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CONCEPTS OF SPACE IN URBAN DESIGN, ARCHITECTURE AND ART

N. N. Patricios*

Abstract—*The contributions that have been made by psychologists, anthropologists and others to the revision of our traditional concepts of space demand, in the author's view, a new approach to urban design, architecture and art. These contributions suggest that two basic categories of space must be distinguished: the physical and the mental. Mental space is shown not to have a one-to-one correspondence with the space that is part of the physical world, due to the mediation of various psychological and cultural factors. A concept of space may be said to originate in an observer's mind and is a structure that is imposed on the physical world. The author discusses how concepts of space have been found to differ on a cultural basis and he gives some examples of how they have influenced urban design, architecture and art in various cultures. To analyse this relationship further, mental space has been sub-divided into three major types: the biological, the symbolic and the mathematical. Specific examples are given of these as they have been embodied in the layout of towns, building design and painting.*

I. INTRODUCTION

The question as to what the nature of space is has long fascinated man. For many centuries the notion of space has intrigued artists and architects and exercised the minds of philosophers and mathematicians. In recent years, psychologists and cultural anthropologists, in particular, have opened up new avenues that suggest a revision of the usual approach to the conception and representation of space. By drawing upon their contributions, I hope to show that one is enabled to explain why different cultures have characteristic spatial designs, as expressed in their cities, buildings and art.

II. CONCEPTS OF SPACE

1. Traditional definitions

According to the *Oxford English Dictionary* the word space has two meanings: the first denotes *time or duration* and the second *area or extension*. The second meaning is the more common and was first used in Middle English back in the 13th century. The English word was adapted from the Old French

espace which in turn was derived from the Latin word *spatium* [1]. In physics, space has three dimensions and is considered as a volume, not an area.

On the other hand the *idea* of space, which was elaborated by Sir Isaac Newton in the 17th century, is that space is absolute, has an existence proper to itself and is independent of the bodies it contains [2]. My discussion does not require the use of the concept of space of the theory of relativity, which is more closely approximated by non-Euclidean geometry, however I do mention it.

2. A new approach [3]

From the studies of psychologists, anthropologists, philosophers and physicists and others, it would appear that they distinguish two broad categories of space: the *physical* and the *mental*. For the purposes of this paper when reference is made to physical space, it is that defined as continuous, unbounded extension in three directions, regarded as void of matter or without reference to it.

Mental space, however, is an image of physical space. Early psychologists believed that there was an exact correspondence between a mental image and the physical world. Now, however, there is dissension as to the process and mechanism of the perception of space, mainly as there is evidence to show that the resultant images are sensations manipulated primarily by factors such as personality

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and culture of the perceiver and modified by expectation, attention, motivation and emotion [4].

One dissenting voice is that of J. J. Gibson [5] whose theory is based on the radical assumption that light can convey information about the world and, hence, that the phenomenal world does not have to be constructed by the mind (or brain) out of meaningless data. As I am concerned here with the cultural determinants of the resultant mental image rather than with other aspects in the mechanism of perception, I shall leave discussion of the theory to others [6].

Mental space, then, is largely the result of a constructive process that generally causes the perceiver to see the world not as it is but in a way that is conditioned by the conventions of his culture. These conventions are in the form of built-in schemata or models to which perceptions of the physical world are matched or adapted in consciousness. The determinants of schemata have been well documented by cultural anthropologists [7] and studies show that individuals learn them, consciously and unconsciously, by way of sub-parts of their culture.

Each culture will normally have its own concept of space, which is original, adapted, derived or borrowed. It is of fundamental importance that one recognize these differences, otherwise the error of imposing one's own concepts on those of other cultures will be committed. As I shall attempt to show later, one can gain rich and relatively undistorted insights into the way other cultures have shaped their physical environments and their own concepts of space by peeling away one's individual notions.

