

BOOK II

INTRODUCTION

1. **DINOCRATES**, an architect who was full of confidence in his own ideas and skill, set out from Macedonia, in the reign of Alexander, to go to the army, being eager to win the approbation of the king. He took with him from his country letters from relatives and friends to the principal military men and officers of the court, in order to gain access to them more readily. Being politely received by them, he asked to be presented to Alexander as soon as possible. They promised, but were rather slow, waiting for a suitable opportunity. So Dinocrates, thinking that they were playing with him, had recourse to his own efforts. He was of very lofty stature and pleasing countenance, finely formed, and extremely dignified. Trusting, therefore, to these natural gifts, he undressed himself in his inn, anointed his body with oil, set a chaplet of poplar leaves on his head, draped his left shoulder with a lion's skin, and holding a club in his right hand stalked forth to a place in front of the tribunal where the king was administering justice.

2. His strange appearance made the people turn round, and this led Alexander to look at him. In astonishment he gave orders to make way for him to draw near, and asked who he was. "Dinocrates," quoth he, "a Macedonian architect, who brings thee ideas and designs worthy of thy renown. I have made a design for the shaping of Mount Athos into the statue of a man, in whose left hand I have represented a very spacious fortified city, and in his right a bowl to receive the water of all the streams which are in that mountain, so that it may pour from the bowl into the sea."

3. Alexander, delighted with the idea of his design, immediately inquired whether there were any fields in the neighbour-

hood that could maintain the city in corn. On finding that this was impossible without transport from beyond the sea, "Dinocrates," quoth he, "I appreciate your design as excellent in composition, and I am delighted with it, but I apprehend that anybody who should found a city in that spot would be censured for bad judgement. For as a newborn babe cannot be nourished without the nurse's milk, nor conducted to the approaches that lead to growth in life, so a city cannot thrive without fields and the fruits thereof pouring into its walls, nor have a large population without plenty of food, nor maintain its population without a supply of it. Therefore, while thinking that your design is commendable, I consider the site as not commendable; but I would have you stay with me, because I mean to make use of your services."

4. From that time, Dinocrates did not leave the king, but followed him into Egypt. There Alexander, observing a harbour rendered safe by nature, an excellent centre for trade, cornfields throughout all Egypt, and the great usefulness of the mighty river Nile, ordered him to build the city of Alexandria, named after the king. This was how Dinocrates, recommended only by his good looks and dignified carriage, came to be so famous. But as for me, Emperor, nature has not given me stature, age has marred my face, and my strength is impaired by ill health. Therefore, since these advantages fail me, I shall win your approval, as I hope, by the help of my knowledge and my writings.

5. In my first book, I have said what I had to say about the functions of architecture and the scope of the art, as well as about fortified towns and the apportionment of building sites within the fortifications. Although it would next be in order to explain the proper proportions and symmetry of temples and public buildings, as well as of private houses, I thought best to postpone this until after I had treated the practical merits of the materials out of which, when they are brought together, buildings are constructed with due regard to the proper kind of material for each part, and until I had shown of what natural elements those materials are composed. But before beginning to explain their

natural properties, I will prefix the motives which originally gave rise to buildings and the development of inventions in this field, following in the steps of early nature and of those writers who have devoted treatises to the origins of civilization and the investigation of inventions. My exposition will, therefore, follow the instruction which I have received from them.

CHAPTER I

THE ORIGIN OF THE DWELLING HOUSE

1. THE men of old were born like the wild beasts, in woods, caves, and groves, and lived on savage fare. As time went on, the thickly crowded trees in a certain place, tossed by storms and winds, and rubbing their branches against one another, caught fire, and so the inhabitants of the place were put to flight, being terrified by the furious flame. After it subsided, they drew near, and observing that they were very comfortable standing before the warm fire, they put on logs and, while thus keeping it alive, brought up other people to it, showing them by signs how much comfort they got from it. In that gathering of men, at a time when utterance of sound was purely individual, from daily habits they fixed upon articulate words just as these had happened to come; then, from indicating by name things in common use, the result was that in this chance way they began to talk, and thus originated conversation with one another.

