

Order and structure in urban design: The plans for the rebuilding of London after the Great Fire of 1666

Julienne Hanson

Dr Hanson is Lecturer in Architecture at the Bartlett School of Architecture and Planning, University College London. She directs the MSc in Advanced Architectural Studies which works in close association with the Unit for Architectural Studies and supervises a large number of Ph.D students. She is the co-author with Bill Hillier of The Social Logic of Space (Cambridge University Press, 1984), and has recently contributed several chapters in the new edition of the Bannister Fletcher History of Architecture which was edited by John Musgrove (Butterworths, 1987). In recent years she was the coordinator of the second year design studios at the Bartlett.

Introduction

Whenever we design, whether it be a building, an urban area, or an entire town, we tend to use *order* concepts to organize the plan: order, in the sense of principles based on some generally accepted notion of sameness, repetition, geometry, grid, rhythm, symmetry, harmony and the like. These concepts speak to us directly without mediation, and can be apprehended at once, almost as a gestalt. Because order concepts are formal, they appear logical. Order concepts are one of the principal means by which we recognize the architectural imagination at work.

There is a tendency to assume that order yields *structure* in the experiential reality of the buildings and places we create through architectural means: structure, in the sense of making places intelligible through creating local differences which give both a sense of identity and a grasp of the relation between the parts and the whole, such that we are able reliably to infer the global form from any position within it.

But order and structure are not the same thing at all. A plan or a bird's eye view represents buildings and places with a conceptual unity which cannot be duplicated on the ground because we do not experience architecture this way. Moving about a building or place fragments our experience. We learn to read structure over time. Hence, an apparently disorderly layout may turn out to be well-structured and intelligible to its users, whereas a highly-ordered architectural composition may in fact be unstructured when we experience it as a built form. However much we may appreciate order concepts when criticizing architecture on the drawing board, well-structured realities seem to be what matter most on the ground, not least by generating and controlling patterns of everyday use and movement.

This view is argued here by looking at an historical example from urban design: the proposals for the redesign of the City of London after the Great Fire of 1666. If order concepts have any place in the architecture of the cities of the future, it is to confirm structure and not to disguise its absence.

London, the great emporium

The City of London on the eve of the Great Fire of 1666 is generally held to be the archetypal organic city, moulded directly by social and economic processes without the imprint of conscious design. All the accounts describe it as disordered, overcrowded and insanitary. Few houses were constructed from stone or brick, and the majority were of timber-framed construction built according to regulations first laid down in the twelfth century. Streets throughout the City were narrow, overhung by tall jettied buildings and blocked by open markets. The conditions in the interiors of the urban blocks were terrible, produced by a combination of dirt, open sewers, overcrowding and a maximum coverage of sites by buildings. The main thoroughfares were lined by the more prestigious houses of the merchants and traders from whose activities the City derived its wealth and power. In this way rich and poor lived side by side, but wealth was precisely indexed through proximity and adjacency to the main theaters of public life.

This apparent disorder does not mean that the City was in a state of decay. On the contrary, continental visitors of the time found it a stimulating, vital and even awe-inspiring place which embodied the best of contemporary urban life.¹ The shops and selds² of Cheapside, the main shopping street of the City, were thronged by customers and were renowned throughout Europe for their concentration of luxury goods. Cheapside was flanked by buildings rising to a height of six storeys along much of its length, and was lined by elaborate facades which were emblazoned with the names and signs of retail traders. It was the most important place of open air public display and spectacle within the City (fig.1), but much of the everyday life of the City took place out of doors in the dense grid of streets confined within the square mile of the Roman walls. The entire City functioned as a great trading emporium, with an economy dependent on the maintenance of a dense pattern of everyday interaction and encounter in the public space

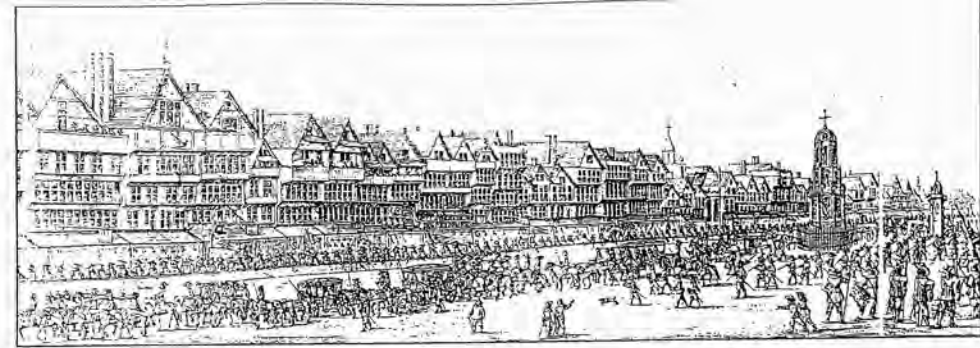


Fig. 1: Cheapside, London, in 1638, showing the processional entry of Marie de Médicis into the City. (Source: Derek Keene, *Cheapside Before the Great Fire*, ESRC, 1985).

of the streets.

All the contemporary accounts paint a picture of a City which was disordered but well-structured. While this is difficult to ascertain from the map record,³ the first true ground plan of the mediaeval City, that of the devastated area produced immediately after the Great Fire by Leake (fig. 2), corroborates verbal accounts of an intelligible working city. Analysis cannot be relied on in the detail, but the general shape of the main street grid yields a picture of public space which is both broadly in line with historical accounts and is also comparable in terms of scale and attention to detail with the set of proposals for the reconstruction of the City. Leake's plan therefore provides a benchmark for looking at the design proposals for the reconstruction of London after the Great Fire.⁴

A glance at the ground plan (fig. 3) of the City abstracted from Leake's map picks out immediately the principal streets of mediaeval London. In the approximate mid-point of the north-south axis run the major market streets of Newgate Street and Cheapside, fanning out in the heart of the City towards the north and east. The road from Bishopsgate, the main road into London from the north, to the lowest crossing point of the Thames at London Bridge⁵ can be seen clearly a little further to the east. The southern half of the plan is cross-cut by a dense lattice of small streets and lanes. The longest and straightest of these run in an east-west direction, parallel to the river. The riverfront itself is close-packed with wharves. North of Cheapside, development is relatively sparse and fragmented.⁶ The only large open spaces in the street network surround the dominant buildings of St. Paul's and the Tower. Both are ancient public gathering places. The remaining public buildings, the parish churches and the guild buildings⁷ are, with the exception of the Guildhall complex to the north of Cheapside, completely embedded in the building fabric and form a random scatter throughout the plan. Some of the more prestigious houses can be picked out as large courtyard formations since the majority were located in the north-east quarter of the City, and hence within the unburned area of Leake's map. The plan transcribes into the axial map⁸ shown in figure 4.



Fig. 2: London — John Leake's plan of the City after the Great Fire of 1666. (Source: Harry Margary, *Lymington Castle Kent in association with the Guildhall Library, London, 1981*).

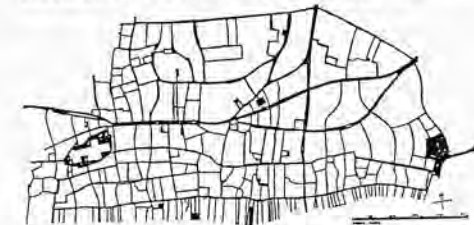


Fig. 3: London — The open space of the City as shown in Leake's map after the Great Fire of 1666, with a 100 meter scale attached.

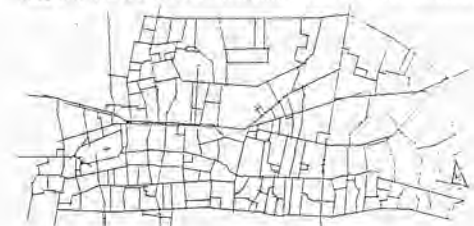


Fig. 4: London — Axial map of the City in 1666.

The integration core⁹ of the City (fig. 5) is concentrated in the heart of the commercial center, linking together the two major open general food markets which are known to date back to the Anglo-Saxon period, the western market which runs the whole length of the thoroughfare from Newgate to the Walbrook with a main focus on Cheap-side and the eastern market, which covers a wider network of streets including Eastcheap, Bridge Street, and Gracechurch Street and runs along Cornhill to Leadenhall. These markets are located on or near the principal east-west and north-south through routes by way of the main City gates. The ancient dividing line of the City along the Walbrook features early within the integration core, as does the street leading up to the mediaeval Guildhall,¹⁰ the administrative and government center. Bow Lane is also picked up in the south-west, pointing in the direction of the more recently established and more specialized food and produce markets centered around Old Fish Street and Queenhithe.