3. *The reality of space*

On the basis of this new approach, it can now be shown that the reality of space resides essentially in the mind. While physical space may be said to exist, it acquires meaning for man through the form of his perception, in its widest meaning, and through its relevance to his actions. Thus, the Newtonian idea of a 'neutral' medium defined earlier would need to be replaced by the concept of space as a *variable* with a potential effect of its own. Piaget, in fact, states that the reality of space is not in the extended or unextended character of sensations, envisaged as such, but in their construction [8]. In other words, an observer's experience of physical space is a product of his mind, rather than consisting in a one-to-one correspondence between mental space and the physical world. This must be distinguished from hallucination where '... observers tend to believe in the existence of a world that is different from the environment they usually perceive, that they either want to experience it or are fascinated by the possibility and that hence they are not inclined to apply ... tests for the existence of a real object' [9, 10].

It is worth recalling here the words of Arthur Eddington [11]: 'The space-time frame is ... something overlaid by the observer on the external

world; ... and is of great utility and convenience in describing phenomena ... but we must endeavour not to lose sight of its fictitious and arbitrary nature.'

As indicated previously, the raw material of vision is transformed into a phenomenon or a finished product by what Arthur Koestler terms the most powerful single factor among the many factors that enter into the processing of the visual impact: the power of convention as a hidden persuader [12].

4. *A conceptual framework*

I have sub-divided mental concepts of space into three major types as far as the implications for the three fields of design under discussion here are concerned. These are the *biological*, *symbolic* and *mathematical* types of schemata.

Man has so elaborated his biological activities culturally that it is difficult to describe those schemata that can be traced back to biological roots. However, mainly through the work of anthropologist Edward T. Hall [13], two spatial schemata have now been identified: those of territoriality and of orientation. These schemata are common to most cultures; any variations that do occur are mainly a difference in degree or emphasis.

The symbolic schemata differ in that they have egocentric and anthropomorphic characteristics and are bound up with a particular culture. Most images of symbolic space are derived from a culture's religion and cosmology and some prevailed in Western civilization from prehistoric times to the Renaissance. Symbolic schemata played a large part during this time in the way man organized the landscape, laid out cities, designed buildings and painted. However, these particular schemata play little part in present-day Western cultures that are relatively secular and rational.

Mathematical schemata are the most abstract of the three types of mental space, involving as they do the *idea* of some pattern or structure of space. When man in early times was able to isolate and consider abstract relationships between areas and volumes, it meant that he was no longer dependent on concrete sense data but could conceive these relationships 'in themselves', as in geometry.

III. SPATIAL SCHEMATA IN URBAN DESIGN, ARCHITECTURE AND ART

1. *Cultural differences in concepts of space*

There have been but a few studies concerned with a culture's spatial schemata and their relationship to man-made artifacts. It would be useful here to draw attention to the work of Dorner [14], for he relates man's intellectual transformation from the earliest times up to the present and shows the influence this had on painting. Perhaps one of the earliest spatial schemata of the cosmos is the circle. Later the cross was inserted into the circle, relaying the image of the four cardinal points of east, west, north and south. In fact, the hieroglyph for 'city'

is identical with this symbol of a circumscribed cross, which appears again and again on ritual vessels of Egyptian, Mesopotamian and other cultures.

A modern interpretation of the ancient Greek's concept of the cosmos is that of an enormous sphere with nothing outside its circumference. The Earth was considered to be at the centre of this cosmic sphere, the inner surface of which was believed to contain all the stars. It is very important to establish here that the gap between the Earth and the concave plane (the inner surface of the sphere) containing all the stars was considered by the influential Greek philosophers to contain orbiting planets and to be filled with air, and was never considered to be space in the Newtonian sense of the expanse *in which* the solar and stellar systems, nebulae, etc. are situated [15]. The principles of this cosmic concept, I believe, were used in the laying out of whole towns and in the arrangement of buildings in temple precincts and *agorae*. Many authorities have described the location of buildings in ancient Greek temple precincts as haphazard but I have shown that this conclusion is derived by considering these precincts in terms of the present concept of space; I have also shown in some detail how the principles referred to above were applied [16]. Briefly, I found that ancient Greek layouts and arrangements become meaningful when the buildings are considered as bodies *separated* by air and not as bodies *set in* space. Buildings were arranged in such a way that the mathematical relationships between them were symbolically the same as those between the planets themselves.

