

VITRUVIUS

THE TEN BOOKS ON ARCHITECTURE

TRANSLATED BY MORRIS HICKY MORGAN, PH.D.,
LL.D. LATE PROFESSOR OF CLASSICAL
PHILOLOGY IN HARVARD UNIVERSITY

WITH ILLUSTRATIONS AND ORIGINAL
DESIGNS PREPARED UNDER THE DIRECTION
OF HERBERT LANGFORD WARREN, A.M. NELSON
ROBINSON JR. PROFESSOR OF ARCHITECTURE IN
HARVARD UNIVERSITY CAMBRIDGE HARVARD
UNIVERSITY PRESS

LONDON: HUMPHREY MILFORD OXFORD
UNIVERSITY PRESS 1914

COPYRIGHT, HARVARD UNIVERSITY PRESS

CHAPTER IV

THE SITE OF A CITY

1. For fortified towns the following general principles are to be observed. First comes the choice of a very healthy site. Such a site will be high, neither misty nor frosty, and in a climate neither hot nor cold, but temperate; further, without marshes in the neighbourhood. For when the morning breezes blow toward the town at sunrise, if they bring with them mists from marshes and, mingled with the mist, the poisonous breath of the creatures of the marshes to be wafted into the bodies of the inhabitants, they will make the site unhealthy. Again, if the town is on the coast with a southern or western exposure, it will not be healthy, because in summer the southern sky grows hot at sunrise and is fiery at noon, while a western exposure grows warm after sunrise, is hot at noon, and at evening all aglow.

[18]

2. These variations in heat and the subsequent cooling off are harmful to the people living on such sites. The same conclusion may be reached in the case of inanimate things. For instance, nobody draws the light for covered wine rooms from the south or west, but rather from the north, since that quarter is never subject to change but is always constant and unshifting. So it is with granaries: grain exposed to the sun's course soon loses its good quality, and provisions and fruit, unless stored in a place unexposed to the sun's course, do not keep long.

3. For heat is a universal solvent, melting out of things their power of resistance, and sucking away and removing their natural strength with its fiery exhalations so that they grow soft, and hence weak, under its glow. We see this in the case of iron which, however hard it may naturally be, yet when heated thoroughly in a furnace fire can be easily worked into any kind of shape, and still, if cooled while it is soft and white hot, it hardens again with a mere dip into cold water and takes on its former quality.

4. We may also recognize the truth of this from the fact that in summer the heat makes everybody weak, not only in unhealthy but even in healthy places, and that in winter even the most unhealthy districts are much healthier because they are given a solidity by the cooling off. Similarly, persons removed from cold countries to hot cannot endure it but waste away; whereas those who pass from hot places to the cold regions of the north, not only do not suffer in health from the change of residence but even gain by it.

5. It appears, then, that in founding towns we must beware of districts from which hot winds can spread abroad over the inhabitants. For while all bodies are composed of the four elements (in Greek στοιχεῖα), that is, of heat, moisture, the earthy, and air, yet there are mixtures according to natural temperament which make up the natures of all the different animals of the world, each after its kind.

6. Therefore, if one of these elements, heat, becomes

predominant in any body whatsoever, it destroys and dissolves all the

[19]

others with its violence. This defect may be due to violent heat from certain quarters of the sky, pouring into the open pores in too great proportion to admit of a mixture suited to the natural temperament of the body in question. Again, if too much moisture enters the channels of a body, and thus introduces disproportion, the other elements, adulterated by the liquid, are impaired, and the virtues of the mixture dissolved. This defect, in turn, may arise from the cooling properties of moist winds and breezes blowing upon the body. In the same way, increase or diminution of the proportion of air or of the earthy which is natural to the body may enfeeble the other elements; the predominance of the earthy being due to overmuch food, that of air to a heavy atmosphere.

7. If one wishes a more accurate understanding of all this, he need only consider and observe the natures of birds, fishes, and land animals, and he will thus come to reflect upon distinctions of temperament. One form of mixture is proper to birds, another to fishes, and a far different form to land animals. Winged creatures have less of the earthy, less moisture, heat in moderation, air in large amount. Being made up, therefore, of the lighter elements, they can more readily soar away into the air. Fish, with their aquatic nature, being moderately supplied with heat and made up in great part of air and the earthy, with as little of moisture as possible, can more easily exist in moisture for the very

reason that they have less of it than of the other elements in their bodies; and so, when they are drawn to land, they leave life and water at the same moment. Similarly, the land animals, being moderately supplied with the elements of air and heat, and having less of the earthy and a great deal of moisture, cannot long continue alive in the water, because their portion of moisture is already abundant.

