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must know music in order to be familiar with mathematical relations and be able to adjust the ballistae, catapults, and scorpions (I.I.8).[12] As in the case of architecture, where *symmetria* is complemented by *eurythmia*, the system of *symmetria* for the scorpions is complemented by a similar principle of adaptation, allowing for corrections through addition or subtraction.

The discussion above leads to the following conclusions concerning the universal laws of nature:

a. The laws of nature are the laws regulating the skies and the universe, which have a divine origin.
b. They are attached to the four cosmic elements.
c. Dynamically, they are natural causalities and of a mechanical nature.
d. Statically, they consist in: i. Proportional relations, quantitative and qualitative; ii. numbers with characteristic properties; iii. geometrical figures and qualities.
e. More specifically, they regulate the rotation of the planets and the stars, the winds and the sites, the animal world and the trees, and the health and form of man
f. They must be imitated by the works of man: buildings and machines.
g. They cause the beauty of the human body and by extension of buildings, which imitate it. (see also Gros 1990: LIII)

The conclusion is that, exactly as for the Pythagoreans, so for Vitruvius there is a cosmic order connected to the four elements and founded on number and proportion, of which *symmetria* is the (quasi-) aesthetic aspect; quasi-aesthetic, because this is not a pure aesthetics but a cosmic aesthetics: objective beauty is not a subjectively pleasing quality, but the result of the application of the laws governing the cosmos. Vitruvius's city, as a work of man and as a cosmic city, cannot but incorporate the laws of nature and *symmetria*, and as a model for built space it should have the attribute of beauty. The model for this city, the windrose, since it shows the dynamic structuring of the cosmic element air, should also show *symmetria* (cf. Steckner 1984: 269). I shall examine these matters in the next and last section.

9. The aesthetic city and the aesthetic windrose

It is common knowledge in semiotics that a text delivers its complete meaning only when it is read within its context. The isolation of the urban planning theory of Vitruvius from the rest of his work, understandable as it is due to the specialized interests of the scholars working on this matter,

has led to a partial — to say the least — understanding of the meaning, the layers of signification that envelop his proposed city. The cosmic richness of the latter has with very few exceptions passed unnoticed, and the same is true of its aesthetics. For example, the excellent French historian of urban planning Pierre Lavedan (Lavedan and Hugueney 1966: 362–363) retains only the obvious, the salubrity factor, in Vitruvius's urban proposal and the resulting orientation of the streets; as for aesthetics, he finds it only in the rules of proportion and *symmetria* for individual buildings. Fleury himself writes (1990: CIII) that aesthetic considerations are totally absent from the Vitruvian city — and the interests of Caesar and Octavian in the renovation of Rome ignored — and he tries to justify this presumed lack by stating that the description of the city is in an abridged form, and the intended readers of the work were not architects, but clients.

There have been some attempts to define Vitruvius's urban aesthetics, but they do not refer to his proposed city. In an unpublished paper, Gros, based on the description Vitruvius gives (II.VIII: 11 and 13) of the site and arrangement of the city of Halicarnassus, concludes that this allows us to form an idea of how Vitruvius conceives the beautiful urban landscape (see Fleury 1990: XCIV, n. 60). And Fleury (1990: 151, n. 5) adds to the brief catalogue of scholarship on Vitruvius's conception of urban beauty by referring to the opinion of Vitruvius (I.VI.1) that the town of Mytilene on the island of Lesvos is built with magnificence and elegance.

We may, however, have a more concrete and deeper grasp of Vitruvius's urban aesthetics by a contextual work on his urban proposal. As we saw, his city is implicitly or explicitly connected to a square. The square had two major and interrelated qualities. First, it was considered as one of the fundamental geometrical figures and a constituent of the cube. Second, it had attracted attention that the ratio of any two sides of a square is equal to one, the first integral number. The importance of these qualities makes it plausible that they are consciously incorporated in Vitruvius's urban square. If this is so, his proposal must be integrally related to proportion and to the aesthetics of the square. The square is also the unitary, generative and constantly repeated element of the city.[13]

The possibility that this square is semantized with an aesthetic code increases further from its inscription within a circle. For the Pythagoreans, beauty derives from simplicity, regularity, and order. This frequently implies reference to a center and uniformity around it, a pattern, which attains perfection with the circle and the sphere (Schlikker 1940: 67). For Vitruvius also, not only is the circle as such perfect, but the combination of the circle and the square marks his aesthetics of the body.

In fact, the geometrical complex of the windrose-cum-city is almost the same as the geometry accompanying the human body (cf. Gros 1990: 172, n. 2). The geometry of the windrose is based on a center, the combination of a circle and a square, the perpendicular axes of the former and of the latter, and radii (identified with the semi-axes). These same elements, in a less rigid geometrical form, accompany the human body: the navel as center, the circle and the square, the perpendicular axes of the circle formed by the diagonally spread members, which also correspond to radii, and the perpendicular axes of the square, formed by the height of the body and the outstretched hands (though the four parts of these axes are not all equal).

