The architecture of the urban object

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Introduction

"Architecture" is a strange word. We use it to refer to the appearances of things, as in "baroque architecture" or "seaside architecture," but we also use it to refer to the deep structure of things, as in "the architecture of matter" or the "architecture of the cell." The expression "the architecture of the city" thus has a certain ambiguity. It might mean the characteristic or appropriate appearance of buildings in cities. Or it might mean the deep structure of the city itself as a material object. This essay is about the second meaning: the "architecture" of the urban object itself.

The city as architectural object

Two questions immediately arise: does such a thing exist? And if so, is its existence significant? Much recent theory on the origins and nature of urbanism suggests that even if it does exist, its significance is doubtful (Adams, 1966; Wheatley, 1972; Carter, 1983). The city is, after all, so much more than a material artefact. It is economic processes, social relations, psychological states, cultural milieu, and so on. Each offers a different way of studying the city and a different base from which to construct the theories we need in order to act upon it.

It seems that the more we have become more aware that the study of the city involves the study of these dynamic processes, the more we have come to see the material form of the city as an epiphenomenon, a byproduct of these dynamic processes. Its relevance has come to be seen only in terms of the clues that it can give to the form and nature of these processes, not as an essential constituent of them. In the extreme form of this argument, the material city vanishes, to be replaced by a de-spatialized network of communications and transactions (Webber, 1964).

Architecture, defeated by the failure of modernist social engineering, has found few effective ways to re-argue the cause of the material city. It has responded either with theories that reject the twentieth century and see the architecture of the historic city in terms of a lost symbolic tradition (for example Rykwert, 1976), or vanished lifestyle (for example Krier, 1979), or with theories that celebrate the architecture of appearances of the modern city but which deny any questions of deeper "architecture." None challenge the power and dominance of the theories which de-materialize the global form of the city by linking the architecture of the city to its dynamic processes.

Yet all these views contain a paradox. If the city is distinctive in the richness and density of its social, economic and cultural milieux, then there must be some sense in which these arise from the material basis of the city. It is not enough to see the architecture of the city as a vague reflection of its social forms. If social forms are unique to the material city, then logic requires that there must also be some sense in which they are a product of the material city. Common sense affirms this. Cities of different cultural types and different scales embody different spatial identities. Our experience of these seems intrinsic to what cities are. We do not de-materialize our urban experience in the way in which we have de-materialized our urban theories.

What I sketch in this essay is a theory of the architecture of the urban object itself, that is a theory of the deep structure of the material form of the city, both as an autonomous reality in itself and as an essential constituent of the dynamic processes that make up the city. Aldo Rossi (1966) was, I believe, the first author in modern time to advance a theory arguing that the material form of the city is intrinsic to its sociological, cultural and psychological reality. In this paper I take a position that also goes well beyond Rossi's theory by trying to demonstrate empirically as well as theoretically the autonomy of the urban artefact, and then go on to argue that it is only by understanding this autonomy that we can understand why the material form of the city is an intrinsic aspect of its social existence.

The laws of the urban object

I will argue that to understand the city we must first understand its material form, and most especially its spatial form; and that we cannot understand its material form until we understand the laws underlying the form — that is the laws of the urban object itself. Only through these laws can we understand the city as an object in all its social, cultural and psychological complexity. I do not contend that these laws of material form are sufficient for an understanding of the city; but I do contend that they are necessary for it. I do not hope to replace...
social, economic and cultural theories of the city. But I do hope to complement them.

There are, I believe, three types of laws necessary to an analysis of the urban object:

- **Type 1:** Laws for the generation of the urban object itself, i.e., laws governing the ways in which buildings can be aggregated to form towns or urban areas: these we might call the **laws of the object itself**;
- **Type 2:** Laws of how society uses and adapts the laws of the object to give spatial form to different types of social relation: these we might call the **laws from society to urban form**; and,
- **Type 3:** Laws of how urban form then has effects back on society — the old issue of architectural determinism, if you like: these we might call the **laws from urban form to society**.

If we accept the argument that architecture is made up of three disciplines, not one:

- construction (firmitas),
- style (venustas), and
- space (commoditas),

then I believe that construction has only the first type of law, style the first and second, while space, and only space, has all three types of law. In this paper, my argument is confined to space. I give examples of each type of law, and show how all three are involved in understanding urban form.

**Spatial culture**

As far as space is concerned, the three types of law, although analytically separable, eventually come down to one fundamental proposition: that human societies order their spatial milieu in order to construct a spatial culture, that is, a distinctive way of ordering space so as to produce and reproduce not actual social relations (the essential error of modernist architectural determinism) but the **principles for ordering social relations**. Space is used sometimes to generate and sometimes to restrict the **field of encounter** of human beings and their symbols. How this happens depends on the forms of social reproduction involved. In all cases, however, space is not simply a function of the principles of the social reproduction: it is an **intrinsic** aspect of it, a necessary part of the social morphology.

Once we understand this critical relation, then we can begin to understand why it is that cities take on such different forms in different social and cultural conditions: why there are administrative cities and commercial cities, which are physically as well as sociologically distinct from each other; and why there are Islamic cities and Italian cities, each with their distinct characteristics as material forms and as cultural milieux.

**The three types of law that underlie urban form**

Examples of each of the three types of law are presented here in such a way as also to suggest a theory for the generation of urban form itself, focusing first on the origins of the urban block, then on its transformation in the creation of urban form itself, and finally its recent tragic disaggregation. In other words, I hope that my presentation will be read not only as an attempt to "explain" urban form, but also as a radical critique of recent practice.

**Type 1: Laws of the urban object itself**

Through the structure of certain small settlements in the north of England (figs. 1a and 1b) or in the south of France (figs. 2a and 2b) we can discover the origin of the urban block. All four examples are of the kind that would normally be classified as "irregular" or "random," since they lack the kinds of defining features that govern standard classifications: village greens, linear streets, and so on. Yet, oddly, their very irregularity suggests that they might be — at some level — of a similar **organic** type.

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**Fig. 1:** The structure of two small settlements in the north of England (a) Muker (b) Middlesmoor.