Raising the core to 10 percent (fig. 6) merely adds the streets adjacent to Cheapside to draw the area of the selds and specialist shops selling luxury goods into the core. Radius three integration (fig. 7) confirms the 5 percent city-wide integration core, but there is an interesting shift away from the north and east, and hence away from the Guildhall and the principal residential streets of the wealthiest of the merchants and traders, towards the south-west markets in the area around Fish Street and Queenhithe. Local integration picks out the streets of the everyday marketing system, whereas global integration links the original market areas with the center of power at the Guildhall and the houses of the ruling class of merchant traders.

Segregation (fig. 8) is concentrated around the outskirts of the City, picking up the area around the Tower in the east and the sites of Baynard's and Montfitchet's castles to the south-west of St. Paul's and then consolidating them into two large continuously segregated areas. These were the places where the monarch established strongpoints in the free-trading city after the Norman Conquest of 1066, and it would be tempting to associate these "alien" implants with the distortion of the grid away from those areas of the City. The northern fringe of the City is also relatively segregated, but there is not the same amalgamation of lines into segregated zones. The largest zone of segregated lines is in the extreme north-west of the City, on the site of the Roman fort.¹² Segregation elsewhere is largely confined to the hinterland of some of the largest of the urban blocks which even at this time of intensive development were laid out as orchards and gardens.

There is, however, a second possible account of this distribution of segregation. Within the center of the City, there is very little segregated space indeed. The most consistent feature is produced by the freestanding parish churches. Typically, these front onto a main street but are surrounded by more segregated alleyways whose purpose is to disassociate the church from its profane neighbors and to set it slightly apart. The peripheral segregation matches closely the distribution of monastic foundations within the City, and it is tempting to think that the monks and friars initially selected those locations for their houses which offered them relative seclusion from the hubbub of everyday life.¹³

Insofar as integration is a precise index of the degree



Fig. 5: London — 5 percent integration core of the City in 1666, numbered in order of integration from the most integrated axial line.



Fig. 6: London — 10 percent integration core of the City in 1666, numbered in order of integration from the most integrated line.

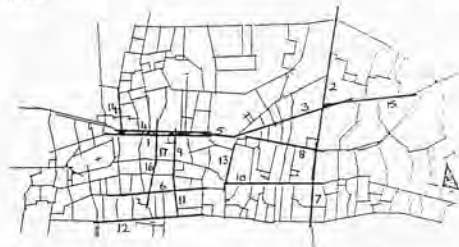


Fig. 7: London — The core of 5 percent most integrated lines in the City in 1666 at a radius of three axial steps, numbered in order of integration from the most integrated line.

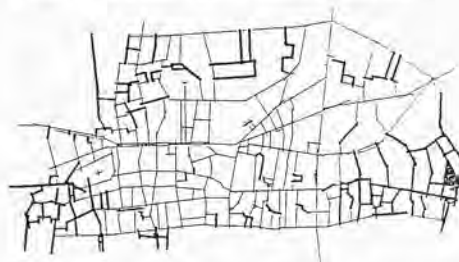


Fig. 8: London — 50 percent of segregated lines in Leake's map of the City.

of space occupation and use,¹⁴ it is clear that the integration core of the City renders the commercial streets shallow and accessible both to the citizens and to strangers from the outside. It constructs a dense and continuous trading interface within the heart of the city which is the mediaeval equivalent of the department store. The apparent visual disorder of the street grid is not symptomatic of an absence of spatial structure.

The first competition design

The story of the Great Fire of 1666 is a familiar one which will not be rehearsed here. What is less well-known is that as a result of the devastation, a number of designs were prepared for the rebuilding of London which, taken together, represent the earliest and possibly the most significant proposals for the rebuilding of a major English town which exist. Furthermore, a comparison of the proposals reveals striking differences in the conceptions of a town held by the various authors, concepts which can still be found today in urban design discourse.

Two of the plans, those by Wren and Evelyn (figs. 9 and 10), are generally held to be a product of an architectural imagination whilst the remainder of those which survive,¹⁵ by Hooke, Knight and particularly by Newcourt (figs. 11, 12 and 13), are ascribed to the domain of planning. This partition is made on the basis that the former appear to be more concerned with built form, aesthetics, composition, shape and motif whereas the latter are a product of functional requirements, the analysis of social processes, density, economics, and workability. In terms of the structure-order distinction outlined above, it is clear that all the plans are derived from order concepts, but that they differ in the degree of complexity involved. The ascription of the designs reflects the extent of the bias towards order in the plans, singling out those which use a more complex set of order concepts as belonging to architecture and those which use a single generating idea as the precursors of modern town planning. This consensus on the origin and locus of the concepts used to generate these town forms co-exists with vociferous disagreement amongst scholars as to the merits or deficiencies of the various plans proposed for the rebuilding of London, as compared with the mediaeval City and the City as it was rebuilt and recorded in 1676 by Ogilby and Morgan.



Fig. 12: Knight's plan for the rebuilding of London photographed by the author from his original manuscript in the Guildhall Library.



Fig. 9: Wren's plan for the rebuilding of London. (Source: C. Hibbert, *London: The Biography of a City*, Harmondsworth, Penguin, 1980).

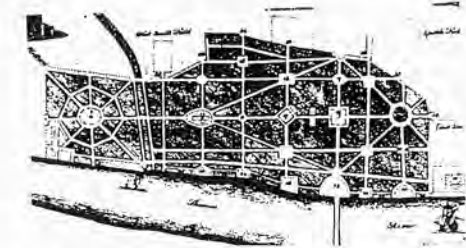


Fig. 10: Evelyn's plan for the rebuilding of London. (Source: Hibbert, *op. cit.*)

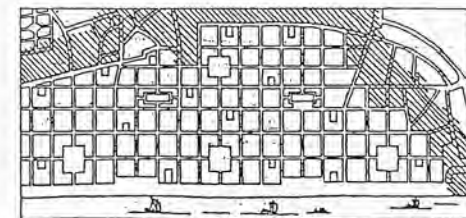


Fig. 11: Hooke's plan for the rebuilding of London. (Source: S.E. Rasmussen, *London: The Unique City*, Harmondsworth, Penguin Paperback Edition, 1960).

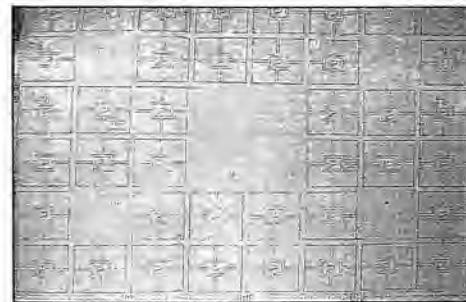


Fig. 13: Newcourt's plan for the rebuilding of London photographed by the author from his original manuscript in the Guildhall Library.

A transcription of the five plans into public open space maps is given in figure 14 and into axial maps in figure 15. For convenience, they are dealt with in ascending

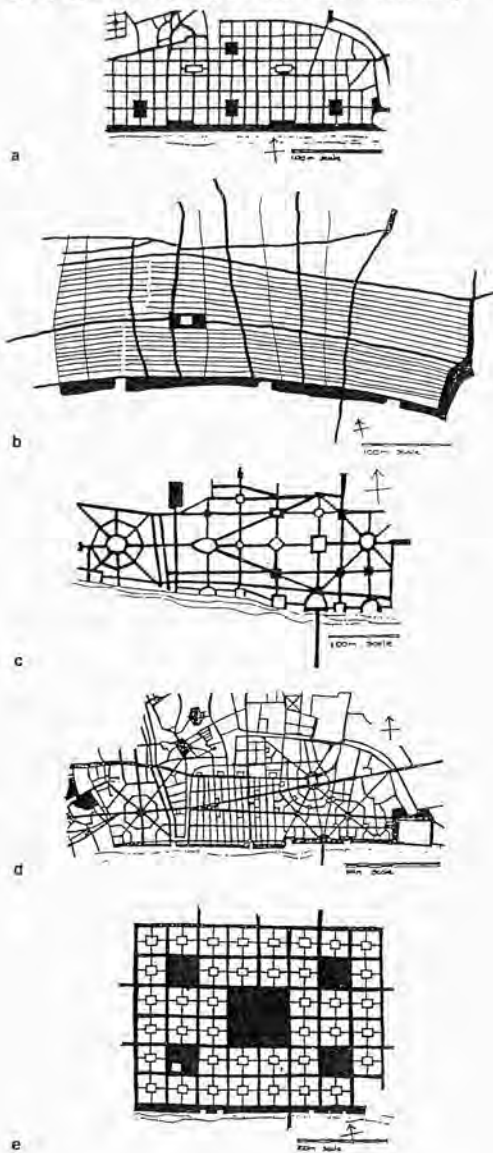


Fig. 14: Transcription of the plans for London proposed by Hooke (a), Knight (b), Evelyn (c), Wren (d) and Newcourt (e) into open space maps — all with a 100-meter scale indicated.

order of size, measured in terms of the number of axial lines contained in each plan; that is, Hooke,¹⁶ Knight,¹⁷ Evelyn,¹⁸ Wren¹⁹ and Newcourt²⁰ respectively.