8. Therefore, if all this is as we have explained, our reason showing us that the bodies of animals are made up of the elements, and these bodies, as we believe, giving way and breaking up as a result of excess or deficiency in this or that element, we cannot but believe that we must take great care to select a very

[20]

temperate climate for the site of our city, since healthfulness is, as we have said, the first requisite.

9. I cannot too strongly insist upon the need of a return to the method of old times. Our ancestors, when about to build a town or an army post, sacrificed some of the cattle that were wont to feed on the site proposed and examined their livers. If the livers of the first victims were dark-coloured or abnormal, they sacrificed others, to see whether the fault was due to disease or their food. They never began to build defensive works in a place until after they had made many such trials and satisfied themselves that good water and food had made the liver sound and firm. If they continued to find it abnormal, they argued from this that the food and water supply found in such a place would

be just as unhealthy for man, and so they moved away and changed to another neighbourhood, healthfulness being their chief object.

10. That pasturage and food may indicate the healthful qualities of a site is a fact which can be observed and investigated in the case of certain pastures in Crete, on each side of the river Pothereus, which separates the two Cretan states of Gnosus and Gortyna. There are cattle at pasture on the right and left banks of that river, but while the cattle that feed near Gnosus have the usual spleen, those on the other side near Gortyna have no perceptible spleen. On investigating the subject, physicians discovered on this side a kind of herb which the cattle chew and thus make their spleen small. The herb is therefore gathered and used as a medicine for the cure of splenetic people. The Cretans call it *σπληνον*. From food and water, then, we may learn whether sites are naturally unhealthy or healthy.

11. If the walled town is built among the marshes themselves, provided they are by the sea, with a northern or north-eastern exposure, and are above the level of the seashore, the site will be reasonable enough. For ditches can be dug to let out the water to the shore, and also in times of storms the sea swells and comes backing up into the marshes, where its bitter blend prevents the reproductions of the usual marsh creatures, while any that swim

[21]

down from the higher levels to the shore are killed at once

by the saltness to which they are unused. An instance of this may be found in the Gallic marshes surrounding Altino, Ravenna, Aquileia, and other towns in places of the kind, close by marshes. They are marvellously healthy, for the reasons which I have given.

12. But marshes that are stagnant and have no outlets either by rivers or ditches, like the Pomptine marshes, merely putrefy as they stand, emitting heavy, unhealthy vapours. A case of a town built in such a spot was Old Salpia in Apulia, founded by Diomedes on his way back from Troy, or, according to some writers, by Elpias of Rhodes. Year after year there was sickness, until finally the suffering inhabitants came with a public petition to Marcus Hostilius and got him to agree to seek and find them a proper place to which to remove their city. Without delay he made the most skilful investigations, and at once purchased an estate near the sea in a healthy place, and asked the Senate and Roman people for permission to remove the town. He constructed the walls and laid out the house lots, granting one to each citizen for a mere trifle. This done, he cut an opening from a lake into the sea, and thus made of the lake a harbour for the town. The result is that now the people of Salpia live on a healthy site and at a distance of only four miles from the old town.

CHAPTER VI

THE DIRECTIONS OF THE STREETS; WITH REMARKS ON THE WINDS

1. The town being fortified, the next step is the apportionment of house lots within the wall and the laying out of streets and alleys with regard to climatic conditions. They will be properly laid out if foresight is employed to exclude the winds from the alleys. Cold winds are disagreeable, hot winds enervating, moist

[25]

winds unhealthy. We must, therefore, avoid mistakes in this matter and beware of the common experience of many communities. For example, Mytilene in the island of Lesbos is a town built with magnificence and good taste, but its position shows a lack of foresight. In that community when the wind is south, the people fall ill; when it is northwest, it sets them coughing; with a north wind they do indeed recover but cannot stand about in the alleys and streets, owing to the severe cold.

2. Wind is a flowing wave of air, moving hither and thither indefinitely. It is produced when heat meets moisture, the rush of heat generating a mighty current of air. That this is the fact we may learn from bronze eolipiles, and thus by means of a scientific invention discover a divine truth lurking in the laws of the heavens. Eolipiles are hollow bronze balls, with a very small opening through which

water is poured into them. Set before a fire, not a breath issues from them before they get warm; but as soon as they begin to boil, out comes a strong blast due to the fire. Thus from this slight and very short experiment we may understand and judge of the mighty and wonderful laws of the heavens and the nature of winds.