**Fig. 2:** The structure of two small settlements in the south of France (a) Perrotet (b) Les Yves.

Careful description can indeed reveal certain common properties. Each settlement is composed of dwellings that define, by their location and orientation, a continuous structure of open space which has a very characteristic form.

- First, there is constant variation in the width of the open space, so that "fatter" areas of space are linked to other fatter areas through "thinner" spaces, creating an effect rather like irregular beads on a string.
Second, the structure of open space forms at least one ring, and maybe several intersecting rings, which means that there is always at least one alternative route from every point in the settlement to every other point.

Third, although the maps do not show this, nearly every distinguishable segment of space, fat or thin, is directly adjacent to at least one building entrance, so that the spatial pattern seems to be in some sense defined by building entrances.

Taken together, these three properties bring to mind a primitive and irregular version of the urban block, with its outward facing groups of contiguous buildings defining rings of space.

In spite of their individuality, all four settlements have in common what we might call, for want of a better term, a "beady ring" structure: that is, a ring or rings of space formed like beads on a string by the orientation of dwelling entrances. What can explain this family likeness? None of the usual candidates — climate, topography, defence, land tenure systems, and so on — seem to begin to explain the spatial peculiarities of this form. So perhaps we should explore what might seem, on the face of it, a more natural possibility: that the beady ring form arises from some process of organic growth.

A simple model can suggest such an aggregative process. Let us define an "elementary unit" for this process as being made up of a single square dwelling with one entrance and a segment of open space on the entrance side equal in size and shape to the dwelling (fig. 3). Now, let us define a process of random aggregation of such units, subject to two rules: each unit must, as it is added to the complex, be joined by its open space full facewise (i.e. joining the whole side) to the open space of a unit already in the complex; and while full facewise joins of dwellings are allowed where they occur randomly, the joining of dwelling by their vertices is not allowed, since it is unlfelike.

Figure 4 shows a fairly typical result of such a process of aggregation, carried out by computer to ensure randomness, and frozen at about the size of a real "beady ring" settlement. Figure 5 is a much bigger surface generated by the same process. It is clear that all three defining characteristics of the real beady ring structure — the formation of variable beads and strings of space, the formation of rings, and the adjacency of space segments to building entrances — are all realized in the simulated process. Of course, one might object that the form is over-regularized! But it need not be so. Figure 6 is a village layout generated on the computer by Paul Coates of UCL and Autopgraphics Ltd in an effort to simulate some rather more linear beady ring forms that are found in the north of England. The beady ring process is, it seems, robust enough to survive most minor changes in the process. It is the accumulation of spatial relations that give rise to the form.

What about the variations between the settlements in figures 1 and 2? The main difference seems to be in the number and size of the rudimentary "blocks." Those in figure 1 have several small blocks, while those in figure 2 have one dominant block surrounded by several small ones. This difference in fact could be modelled by a simple change in the generative rules. In the process already described, the joining of two dwellings — as opposed to their spaces — occurred only where the process
generated it randomly. But we can make this subject to a rule, one perhaps which increases the probability of dwelling joins. The effect of this will be, as we might imagine, to increase the size and decrease the number of the blocks as we increase this probability and vice versa; and this of course is the main difference between the figure 1 type and the figure 2 type.

We can then extend this change in the process to its limit until we require the dwelling to join and allow space joins only where they occur randomly. This will generate a single irregular block, penetrated by deep, wandering three-sided courtyards (fig. 7). Such a phenomenon can often be found in settlements, especially where some external restriction — say, the presence of a highly restrictive town wall — forces dwellings into greater contiguity. Could some of the block shapes in figure 8 perhaps be influenced by such factors?

Other variations follow from changing the scope of the rules. In figure 9, for example, the basic bead ring process seems to be present, but to have become more regularized so that lines of sight are much more extended than they would be in a randomly generated aggregation. Such an effect can be produced by a rule that requires each added unit to take into account not only how it relates to an immediate neighbor, but also how it relates to other dwellings some distance away, i.e. if the scope of rules is extended. It was in fact once suggested to me by a local builder that new houses could once be located at will, provided they did not obscure sight lines from any dwelling entrance to any other. Such a rule would be likely to have the effect, in an otherwise random process, of producing a greater tendency to linearity of the kind seen in figure 9.

Can we then say that the various processes "explain" the forms? The question is difficult to answer on the basis of the completed forms, since we need to consider the historical data on the step by step growth of each settlement. Such data are, unfortunately, hardly ever obtainable. We have, however, tried to test the proposition in the case of the bead ring settlements in the south of France by mapping some 77 apparently random clusters of buildings in the vicinity of the two illustrated settlements. Figures 10a and 10b are examples of small clusters, figure 11 a larger one (drawn to a slightly smaller scale). Analysis of the sample shows:

— first, that every cluster of sufficient size takes on a clear bead ring form, subject to topographical constraints; and,
— second, that all smaller clumps are either compatible with a bead ring process, or strongly suggestive of it. Figure 10a is a "compatible" case and 10b a "suggestive" one.

Suppose, then, that the bead ring process were involved in the formation of these settlements. What would this tell us, philosophically? Surely it would tell us that to explain settlement forms we need two kinds of knowledge, not one. We need knowledge of real historical events and the socio-economic processes in which they were embedded. But this, on its own, would never explain the morphological regularities. To explain these, we also need to know that the local rule of "open space joins" applied to an otherwise random process of growth will itself lead to the bead ring form. The historical process has, as it were, activated a morphological process.
But the morphological process is lawful in itself, and it is this internal lawfulness that in the last analysis actually produces the global morphological regularities. In other words, knowledge of laws of type 1, the laws for the formation of the object itself, is indispensable for an understanding of the material form. Moreover, it seems highly likely that the best key to the "spatial culture" of the settlements might be the generative rules underlying the material form, rather than simply the form itself. We can explore this possibility further by considering some rather more complex cases, and looking for laws of type 2.