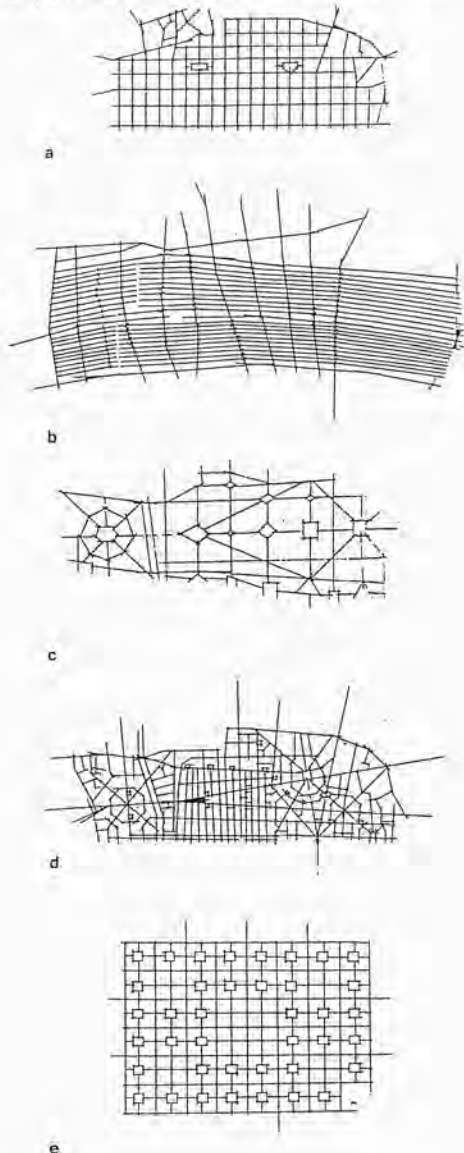


Fig. 15: Transcription of the plans for London prepared by Hooke (a), Knight (b), Evelyn (c), Wren (d) and Newcourt (e) into axial maps.

Each of the plans except those of Newcourt and Hooke, which greatly enlarge the City area and ignore existing topographical features, will be discussed in two stages: first in terms of the area of the design lying within the City walls in order to facilitate comparisons with the City as it evolved historically and then in its entirety.²¹ The plans are first introduced and compared in terms of their respective patterns of open space and then analyzed syntactically.

● **Hooke's plan** shows a square orthogonal gridiron punctuated by four major squares in which markets or fountains were to be placed. The large open space adjacent to the Tower is retained, as is the mediaeval street grid outside the fire-damaged area (shown hatched). The new streets are connected to the old by slight changes of alignment wherever possible. Sites for fifteen churches are indicated in the plan (as opposed to a hundred or more before the Fire) all facing onto the east-west cross routes so that all roads except one, in the north, has at least one church giving onto it at some point along its length. The actual disposition of churches seems random in the sense that they are not located at intersections or in major public spaces. St. Paul's Cathedral and the Guildhall are each located within the interior of two parallel blocks amalgamated to form larger rectangular islands in the heart of the City. St. Paul's, relocated to the north of its actual site, is approached by way of four roads leading from the mid-points of the block to an inner ring of streets surrounding the Cathedral, and the Guildhall, a little to the east of its actual site, is accessed by a similar configuration of routes but with the addition of a small forecourt on the side facing the river.

A major feature of the plan is a wide quay along the entire length of the Thames, although this is clearly notional since it takes no account of the actual curvature of the Thames at the point. The line of the old walls is equally notional, although Hooke seems to have intended to perpetuate the line of the wall in the form of a new ring road. To the west of this road, the grid continues unabated across the Fleet River covering the remaining area of devastation, so that the western extremity of the old City is all but obliterated in the new design.

The sheer size of the proposed market squares and the new quay is striking, particularly when compared with the scale of the building blocks or the apron to the Guildhall. The square grid is pursued relentlessly save where Hooke makes use of the geometric device of "biting into" the corners of four adjacent blocks to accommodate the market squares and major public buildings. This device ensures that, apart from at the center where the through-routes intersect, the squares appear relatively enclosed. In the case of St. Paul's and the Guildhall, the east-west views from the facades are also terminated by the adjacent island blocks so that the only long vista is from the centers of the long sides of the two building facades in a southerly direction down to the River Thames.²²

● **Knight's plan** is rudimentary and incomplete and most of his roads are drawn notionally rather than to scale. However, it is possible to reconstruct something of what Knight intended by comparing his text with the accompanying drawing. Knight intended to have six streets, each 50 ft (approx. 15 m) wide and a further five streets 30 ft (approx. 9 m) wide, all running north-south. Crossing these

in an east-west direction he proposed two major 50 ft (approx. 15 m) wide routes and another twenty streets 30 ft (approx. 9 m) wide, all roughly following the curve of the river. St. Paul's is indicated by Knight as standing in an open piazza between two of his new minor roads, with the southern major road, roughly on a line with the old Fleet Street and Ludgate Hill, striking the west front of St. Paul's and then continuing from the east window as far as the Tower. Unlike Evelyn and Wren, who started from the street grid and let the block structure emerge as a by-product, in Knight's case the entire layout was derived by first designing a prototype urban block 500 ft (approx. 152 m) long by 70 ft (approx. 21 m) across and composed of two parallel terraces separated by a narrow open yard. The pavements at ground level were to be arcaded with access to commercial facilities at street level and houses above.

● **Evelyn's design** for the rebuilding of London shows a gridiron plan overlaid with a kite-shape in the east and a octagon of streets in the west between the Fleet and the Temple. This suburb appears quite distinct from the City within the walls, and is separated from it by the River Fleet which has roads on both banks and is bridged at three points roughly on the lines of Newgate, Ludgate and Upper Thames Street. His plan for the new City retains the existing walls and gates and constructs within these an entirely new pattern of major routes. Chief of these is a new river route lined by major public buildings fronting onto the Thames, including the Royal Exchange, the Customs House and Admiralty Buildings as well as several landing stages, wharves and outdoor markets. A second important east-west route lies in the center of the City and runs from Ludgate to East Smithfield. This is marked by four large public spaces containing St. Paul's, the Mayor's House, a major food market and St. Dunstan's Church. This northern route is, in addition, lined with parish churches and public buildings as well as the guild and livery halls of the ancient Companies of London. Four further routes are shown running east-west. The next most southerly of these, roughly on a line with Upper and Lower Thames Streets, has few major buildings and only one open space, a piazza marking the approach to London Bridge, associated with it. A little to the north again is a straight street crossing the City lined with guild buildings, churches and naval buildings, as well as linking three open market squares in the east where major routes converge. Finally two more streets in the north of the City cross from east to west, and are lined with churches, and other public buildings which are interspersed with open piazzas. The most important of these is the Guildhall.

Crossing at right angles are nine north-south streets; to the west are two routes with churches and public buildings at strategic locations where they intersect with the east-west cross routes, then the route is blocked by the major bulk of St. Paul's and by a new market building on the riverfront, and one parallel with the smaller piazzas at the major intersections containing more churches and other public buildings. The two routes from Moorfields to the river and from Bishopsgate to London Bridge are both highly elaborated with large-scale piazzas at the intersections. The first contains the Guildhall, the Mayor's house, an open piazza and the Royal Exchange, all representing wealth and luxury, and the second links the produce market and the fish market em-

phasizing the importance of these items in the staple diet of the day. The north-easterly north-south routes again have a mixture of open spaces and intersections blocked by buildings.