Dorner believes that in the Middle Ages the Greek concept of space (an aggregate of bodies separated by air) was changed into a spiritual vision of a unified solidity that was permeated with a supernatural 'light of love'. The idea of the cathedral is derived from some of the prevailing philosophical ideas of the time. The idea is not entirely at the didactic level, as shown so clearly by Emile Male, but, more precisely, it is an image representing supernatural reality, as expounded by Otto von Simson [17]. The cathedral, in whole and in all its detail, was an architectural analogy of the image of Heaven and, according to von Simson, this experience by the faithful was achieved by means of 'Measure' (the use of mathematics and certain significant proportions as in the case of the ancient Greeks) and 'Light'—the corporeal light shining through coloured glass symbolizing spiritual *lux* by which the soul reaches sure knowledge.

The Renaissance concept of space, in contrast, is characterized by rationality and one-point, or central, perspective of a simple object. The ensuing 'geometrization' of natural and human life is clearly seen in *La Grande Perspective* of the palaces and mansions where buildings, gardens and sculpture are frozen into a formal layout. The centrally designed church or cathedral and the star-shaped city fulfilled the same role—that of a symbolic observer standing at the focal point of the building or the city. In Renaissance painting too, for example Raphael's 'School of Athens', the static

order imposed by the perspective characteristics of the prevailing concept of space, the composition in representational three-dimensional space and the harmony of geometric proportions is evident. On the other hand, Baroque perspective had multiple planes receding into a limitless field of vision. Typical towns of the late Baroque period, such as Versailles and Karlsruhe, had the palace of the ruler as the origin of an axial vista that pointed to infinity. It appears that the discovery of infinitesimal calculus led to a widespread acceptance of the concept of infinity at this time.

Bacon [18] follows Dorner's approach but he interprets the interaction of spatial concepts and their physical realization over only four periods of history. However, Siegfried Giedion [19] in his research into the evolution of ideas in architectural space, attributes the most ambitious attempt ever made to interpret the whole course of art history in terms of changing modes of perception to Alois Riegl (1858–1905) in his *Spätromische Kunst-Industrie*. Heinrich Wölfflin (1864–1945) in his work *Principles of Art History* has also shown that the comprehension of the art of a period requires some knowledge of the philosophical, religious and scientific attitudes of that period. This tradition has been continued by E. H. Gombrich when he contrasts the Egyptian artists who relied on 'what they knew' and the Impressionists, who succeeded in recording 'what they saw' [20]. In re-examining the traditional distinction between 'knowing' and 'seeing', he reaches the conclusion that no artist can 'paint what he sees' [21] (Fig. 1). This view is supported by a recent study that shows that painters in different epochs, without necessarily being fully aware of the fact, have represented in painting the mental images of reality of their times [22] (Fig. 2).

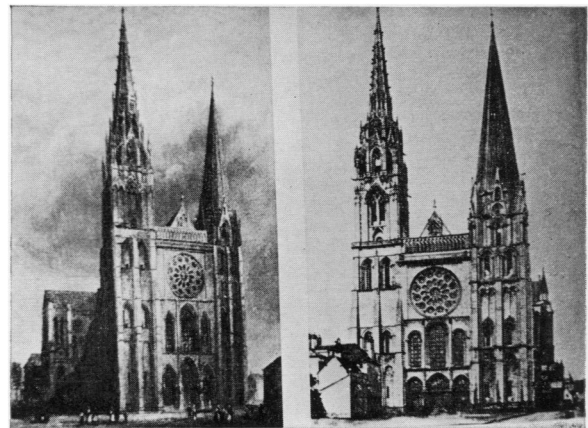


Fig. 1. Cathedral of Notre Dame, Chartres. Left: Robert Garland, 1836, engraving after lithograph from B. Winkles, 'French Cathedrals'. Right: Modern photograph. (Illustrations 48 and 49, E. H. Gombrich, *Art and Illusion* (London: Phaidon Press, 1960)).

The artist is a romantic to whom the French cathedrals are the epitome of the Gothic centuries. He conceives of Chartres as a Gothic structure with pointed arches but fails to record the Romanesque rounded windows of the west facade.

