Exploring the frontiers of space: Bill Hillier (1937–2019)

Bill Hillier, photographed by Lord Snowdon. This portrait was presented to Bill by Peter Palumbo in thanks for Bill's evidence at the Mansion House Square public inquiry in 1984. Reproduced with the permission of the Hillier family.

Bill Hillier, who died on 5 November 2019, was a scientist and theoretician of the first order, whose life's work placed the study of architecture firmly into the Anglo-Saxon tradition of empirical science. He showed how society inscribes its structures in the buildings we shape and the environments we appropriate. He demonstrated how the configuration of the environment in turn acts to shape social structure through the way that people behave in, move through and use space, and the patterns of human contact this creates.

In this way he identified a mechanism essential to the full explanation of social reproduction – the way in which social forms persist over timescales that outstrip the lifespan of the individuals of which they are composed – and social evolution – the way in which social forms can, at times, evolve and innovate extremely rapidly in the face of events. He showed that architecture is not just a social product reflecting the society that makes it, nor merely a passive background to social action, but that it is also an active agent in the way that society is constructed and reproduced over time. In a nutshell, he showed how it was possible for buildings and cities to flourish or to fail in social and economic terms, and how this helps explain the progress of human society.

The son of a London property developer, Bill was neither an architect nor a scientist by training. He took the English Tripos at Queen's College, Cambridge, and could perhaps have become a poet. He was a golf blue but used to say that his interest in architecture was piqued when cycling, Pevsner in pocket, around the perpendicular churches of the fenland. On graduating and after a spell working in the City of London, he became the youngest-ever secretary of the Royal Institute

of British Architects, where he established the RIBA Intelligence Unit as the professional body's response to the 1958 Oxford conference on architectural education.

This period of his life was formative in that, working with others such as John Musgrove, Pat O'Sullivan and Adrian Leaman, he developed the outline of a research programme for the scientific study of architecture. The programme was firmly based in a wide reading of the philosophy of science and linguistics, something that the English Tripos had given him. Papers from these years, 'Knowledge and design' (Hillier *et al*., 1972); 'The man-environment paradigm and its paradoxes' (Hillier and Leaman, 1973); 'Structure, system transformation' (Hillier and Leaman, 1972), and 'How is design possible?' (Hillier and Leaman, 1974) set out that programme and led to him being invited in 1975 to join UCL's School of Environmental Studies (as the Bartlett was then called). He used to say that this was timely, as his favour at the RIBA had been on the wane following his comparison of the social structure of architectural practice to that of the Hamadryas baboon.[1] At UCL he succeeded John Musgrove as Director of the University of London Unit for Architectural Studies, and established the MSc programme in Advanced Architectural Studies. These became the platform through which he went on to deliver the research programme.

From the outset this work was collaborative, working with Adrian Leaman, Alan Beatie and Julienne Hanson to put flesh on the bones of the research, and with Basil Bernstein (at the Institute for Education) who acted as a sounding-board for the emerging theory. With Mick Bedford, Paul Stansall, John Peponis, Ricky Burdett and many others, he embedded himself in a group of researchers, MSc and PhD students whose ideas and evidence became the raw material for the emerging theory.

In 1984 he and Julienne Hanson published *The social logic of space* (Hillier and Hanson, 1984). This brought together in one place a theory, supported by evidence from the anthropological and historical record of human civilisation, demonstrating a central role for architecture in society. It remains seminal and its Chinese edition, translated by his most recent doctoral graduate, Tao Yang, was his final published work.

The way in which Bill worked occasionally brought him into tension with those closest to him. Ideas and empirical phenomena would be shared amongst the group, but invariably Bill would emerge a couple of days later with an idea transformed into his own theoretical base. His ability to spot the power in an idea or a phenomenon, and then to transform it into a coherent part of his growing theoretical framework, was one of his intellectual strengths.

Bill had an insatiable appetite for problem solving with pen, paper and a pocket calculator, to work out the fundamentals of how parts configure themselves into wholes: a central enigma of architecture, urbanism and society, and one which paid rich dividends. In this he became a self-trained mathematician and stimulated the development of architectural computing, working with Paul Coates, Stefan Czapski, Nick (Sheep) Dalton, Alasdair Turner, Schinichi Iida and Tasos Varoudis. Each of these – and countless doctoral students over the years – created 'tools for thinking with' that kept Bill supplied with tests of his hypotheses and new phenomena about which to theorise.