The initial impression of Evelyn's plan is one of an attempt to make each road intersection a unique combination of plan geometry and facades, not just by lining his routes and articulating the space of the plan but rather by blocking the most important road intersections with prominent public buildings such that through-views are obscured. Moving about the City, one would be aware of moving from one important building to another. This picture is confirmed by the open space map, which highlights the concentration of public buildings at and in the intersections of the streets. As Evelyn himself remarks, it should not be possible to pass through the City:

all in one tenor without varieties, usefull breakings and enlargements into piazzas at competent distances, which ought to be built exactly uniform and strong and with beautiful fronts. Nor should these be all of the square, but some of the oblong, circular and oval figures, for their better grace and capacity. I would allow none of the principal streets to be less than a hundred feet in breadth nor any of the narrowest than thirty.

Within the island blocks Evelyn envisaged further developments taking place, including a system of lanes and alleys, but he did not consider the specification of these necessary to the proper execution of his design. So here, as before, the plan is incomplete, but this time it is the interstices of the "grand design" which are missing.

Compared with the plans of Hooke and Knight, Evelyn's plan is striking for two reasons. It shows both a basic rectilinearity in the layout of the principal streets, but adds a kite-shaped formation of streets cross-cutting the grid. It shares with Hooke (but not with Knight) an interest in articulating the streets into a system of narrower and wider public streets and squares, but adds a further distinction — the inverse of Hooke's internally elaborated blocks which separate public buildings from the principal streets — the elaborated, blocked intersection.

● Evelyn's design is, in this respect at least, in complete contrast to that of Wren. Wren's priorities lay in creating unimpeded vistas along major thoroughfares driving across the city to link together the "several remote quarters of the City." These streets were intended to be the principal trading streets with the churches and other public buildings related at key intersections in such a way as not to disturb the line of sight and access from one part of the City to another. Like Evelyn, Wren includes an octagonal arrangement of streets between the Fleet and the Temple.²³ Unlike Evelyn, Wren purposefully links his octagonal design to the surrounding network of streets to give precisely those views which Evelyn blocks off.

As in the previous cases, Wren's plan for the western half of the City takes the form of a more or less regular grid, but with a V-shaped formation continuing the line of Ludgate Hill and splitting either side of St. Paul's to drive eastwards past the Royal Exchange to Aldgate and south-eastwards through a series of piazzas to the Tower. In contrast, the eastern half of the City is organized around intersecting groups of streets radiating from a number of foci, notably the Royal Exchange in the north, the two piazzas on the route from Ludgate to the Tower

previously mentioned, and the approach to London Bridge. With the sole exception of the Royal Exchange, which acts both as an organizing focus for, and as a block to, north-south views through the heart of the City,²⁴ all the major public buildings are offset so as not to obscure long vistas along the major thoroughfares.

It is this east-west orthogonal-radial duality which visually sets Wren's plan apart from the previous cases. He shares with his contemporaries the retention of the existing line of the city walls and gates, the creation of a new quay along the River Thames (like Hooke, this is largely notional and does not take into account the bends in the river). Compared to Hooke and Evelyn, Wren invests rather little in developing the piazzas as a form of public space apart from those which form the foci of radial arrangements of streets in the eastern half of the city. His buildings sit in irregular "beads" of space rather than in geometrically composed configurations. Compared with Knight and Evelyn, Wren appears geometrically to differentiate the City without fragmenting it.

● The manuscript accompanying Newcourt's rebuilding scheme contains a vivid if somewhat depressing account of living conditions in mid-seventeenth century London. It is unsurprising, therefore, that of all the five plans Newcourt's pays least regard to the existing city fabric. His plan is square and walled but doubles the area within the city limits. Within the walled area, the City is divided into almost square blocks, approximately 285 x 260 yards (approx. 260 x 237 m) in size, eight in an east-west direction, and six in a north-south direction. The four central blocks are amalgamated to form a major public square and four further blocks are taken into the public realm to give minor squares in the quarters of the plan. The extreme south-eastern block is incomplete, and possibly may have been intended to remain as an open space because of the obstructing bulk of the Tower of London.

Within each block, four roads lead to an inner square of streets surrounding a church (an arrangement identical to Hooke's embedding of St. Paul's in the center of an island block). In Newcourt's plan, this has been raised to a general principle for the design of urban blocks. Thus the plan divides itself into a grid of thoroughfares running in both directions right across the city, a secondary system of end-stopped roads running from church to church, and a tertiary system of short roads in the heart of each block surrounding the church with no long vistas to the outside of the block. Like his contemporaries, Newcourt intended the river frontage to have been a new quay running the whole length of the City, although he parted company with them in intending this not to be ornamented by major public buildings. These were to be grouped in the central square. St. Paul's was the exception, being sited in the south-west square.

Apart from its almost perfect geometry (save for the location of St. Paul's and the Tower), the most striking feature of Newcourt's plan is the sheer scale of his open spaces.²⁵ Each block, Newcourt intended, was to house the population of a parish, each minor square was to be the meeting place of its surrounding parishes, and the central square the focus of the public life of the entire City.

Comparison of the five plans

To summarize the argument to date, a visual inspection

of the post-fire plans reveals the following points of comparison and contrast. The commonality of the plans lies in their dependence on order concepts to guarantee their conceptual clarity. However, the way in which order is projected into the plan is markedly different in each of the five cases:

● *Hooke's plan* is of a geometrically unified City over the whole of the devastated area, based on a regular orthogonal grid. It displays a combination of long vistas right across the plan from north to south and east to west in the thoroughfare streets, and convexly articulated squares which are traversed by the thoroughfares but are relatively "enclosed" by buildings. The major public buildings, St. Paul's and the Guildhall, are located within the islands and are not associated with the major public spaces. Likewise, the more locally-orientated public buildings, the parish churches, are associated with almost all the east-west cross-routes, but are not placed at intersections, nor are they marked by any increase in the size of the spaces onto which they front. The emphasis here seems to be on a *disjunction between the global orientation of the thoroughfare grid and the localization of piazzas and public buildings*.

● *Knight's plan* appears geometrically to be a unified design based on a "tartan" orthogonal grid over the whole of the devastated area, but the retention of the walls in the west and the positioning of St. Paul's fragment the City into two, although this is not reflected by any difference in geometrical composition. The thoroughfares form a slightly deformed grid in both directions. It is not possible to see and pass directly from one side of the City to the other, but the deformation is slight, following the curve of the river. There is no attempt to locate public buildings with the exception of St. Paul's within the plan. Other major buildings are located outside the built-up area, in the unbuilt space between the new compact street grid and the Roman walls. The location of St. Paul's is such as to further block the line of sight and access along the central major east-west thoroughfare, although this is not attended by any attempt to form a major public space. Rather, St. Paul's is simply accommodated by taking up the two adjacent blocks to the north and south of this line and amalgamating them into a larger site. The emphasis here seems to be on an *economical disposition of densely packed blocks*.

● *Evelyn's plan* differentiates the City within and outside the walls both by retaining the City wall and connecting through only at three points and by reflecting this geometrically in an orthogonal-radial/orthogonal-kite distinction without and within the walls. Vistas are short, running from public building to public building, these being sited so as to block the intersections of the principal routes and to interrupt the grid. Where this is not done, intersections are convexly enlarged to form major public piazzas at the junction of principal routes. The emphasis here seems to be on *producing a unique combination of plan geometry and facade at each major intersection*.

● *Wren's plan* differentiates the devastated area into three geometrically distinct areas, outside the walls by a radial-orthogonal composition, and inside the walls by a regular orthogonal grid in the west and a series of radial clusters in the east; but these are connected by a grid of long thoroughfare routes giving vistas across

the entire City in all directions. There is little attempt at formal composition in the public piazzas. Rather, the major public buildings are, with the exception of the Exchange, located asymmetrically or off-center in irregular "beads" of public space, so that they do not obstruct the view. Parish churches are the exception to this rule, and a number of these are located in such a way that their principal facades end-stop minor routes. The conception here seems to be that of *maximizing the potential for long thoroughfares linking the geometrically distinct local parts of the City together, and constituting these by major public buildings set informally on small aprons so as not to obscure the view*.