Type 2: Laws from society to space

Let us compare a representation of the town of Gassin (fig. 9) again, with the open space structure rather than the blocks in black (fig. 12), with a similar representation of another southern French town, Apt (fig. 13). Gassin is a small town on the ridge of a hill. Apt is a large town on a flat plain by a river. I argue that in spite of these locational and topographical differences, these two towns share a common morphological genotype, one which compels a social interpretation of spatial form. In explaining this, I also explain something of the method of spatial analysis we have developed called "space syntax," and use it to show that the more urban type of order found in these towns arises, to a considerable extent, from the transformation of the urban block — that is, the rules of aggregation are assigned to the block rather than the individual building.

What has to be explained in these cases is the partly regularized but still irregular pattern of open space structure, and how it is produced by the arrangement of buildings. We can begin by observing that, although irregular, both settlements are composed of blocks surrounded by space which form intersecting rings, and therefore take a form which has a topological resemblance at least to an urban grid. We might call them "deformed grids" — and note in passing that the great majority of towns constructed by human beings throughout history are based on some variant of the deformed grid.

In what sense is the grid deformed? I suggest that it is simpler than it looks and that the beady ring settlements have already given us the basic concepts we need. All that is needed is to make them more rigorous.

- First, the grid is, I suggest, deformed two-dimensionally to form a set of identifiable convex spaces, some fat and some thin. Figure 14 is a break-up of the open space of Gassin into its fattest convex spaces (a piece of space always forms part of the fattest space it can). This immediately shows that the principle noted in the beady rings, that nearly all identifiable spaces, thin as well as fat, have entrances opening onto them, is maintained in Gassin. The same is also true of Apt. The adjacency of convexly defined spaces to entrances must therefore be held to be a genotypical spatial property of these settlements.

But it is more than a purely spatial property. A convex space is one in which each point is directly visible and accessible from every other point. If building entrances are systematically related to convex spaces, then it must be because they are meant to participate in this "all play all" mutual surveillance. The "convex space entrance" principle ensures that virtually all, not just some, spaces in the settlement are, in a sense, under the control of entrances and, potentially, of people who may come and go through them. We are therefore dealing with a genotypical socio-spatial property of the settlements.

- Even more striking socio-spatial properties appear when we consider the second kind of deformation of the grid: the one-dimensional or axial deformation. Figure 15 is an "axial map" of Gassin, formed by drawing the longest and fewest lines of direct access and visibility that cover all the convex spaces of the settlement. Figure 16 is a similar map for Apt. Certain properties are immediately apparent. First, although there are far more lines in the settlements than would be needed to cover a perfectly regular grid (how many more is one index of how axially deformed the grid is), there are not so
many as to suggest terms like “labyrinthine.” The two-dimensional deformity does not always entail one-dimensional deformity. On the contrary, it is a striking feature of both settlements that axial lines seem to run through whole series of convex spaces.

This is an important property in defining “urban” spatial experience. If a convex space is that region around us where all points are visible and directly accessible from all other points, then axial lines tell us about some points in other, perhaps remote, convex spaces which are also visible and directly accessible to us. Through this relation between convexity and axially in space, we are in effect given two kinds of information from space: complete local information about the space we are in through the convex organization; and partial global information about spaces we might go to through the axial organization. In urban space, we are in effect given information about two scales at once. This compression of scales, to my mind, comes close to being the essence of urban spatial experience.

But to arrive at the full picture of the socio-spatial genotype underlying these two settlements, we need to go beyond direct experience and consider the spatial pattern of the settlement as a whole. Because it is the most global representation of the spatial structure, we will consider the axial map on its own, and introduce some of the numerical techniques of space syntax analysis.

Of these, the most important is a measure we call integration. If we look at the axial map we can see that every other line is linked to every other line, either directly or by way of a certain minimum number of intervening line segments, or “steps.” We will call this the property of depth. A line is as deep as another line as the least number of steps that have to be used to go from one to the other. Thus a space is at depth one from another space if it is directly connected to it, at depth two if there is one intervening step, and so on. It follows that every line has a certain depth from every other line. The integration value of a line is a mathematical way of expressing the depth of that line from all other lines in the system (Hillier and Hanson, 1984, for the equation). It is not at all obvious that these values will differ significantly from one line to the next; but that they do is one of the most significant properties of architectural and urban spatial configurations.

A graphical way of expressing that difference is shown in figures 17a and 17b. Figure 17a is a “justified graph” of the system of lines as seen from the point of view of the long line (marked “a”) descending from the edge of the settlement at half past two towards the center, the most “integrating” line in the settlement. The points in the graph represent the lines, and the connections represent the intersections of lines. The long line, “a,” of figure 15 is the “root” of the graph, and each level of “depth” away from that line is aligned vertically, so that the height of the graph shows how integrated the line is: the shallower, the more integrated, and vice versa. Figure 17b is a similar graph drawn from a short line (marked “b”) in the bottom right complex of figure 15. The greater height of the graph shows that the system has more “depth” from that line, and that line is therefore less “integrated,” or more “segregated.”

The integration core of the settlement is then the 10 percent (or 5 percent or 25 percent, depending on what is to be shown) of most integrating lines, numbered in order of integration. Figure 18a is the integration core of Gassin and Figure 18b that of Apt, marked in black, with the dotted lines representing the most segregated lines. Both cores take the form we call a deformed wheel: a semicircle, or “hub” of lines in the interior of the settlement is linked by lines, or “spokes,” in several directions to peripheral, or “rim” lines. The segregated lines then cluster in the interstices formed by this wheel structure. Underlying the differences in size, location and topography, therefore, the two settlements share the same “deep structure” or genotype.

Is this, then, also a socio-spatial genotype? The form of the core surely gives a clue. By linking the interior of the settlement to the periphery in several directions — and always in the direction of the main entrances to the settlement and the neighboring towns — the effect of the integrated lines is to access the central areas of the town from outside, while at the same time keeping the core lines close to the segregated areas, in effect linking them together. Since the core lines are those that are most used by people, and also those on which most space-dependent facilities like shops are located, and the segregated areas are primarily residential, the
effect of the core is to structure the path of strangers through the settlement, while at the same time keeping them in a close interface with inhabitants moving about inside the town. The structure of the core not only accesses strangers into the interior of the town, but also ensures that they are in a constant probabilistic interface with moving inhabitants. Indeed, it seems reasonable to propose that the spatial structure of the settlement exists in order to construct this interface.