2. Therefore it was the discovery of fire that originally gave rise to the coming together of men, to the deliberative assembly, and to social intercourse. And so, as they kept coming together in greater numbers into one place, finding themselves naturally gifted beyond the other animals in not being obliged to walk with faces to the ground, but upright and gazing upon the splendour of the starry firmament, and also in being able to do with ease whatever they chose with their hands and fingers, they began in that first assembly to construct shelters. Some made them of green boughs, others dug caves on mountain sides, and some, in imitation of the nests of swallows and the way they built, made places of refuge out of mud and twigs. Next, by observing the shelters of others and adding new details to their own incep-

tions, they constructed better and better kinds of huts as time went on.

3. And since they were of an imitative and teachable nature, they would daily point out to each other the results of their building, boasting of the novelties in it; and thus, with their natural gifts sharpened by emulation, their standards improved daily. At first they set up forked stakes connected by twigs and covered these walls with mud. Others made walls of lumps of dried mud, covering them with reeds and leaves to keep out the rain and the heat. Finding that such roofs could not stand the rain during the storms of winter, they built them with peaks daubed with mud, the roofs sloping and projecting so as to carry off the rain water.

4. That houses originated as I have written above, we can see for ourselves from the buildings that are to this day constructed of like materials by foreign tribes: for instance, in Gaul, Spain, Portugal, and Aquitaine, roofed with oak shingles or thatched. Among the Colchians in Pontus, where there are forests in plenty, they lay down entire trees flat on the ground to the right and the left, leaving between them a space to suit the length of the trees, and then place above these another pair of trees, resting on the ends of the former and at right angles with them. These four trees enclose the space for the dwelling. Then upon these they place sticks of timber, one after the other on the four sides, crossing each other at the angles, and so, proceeding with their walls of trees laid perpendicularly above the lowest, they build up high towers. The interstices, which are left on account of the thickness of the building material, are stopped up with chips and mud. As for the roofs, by cutting away the ends of the crossbeams and making them converge gradually as they lay them across, they bring them up to the top from the four sides in the shape of a pyramid. They cover it with leaves and mud, and thus construct the roofs of their towers in a rude form of the "tortoise" style.

5. On the other hand, the Phrygians, who live in an open coun-

try, have no forests and consequently lack timber. They therefore select a natural hillock, run a trench through the middle of it, dig passages, and extend the interior space as widely as the site admits. Over it they build a pyramidal roof of logs fastened together, and this they cover with reeds and brushwood, heaping up very high mounds of earth above their dwellings. Thus their fashion in houses makes their winters very warm and their summers very cool. Some construct hovels with roofs of rushes from the swamps. Among other nations, also, in some places there are huts of the same or a similar method of construction. Likewise at Marseilles we can see roofs without tiles, made of earth mixed with straw. In Athens on the Areopagus there is to this day a relic of antiquity with a mud roof. The hut of Romulus on the Capitol is a significant reminder of the fashions of old times, and likewise the thatched roofs of temples on the Citadel.

6. From such specimens we can draw our inferences with regard to the devices used in the buildings of antiquity, and conclude that they were similar.

Furthermore, as men made progress by becoming daily more expert in building, and as their ingenuity was increased by their dexterity so that from habit they attained to considerable skill, their intelligence was enlarged by their industry until the more proficient adopted the trade of carpenters. From these early beginnings, and from the fact that nature had not only endowed the human race with senses like the rest of the animals, but had also equipped their minds with the powers of thought and understanding, thus putting all other animals under their sway, they next gradually advanced from the construction of buildings to the other arts and sciences, and so passed from a rude and barbarous mode of life to civilization and refinement.

7. Then, taking courage and looking forward from the standpoint of higher ideas born of the multiplication of the arts, they gave up huts and began to build houses with foundations, having

brick or stone walls, and roofs of timber and tiles; next, observation and application led them from fluctuating and indefinite conceptions to definite rules of symmetry. Perceiving that nature had been lavish in the bestowal of timber and bountiful in stores of building material, they treated this like careful nurses, and thus developing the refinements of life, embellished them with luxuries. Therefore I shall now treat, to the best of my ability, of the things which are suitable to be used in buildings, showing their qualities and their excellencies.