● *Newcourt's plan*, finally, appears to be unified not by geometry but by a more abstract concept; that of hierarchy, applied to every aspect of the plan. It displays a hierarchy in the size, length and global penetration of routes which is paralleled by a hierarchy of size of public squares, which in turn relates to a hierarchy of public buildings. Those used by the entire population of the City are located in the main square where the penetration of major thoroughfares coincides with a grossly enlarged space, while the parish churches are located in the heart of each block without any investment in convex articulation. *The levels of the social organization of the City — parish, neighborhood, community — are clarified²⁶ by reflecting them directly in the plan and making them correspond to the hierarchy of identifiable spatial domains*.

The question immediately arises as to whether this shift towards order concepts is accompanied by changes in the way in which the City is structured, and hence might be expected to perform as an intelligible working entity. Even those plans which appear at first sight to use a similar repertoire of geometrical motifs differ in the way in which these are assembled into an overall configuration. Each one is an individual with a distinctive order-related identity but can the same be said of their structure-related properties?

Structure and order revealed

Before embarking on an analysis of the distribution of integration and segregation in each of the individual designs, a number of common features of the set of plans should be discussed, which give some idea of the radical nature of the changes envisaged. These features are summarized in table 1.

● First, the sheer number of streets proposed in the new post-fire designs drops dramatically in all cases as compared with the street grid identified by Leake and as recorded after the rebuilding by Ogilby and Morgan. Newcourt's design, which comes closest in numerical terms, more than doubles the built-up area while Knight's which halves the built-up area would still need to contain twice the number of streets to approximate even the crude main street grid plotted on the Leake plan.

● A second feature which differentiates the post-fire plans from their mediaeval predecessor is that all but one²⁷ of the post-fire plans contain *no dead end spaces or cul-de-sac*. This cannot be because the authors of the various plans were unaware of the possibility — as Brown²⁸ has shown (1985), the "court" form of development in particular was widespread in the City during this period, as indeed it was generally in urban areas

Table 1
London — Characteristic measures for comparison of the changes envisaged by the five post-fire plans

Plan name	Number of axial lines	Thoroughfare: dead-end ratio	Number of islands	Grid axiality	Mean depth (mean integration, RRA)
1. Leake	374	—	185	0.0780	0.9352
2. Ogilby + Morgan	797	0.853	469	0.0569	0.7501
3. Hooke	61	—	120	0.3920	0.4680
4. Knight-City	94	11.75	169	0.2980	0.3756
5. Knight-all	136	7.263	210	0.2259	0.5037
6. Evelyn-City	31	—	56	0.1440	0.7070
7. Evelyn-all	118	—	74	0.1690	0.7222
8. Wren-City	178	—	224	0.1790	0.4679
9. Wren-all	225	—	264	0.1530	0.5007
10. Newcourt	264	—	227	0.1220	0.5900

at that time. The Ogilby and Morgan map of the City as rebuilt is striking for its large numbers of dead end alleys and courts, accounting for 937 axial lines and giving a positive dead end:thoroughfare ratio of 1:0.853.

● The number of islands or urban blocks is also of interest. In the Leake map, which showed only the major blocks, there are 185 insulae. The value for Ogilby and Morgan's map is 469, showing just how important is the development of lanes and alleys in splitting up the visually identifiable large-scale blocks confronting the major street grid into smaller constituent parts. All the post-fire plans with the exception of Evelyn's have about the same number of islands as the mediaeval City map. However Knight's plan takes up roughly half the area previously occupied by the City, and Newcourt approximately doubles the size of the City in his design. So of all the designers, Wren seems to be the most sensitive to the existing scale of the City and Evelyn the least.

● The deformation of the grid which shapes the islands is equally significant. The main grid can be more or less deformed, irregularly as in the mediaeval City or in an ordered way through geometry, into polygonal blocks while secondary development within the insulae can reduce rectilinearity almost as dramatically as deforming the main grid but without appearing to do so visually. As might be expected, grid axiality²⁸ increases markedly for all the post-fire designs, when compared with the mediaeval and restored City. The values for Leake's and Ogilby and Morgan's plans, both below 0.1, indicate that grid-like order is almost non-existent in the City. As a crude measure of increased rectilinearity, the values for the five plans confirm a clear increase in regularity overall, but the differences are equally revealing. Newcourt's design has the lowest value of all the plans despite its extreme regularity and apparent similarity to Hooke's, which has the greatest, due entirely to the break-up of the large-scale blocks defined by the supergrid.

● Finally, if the mean depth (mean integration)³⁰ of the system from all points is compared to that for the City as it evolved historically, with one notable exception, Evelyn's plan, these are noticeably more integrated overall. But whereas in the case of the historically-evolved City, much of the depth is accounted for at the periphery and by the less "griddy" development in the "backland" areas of blocks, in Evelyn it is accounted for in the geometric heart of the City by the contorted morphology of the major street grid. The increase in mean integration in the remainder of the designs is a reflection of the imposition overall of a more regular orthogonal grid in the

designs.³¹ The varied distribution of segregation above this mean shows the independence of order, geometry, gridness and integration. It seems that there are two principal ways of raising the overall degree of asymmetry within a plan. The first might be considered more a global feature of the plan since it results in its partition into an integrated core and large areas of contiguous segregated lines, either surrounding or surrounded by the core spaces. The second might be considered a more local feature of the plan, in that small clusters of segregated lines are distributed throughout the plan so that they do not cohere among themselves.

Another way of looking at it might be to consider the first as being segregation in relation to the core, and the second as atomization. These differences are given substance when the shape of cores is looked at in more detail.

The geometry of cores

In comparing the organization of the integration cores and segregated areas³² for the five designs, the following are to be noted.

● The integration core of the Hooke map (fig. 16) is composed of seven lines. The first of these is the major cross-City route from Holborn to Aldgate, and the second is the next most southerly east-west route. Between them these contain the two major buildings in the plan, St. Paul's and the Guildhall, and in the latter case the apron in front of the Guildhall is actually traversed by the second most integrating axial line. The third line is that corresponding to what is today the line of Upper and Lower Thames Streets, which traverses the three major

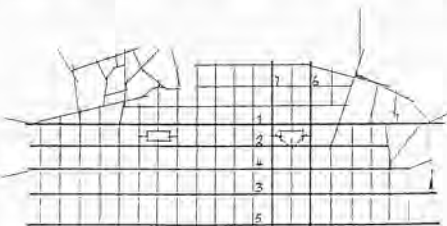


Fig. 16: London — 10 percent integration core for Hooke's design, numbered in order of integration from the most integrating axial line.

open squares adjacent to the riverfront, and the fourth line is that running from the Strand, which links the City and Westminster, to the public open space at Tower Hill. The new river frontage completes the east-west links in the core. The final two lines of the core run in a north-south direction. Strikingly, these do not correspond to any major cross-City routes, unlike those running in the east-west direction, but rather run from the inside of the City wall to a new landing stage on the river, passing en route either side of the new Guildhall building and thus completely encircling it with integrating lines. The shape of the integrated core as a whole is, therefore, asymmetric in the geometric sense, and is directed more to the east of the City and the riverfront than to the north and west. This is despite the fact that the most integrating line is the most northerly. The spread of the core is large, completely traversing the City in both directions, although the dominant emphasis here is westwards in the direction of Westminster. All the east-west lines spread through to the adjacent streets, and the design ignores the line of the old walls in the west and incorporates the entire western suburb into the new City.

The map of 50 percent of segregated lines (fig. 17) shows that these are heavily biased at the periphery in the north of the City, running round almost the entire ring street immediately inside the walls and radiating from the Tower. These segregated areas correspond to that part of the City which was undamaged by the Great Fire. It appears that, despite Hooke's attempts to connect his routes to the existing streets of the City the misalignments which he introduced in relating the old and the new are such as to render the older parts of the City inaccessible as destinations for spaces within the new design, particularly since the new grid makes all potential routes within the new scheme relatively direct. By contrast, none of the area outside the City in a westerly direction appears in the segregated map and the new is more continuous with the pre-existing city fabric.

