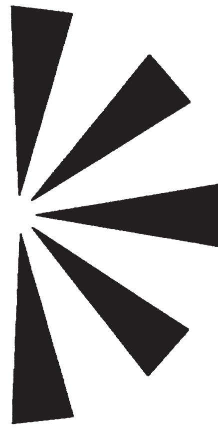

VIEWPOINTS

Discussion of topical issues
in urban morphology

A configurational theory of architecture: the lifework of Bill Hillier (1937–2019)

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The great breakthroughs in scientific knowledge are accomplished by individual men and women, not by groups of people or organizations. From time to time, someone comes along who is able to see the problem from an entirely new angle, suddenly turning it into something logical and graspable. Thomas Kuhn (1962) called these epistemological events 'paradigm shifts' – enlighted moments during which 'extraordinary science' is produced and our understanding of the world greatly expands.

Sometimes it is the foundations of an entire scientific field that are laid. Biology, for example, could hardly be deemed a science before Charles Darwin. He endowed it with its fundamental principle (natural selection), definitely rooting the discipline into logic and fertile ground. It is my belief that Bill Hillier has done the same for architectural theory and, indeed, for all the social sciences, insofar as they address the relationship between society and the built environment. In this Viewpoint I will set out the reasons why I think Bill stands among those men and women who have unveiled entire new sections of reality, by providing congent answers to some of its endless riddles.

The history of architecture is at least as long as the history of civilization. One might, therefore, presume that the theory of architecture was a long-established field of knowledge. But nothing could be further from the truth. Bruno Zevi declared in 1948 that 'we do not yet have an exact definition of the character of architectonic space'; and that 'the problem of the representation of space, far from having been solved, has not even yet been placed' (Zevi, 1948, p. 30). Much has been written on architectural theory during the two millennia that separate Vitruvius from Zevi – yet such was the state of art in 1948.

The truth is that architecture and the built environment in general (in the same way as language or social conventions) are part of those phenomena which, being such an integral part of our lives, do not seem to require an explanation. We make use of them intuitively. Yet, although the use of language and of social norms may be intuitive to us, the verbal (discursive) enumeration and explanation of their internal rules could not be less so. There are even two scientific disciplines devoted to that alone: linguistics and sociology.

Bill Hillier realized that something similar was going on with human spatial systems. He understood that the rules of organization[1] through which architectural space acquires functional and social meaning are *non-discursive* in nature – they cannot be described or analyzed through verbal concepts alone. With the help from his colleagues at UCL, he developed non-discursive techniques for describing and analyzing space (derived from discrete geometry and graph theory) which, in fact, filled the epistemological void to which Zevi referred in 1948. Armed with those techniques, he delved deeply into the anthropological

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record of both buildings and settlements, finding unsuspected spatio-structural regularities as well as striking socio-spatial specificities. Most importantly, Hillier discovered that the structural properties that turn amorphous space into a shelter for human life and society are not, in essence, material, visual or aesthetic. Those properties are relational and non-local – they exist within the network of permeability relations (that Hillier called 'spatial configuration'), created *simultaneously* by all the spaces making up each architectonic complex. This network of relations has structural properties that limit or favour what we can (or cannot) do inside it. At its most fundamental level, it is these properties that architecture manipulates in order to endow space with social and functional appropriateness.

This is a rather counter-intuitive idea. However, once understood, it unleashes all its explanatory and predictive potential. For example: what will lend more importance to a given space within the ensemble of a given building? Will it be its individual properties (that is, its specific programmatic function, its area, its height, the degree of illumination or of plastic elaboration)? Or will it be its particular location in the arrangement of all other spaces composing the building (that is, its degree of accessibility in relation to the other spaces and to the exterior, or its inevitability as a route between them all)? At first sight, the first hypothesis may seem plausible; but, on reflection, it becomes obvious that it is the second that will be more true. In fact, one could ultimately conclude that the coherence of the building as a whole will emerge from the systematic concordance between the local and global properties of its spaces (for example, between their individual programmatic roles and their positions in the global centrality hierarchy). In contrast, it will be from gross disagreement between local and global properties that elementary functional inadequacies will emerge (such as a space with an important programmatic function, but which is concealed in a remote part of the building). Naturally, spatial configuration does not exhaust the list of what is relevant in architecture, but it is its most elementary and structuring aspect – its spatial 'skeleton', so to speak. It is unlikely that any organism with a deficient skeleton could ever be successful, even if visually it may be very attractive.