Not all towns have this type of structure: it depends on what kind of interface is to be constructed. In the two settlements we have just looked at, the structure of space has to do with the practicalities of moving people into and around the settlement. Space plays a largely instrumental role. In other types of town, however, space appears to be organized more to relate buildings of symbolic importance, something that is largely lacking in the towns we have looked at.

Let us begin with an extreme example: the pre-Columbian American “town” of Teotihuacan (fig. 19). In spite of the fact that the compounds seem to be based on a standardized metric, the town seems to lack any obvious form of axial logic — apart, that is, from the single central axis which passes between the Great Compound and the Citadel, crosses the town and strikes full face onto the Pyramid of the Moon at its other extremity.

In fact, the more we look at it, the Teotihuacan seems to contradict the spatial logic of the “instrumental” towns at every point. In spite of its greater geometricity, the open space is more broken up, both convexly and axially.

Fig. 17: A justified graph of spatial relations in Gassin (a) from an “integrated” line, (b) from a “segregated” line.

Fig. 18a: Axial map of Gassin with the 25 percent integration core shown in heavy black, and the 25 percent most segregated lines shown dotted.

Fig. 18b: Axial map of Apt with the 10 percent integration core shown in heavy black and the 50 percent most segregated lines shown dotted.

There is no consistent relation between convex spaces and building entrances. On the main axis, there are very few, if any, everyday building entrances, and to a great extent the axis is bounded only by ceremonial structures. This axis also approximates in itself to a convex space. Instead of an axial line penetrating many convex spaces, the convex space is expanded to become co-terminous with a single axial line. Nor does this axis link edge to center in the manner of the previous cases. It runs between two major buildings and strikes another full face.

This orthogonal striking of major axial lines on building facades is again a property not found in the previous two cases. In these, most axial lines “glance off” major and minor buildings indiscriminately at open angles, suggesting movement beyond the point where the line strikes the building. Only in the more segregated areas do lines strike buildings more orthogonally.

I suggest that this basic morphological scheme is the one that tends to be used in towns which are less concerned with the production of everyday life and more with the formal reproduction of social structures. The orthogonal end-stopping of axes on major buildings, in contrast to the way in which lines glance off buildings in instrumental settlements; the expansion of convexity to cover most of the length of major axial lines, as opposed to the linking of convex spaces by axial lines; the removal of everyday buildings from selected major axes, as opposed to their ubiquitous presence; the running of major axes from major building to major building, rather than to direct movement from outside to interior and
out again; the strong contrast between a few very powerful spaces and the much more even distribution of integration throughout the settlement — all these are the means by which the spatial structure of a town is changed from being an instrument of pervasive but variable co-presence to a symbolically ordered ideological landscape expressive of the forms of power in a society. Versailles and Brasilia (figs. 20 and 21) are examples of such structures. So is Krier’s New Luxembourg (fig. 21a).

These two types of town (there are also many others, of course) are not simply unlike each other; they are systematically unlike each other. The principles they use are in key morphological senses the opposite of each other; and they are so because they realize in space quite different social schemes and priorities. And their encounter consequences are different. In instrumental towns, space is differentially used but is everywhere dense. In symbolic towns, many important spaces are much more sparsely used. The spatial genotype as it were freezes the instrumental use of space, thus emphasizing its primarily symbolic nature.

In many towns, of course, one can find both types of spatial ordering, but, I suggest, always in such a way that the functions of everyday production and exchange are realized through the first, instrumental principles of
spatial patterning, while those that have to do with the functions of social reproduction are realized through the second, or symbolic principles of order. In other words, the means by which social formations impress themselves on urban form are themselves subject to regularities which, in turn, are the product of underlying laws. To understand towns, therefore, we need understanding also of this second type of law, and these could not have been understood without prior knowledge of laws of type one.

Type 3: Laws from space to society
Laws from space to society are those by which determinable and describable effects on people arise from spatial form. This is the dangerous ground of architectural determinism, a hypothesis which I, among others, have argued against in its naive forms. I must therefore state my case with great care. I argue that the belief that spatial form has no effects on people and society is patently absurd. If this were the case then we could design every monstrosity without penalty. My proposal is that the determinable effects of spatial form on people are both limited and precise. Spatial form, I argue, creates the field of probable — though not all possible — encounter and co-presence within which we live and move; and whether or not it leads to social interaction, this field is in itself an important sociological and psychological resource. I will try to show that this field has a definite structure, as well as properties of density or sparsity. It therefore deserves a name. I will call it the virtual community, meaning that it exists even though it is latent and unrealized. The virtual community is the direct product of spatial design.

While I believe I can demonstrate the existence of the virtual community as an entity with a definite structure, I can only express my belief that it is a sociologically important entity, and only argue that the relationships that have usually been advanced in support of architectural determinism — for example the relation between architecture and crime, or that between architecture and community formation — if they exist at all, exist through the intermediary role of the relationship between spatial form and the virtual community. Without knowledge of this fundamental relation, it is impossible to identify any systematic relation between architecture and people.

Because the virtual community is the product of spatial configuration, it has only been possible to detect its existence by the use of space syntax analysis, coupled to very precise and systematic observation of where people are in space and how they move. Systematic observation of spaces on the basis of a syntactic analysis shows that the rates at which people use space and move through it are statistically reliable properties of spaces, and can be assigned to spaces as encounter rates for those spaces. Different encounter rates can be established for different categories of people: moving and static people, men and women, adults and children, and so on. Because they are numbers, these encounter rates can then be correlated with the values (for example, integration values) assigned to the spaces by syntactic analysis. The pattern of correlation will then allow us to build up a picture of the fundamental relationship between the spatial configuration and encounter pattern of an area. This relationship is the structure of the virtual community for that area. It turns out that this relationship is, again, in itself, lawful. The laws of the socio-spatial entity we call the virtual community are then my laws of Type 3: laws from space to society.

A considerable body of research now exists on the relationship between the spatial syntax of an area and its encounter pattern (HILLIER et al., 1987). Here I simply illustrate this work by reference to a single large scale study in north London. Figure 22 is the Ordnance Survey map of a section of north London stretching from King’s Cross in the west, the limits of the City in the east, and Holloway and Canonbury in the north. Six local studies were carried out in the area: two of nineteenth century street systems, three of housing estates built in the last quarter century, and one a mixture of estates and a residual street system.