Even more striking are the lines picked out in the interior of the new City. These segregated lines pick out in the west the ring of spaces encircling St. Paul's, together with the approaches to the west front and the east window, and the route leading from the south front to the new quay. In the east, a comparable ring of segregated lines encircles the Guildhall, together with its approaches on three sides. Thus, although the integrated core sweeps across the front of the forecourt to the Guildhall, the bulk of this apron, convexly defined, is relatively segregated. It seems then that the effect of singling out these two buildings for more elaborate geometrical treatment is to distance or "deepen" them from the surround-

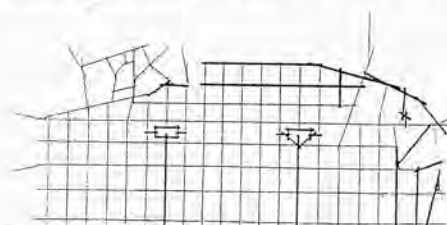


Fig. 17: London — 50 percent of segregated lines in Hooke's plan.

ding shallow grid and literally to set them "apart" as special buildings. The major buildings literally turn their back to the most integrated street.³³

As an experiential reality, geometry and structure appear to function differently within Hooke's design itself from how the design as a whole relates to its surroundings. The order concept which generates the regular orthogonal grid renders Hooke's plan indifferent to its surroundings, particularly in the east of the City, despite the lip service paid to "integrating" it with the surrounding area. To achieve integration requires more than simply joining streets together but rather some recognition of street alignments has to be made, as is the case in the west of Hooke's design.

Within the design, the deformation of the major grid roads is slight. There are differences in the way in which the framework of streets constructs channels of use and movement, which the visual order in the grid serves only to conceal. Hooke's streets are more differentiated than they appear.

The relative segregation of St. Paul's and the Guildhall, whether intentional or not, recognizes the important ceremonial functions of these major spiritual and civic buildings by differentiating them, and if there is any structure-level interpretation of the proposition that "greater space means more formality"³⁴ then "more segregation" is arguably one way of achieving it. In the mediaeval City St. Paul's is clearly distanced in this way, although Guildhall is not and the integration core strikes the main entrance to the building head-on. However, it is not the way in which either of these buildings is incorporated into the post-fire City. In the City as rebuilt, St. Paul's is almost completely surrounded by well-integrated lines, and the roads from the Thames to the Guildhall are actually widened and straightened to make it more integrated than before the Great Fire. The Restoration City does not, it seems, experience any discontinuity between the space of everyday life and that of ceremony which we recognize in Hooke's design.

● Moving on to Valentine Knight's plan, this might be expected to display the same kind of east-west emphasis as Hooke, judging from a purely visual comparison of the two plans and this is, to a very limited extent, shown to be the case. However, the build-up of the core and the disposition of segregation is strongly affected by the incorporation of the Roman walls into the design, which will therefore be examined in two stages looking first at the inter-mural City and then at the plan for the whole of the devastated area.

The build-up of integration values in the area within the walls (fig. 18) yields a very compact integration core indeed in the geometric center of the City. The first line in the core runs in a north-south direction, roughly on a line which is a continuation of the relatively insignificant entry at Cripplegate and which stretches down to the river. The second is a more important north-south line connecting Bishopsgate in a southerly direction towards London Bridge, which the core eventually reaches with line 6. Two neighboring horizontal routes link these two vertices in an east-west direction and a third, a continuation of the axial line which passes to the north of St. Paul's, also joins the core at this point with the same value. Lines 7, 8 and 10 consolidate the east-west core in the heart of the City. Equal 8th value is shared by a north-south line from Smithfield.³⁵

This density of integration is bought at the expense of extensive segregated zones at the periphery (fig. 19), which include almost all the area to the east of the Bishopsgate to London Bridge route where the majority of the longest axial lines in the design are concentrated, as well as a zone close to the river in the south-west at Blackfriars and a third large contiguous group wrapping around the north-western perimeter and extending into the undeveloped areas within Knight's map. Whilst all these areas were relatively segregated historically, this effect has been greatly exaggerated in the case of Knight's design. Moreover, the integrating core completely fails to reach the perimeter at any point in an east-west direction, despite the apparent east-west orientation of the design.

The effect of adding the area of Knight's plan outside the walls is to introduce "holes" between groups of integrated streets (fig. 20) and to spread the integration core over a wider area of the City.³⁶ The area traversed by the core shifts westwards away from the Bishopsgate to London Bridge route to include the line passing across the west front of St. Paul's and three streets immediately to the south of St. Paul's, so that the cathedral is drawn into the center of the grid of shallow and accessible lines. Moreover, part of the riverfront is also drawn into the core. If one were to envisage the north-south routes compressed to the same distance apart as those running east-west, i.e., a dimensionless drawing of the core, then the core forms an irregular S-bend of well-integrated routes which contain St. Paul's at their center but which fail to reach the periphery of the City in any direction.

The 50 percent segregation map (fig. 21) is even more striking. Despite the move by the integration core in a westerly direction, this has very little effect in integrating the area of the design outside the walls to the west of the City. The area added in the west is all segregated. The effect is to produce two extensive segregated zones on either side of the geometric center of the plan.

So far as rendering spaces accessible as destinations for all other spaces in the system is concerned, the principal effect of Knight's layout seems to be that the City is divided into three clear areas; a central relatively accessible area with eastern and western fringes which are completely inaccessible. More than any other, Knight's plan illustrates the fallacy of confusing order principles with those of structure. The geometric nature of his street grid actually serves to conceal the profound differences he introduces in the way in which individual streets are related together to form a *street system* — a structure of public space. This is particularly the case in the north-south axis, where slight changes of alignment are introduced for no apparent reason, so that at no point can the Thames be seen directly from the northern boundary of the built-up area of the City, but it is also true in the east-west dimension where the idea that the streets follow the curve of the river does not explain the precise way in which this is achieved by re-aligning streets in small groups at several points along their length. The effect on the way space is structured means that streets are arbitrarily privileged or disadvantaged with respect to the configuration as a whole: arbitrarily because this makes sense neither in terms of the generating concept of the block, which is uniform throughout the City, nor in terms of any attempt to acknowledge and organize relations between incoming routes and important destina-

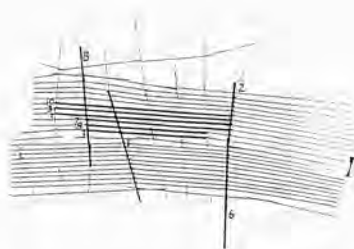


Fig. 18: London — 10 percent integration core for Knight's design within the walls, numbered in order of integration from the most integrating axial line.

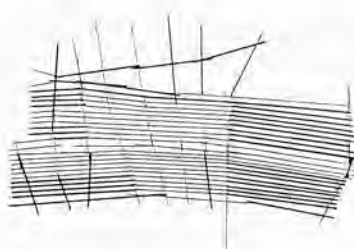


Fig. 19: London — 50 percent of segregation in Knight's design within the walls.

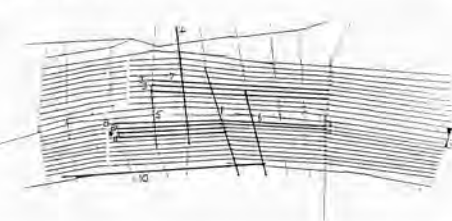


Fig. 20: London — 10 percent integration core for the complete Knight plan numbered in order of integration from the most integrating axial line.

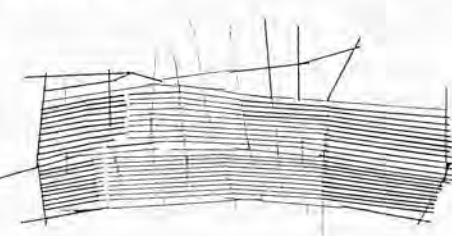


Fig. 21: London — 50 percent segregation for the complete Knight plan.

tions within the City.

Three concentrations in the points where streets change direction are worth noting however, because they suggest that Knight may not have been completely indifferent to the historically-evolved City, but rather that his understanding was emphasizing a representational rather than an experiential level of reality. The whole of the eastern area beyond the route from Bishopsgate to the Bridge is segregated because Knight consistently breaks the east-west street grid at this point, perhaps articulating some half-formed notion that the areas to the east were becoming less important and maybe less socially desirable.³⁷ A second concentration of breaks in axiality occurs along the Walbrook, the ancient dividing line of the City. The third group is different to the previous two in character because the axial shift in east-west emphasis does not coincide with the line of a north-south street. Street alignments in the block adjacent to the Roman wall are shifted to acknowledge the direction of streets on the far side of the City walls but without any attempt to create access. This suggests that the relation between the inter-mural City and the western suburb is at best half-hearted. Whereas integration seems arbitrary and unrelated to use and movement within the City, segregation may reflect some deeper level of structure which belies the apparent east-west order which gives visual unity to Knight's design.