3. By shutting out the winds from our dwellings, therefore, we shall not only make the place healthful for people who are well, but also in the case of diseases due perhaps to unfavourable situations elsewhere, the patients, who in other healthy places might be cured by a different form of treatment, will here be more quickly cured by the mildness that comes from the shutting out of the winds. The diseases which are hard to cure in neighbourhoods such as those to which I have referred above are catarrh, hoarseness, coughs, pleurisy, consumption, spitting of blood, and all others that are cured not by lowering the system but by building it up. They are hard to cure, first, because they are originally due to chills; secondly, because the patient's system being already exhausted by disease, the air there, which is in constant agitation owing to winds and therefore deteriorated, takes all the sap of life out of their diseased bodies and leaves them more

[26]

meagre every day. On the other hand, a mild, thick air, without draughts and not constantly blowing back and forth, builds up their frames by its unwavering steadiness, and so strengthens and restores people who are afflicted with these diseases.

4. Some have held that there are only four winds: Solanus from due east; Auster from the south; Favonius from due west; Septentrio from the north. But more careful investigators tell us that there are eight. Chief among such was Andronicus of Cyrrhus who in proof built the marble octagonal tower in Athens. On the several sides of the octagon he executed reliefs representing the several winds, each facing the point from which it blows; and on top of the tower he set a conical shaped piece of marble and on this a bronze Triton with a rod outstretched in its right hand. It was so contrived as to go round with the wind, always stopping to face the breeze and holding its rod as a pointer directly over the representation of the wind that was blowing.

5. Thus Eurus is placed to the southeast between Solanus and Auster; Africus to the southwest between Auster and Favonius; Caurus, or, as many call it, Corus, between Favonius and Septentrio; and Aquilo between Septentrio and Solanus. Such, then, appears to have been his device, including the numbers and names of the wind and indicating the directions from which particular winds blow. These facts being thus determined, to find the directions and quarters of the winds your method of procedure should be as follows.

6. In the middle of the city place a marble amussium, laying it true by the level, or else let the spot be made so true by means of rule and level that no amussium is necessary. In the very centre of that spot set up a bronze gnomon or "shadow tracker" (in Greek σκιαθήρας). At about the fifth

hour in the morning, take the end of the shadow cast by this gnomon, and mark it with a point. Then, opening your compasses to this point which marks the length of the gnomon's shadow, describe a circle from the centre. In the afternoon watch the shadow of your gnomon as it lengthens, and when it once more touches the circumference of this

[27]

circle and the shadow in the afternoon is equal in length to that of the morning, mark it with a point.

the tower of the winds at athens

7. From these two points describe with your compasses intersecting arcs, and through their intersection and the centre let a line be drawn to the circumference of the circle to give us the quarters of south and north. Then, using a sixteenth part of the entire circumference of the circle as a diameter, describe a circle with its centre on the line to the south, at the point where it crosses the circumference, and put points to the right and left on the circumference on the south side, repeating the process on the north side. From the four points thus obtained draw lines intersecting the centre from one side of the circumference to the other. Thus we shall have an eighth part of the circumference set out for Auster and another for Septentrio. The rest of the entire circumference is then to be divided into three equal parts on each side, and thus we have designed a figure equally apportioned among the eight winds. Then let the directions of your streets and alleys be laid down on the lines of division between the quarters of two winds.

8. On this principle of arrangement the disagreeable force of the winds will be shut out from dwellings and lines of houses. For if the streets run full in the face of the winds, their constant blasts rushing in from the open country, and then confined by narrow alleys, will sweep through them with great violence. The lines of houses must therefore be directed away from the quarters from which the winds blow, so that as they come in they may strike against the angles of the blocks and their force thus be broken and dispersed.

9. Those who know names for very many winds will perhaps be surprised at our setting forth that there are only eight. Remembering, however, that Eratosthenes of Cyrene, employing mathematical theories and geometrical methods, discovered from the course of the sun, the shadows cast by an equinoctial gnomon, and the inclination of the heaven that the circumference of the earth is two hundred and fifty-two thousand stadia, that is, thirty-one

[28]

one million five hundred thousand paces, and observing that an eighth part of this, occupied by a wind, is three million nine hundred and thirty-seven thousand five hundred paces, they should not be surprised to find that a single wind, ranging over so wide a field, is subject to shifts this way and that, leading to a variety of breezes.

10. So we often have Leuconotus and Altanus blowing respectively to the right and left of Auster; Libonotus and Subvesperus to the right and left of Africus; Argestes, and

at certain periods the Etesiae, on either side of Favonius; Circias and Corus on the sides of Caurus; Thracias and Gallicus on either side of Septentrio; Supernas and Caecias to the right and left of Aquilo; Carbas, and at a certain period the Ornithiae, on either side of Solanus; while Eurocircias and Volturnus blow on the flanks of Eurus which is between them. There are also many other names for winds derived from localities or from the squalls which sweep from rivers or down mountains.