Figure 23 is an axial map of the area considered as
a street system only. Figure 24 is the same axial map with the ground level of the estates added. The contrast is instructive. Although the estates cover only a fraction of the total surface, they more than double the number of lines in the system, with an average length of line much shorter than in the street system. This is true of all the estates, even though some are early modern slab blocks, others are sixties blocks-in-courts megastructures, and other recent neo-vernacular attempts to copy the urban or village past. All, it turns out, dramatically reduce the scale of effective space, and render it much more localized, and deep from the street system, and therefore substantially more segregated from the urban fabric as a whole. This can be expressed mathematically: the mean integration of lines in the street system is .76, a typical urban value for London, while that of the estates is .96 — the higher number expressing substantially more depth and less integration.

But the street areas and estates also differ on another fundamental mathematical property, which we call intelligibility. Intelligibility is the degree of correlation that exists in a system of spaces between how connected each line is to others, i.e. how many immediate neighbors it has intersecting it, and how integrated it is into the system as a whole. We call this measure intelligibility because the number of lines intersecting a line can be directly seen from that line, while the property of integration cannot be directly seen since it expresses the depth of a line from every other space in the system, most of which will be invisible. The degree of correlation between connectivity and integration for lines in a system therefore expresses the degree to which the local and visible properties of spaces are a good guide to the global and merely inferable position of spaces in the area as a whole. In the case of figure 24, the degree of intelligibility in the street areas is .61 (a high value expresses more intelligibility), while for the estates it is only .26. This mathematically captures the intuitive sense that the spatial structures of the estates somehow lack structure and intelligibility, even where they are relatively geometrical.

Now let us look at some of the results of encounter studies. Figure 25 is the map of one of the street areas, the St. Peter's Street area, figure 26 is its black on white space structure, and figure 27 is its axial map with integration core and segregated areas marked in the usual way. The most integrated lines are the relatively short lines that pass through the village center for the area, with shops and various other facilities. The next most integrating lines then link this “village center” to the most important peripheral lines of the area’s “supergrid,” which also act as part of the area core. In effect, the area reproduces something like the “deformed wheel” core that we noted in the two original settlements. This, it turns out, is true of most inner London named areas, like Soho or Covent Garden.

Figure 28a is then a scattergram in which the vertical axis is the integration value of lines and the horizontal axis the mean observed encounter rate for moving people on those lines. If this relationship were perfect — that is, if integration were a perfect predictor of encounter rate — then the points would lie in a precise line at 45 degrees. As it is, the distribution gives a powerful approximation of this, with a statistical correlation of .7742 (a perfect correlation would be 1, and random rela-
tion 0). This is about average for an urban area. Other spatial parameters (for example, the simple connectivity of lines) will also show a good correlation, but in most types of urban area integration is the best, and can be used with considerable reliability as a means of predicting the general movement pattern of a layout at the design stage.

However, several other important spatial effects can be discovered by pursuing the correlation between integration and encounter rates for moving people.

- First, in figure 28a, the scattergram is rather lumpy. It turns out that if we divide the area into localized groups of linked lines — while still calculating integration in terms of the whole area shown in figure 27 — then the correlation between integration and movement within these groups is even stronger, usually at about the .9 level. This does not always happen in an urban area. It only happens where there is some tendency for identifiable sub-areas to form within the main area. In this case, the sub-areas are formed by the divisive effects of a canal, an industrial development and housing estates, one very large. Part of the lumpiness of the scattergram reflects this tendency towards sub-areas. It is important.

- Second, the integration values used in figure 28a are calculated only on the basis of the street system, ignoring the level ground interiors of housing estates. If integration values are re-calculated to include these, then scattergram 28b is the result: a marked deterioration in the correlation. This shows in a very simple way that the interior space patterns of the estates are unrelated to the way in which the street layout is producing a predictable encounter pattern. The predictive power lies only in the street pattern itself.

- Third, if we then re-calculated the integration values to take into account the much larger area shown in figure 23 (or indeed any larger area than the one shown in figure 27), then once again there is a dramatic deterioration in the correlation. This shows, again, that the encounter pattern of the area is very much a product of the area itself, and that it is not much affected by the pattern of other areas. The St Peter's Street area thus operates to some extent as a natural area within the larger urban framework, to which it is, however, highly connected and with which it shares the all-important supergrid. Optimizing correlations between encounter rates and integration by varying the scale of the area referred to in the integration calculation thus offers a powerful method for identifying "natural areas" within a larger urban system. Whatever reference area we use to measure it, integration in nearly always the best spatial parameter for predicting the encounter rates for moving people. People construct their patterns of movement, it seems, according to the picture they have of the axial depth of spaces from each other, with reference to a fairly large system of spaces. Effective spatial knowledge is thus at some level global knowledge. It is this that gives rise to one of the most fundamental of all spatial properties of urban areas: that the knowledge people have of the spatial structure of an area is also knowledge of encounter potential. Our picture of the area mixes space and people, because encounter rates are predictable from spatial structure, and spatial structures are arranged to be so predictable.

There is, however, a significant caveat. This relationship — the very basis, I would suggest, of the virtual community — only exists to the extent that the area is intelligible (in the mathematical sense in which we have defined it). Once again, this can be demonstrated.

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Fig. 28a: St. Peter's Street urban area; correlation of encounters with integration ($r = .7742$).

Fig. 28b: St. Peter's Street urban area with estates included; correlation of encounters with integration ($r = .5983$).
In the estates shown in figure 24, intelligibility breaks down, whether the estates are considered on their own or as part of some larger area. In close parallel, the predictability of encounter rates from spatial structure within the estates also collapses. Figure 29 is a scattergram of the relationship between intelligibility (the correlation between connectivity and integration) and predictability (the correlation between integration and observed encounter rates for moving people) for the six studied areas. As intelligibility increases, so predictability improves almost linearly.