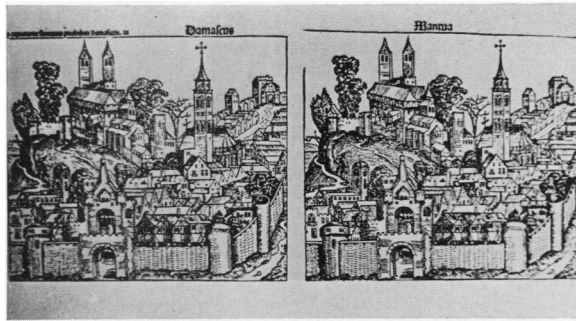


Fig. 2. Wolgemut: Woodcuts from the 'Nuremberg Chronicle', 1493. Left: Damascus, Right: Mantua. (Illustrations 41 and 42, E. H. Gombrich, *Art and Illusion* (London: Phaidon Press, 1960)).

A standard image was used to represent what a medieval city should look like, displaying an indifference as to what the cities of Damascus, Mantua or Ferrara and Milan actually looked like.

There are many examples of different cultures reflecting different space concepts. These differences have existed because the 'hidden persuaders', the subconscious rules of schematic perception, are different. Opposing notions of perspective, for example, are obvious in Western and Chinese landscape painting [23]. The Western notion of representing a three-dimensional world in a two-dimensional painting depends on presenting an apparently continuous receding ground plane in which the vertical elements rest, while diminishing in size according to their distance away from the spectator. Chinese paintings have three discontinuous planes: the foreground, middle distance and far distance, each parallel to the picture plane. The eye of the spectator is meant to jump from one plane to the next through a 'void'. In looking at Egyptian paintings, one notes that current schemata, which are based on vision and include conventional rules about perspective, might lead one to conclude that Egyptian artists did not know how or were not interested in rendering depth. This, in my opinion, would be erroneous, as vision was only allowed a very subsidiary part in Egyptian schemata. Objects were rendered as they appeared to the sense of touch, the more 'objective' sense that is concerned with the permanent shape of things, irrespective of a shifting viewpoint [24].

2. Some examples of the influence of spatial schemata on design

A. Spatial schemata of biological origin. Territoriality is considered one of the most fundamental variables in the life of animals. My interest here is that it is the means by which man and other species lay claim to a given area. Routes of flight and other critical distances have been measured accurately for various species of animal but the size of various human zones has not been well established. The few studies that have been carried out, however, point to a characteristic scheme of zones for different cultures [25].

In an investigation carried out by Thiel [26] into

the problem of estimating zonal distances in cities, he arrived at the following three types:

Local zone:	up to 200 ft.
Transactional zone:	200 to 450 ft.
'Aerial' zone:	450 to 1500 ft.

Thiel assigns these figures to the width and length of urban squares and other urban spaces or else to the diameter of a circle of equivalent size, depending on the form of the particular area.

It is of interest to note that Camillo Sitte has found that the average size of the great squares of Medieval European cities is 190 by 465 ft. [27]. According to Thiel the distance of 465 ft. is roughly the distance that objects of about $\frac{1}{2}$ inch in size may be seen under reasonable daylight conditions and that a dimension of $\frac{1}{2}$ inch is about the order of identifiable facial characteristics. Possibly then, the maximum size of these squares has been based on the need for facial recognition. The sizes of Medieval squares thus fall, more or less, within Thiel's transactional zone.

Another fundamental aspect of animal life is that of *orientation*. It is a practical necessity for animals to find their way about wherever they are, for purposes of survival and growth. For man to be able to find his way about a city, he needs to be able to 'read' the situation so that he may respond to it; he needs to know the relation of the self to the local environment. Lynch [28] has defined five elements of the city that appear to be basic to its 'imageability' for the purpose of orientation. These five elements are paths, edges, districts, nodes and landmarks.

B. Symbolic spatial schemata. Most symbolic spatial schemata have arisen from man's search for a conception of celestial order among the Sun, Moon and stars in the sky, the cycle of the seasons that reflected his own idea of order and the character of his social organization. The beliefs of different cultures were the basis for transforming the landscape in many places to conform to these beliefs.

Symbolic spatial relations can be classified into three sub-types: *totemistic*, *socio-mythical* and the more sophisticated *astrological-cosmic* kind [29]. A fourth type, the *metaphysical*, which is concerned with theological ideas of cosmic order [30] can be added to these. There are numerous examples of the influence of these symbolic spatial schemata in urban design, architecture and art. For the purposes of illustrating this influence, a few selected examples of mainly socio-mythical and astrological-cosmic types will be described.