11. Then, too, there are the breezes of early morning; for the sun on emerging from beneath the earth strikes humid air as he returns, and as he goes climbing up the sky he spreads it out before him, extracting breezes from the vapour that was there before the dawn. Those that still blow on after sunrise are classed with Eurus, and hence appears to come the Greek name εὔρος as the child of the breezes, and the word for "to-morrow," αὔριον, named from the early morning breezes. Some people do indeed say that Eratosthenes could not have inferred the true measure of the earth. Whether true or untrue, it cannot affect the truth of what I have written on the fixing of the quarters from which the different winds blow.

diagram of the winds (from the edition of vitruvius by fra giocondo, venice, 1511)

12. If he was wrong, the only result will be that the individual winds may blow, not with the scope expected from his measurement, but with powers either more or less widely extended. For the readier understanding of these topics, since I have treated them with brevity, it has seemed best to me to give two figures, or, as the Greeks say,

σχήματα, at the end of this book: one

[29]

designed to show the precise quarters from which the winds arise; the other, how by turning the directions of the rows of houses and the streets away from their full force, we may avoid unhealthy blasts. Let A be the centre of a plane surface, and B the point to which the shadow of the gnomon reaches in the morning. Taking A as the centre, open the compasses to the point B, which marks the shadow, and describe a circle. Put the gnomon back where it was before and wait for the shadow to lessen and grow again until in the afternoon it is equal to its length in the morning, touching the circumference at the point C. Then from the

[30]

points B and C describe with the compasses two arcs intersecting at D. Next draw a line from the point of intersection D through the centre of the circle to the circumference and call it E F. This line will show where the south and north lie.

13. Then find with the compasses a sixteenth part of the entire circumference; then centre the compasses on the point E where

the line to the south touches the circumference, and set off the points G and H to the right and left of E. Likewise on the north side, centre the compasses on the circumference

at the point F on the line to the north, and set off the points I and K to the right and left; then draw lines through the centre from G to K and from H to I. Thus the space from G to H will belong to Auster and the south, and the space from I to K will be that of Septentrio. The rest of the circumference is to be divided equally into three parts on the right and three on the left, those to the east at the points L and M, those to the west at the points N and O.

[31]

Finally, intersecting lines are to be drawn from M to O and from L to N. Thus we shall have the circumference divided into eight equal spaces for the winds. The figure being finished, we shall have at the eight different divisions, beginning at the south, the letter G between Eurus and Auster, H between Auster and Africus, N between Africus and Favonius, O between Favonius and Caurus, K between Caurus and Septentrio, I between Septentrio and Aquilo, L between Aquilo and Solanus, and M between Solanus and Eurus. This done, apply a gnomon to these eight divisions and thus fix the directions of the different alleys.

CHAPTER VII

THE SITES FOR PUBLIC BUILDINGS

1. Having laid out the alleys and determined the streets, we have next to treat of the choice of building sites for temples, the forum, and all other public places, with a view to general convenience and utility. If the city is on the sea, we should choose ground close to the harbour as the place where the forum is to be built; but if inland, in the middle of the town. For the temples, the sites for those of the gods under whose particular protection the state is thought to rest and for Jupiter, Juno, and Minerva, should be on the very highest point commanding a view of the greater part of the city. Mercury should be in the forum, or, like Isis and Serapis, in the emporium: Apollo and Father Bacchus near the theatre: Hercules at the circus in communities which have no gymnasia nor amphitheatres; Mars outside the city but at the training ground, and so Venus, but at the harbour. It is moreover shown by the Etruscan diviners in treatises on their science that the fanes of Venus, Vulcan, and Mars should be situated outside the walls, in order that the young men and married women may not become habituated in the city to the temptations incident to the worship of Venus, and that buildings may be free from the terror of fires through the religious rites and sacrifices which

[32]

call the power of Vulcan beyond the walls. As for Mars, when that divinity is enshrined outside the walls, the

citizens will never take up arms against each other, and he will defend the city from its enemies and save it from danger in war.

2. Ceres also should be outside the city in a place to which people need never go except for the purpose of sacrifice. That place should be under the protection of religion, purity, and good morals. Proper sites should be set apart for the precincts of the other gods according to the nature of the sacrifices offered to them.

The principle governing the actual construction of temples and their symmetry I shall explain in my third and fourth books. In the second I have thought it best to give an account of the materials used in buildings with their good qualities and advantages, and then in the succeeding books to describe and explain the proportions of buildings, their arrangements, and the different forms of symmetry.