With the windrose Vitruvius gives a specific geometrical relation between the two figures of circle and square,[14] as he did not do in their encounter when delimiting the extremities of man. We get the impression that the windrose allowed Vitruvius to formulate a perfect geometrical complex, to which he also assimilates the body, although the constraints of the latter forced him to a looser conceptualization. The aesthetic perfection surrounding the urban competes with that of the body. The above inscription of the urban leading to a coherent combination of two perfect geometrical figures crowns, to use Gros's observation on the circle, its meaning as a totality incorporating *symmetria* and reveals its beauty. But there is even more *symmetria* in the windrose.

Vitruvius (III.I: 5–9), wanting to found the units of measurement on nature, makes reference to the perfect number of the Greeks, the number ten; this number he considers perfect because it follows from the number of the fingers of the two hands. Let us recall here that ten was the perfect number for the Pythagoreans (called also "memory") and is also the number of the books of Vitruvius's own work. Concerning this last point, Alexander Kessissoglu argues that Vitruvius in the organization of his work followed the Pythagoreans, who used to divide the elaboration of a subject into ten parts, and when they could not attain this number with the pertinent material they did so with borrowings from adjacent subjects. The latter would be the case, according to Kessissoglu, with Vitruvius, since of his ten books only the first seven concern architecture in the narrow sense, as Vitruvius himself testifies (Kessissoglu 1993: 100, 101–102, 114). But, on the other hand, Vitruvius is explicit that architecture is composed of three parts: building (see Books I–VII), horology (Book IX) and mechanics (Book X) — see I.III.1. Of course, horology and mechanics mainly concern engineers, but as we saw there was no strict division in antiquity between engineers and architects. Now, Book VIII revolves around hydrology and hydraulics. A limited part of it, concerning aqueducts and similar matters, is related to building, but its major part, a trea-

tise on water, is in fact very loosely related to it (Callebat 1973: VII–X; see also Fleury 1990: 121–122, n. 1). Given the above, Kessissoglu's view on the number of books is sound, but his argument concerning the artificial completion of this number in Vitruvius's work is rather weak.

On the matter of the perfection of the number ten, Vitruvius also mentions Plato and contrasts his view with that of the "Mathematicians" — the neo-Pythagoreans and the Euclideans as distinguished from the Pythagoreans — for whom the perfect number was six (see also Gros 1976: 689–700, 1990: 73, n. 1 and 2001: 18). Both numbers influenced his windrose, as I shall argue immediately below. Vitruvius goes on to present different numerical qualities of six; one of these is that if one-third of six is added to this number we get eight. According to Gros (1990: 74, n. 5), Vitruvius may here be misunderstanding the Greeks, mistaking numbers for relations; he points out, however, that Vitruvius's source was reliable. Six would be perfect also because it is found in the human body: the foot is one-sixth of the height, and the cubit consists of six palms or twenty-four fingers (III.1: 5–7). Vitruvius knew that six was the foundation of the principle, which he attributes to the Pythagoreans, that a text should be no more than three cubes long, because the number of 216 lines of the cube corresponds to the volume of a cube with an edge having a length of six ($216 = 6^3$); this cube was called by the Pythagoreans *σφαιρικός* (spherical), because 216 ends with six, and *ἀποκαταστατικός*, because, since each edge of it equals six units, it shows everywhere the same perfection (see Kessissoglu 1993: 103).

Later, as Vitruvius explains, the ancestors combined these two perfect numbers into one "most perfect" number, sixteen. It originates from the foot, because the foot equals sixteen fingers (III.1.8).[15] We see that the foot is the common locus of the perfection of six and sixteen. The body, through the unit (and sub-units) of measurement it provides and the proportions within and between its parts and between them and the whole, which are related to this unit, delivers the perfect numbers and articulates the system of measurement and *symmetria* (cf. III.1.9; see also Gros 1990: 65, n. 7). We should recall here the Etruscan division of the celestial circle into sixteen parts. On this basis, the number sixteen would not only be derived from the body, but also from the universe. We may conclude that Vitruvius's eight-part and octagonal windrose was considered by him to be related to the most perfect number, sixteen, both because of the numerical relation between eight and sixteen ($16{:}2 = 8$), and because he arrives at its form through a notional sixteen-sided polygon. Thus, the windrose seems to incorporate sixteen in an indirect manner, and it also probably incorporates indirectly the number six, in the form of the *ἐπίτριτος* ($6 + 1/3 \times 6 = 8$).