But it is not only the predictability of encounter rates from integration that falls in the estates. The encounter rates themselves fall to, on average, about one third of the rates in the residential street areas. This occurs in spite of the fact that the housing densities are often much higher on the estates. Remarkably, there are more people in the estates, but the encounter field is much sparser. Figure 30 is then a scattergram of the relation between mean integration and mean encounter rate for each of the six areas. Again, the correlation is very powerful: as integration improves, so the mean encounter rate increases. In other words, just as the predictability of encounter rates from space depends on intelligibility, so the actual level of encounter in an area depends on its degree of integration into the larger scale system. These two effects between them constitute, we believe, the often observed “urban desert effect” in new estates, where much space is empty for much of the time and people only appear in space unexpectedly.

One final correlation: the degree of intelligibility in an area turns out itself to be highly influenced by the degree of integration. Figure 31 is a scattergram showing the correlation between integration and intelligibility in the six areas. The correlation is weakened, it turns out, by the presence in one of the estates of a main street system line which runs through it and which improves the measured intelligibility of the estate more than it improves its integration. Properly speaking the line should be removed, but if it is, the estate decomposes into two segments. If we remove this estate from the scattergram, however, the correlation again becomes very powerful (fig. 32).

This interrelationship between integration, intelligibility and predictability has been explored now over a whole range of observational studies, and seems to be fundamental. We have also explored the purely spatial interrelationships statistically on a sample of 75 towns and urban areas drawn from many parts of the world to see how far they permit us to use these concepts in building a general theory of the spatial structuring of urban systems, with special reference to the problem of growth. Here again they show themselves to be very powerful. Taking observational and purely analytic studies together, we are in little doubt that these three properties offer the key to understanding the well-ordering of urban systems, and therefore of the virtual community, which it seems to be their function to construct. The third type of law may therefore turn out to be the most powerful and basic of all the types of law, in the sense that all three types are in some sense a product of this basic propensity for space to construct the field of potential encounter and co-presence we call the virtual community.

The city as socio-spatial artefact

Of course, this is not all that urban space does. But, I would suggest, the spatial generation of the virtual community is the precondition for space doing anything at all. What else space does refers, I suggest, to some transformation of the virtual community, requiring a parallel transformation of space. To explain this further, I would like to advance two propositions, and then develop them a little on the basis of one more example: the City of London.

The notion of community always has within it the theoretically dangerous idea that people are members of a community. This leads the researcher to try to identify the community of which an individual is a member, to discover its spatial limits and to analyze its structural complexities. This overlooks the fact that the defining feature of human societies — in contrast to, say, ant or wildebeest societies — is that each individual belongs to many types, or transformations of community. At the very least, every individual will belong to at least one spatially defined group — a household group, a village or a university are all instances of such, being defined in terms of the spatial continuity of some domain and the everyday spatial proximity of members — and at least one transpatially defined group, such as a clan, a trade, or an academic discipline. These I call “transpatial” because they link people of a similar category or kind, regardless of spatial proximity. Transpatial groups work by analogy or identity rather than spatial contiguity. They overcome spatial separation, and integrate conceptually individuals that are spatially apart.

Fig. 29: Concatenated area correlation between intelligibility and real predictability for 6 systems \( r = .5938 \).
Fig. 30: Concatenated area correlation of integration with log encounters \( r = .9827 \).
Fig. 31: Concatenated area correlation between integration and intelligibility for 6 systems \( r = .9401 \).
Fig. 32: Concatenated area correlation between integration and intelligibility for 5 systems (excluding Packington) \( r = .9405 \).
Now it has become common to argue that the existence and even dominance of transpatial groupings in societies, and their lack of correspondence with spatially defined communities, is evidence for the independence of society from space. Nothing could be farther from the case. All transpatial groupings have, at some time or other, a spatial realization. Any transpatial group that does not from time to time realize itself in space is likely to risk its existence as a group. Thus clans have ceremonies, trades have congresses and academic disciplines have conferences.

Now it can happen, though rather rarely, that spatial and transpatial groups will coincide with each other, and create a correspondence between these two types of human membership. Such systems tend to produce tight, localized and internally hierarchical socio-spatial groups, because both types of membership reinforce each other and tend to render the social group closed. Sadly, the current fashion for the "territorial" theory of human space in some parts of the Anglophone world, especially the USA, has led to the implicit adoption of the "correspondence" type as being both basic to human nature (the history of humankind has been rewritten to make this tragic idea appear plausible) and actually desirable as an ideal.

I have dealt with this problem at length elsewhere (HANSON and HILLIER, 1987; HILLIER and HANSON, 1984) and it is not my main theme here. What I want to describe here is the more common human situation, where individuals are not only members of many different transformations of community, but that these transformations all co-exist in the same spatial domain, even though each transformation of community unfolds in space in a different way, often according to spatial principles that contradict those of another transformation. The city is the archetype of such a spatial domain. Each urban individual lives his life in various kinds of membership, using different spatial principles for each. How these different spatial principles unfold in relation to each other defines the city as a socio-spatial artefact.

This must sound obscure, so let me work through an example. Figure 33 is a map of the City of London dated 1800, before major changes were made to it in the nineteenth century. It is a typical deformed grid with a covering core, that is, a deformed wheel but without the peripheral spaces. What interests me here is, however, not the spatial structure alone, but the spatial structure in relation to the various public and institutional buildings that form part of it, that is, the buildings that relate to various kinds of community membership.

First, some preliminaries. A striking feature of the City is the extent to which it lacks the kinds of spatial and formal ordering which I defined as characterizing the cities of social reproduction. Thus, the most famous building of all — St. Paul’s Cathedral — is axially virtually unrelated to the urban fabric as a whole. The three major buildings at the center — the Mansion House, the Bank of England and the Royal Exchange — all manage to avoid orthogonal axial lines on their facades in spite of their strong central location, and this is still true today, even though three new major axes are linked to the central area. The major buildings are, it seems, locationally but not spatially significant in the urban surface. The logic behind this is not hard to find. The City of London is structured in such a way as to generate the dense and continuous encounter field on which its history as a center of commerce depended, not in order to express the categories of ideological power.