8. Some persons, however, may find fault with the position of this book, thinking that it should have been placed first. I will therefore explain the matter, lest it be thought that I have made a mistake. Being engaged in writing a complete treatise on architecture, I resolved to set forth in the first book the branches of learning and studies of which it consists, to define its departments, and to show of what it is composed. Hence I have there declared what the qualities of an architect should be. In the first book, therefore, I have spoken of the function of the art, but in this I shall discuss the use of the building materials which nature provides. For this book does not show of what architecture is composed, but treats of the origin of the building art, how it was fostered, and how it made progress, step by step, until it reached its present perfection.

9. This book is, therefore, in its proper order and place.

I will now return to my subject, and with regard to the materials suited to the construction of buildings will consider their natural formation and in what proportions their elementary constituents were combined, making it all clear and not obscure to my readers. For there is no kind of material, no body, and no thing that can be produced or conceived of, which is not made up of elementary particles; and nature does not admit of a truthful exploration in accordance with the doctrines of the physicists without an accurate demonstration of the primary causes of things, showing how and why they are as they are.

CHAPTER II

ON THE PRIMORDIAL SUBSTANCE ACCORDING TO THE
PHYSICISTS

1. FIRST of all Thales thought that water was the primordial substance of all things. Heraclitus of Ephesus, surnamed by the Greeks *σκοτεινός* on account of the obscurity of his writings, thought that it was fire. Democritus and his follower Epicurus thought that it was the atoms, termed by our writers "bodies that cannot be cut up," or, by some, "indivisibles." The school of the Pythagoreans added air and the earthy to the water and fire. Hence, although Democritus did not in a strict sense name them, but spoke only of indivisible bodies, yet he seems to have meant these same elements, because when taken by themselves they cannot be harmed, nor are they susceptible of dissolution, nor can they be cut up into parts, but throughout time eternal they forever retain an infinite solidity.

2. All things therefore appear to be made up and produced by the coming together of these elements, so that they have been distributed by nature among an infinite number of kinds of things. Hence I believed it right to treat of the diversity and practical peculiarities of these things as well as of the qualities which they exhibit in buildings, so that persons who are intending to build may understand them and so make no mistake, but may gather materials which are suitable to use in their buildings.

CHAPTER III

BRICK

1. BEGINNING with bricks, I shall state of what kind of clay they ought to be made. They should not be made of sandy or pebbly clay, or of fine gravel, because when made of these kinds they are in the first place heavy; and, secondly, when washed by

the rain as they stand in walls, they go to pieces and break up, and the straw in them does not hold together on account of the roughness of the material. They should rather be made of white and chalky or of red clay, or even of a coarse grained gravelly clay. These materials are smooth and therefore durable; they are not heavy to work with, and are readily laid.

2. Bricks should be made in Spring or Autumn, so that they may dry uniformly. Those made in Summer are defective, because the fierce heat of the sun bakes their surface and makes the brick seem dry while inside it is not dry. And so the shrinking, which follows as they dry, causes cracks in the parts which were dried before, and these cracks make the bricks weak. Bricks will be most serviceable if made two years before using; for they cannot dry thoroughly in less time. When fresh undried bricks are used in a wall, the stucco covering stiffens and hardens into a permanent mass, but the bricks settle and cannot keep the same height as the stucco; the motion caused by their shrinking prevents them from adhering to it, and they are separated from their union with it. Hence the stucco, no longer joined to the core of the wall, cannot stand by itself because it is so thin; it breaks off, and the walls themselves may perhaps be ruined by their settling. This is so true that at Utica in constructing walls they use brick only if it is dry and made five years previously, and approved as such by the authority of a magistrate.

3. There are three kinds of bricks. First, the kind called in Greek Lydian, being that which our people use, a foot and a half long and one foot wide. The other two kinds are used by the Greeks in their buildings. Of these, one is called *πεντάδωρον*, the other *τετράδωρον*. *Δῶρον* is the Greek for "palm," for in Greek *δῶρον* means the giving of gifts, and the gift is always presented in the palm of the hand. A brick five palms square is called "pentadoron"; one four palms square "tetradoron." Public buildings are constructed of *πεντάδωρα*, private of *τετράδωρα*.

4. With these bricks there are also half-bricks. When these are used in a wall, a course of bricks is laid on one face and a course