In ancient Greece the mythologization of the natural world of 'time and space' (the macrocosm) can be traced in its development from a doctrine that assumed a correspondence between the nature of man and the nature of the physical world [31]. Of interest here is that to the ancient Greek mind cities were not a mere collection of buildings inhabited by people who had come together for economic reasons, they were divine beings with an immortal conscious personality, capable of assuming a corporeal shape. The symbolic rendering of the *polis* in the form of sculpture passed through several

clearly defined stages: representation by the guardian divinity or the eponymous hero or founder of the city; representation by an invented allegorical figure with emblematic attributes; and representation by the *tyche*, or fortune, of the place. The political structure of the Greek world was further symbolized in plastic art by a great variety of personifications of cities, peoples and continents [32].

On the Gold Coast of Africa the old city layouts of the Akan tribe were built with seven main quarters, each belonging to one of the seven matrilineal clans that represented on Earth the seven heavenly bodies of Sun, Moon and the five known planets [33]. The Dogon tribe conceive the development of the world in the form of a spiral and this schema they translate into the way they lay out their fields. Villages are built in pairs and are regarded as Heaven and Earth, while the layout of the villages, even of homes, embodies mythical conceptions or is modelled on the human figure (Fig. 3).

In the case of Indonesia, certain societies built their villages according to the group's conception of the cosmos [34]. In the minds of the South Nias Islanders, for example, their village is synonymous with the cosmos. Firstly, a broad central village street forms the main axis and is oriented from east to west, or sometimes north to south, which is related directly to the cardinal points of the compass. Secondly, the chief's house is invariably located at the upper end of the main street, symbolic of sunrise/sunset and upriver/downriver. Other houses are located with respect to the chief's house, taking into account the social hierarchy of the village.

The Hindu *Mānasāra Silpa-Sastras* (possibly compiled during the 5th or 6th century A.D.) contains ideal layouts that formed the basis for many Indian villages [35] and towns (Fig. 4). In particular, the Dandaka plan called for a rectangular block arrangement surrounded by a path of auspicious-

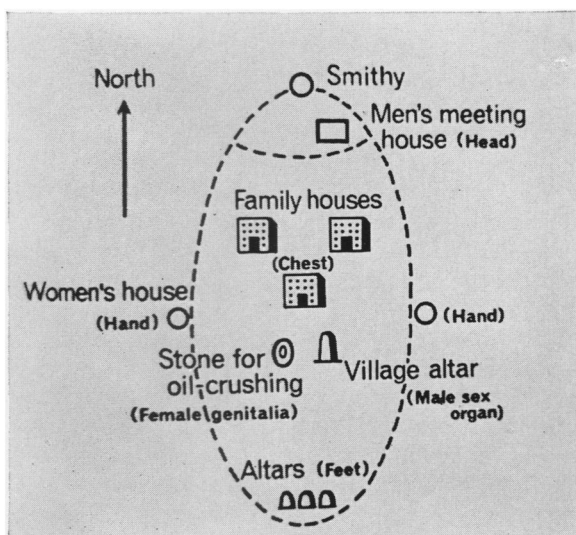


Fig. 3. Ideal schema of a Dogon village modelled on the human figure, Mali, Africa. (Illustration 4, D. Fraser, *Village Planning in the Primitive World* (London: Studio Vista, 1968)).

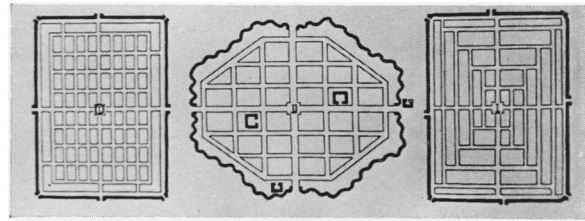


Fig. 4. Schematic city plans from the *Mānasāra manual*. (Illustration 168, S. Moholy-Nagy, *Matrix of Man* (London: Pall Mall Press, 1968)).

The common core is the 'mundus plate', anchoring the city to the universe.

ness for the daily procession of the priests. At the intersection of the main North and South Streets, a banyan or pipal tree was planted to mark the centre of the 'cosmic cross'. The tree symbolized the Tree of Vishnu, the Sun at noon and the 'all-pervading cosmic force'. Other plans called for villages to be laid out in the form of a lotus leaf or swastika, for example.

