as the figure appended at the bottom of the page will show.

6. Then again, Pythagoras showed that a right angle can be formed without the contrivances of the artisan. Thus, the result which carpenters reach very laboriously, but scarcely to exactness, with their squares, can be demonstrated to perfec-

tion from the reasoning and methods of his teaching. If we take three rules, one three feet, the second four feet, and the third five feet in length, and join these rules together with their tips touching each other so as to make a triangular figure, they will form a right angle. Now if a square be described on the length of each one of these rules, the square on the side of three feet in length will have an area of nine feet; of four feet, sixteen; of five, twenty-five.

7. Thus the area in number of feet made up of the two squares on the sides three and four feet in length is equalled by that of the one square described on the side of five. When Pythagoras discovered this fact, he had no doubt that the Muses had guided him in the discovery, and it is said that he very gratefully offered sacrifice to them.

This theorem affords a useful means of measuring many things, and it is particularly serviceable in the building of staircases in buildings, so that the steps may be at the proper levels.

8. Suppose the height of the story, from the flooring above to the ground below, to be divided into three parts. Five of these will give the right length for the stringers of the stairway. Let four parts, each equal to one of the three composing the height between the upper story and the ground, be set off from the perpendicular, and there fix the lower ends of the stringers. In this manner the steps and the stairway itself will be properly placed. A figure of this also will be found appended below.

9. In the case of Archimedes, although he made many wonderful discoveries of diverse kinds, yet of them all, the following, which I shall relate, seems to have been the result of a boundless ingenuity. Hiero, after gaining the royal power in Syracuse, resolved, as a consequence of his successful exploits, to place in a certain temple a golden crown which he had vowed to the immortal gods. He contracted for its making at a fixed price, and weighed out a precise amount of gold to the contractor. At the appointed time the latter delivered to the king's satisfaction an exquisitely finished piece of handiwork, and it appeared that in

weight the crown corresponded precisely to what the gold had weighed.

10. But afterwards a charge was made that gold had been abstracted and an equivalent weight of silver had been added in the manufacture of the crown. Hiero, thinking it an outrage that he had been tricked, and yet not knowing how to detect the theft, requested Archimedes to consider the matter. The latter, while the case was still on his mind, happened to go to the bath, and on getting into a tub observed that the more his body sank into it the more water ran out over the tub. As this pointed out the way to explain the case in question, without a moment's delay, and transported with joy, he jumped out of the tub and rushed home naked, crying with a loud voice that he had found what he was seeking; for as he ran he shouted repeatedly in Greek, "Εύρηκα, εύρηκα."

11. Taking this as the beginning of his discovery, it is said that he made two masses of the same weight as the crown, one of gold and the other of silver. After making them, he filled a large vessel with water to the very brim, and dropped the mass of silver into it. As much water ran out as was equal in bulk to that of the silver sunk in the vessel. Then, taking out the mass, he poured back the lost quantity of water, using a pint measure, until it was level with the brim as it had been before. Thus he found the weight of silver corresponding to a definite quantity of water.

12. After this experiment, he likewise dropped the mass of gold into the full vessel and, on taking it out and measuring as before, found that not so much water was lost, but a smaller quantity: namely, as much less as a mass of gold lacks in bulk compared to a mass of silver of the same weight. Finally, filling the vessel again and dropping the crown itself into the same quantity of water, he found that more water ran over for the crown than for the mass of gold of the same weight. Hence, reasoning from the fact that more water was lost in the case of the crown than in that of the mass, he detected the mixing of silver with the gold, and made the theft of the contractor perfectly clear.

13. Now let us turn our thoughts to the researches of Archytas of Tarentum and Eratosthenes of Cyrene. They made many discoveries from mathematics which are welcome to men, and so, though they deserve our thanks for other discoveries, they are particularly worthy of admiration for their ideas in that field. For example, each in a different way solved the problem enjoined upon Delos by Apollo in an oracle, the doubling of the number of cubic feet in his altars; this done, he said, the inhabitants of the island would be delivered from an offence against religion.

14. Archytas solved it by his figure of the semicylinders; Eratosthenes, by means of the instrument called the mesolabe.

Noting all these things with the great delight which learning gives, we cannot but be stirred by these discoveries when we reflect upon the influence of them one by one. I find also much for admiration in the books of Democritus on nature, and in his commentary entitled *Χειρόκμητα*, in which he made use of his ring to seal with soft wax the principles which he had himself put to the test.

15. These, then, were men whose researches are an everlasting possession, not only for the improvement of character but also for general utility. The fame of athletes, however, soon declines with their bodily powers. Neither when they are in the flower of their strength, nor afterwards with posterity, can they do for human life what is done by the researches of the learned.

16. But although honours are not bestowed upon authors for excellence of character and teaching, yet as their minds, naturally looking up to the higher regions of the air, are raised to the sky on the steps of history, it must needs be, that not merely their doctrines, but even their appearance, should be known to posterity through time eternal. Hence, men whose souls are aroused by the delights of literature cannot but carry enshrined in their hearts the likeness of the poet Ennius, as they do those of the gods. Those who are devotedly attached to the poems of Accius seem to have before them not merely his vigorous language but even his very figure.

17. So, too, numbers born after our time will feel as if they were discussing nature face to face with Lucretius, or the art of rhetoric with Cicero; many of our posterity will confer with Varro on the Latin language; likewise, there will be numerous scholars who, as they weigh many points with the wise among the Greeks, will feel as if they were carrying on private conversations with them. In a word, the opinions of learned authors, though their bodily forms are absent, gain strength as time goes on, and, when taking part in councils and discussions, have greater weight than those of any living men.

18. Such, Caesar, are the authorities on whom I have depended, and applying their views and opinions I have written the present books, in the first seven treating of buildings and in the eighth of water. In this I shall set forth the rules for dialling, showing how they are found through the shadows cast by the gnomon from the sun's rays in the firmament, and on what principles these shadows lengthen and shorten.

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