Bill invented numerous ways of representing built space as well as methods for measuring its pattern properties. On occasion he radically transformed accepted 'ways of doing things'. Perhaps the most remarkable of these was his invention of the 'axial map'. Conventional transport models at that time (and still) describe street systems as a network of 'nodes' at street intersections 'linked' by the segments of streets between intersections. By considering instead the whole length of a street (an 'axial line') as a 'node' in a network linked to the other streets that cross it, Bill overcame at a stroke the limitations of the conventional approach and made sense of data on pedestrian and vehicular traffic. This gave a powerful method to explain the way that design affects human occupancy and an ability to forecast the likely effects of design

changes. The axial representation was seen as an affront to orthodoxy in certain circles and drew criticism which Bill rebuffed decisively (for example Hillier and Penn, 2004); however, the real proof of the pudding lay in the eating – the empirical success of the method has stood the test of time.

Although much of his work could be criticised for being overly technical, Bill was intrigued by the world of experience. The phenomena of both architecture and society are always close at hand. For most of us, and most of the time, they are so present that we cease to think of them, but Bill was constantly and consciously observing each as well as their interplay. He could communicate this experience and place it into a dazzlingly clear light by pointing to a phenomenon and then explaining its theoretical significance.

On one occasion he came into the lab to describe a family party the previous weekend. His grandson Edward, a toddler at the time, had been sitting on the floor in the middle of a circle of adults playing with a helium balloon on a string tied to a weight. He placed it into the middle of the circle, interrupting the adults' conversation. Somebody moved the balloon out of the way. Edward moved it back, always placing it to interrupt the adults' views as much as possible. This observation became a favourite anecdote used to explain a new analysis of centrality that played a key role in Bill's *magnum opus*, *Space is the machine* (Hillier, 1996a).

Every year he would walk the City of London with new students, stopping from time to time to explain exactly what one was seeing and pointing on the spot to why this was of theoretical importance. These peripatetic lectures are remembered by generations of students who have gone on to become researchers and professors in their own right all over the world.

His ability to flip between the experiential and the analytic, to see each as an integral part of the other, was remarkable. This was one of his key insights: that human social groups and the environments they construct bear exactly this dual nature; and that by studying the one, one could gain a handle on the other. This is how architecture becomes socially meaningful and, in this way, society becomes open to empirical study. This helps to explain the interest his work has generated amongst the archaeological community, as it gives a tool to be used to help infer possible social forms from an analysis of physical built remains. His grounding in language informed this, and one of his key contributions was to distinguish between natural language – whose purpose is to convey meaning – and morphic language – whose function he hypothesised is to transmit social structure.

Perhaps this was his fundamental insight. Rather than to see humans and the environment as a dualism, he proposed that they were inseparable from each other in their action. But – and here was a subtle trick – he saw that it was possible to separate them for analytic purposes: to use analysis of one to inform our understanding of the other. And, if this were possible for analytic purposes, it could perhaps also provide a mechanism for description retrieval through which social forms could inscribe their structure for others to retrieve at another time.

His theoretical and methodological contribution was matched by a striking series of empirical breakthroughs. At around the time that the *Social logic of space* went to press, which was a largely theoretical and analytical work, the first findings of empirical studies of pedestrian movement in urban areas began to appear. Here he found that, all other things being equal, the configuration of the street system alone accounts for observed pedestrian movement rates. This was a truly surprising finding at a time when the dominant belief among the transport modelling community was that people move on shortest paths between generator and attractor land uses. Instead, he found that accessibility measured in the axial map of a street system correlated to a high degree with observed pedestrian flow rates without the need to invoke any other factors such as land uses, development densities or street width (the transport modeller's measure of 'capacity'). Moreover, the axial map is a very different object to the transport modellers' network in that, on the face of it, it does

not represent metric distance. Bill proposed a simple model to account for the data. Rather than pedestrians being attracted by attractor land uses, perhaps the opposite process was at work. Pedestrians followed simple routes and the land uses were attracted by the pedestrian footfall. This reversal of almost every tenet of the orthodox view was characteristic of Bill's approach, placing the geometry of space itself as the prime mover. The full evidence published in 'Natural movement: or, configuration and attraction in urban pedestrian movement' (Hillier *et al*., 1993) remains his most highly-cited journal paper (1652 Google Scholar citations as at June 2020).

Two main corollaries followed from the law of natural movement. The first was the theory of the movement economy (Hillier, 1996b). Here Bill suggested that if shops were attracted to locate in more spatially-integrated streets to capture the passing trade, then movement between any origin and destination could be considered as having a by-product in all the spaces passed through on the way. Thus, the street should be considered to have value not only as a means of getting between a and b, but also in bringing potential customers to the land parcels on the way. This may seem obvious, but traffic management at the time paid great attention to the role of the street in keeping traffic moving and seldom considered the traffic itself as valuable.