When space does play a role in relation to institutional buildings, however, it is both subtle and unusual. There are two dominant types of institutional building distributed through the urban fabric of the City: guild buildings (i.e., the buildings of the old medieval guilds) and churches (most of them rebuilt by Wren after the Great Fire). Each type is spatially distinctive. Churches, unusually — especially considering their architectural importance — are often built into the urban fabric, with other, "profane" buildings contiguous to them. In spite of this, most are relatively prominent in public space. Many — though by no means all — are located on significant axes, and everywhere their presence in public space is evident, even when partly concealed by neighboring buildings.

The guild buildings, on the other hand, are much more discreet. One is hardly aware of them from the public spaces. They make little show to the outside, and the courtyards which are a common formal feature tend to be separated from public space by narrow passages. It is only when one arrives in the courtyards that the buildings begin to express themselves as architecture. If one looks further for the halls that constitute the main ceremonial meeting places of the guilds, then this impression is stronger: halls are several steps deep from the outside spatially, even when they have physical adacancy to the courtyard. The guild building seems almost a private realm, and not at all what one would expect of a building concerned to express the identity of a social group in the urban landscape.

Now these two types of building do, of course, embody

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different concepts of "social solidarity" — different transformations of community in my terms, with different kinds of membership. The guild building stands for a transpatial solidarity. It summons all apothecaries, or fishmongers or drapers, regardless of where they are located in space. Its catchment area is not defined by space, but by categoric similarities among individuals. It therefore has some kinship to the sociological concept of "mechanical solidarity" as defined by Emil Durkheim (DURKHEIM 1915; 1933). It celebrates the difference between an individual and his spatial neighbors by calling him or her, but not them, to a separated locale in which this identity can be expressed. Separation is crucial to such identities. Without it, they are in danger of contamination. Only power can express social distance without spatial separation — hence the ideological landscape of the city of social reproduction.

The churches, in contrast, work on socio-spatial principles which are exactly the contrary. The catchment area of each church is spatial. It belongs to its parish; that is, it belongs to a group that is spatially defined, and takes no account of the categoric differences that might exist among the people of that parish. Insofar as its catchment area extends outside the parish — and it does of course do so, since the church is created by, but not restricted to, members of the parish — then it continues to be indiscriminate in this way. In its main interior space — which lacks the careful distancing from outside found in the guild halls, it celebrates not the identity of a categorically defined group, but the community formed by all who happen to be present, explicitly without regard for the social differentiations that prevail outside. This is the transformation of community that Victor Turner, the anthropologist, has so brilliantly identified as "communitas" in his book The Ritual Process (TURNER, 1969), as that form which prevails either in transitional or liminal states in ritual or as temporary states within ritual celebration, and which is characterized by the temporary suspension of all social differentiations and manifestations. Of its essence, "communitas" destructs society in order to create an undifferentiated, if temporary, community subordinate only to the ritual principle itself.

Typically, the individuals of the City will belong to both types of community, and easily move from one to another, using different socio-spatial principles in each case. But membership does not end there. Both of these memberships are realized inside buildings which in some sense represent specific groupings. However, other, less structured and more indeterminate forms of membership are also realized outside buildings in the public space of the town.

Again, we may have recourse to Durkheim, this time to his concept of "organic solidarity." Organic solidarity is, according to Durkheim, a form of social cohesion based not on categoric similarities (as mechanical solidarity is) but on the instrumental differences that arise from the division of labor into specialist trades, and the interdependence that this brings in its train. Such instrumental interdependence depends on a high degree of spatial integration, and a high generation of random encounter is needed to support the field of interaction required to maintain such a system in operation. Much of this interaction occurs at the interface between the domain of the individual tradesman and the pattern of public circulation in the streets. This interface is spatially designed so as to maximize this form of interaction of individuals with different instrumental identities. The streets, therefore, insofar as they relate to everyday building entrances, constitute a space of instrumental interaction, or of the organic solidarity of individual differences.

In other words, the street interface realizes in space the individual differences that form the basis for the group differences celebrated in the guild building. But just as there is an undifferentiated transformation of the differentiated interior community, realized in Turner's "communitas" in the churches, so I believe there is an undifferentiated counterpart to the interactive community of the street interface: the transformation of community which results from the mere non-interactive (or pre-interactive) co-presence of people. This occurs not so much at the street interface as in the streets themselves, and at the indeterminate interface of an area of streets with the world of strangers, a form of community perpetually growing or shrinking as a function of the capacity of the pattern of space to make this community dense or sparse, structured or unstructured, continuous or sporadic. This transformation of community is of course the virtual community itself, perhaps the fundamental entity from which the other transformations are possible.

We may summarize these four transformations of community in a simple model (table 1).

Table 1
The four transformations of community

<table>
<thead>
<tr>
<th>Community type</th>
<th>Differentiated</th>
<th>Undifferentiated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transpatial or inside</td>
<td>mechanical solidarity or type differences spatially separated</td>
<td>communitas or undifferentiated community bounded and ritualized</td>
</tr>
<tr>
<td>spatial or outside</td>
<td>organic solidarity or type differences partially mixed</td>
<td>virtual community or undifferentiated community unbounded and profane</td>
</tr>
</tbody>
</table>

The essence of this model is that its spatial dimensions move strongly from the local to the global. They depend on the non-existence of local boundaries, and on a non-correspondence between the social and the spatial. With the exception of the guild buildings, the boundary of the individual domain is weak, since its aim is to construct an interface with the outside. Likewise, the boundary of the virtual community is weak, both at the level of the local area and of the City as a whole. At each level, it admits strangers, and thus always tends to growth rather than restriction or stabilization. Boundaries in the system are associated with the transpatial — that is, with the creation of solidarities that do not depend on the structure of the encounter field. The urban space pattern as a whole thus reflects the globalizing tendency of the encounter field itself, rather than an order based on representational buildings. It is geared to the continual generation of virtual community, and the conversion of the virtual community into the interactive community through the interface of building and street.
Modern transformations

Against this background, we can begin to see that the transformations of the urban landscape by modernism and its successors have not only a spatial logic, but also a social logic. We can explore this at two levels: the local urban area; and the global structure of the city. The former is dominated by the idea of enclosure; the latter by the urban monument. Each claims ancestry in the European city. Yet each inverts the common forms of the structure of that city.