As with all important ideas, this has ramifications that go far beyond its simplest formulation. When transposed to the context of the city and its network of public space, it can explain fundamental aspects of urban function. The most elementary function of urban public space is that of a movement channel. However, we all know that urban movement is not evenly distributed: it is much more intense in some streets than in others. Why is that? Hillier showed that it is because some streets have a fundamental locational advantage in the network at large, in the sense that they occupy top positions in its centrality hierarchy: they are those streets that are closest to all the others, or those that are more often part of the shortest paths between all the others (or, sometimes, both). From a probabilistic point of view, that simply makes their use as channels for movement between all other locations in the network more likely.

Over the last four decades, numerous empirical studies have supported these theoretical propositions. There is indeed a very strong correlation between the degree of network centrality and the intensity of use of urban spaces (roughly two-thirds of the observed variance in urban movement may be attributable to the configuration of the spatial network alone). In other words, spatial configuration – which depends directly upon the form of the urban grid – is, in itself, a primary modeller of movement patterns. This fundamental relationship between movement and spatial configuration, which Hillier called the 'movement economy', became the cornerstone of his urban theory.

Just as natural selection explains the seemingly miraculous diversity of life around us (what we see when looking at nature is the present outcome of a continuous process of evolutionary selection, operating on very long time scales), the movement economy theory explains why organically grown cities, in spite of their lack of central coordination, display functional distribution patterns where everything seems to be 'in the right place'. This happens because, for micro-economic reasons, different uses are attracted to different movement intensities (which are, to a large extent, shaped by the form of the street network itself). Uses whose activity depends upon public visibility (such as commerce, retail and general services) tend to gravitate towards locations exposed to intense flows, which are more scarce and saturate rapidly; while residential uses, constituting the bulk of urban private space, tend to locate within the larger but relatively less-accessible areas, delimited by the main axes of movement. This process feeds on itself, resulting in the optimized pattern we observe in 'organically'-grown cities, where most residential areas are usually close to small local centres and not far from any more important

centre. As in natural selection, it is a process that exerts its action in a continuous and prolonged way over time, resulting in an organized pattern.

The scope of this series of discoveries cannot be overstated. Bill Hillier's life's work represents a complete conceptual revolution in the way of approaching architectural space and its relationships with society. He has pushed architectural theory out of a purely speculative stage to that of an objective, logically sound, analytical system: 'a configurational theory of architecture' (Hillier, 1996). Above all, he endowed it with a truly scientific paradigm, quantitatively-led and falsifiable, but whose basic assumptions and predictions have shown to be fundamentally sound through a large body of empirical research.

I consider that the most important thing that Bill has bequeathed us is the possibility of pursuing a truly scientific path, as researchers of architecture and the city. In the same way that Darwin forever transformed the life sciences, Hillier has forever transformed the theory of architecture, providing it with the scientific foundations it lacked. There is a famous phrase by the biologist Theodosius Dobzhansky (1973): 'nothing in biology makes sense except in the light of evolution'. I would like to end by saying that, in my view, nothing in architecture makes sense – except in the light of the configurational theory that Bill Hillier left to us.

Note

1. In Bill Hillier's own terms, such rules are the 'syntax for the morphic language of human spatial organization' (Hillier and Hanson, 1984, p. 51). This is the context whence the term 'space syntax' stems, which Bill coined and which was dear to him. I feel, however, that the term has lost part of its original content over time and is today too narrow to cover the whole extent of Bill's overall scientific contribution, hence its absence from this text. I trust that Bill would agree with this personal choice.

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Urban form and climate change planning: on the normative framework for urban design

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The need to connect research and practice in urban planning and urban design has been extensively discussed in the forums of the International Seminar on Urban Form, most recently by Samuels (2019). This requirement is especially relevant when it comes to applying theory to practice on the most urgent issues, such as planning for climate change mitigation and adaptation. However, the implementation of research-based evidence remains slow. As a result, on the one hand our interdisciplinary field generates a growing body of theoretical and highly-specialized research read by a limited audience. On the other hand, planning and design practitioners tend to rely on precedents in the form of best practice case studies as guidance for their project proposals (for example, a collection in Hanzl and O'Reilly, 2018, 2019). In a limited number of cases (for example, Tötzer *et al*., 2018; Shrivastava *et al*., 2019), researchers are invited to contribute their expertise to these projects.

At the same time, in today's circumstances of rapid urbanization combined with the challenges