The second outcome was his identification of foreground and background grid systems in large cities, along with their social and economic counterparts (Hillier, 2016). These, he suggested, allow cities to operate at two fundamental spatial scales at the same time. The foreground grid serves micro-economics and acts as a generator of new social forms, while the background grid is predominantly residential and acts to conserve social structure. This analysis put spatial flesh on the bones of the 'virtual community' (Hanson and Hillier, 1987).

Bill also turned his attention to buildings. Considered always as spatial and relational objects, he showed how buildings act to construct interfaces between different categories of people – inhabitants and visitors, doctors, nurses and patients or shoppers and shop owners (Hillier *et al*., 1984). At the scale of the individual dwelling, he showed how different cultures inscribed family and gender relations into domestic space. He created a methodology to allow social and cultural changes in society to be charted through studies of house plans (Hillier *et al*., 1987) and the way in which these are adapted and occupied, offering fertile territory for numerous doctoral theses around the world.

If, on the one hand, architecture functions by allowing or inhibiting social relationships, on the other this must rely on individual behaviour and intentional action, and this in turn implies a cognitive dimension. This dimension has been present in the theory from the outset through the notion of 'intelligibility' as an intrinsic property of spatial systems. Put simply, it is possible to design mazes to be hard to navigate, but equally many urban forms seem to have developed to make it easy to find one's way. Bill's characteristically elegant insight was that if the local properties of space – those that one can see from where one stands – give a clue as to where one is at a larger scale, then this is directly testable. He found that, in unplanned settlements, local and global measures of the graph of street networks were often correlated. The degree of correlation was defined as the intelligibility of the system. Often, however, modern housing estates were designed to destroy the relationship between local and global and were indeed maze-like.

In 2005 he took the next logical step (Hillier and Iida, 2005). By representing the street network in three different ways, axial, metric distance and with angular direction change, they were able to show that, while axial and angular representations could predict observed movement patterns, metric was much poorer. In effect they found a way to infer how multiple different individuals, moving through urban areas on numerous different trips with different intentions, must be thinking about and understanding the world in common.

He stimulated his own thinking by critiquing and competing with other ideas being discussed at the time. Oscar Newman's

territorial theory of defensible space and Alice Coleman's schemes for regeneration of public housing estates were each in turn subjected to penetrating and decisive statistical analysis (Hillier, 1973, 1986). A modernist at heart, Bill helped explain exactly how the public housing schemes of the 1960s and 1970s had failed, and precisely why Margaret Thatcher's 'Colemanization' programme would also fail. Advising tenants' associations *pro bono* tested the theory in action, and eventually led to Bill being spotted by Norman Foster, and by Stuart Lipton, one of the rising stars of London's commercial property development world who had built the highly successful first phase of Broadgate and wanted to understand and so reproduce that success.

In 1989 Bill set up Space Syntax Limited, a spin-out company, to handle this kind of commission. Bill's analysis and evidence were decisive in numerous projects which have changed the face of London over the last few decades. London's South Bank transformation, the Millennium bridge to the Tate Modern and the opening-up of Trafalgar Square are the most notable of these. All have been shaped with the help of Bill's analysis and insight, and have left a permanent mark on London. With Tim Stonor in charge, the company is flourishing and applying his theories and methods in projects around the world.

Perhaps Bill's greatest legacy is through the people he has taught. Since 1996, an international space syntax symposium has been held in alternate years, always hosted by ex-students and attracting papers from all over the world. The 12th Symposium in 2019 was held in Beijing. Illness prevented Bill from being there in person, but his presence pervaded the event through the inspiration of his ideas.

Bill approached his Parkinson's with customary stubbornness and a determination to carry on regardless. In June 2019 he wrote his final paper with his three remaining functional fingers, yet viewed himself as extremely fortunate to have avoided dementia. After a lifetime of clarity, he died at 82 still employed by the university he loved. He passed peacefully surrounded by his wife and family. He is survived by his wife Sheila, Katy, Charlotte, Ben, Martha, Sarah and Vivien.

Note

1. The Hamadryas baboon lives in North Africa in large cliff-side colonies with a sophisticated social structure. Decision making on where best to forage is characterised by younger members of the troop proposing a direction of travel, to which the alpha male either agrees by getting up and following or disagrees by staying put. Bill suggested that architectural practices often work much the same way through a 'propose and dispose' model, in which junior architects propose designs with which practice partners either concur or dismiss during project review, so delegating creative practice while preserving control over design ethos and aesthetics.

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