● Evelyn's plan for London will also be examined in two stages. The design for the area within the walls contrasts with the previous two cases in that the 10 percent integration core (fig. 22) hugs the river frontage and the perimeter of the City rather than penetrating deep into the geometric heart of the built-up area of the design. The first line passes through an internal route which runs straight from the Fleet to the Tower through two large squares, but it does not pass any major buildings, of which there are many in the plan, *en route*. The second line runs parallel to this, close to the river, again avoiding any major public buildings and crossing only one major space, marking the approach to London Bridge. The third line runs north from Billingsgate on the riverfront to Bishopsgate in the northern wall, crossing these two routes as it does so. The next two lines branch from the major open intersection in front of London Bridge to strike St. Paul's in the west and St. Dunstan's in the

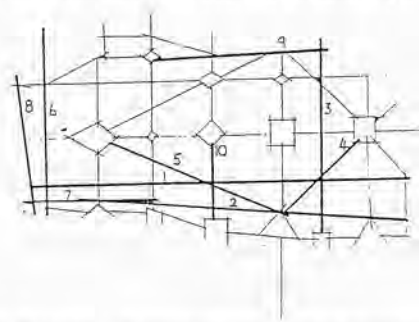


Fig. 22: London — 10 percent integration core for Evelyn's design within the walls, numbered in order of integration from the most integrated axial line.

east. The 6th line also runs north-south parallel to the Fleet River, just inside the western walls, to breach the northern boundary of the City at Smithfield. The 7th step adds a line just north of the river frontage which links across the Fleet into the devastated area outside the walls, and the 8th is a second north-south line running clear along the bank of the Fleet to mark the western boundary of the City. The U-shape on the periphery begins to fill in on the fourth side of the square with line 9 which pushes west from Bishopsgate to reach Christ's Hospital and church which are located in a major intersection close to the western walls. The final line in the integration core links the Royal Exchange on the waterfront with the Mayor's house in the center of the City. Thus at 10 percent of lines, the integration core almost completely encircles the City close to the periphery, and at the same time relates this encircling band to most of the most significant religious and civic buildings. However, it does not perform as a normal city core nor, indeed, as do the cores of historic London in that it completely fails to penetrate to and cross the heart of the City with strong integrating lines. Thus Evelyn has created a situation which is difficult to envisage from a common-sense point of view. His design is one in which the edges of the City are shallower to all other places in the plan than the center, despite its relatively compact shape. This kind of core is the defining feature of many "estate" forms today.

This is confirmed by the 50 percent segregation map (fig. 23). This map shows that, despite its proximity to the most integrating line in the core, the whole of the riverfront containing important public buildings and markets is segregated within the City fabric. A second major group of segregated spaces forms two almost complete rings in the geometric heart of the City between St. Paul's and Gracechurch Market, almost completely encircling all the major public buildings in this part of the City. Further groups of segregated lines outline St. Paul's and St. Dunstan's, which are integrated in the direction of the riverfront³⁸ but segregated to the north-west and north-east respectively. This effect is produced entirely as a result of situating the major buildings in the interstices of routes rather than within the City blocks, and is an exacerbated form of the phenomenon already noted in Hooke — of separating out and distancing the

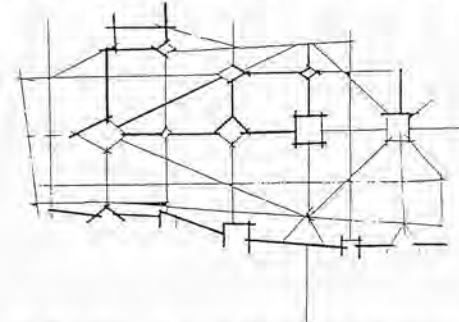


Fig. 23: London — 50 percent of segregation in Evelyn's plan within the walls.

public buildings as destinations within the City fabric — what we might call the "Barbican effect."³⁹

The routes which "work" best are those which are unimpeded by public buildings. Whether intentionally or not Evelyn has, by his decision to elaborate the intersections of his grid by endowing them with free-standing public buildings which block the vistas, produced a City which works "inside-out" with a shallow, peripheral ring of long thoroughfares surrounding a more segregated heart in which views run direct from building to building, but movement is indirect and diverted around and away from them.

This effect is so powerful that it is very little altered by extending the scope of the analysis to include the devastated area outside the walls. The effect on the integration core (fig. 24) is to introduce one integrating line in the area outside the walls, striking into the center of the octagon from a position west of the Fleet at Smithfield and to reverse the directionality of the integrated periphery from east to west towards the Guildhall, with a heavy concentration of integration in the area of the Fleet River around Blackfriars — historically segregated. Apart from this line, nearly all the remainder of the large octagon to the west of the City is segregated (fig. 25). The sheer weight of numbers of the segregated lines in this area has the effect of reducing those within the City itself. The major public buildings on the riverfront remain segregated but less continuously so and St. Paul's leaves the segregated zone entirely. Nevertheless, the group of major public buildings including the Guildhall, Christ's Hospital, St. Dunstan's in the east, a number of parish churches, and many of the markets, large public fountains and the Mayor's House are still all strongly segregated.

Adding the octagonal suburb to the west of the City walls therefore modifies Evelyn's design rather than transforms it. Indeed, it modifies it rather little when it is considered that the plan is thereby enlarged by about 25 percent. This is because the area added is so strongly cut off from the remainder of the City and is a larger and more extensive version of the "blocked intersection" device used by Evelyn throughout the central area of the City. The extra-mural suburb seems to work more as yet another blocking feature in the plan than as a major modifying force within the design.

The order concepts which make Evelyn's design so visually attractive are in an important sense self-defeating.

The blockages and deformities they introduce into the system which Evelyn intended to function as a nexus of well-integrated, busy streets actually impedes their use as a working town center. Rather than reinforcing structure to give it added clarity, visual order conflicts with the spatial structure at every point. Deformity of the grid, like regularity, is not an absolute value but a principle which can only be understood relationally as it constructs the global framework of streets and urban blocks.

● Wren's design, like Evelyn's, will be examined in two stages, first without and then with the extra-mural suburb. The first two lines of Wren's integration core (fig. 26) originate at Ludgate, in front of the piazza on which St. Paul's is situated, and bifurcate to contain St. Paul's between them, the northerly one passing right across the City across the forecourt of the Royal Exchange to Aldgate and the southerly one through two large piazzas to the Tower. A third east-west line from Blackfriars to the Tower is the next line to join the core. The fourth line runs north-south bisecting the City on a line from London Wall to the new quay roughly on a line with Walbrook. The fifth line runs from the piazza at the approach to London Bridge through a second large piazza to meet the most integrating line in the core roughly at the geometrical center of the City where the grid changes from an orthogonal to a radial form. The sixth line crosses in the opposite direction from the Thames to the Royal Exchange. The next three lines to be added to the core run more or less north-south. The first of these stretches from the western section of the quay where Wren intended the guild buildings of the livery companies of London to be situated to the City walls at Aldersgate, passing behind the eastern facade of St. Paul's *en route*. The second, line 8, runs to the east of this, from Queenhythe to Cripplegate, and the third, slightly more oblique line 9, runs north-south from the piazza at London Bridge to Bishopsgate. Of equal value is a line running from the Customs House on the eastern quay to the Royal Exchange. Further integrated lines add a major route from Newgate to the rear of the Royal Exchange building and fill in the orthogonal grid between the east front of St. Paul's and Walbrook. Two lines are added to the grid in the vicinity of the Royal Exchange, one to link it directly to London Bridge and a second to give a second north-south integrated through-route to the west of the Exchange.