According to Patrick Abercrombie [36], the ancient Chinese evolved a definite system to control human additions in the countryside, in the interest of landscape fitness. This system of *Feng Shui* had more than a practical basis, for it was also founded on 'a lofty and somewhat abstruse philosophy and has been described as the science of adapting the residences of the living and the dead so as to co-operate and harmonize with the local currents of the cosmic breath' [37]. There was also the *Tsing* system that Haverfield [38] believes to have been closely connected with the system of laying out settlements. City gates were not placed on opposite ends of any radial streets, so that good luck entering the city from one side would not be able to run straight across it and out through the other side.

In Japan, too, according to Nitschke [39], the layout of a town reflected a conception of cosmic order. Urban spaces were an exact arrangement of built symbols that through their height, volume and overall shape were thought to produce an image of the cosmic order. Since aesthetic relationships between urban elements were not considered, an understanding of the ordering of 'place' must recognize the underlying Japanese religious and metaphysical thought. The basic symbol was that of the mandala, whose system of spatial order was repeated in the arrangements of images in the temples, in the order of architectural components of the buildings, in the layout of buildings in the temple precinct and in the placing of the precincts within the town (Fig. 5).

C. Mathematical schemata. In describing the relationship between space and geometry, Mach [40] sees our notions of space as being rooted in our physiological organism. He envisages geometrical concepts as the product of the idealization of a physical experience of space. There are two types of geometrical space: physical geometry (which is concerned with the theory of the structure of physical space) and pure geometry (which deals with

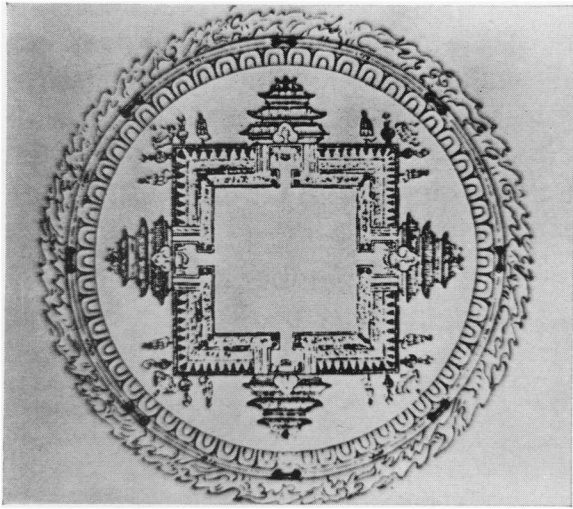


Fig. 5. *Mandala based on the form of a sacred city.* (G. Nitschke, *The Japanese Sense of 'Place' in Old and New Architecture and Planning*, *Arch. Design*, 26, 125 (March 1966)).

A mandala is a map of the cosmos. Here town space and cosmic space are expressed in one diagram.

logical abstract structures unconnected with physical space).

The space described by Euclidean geometry, according to Whittaker [41], is an imagined substratum for the mathematical relations that are approximately valid in physical space: it exists only in the mind of the geometer. However, it has played a great part in forming the concept of physical space for, having been derived originally from the comparison of measurements made in the actual world, it has been projected back on to nature and, thus, has finished as a generally accepted picture of real space.

Until well into the last century, Euclidean geometry was accepted as representing real space. It was not until Riemann, in about the middle of the 19th century, questioned the fundamental assumptions of this geometry that it was realized that there were other possibly valid geometries. Non-Euclidean geometries were developed in which it became possible to consider multi-dimensional space, whereas of course Euclidean geometry is limited to space of only three dimensions. The controversy about which geometry holds true for physical space cannot be undertaken here [42, 43] but what is important to point out is that physical space is not easily described. This is why any one of the mathematically possible geometries can be applied to physical space and the observational facts accounted for by making suitable adjustments in various physical laws. It would appear, however, that, particularly in everyday life, Euclidean geometry will be used because of its simplicity. This view recognizes the important function of conventions if people of a particular culture or of different cultures are to be able to communicate.