Let us begin, as usual, by looking at examples. Figures 34 to 37 are all taken from Kirschenmann and Muschalek's Residential Districts, an international review of built designs published in 1977. By looking through its pages we can begin to see that certain formal and spatial themes — not those which took pride of place in theoretical debates — have a universality which compels us to regard them as paradigmatic, that is as emanating from a deep, taken-for-granted scheme of assumptions rather than from a specifically articulated theory.

I suggest that we can sum up these paradigmatic ideas in three concepts which between them offer the characteristic modern solution to the fundamental problem of urban design: that of combining local parts to form a global whole. These three concepts are: enclosure, repetition, and hierarchy. I will discuss these concepts with reference to a pair of examples drawn from the beginning and end of the modern period.

- Enclosure is the concept through which the smallest urban spatial element is defined. Spatially, it means that a (normally convex) space is defined as distinct from others by being more or less surrounded by buildings. Socially, it means that the buildings and their occupants have a special relationship with that space, a relation that is usually defined in terms of identity. Socio-spatially, it means that the inhabitants are expected to identify with each other through the shared identity with the enclosed space. Morphologically, of course, our research on encounter fields shows the argument to be nonsense. Such spaces are invariably empty of people: of strangers, because they are inevitably segregated from the natural movement patterns in the larger scale urban landscape; of inhabitants, because people forced by space into an over-direct and coercive encounter relation in circumstances where the lack of strangers also implies the loss of useful urban anonymity, invariably seem to reinforce those behaviors of circumspect avoidance by which we regulate relations with neighbors. The segregated spatial enclosure in effect normally negates the spatial community.

- Repetition is then the regulating principle by which a larger scale system is generated out of the local parts. Spatially, it encourages a certain geometricity in layouts, and eventually the domination of spatiality by geometricity. Socially, the principle is loaded with the implication of a segmentary society, that is, a

Figs. 34 to 37: An international selection of housing schemes.

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34 Dimona, Israel
35 Bruket, Sandviken, Sweden
36 Sterishoop, Hamburg, Federal Republic of Germany
37 Pollards Hill, Surrey, England
society composed of separate but identical sub-units, whose integration into a larger society is through symbolic identities rather than through the spatial integration of practical interdependencies. This again resembles the Durkheimian concept of mechanical solidarity, with the addition of the idea that the symbolic identities of segmentary groups arise in the first place from a spatial identity.

- Hierarchy is then the principle by which the aggregation of local parts is given a globally ordered form. Spatially, it means that the local principle of enclosure is applied at a higher level. In parallel, the social implication is that the higher order application of the spatial principle stands for the identification of higher order social groupings, which, as at the smaller scale, couple this distinct identification with separation from the larger world.

The idea of hierarchy as the globalizing principle confirms the ascendancy of geometricity over spatiality. It creates an urban surface which has conceptual intelligibility on the drawing board or when seen from the air, but which destroys the spatial intelligibility from local to global which is the essence of the traditional town. It also destroys the virtual community and its potential to convert into the interactive community through the interface of building and open space. Through its localization of the primary spatial element, the enclosure, it limits the scope of the virtual community to a small group of neighbors; and by its removal of the dwelling entrances from the system of truly public space, it limits the interface potential to the same group.

In all respects, then, this modern paradigm of space is founded on a principle of correspondence between groups of people and spaces, and it is this that leads to the dominant values of enclosure and identity as architectural virtues. It is these alleged virtues, however, that most deeply contradict the socio-spatial principles of traditional urbanism. It is this paradigm, not the high-rise building, that has led in our time to the progressive destruction of the urban fabric of our cities through a whole series of architectural movements.

The essence of the modern transformation of the city is the loss of a global order arising from the way local parts are defined. It is this loss of the global that is at the root of our current preoccupation with monumentality. Monumentality is intended to be the means by which the global urban order is reconstituted. But of course without the reconstitution of the urban fabric itself it can only lead to a caricature, a city in which the monumental structure is added to the city as a separate region in an otherwise spatially fragmented system. Such quasi-urban forms bring to mind the frightening social systems of the proto-urban societies of the ancient near east and pre-Columbian America rather than anything that can be found within the urban tradition proper.

But even if monumentalism is re-integrated into the urban fabric as a globalizing device, it can still only succeed in re-creating the city of power and social reproduction, not the city of everyday life and work. Such everyday cities, which are by far the dominant type in urban history, typically do not depend on monumentality for their global form. On the contrary, global form arises from the way in which space is articulated from the local to the global scale. Monumental buildings are then fitted discretely into an urban fabric whose spatial structure is given by considerations which are at once mundane and marvellous — mundane because they arise from the elementary need for cities to construct an encounter field with a certain structure and density, marvellous because it is this that gives rise to the exhilarating sense of urbanity which pervades everyday life in such cities, and which has given them their dominant cultural character.

The sense of urbanity, I suggest, can only be retrieved in our cities through a new paradigm of socio-spatial organization, one which emancipates itself from the current obsession with localism coupled to monumentalism and reinstates the principle of global spatial design through the deformed grid, in which local places are differentiated from each other, and yet the whole is intelligible from the parts. Space syntax is, I believe, a necessary part of the means to the understanding and design of such urban systems.

**Conclusion**

I am aware that I have not offered a full theory of urban space, far less a theory of urban form. I have not dealt with the third dimension, nor with the style and form of individual buildings (HILLIER, 1985) and have only sketchily dealt with the location of major public buildings in the urban structure. Nor have I dealt with the concept of “memory,” and all that implies for the temporal dimension of cities — though I do believe that the concept of “intelligibility” opens up some of the configurational dimensions of urban memory. All these are aspects of current space syntax research but each would require a presentation as discursive as this one, and must therefore be kept for another occasion.

However, I must not disguise my belief that, important as these other aspects are, it is the syntax of space itself, especially at the global level, and its relation to the virtual community, that is at the heart of the urban question. This I believe is equally true whether we think of it as a question of understanding and research or as a question of design and action. Space syntax, and its associated theory, is both. It is both research instrument and design tool. In either case, it is a “thing to think with.”

**References**