The expression of mathematical schemata in physical form reached its zenith in the Renaissance. A basic maxim of Renaissance architects was that

every part of a building had to be based on the same system of mathematical ratios. These ratios could not be arbitrary but had to comply with conceptions of a higher order embracing and expressing a cosmic order, such as the mathematical ratios assumed to determine the harmony pervading the universe first put forward by Pythagoras and Plato. The Pythagoreans believed that certain musical intervals (the octave, fifth, fourth, etc.) were *determined* by specific ratios (1:2, 2:3, 3:4, respectively) and that the mathematically based intervals constituted the mysterious 'music of the spheres' and thus the harmony of the universe. In fact, Leon Batista Alberti and Leonardo da Vinci expressed their belief that the harmonic relations in music were equally applicable to painting and architecture. That many Renaissance buildings reveal the use of mathematical ratios has been investigated by Wittkower [44] and this is evident in Palladio's aim that the spatial dimensions of churches should be interrelated with universally valid mathematical ratios.

These spatial relations are not obvious to us due to differences between our present day spatial schemata and those of the Renaissance. An example of this is Francesco Giorgi's design for the nave of S. Francesco della Vigna at Venice [45]. To the modern observer the width of the nave is one third of the length of the nave (1:3) but Giorgi expressed this as 9:27 to comply with the ratios of specific musical intervals; it should be pointed out that Giorgi was one of many in the Renaissance who attempted to unify proportion in architecture to the Pythagorean-Platonic philosophy of harmonic musical ratios. For Giorgi, the length of the nave is not simply a triplication of its width but is charged with definite relations: the one unit (9) is seen in relation to its duplication, and the two units together (18) are visualized in relation to the whole length of three units (27). In other words the simple ratio 9:27 is seen in terms of the compound ratio 9:18, 18:27, where the units coincide with prominent architectural features.

IV. CONCLUSION

The last example described above underlines the points I have made previously. Space and spatial relations are seen according to certain conventions of a particular culture and these conventions can be considered as being organized into schemata. Giorgi's spatial relations schema belongs to the mathematical type that is concerned with ratios in music and also geometrical ideas of space. The two other types of spatial schemata I discussed were the biological, concerned with zones of territoriality and orientation, and the symbolic, concerned basically with a broad range of religious and cosmological ideas. To discover the spatial schemata of a culture, it is important, therefore, to analyse their concepts of space.

The largely subconscious conventions, or 'hidden persuaders', are generally shared by members of a

culture. Of course, certain conventions are shared by different cultures, for if there were no sharing, communication and artistic continuity would be very limited. I have, however, concentrated on the cultural differences in spatial perception, as this is not widely recognized, especially in the fields of design. This would be more apparent and likely to be accepted if the conventions for describing space were better known—if it was realized that the reality of space is interpreted by the mind of the observer. From the examples of urban design, architecture and art I have described, it is quite evident that certain spatial schemata, products of the human mind, predominate. Finally, this emphasis on the mental aspects of space is not meant to underrate the importance of an understanding of physical space that is essential as a frame of reference for all organisms, if they are to survive.

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Concepts d'espace dans l'urbanisme, l'architecture et l'art

Résumé—Les contributions que les psychologues, les anthropologues et d'autres ont apportées à la révision de nos conceptions traditionnelles de l'espace, appellent, selon l'auteur, une nouvelle approche de l'urbanisme, de l'architecture et de l'art. D'après ces nouveaux apports deux catégories fondamentales de l'espace doivent être distinguées: l'espace mental et l'espace physique. L'espace mental est décrit comme n'étant pas en relation univoque avec l'espace physique, partie du monde matériel qui nous entoure, mais comme différent de ce dernier, en raison de la médiation des

différents facteurs psychologiques et culturels. On peut dire que le concept d'espace est originaire du cerveau de l'observateur et qu'il est une structure plaquée sur le monde physique. L'auteur décrit ensuite comment les concepts d'espace diffèrent suivant les cultures et il donne quelques exemples de la façon dont ils ont influencé l'urbanisme, l'architecture et l'art dans différents environnements culturels. Pour aller plus loin dans l'analyse de la relation espace mental—espace physique, l'espace mental a été subdivisé en trois grands groupes: le biologique, le symbolique et le mathématique. Des exemples sont donnés correspondant à chacun de ces groupes, ainsi que la façon dont ils ont été incorporés au tracé des villes, à l'habitat et aux formes picturales.