Wren's plan, therefore, differs markedly from Evelyn's in its coverage and density of integrated lines in the area within the walls. The integration core strikes right through the heart of the City in all directions with long cross-City thoroughfares. All of these pass by major buildings or through large piazzas. At the same time, shorter lines integrate the Royal Exchange building — "the nave of the town" — with key commercial facilities on the riverfront. Wren uses the trick of using the buildings to "bounce" axial lines, but unlike Evelyn his design links these buildings directly to the bridgehead, the gates and the major cross-routes. At the same time, he produces a strong concentrated grid of integrating lines in the commercial heart of the City, but again directly linked to the gates and the bridgehead, unlike Knight, who produced a similar though more compact concentration at the expense of creating large segregated zones at the periphery of the City.

Wren's plan contains few such segregated lines (fig. 27). Most of the segregated lines, particularly in the central areas, are segregated "singletons" — isolated, short, secluded streets running between the longer and axially shallower grid lines. In making his churches freestanding within the blocks, Wren also creates, at intervals, a U-shape of more secluded streets which runs round these "embedded" facades to the sides and rear.⁴⁰

Only in one place do these lines of "rear access" begin to aggregate together with those passing across the principal facade to form a more extensive zone of segregated lines. This occurs to the south of the Royal Exchange. Here, whereas the radials are all strong integrators, the laterals ringing the Royal Exchange are segregated. A second wedge of segregated lines is to be found to the rear of the Royal Exchange running northwards to London Wall. Thus, the Royal Exchange is well-integrated with the City as a whole, but it is segregated with respect to its immediate neighborhood. Its global orientation is not accompanied by local prominence. There is a slight build-up of segregated lines towards the western boundary of the City, but this is not pronounced compared with the other designs, nor indeed with the City as it evolved historically.

The addition of the spaces in the fire-damaged area outside the walls results in a shift in the concentration of integrated streets (fig. 28) towards the west, becoming particularly dense in the area west of St. Paul's piazza. The waterfront enters the core, as do the streets on both banks of the Fleet. A line drives right through the heart of the octagonal suburb to meet this nexus of lines and strike the west front of St. Paul's. Thus, in terms of the entire plan, the emphasis placed on particular buildings seems to change, linking the new forms of commercial activity centered upon the Royal Exchange with the older culture of street trading which is located around the spiritual focus of St. Paul's.

This shift towards St. Paul's is reflected in the comparable map of segregation (fig. 29). The segregated lines previously found on the western boundary of the City all but disappear and the "singletons" in the remainder of the City remain almost unchanged, but two large new segregated zones are found on either side of the route from St. Paul's to Temple Bar in the newly-added suburb. In this, at least, Wren's plan shows something in common with that of Evelyn.

Looking at the shape of the cores, it can be said that

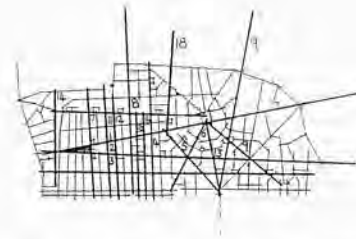


Fig. 26: London — 10 percent integration core for Wren's design within the walls, numbered in order of integration from the most integrated axial line.

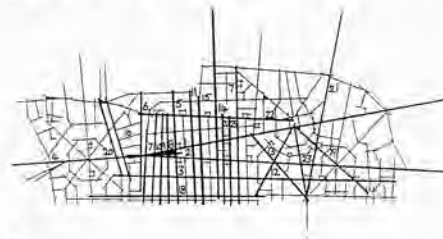


Fig. 27: London — 50 percent of segregation in Wren's plan within the walls.

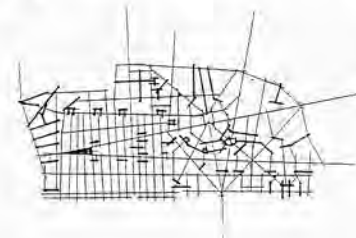


Fig. 28: London — 10 percent of integration for the complete Wren plan, numbered in order of integration from the most integrated axial line.

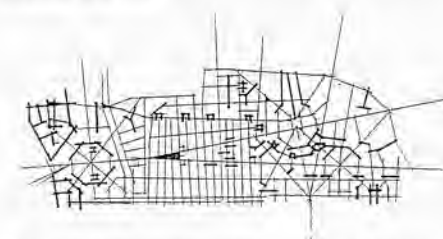


Fig. 29: London — 50 percent segregation for the complete Wren plan.

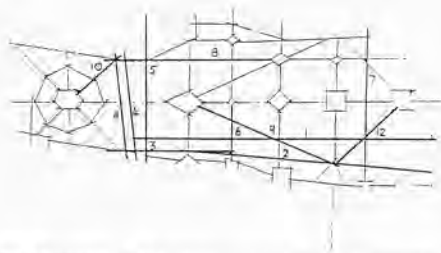


Fig. 24: London — 10 percent integration core for the complete Evelyn plan, numbered in order of integration from the most integrating axial line.

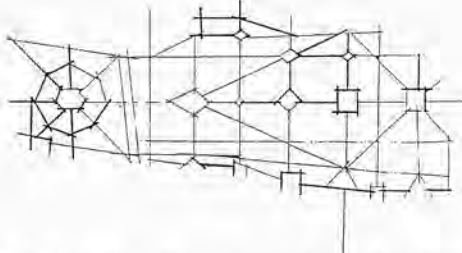


Fig. 25: London — 50 percent segregation for the complete Evelyn plan.

while Evelyn and Wren share a common idea of what constitutes order in design, a common motif in the use of an octagonal suburb to the west of the Fleet, a common interest in radial/orthogonal dualities and even a common preoccupation with the relationship between the major public buildings and the organization of the street grid, from the point of view of structure this is where all similarity ends. Both in terms of the organization of their respective plans within the walled area, and in the way in which the extra-mural suburb is related to the design of the walled City, the two could not be more different. Wren's plan takes the principal features of the mediaeval City and transforms them into a reality which is both well-ordered and well-structured.

The changes which he makes with respect to the mediaeval plan may not, therefore, be completely innocent of meaning and deliberate intention, notably the relegation of the Guildhall to a minor role and the elevation of the Royal Exchange to replace it as a prominent feature of the design, both from the point of view of order and that of structure. It is conceivable that he may have detected the gradual shift in the locus of economic and political power from the Mayor and Common Councilors of the City, the tradesmen and merchants of the street-orientated market economy, to the bankers and traders who frequented the Exchange and on whose activities the City's wealth was in the ensuing centuries increasingly to depend.

● The final design, by **Newcourt**, is similar to that of Hooke in that it covers a larger — in this case a far larger — area than the old walled City. As with Hooke, the plan will be examined in its entirety. At 10 percent of best integrated lines (fig. 30) Newcourt's plan clearly picks out the major grid of through-streets. The effect of the extreme regularity of the design is also reflected in the values in that, unlike the other cases looked at so far, groups of lines share a common value. Only the effect of retaining the Tower, which "bites out" the south-eastern corner of the plan thus skewing the whole of the integrated core away from that corner towards the north-west, saves Newcourt's scheme from reproducing the hierarchy of spatial domains referred to earlier, as a syntactic hierarchy of banded values from relative integration to relative segregation.

The development of a repetitive geometry at the level of order produces a tendency to homogeneity in the structure of overall design. By 10 percent of integrated lines the core picks up all the large open spaces, including all the lines which intersect in the large central square and the two smaller western squares and the vertical lines in the two eastern squares, the skewness of the distribution again reflecting the non-completion of the regular grid in the vicinity of the Tower.

The map of 50 percent segregation (fig. 31) then picks out the local squares in which the parish churches are situated. Most of these are completely encircled by segregated lines, but in the vicinity of the most integrated through-routes these are only partially encircled by segregated lines. Unlike the other plans looked at so far, where secluded spaces are found directly connected to lines within the integration core — as is exemplified by Wren's radials and laterals — the segregated lines do not, on the whole, connect to integrated lines but are mediated by lines which are neither particularly shallow nor deeper than the mean. This distribution of relative

accessibility appears to confirm the intuitive description of the plan offered earlier, in that the major grid roads are shallow with respect to all spaces in the system, the lines running from parish church to parish church between the major grid squares are neither shallow nor deep, and the streets surrounding the local parish churches are relatively inaccessible as destinations for all spaces in the system. Newcourt's plan, in other words, does seem to display a hierarchy of accessibility — the imperfection in the realization being entirely due to the non-completion of the grid.

Insofar as structure exists, it does so simply to differentiate the various levels in the hierarchy, but without structuring space within any particular level. This identity in the parts makes spatial recognition and orientation difficult, since all streets are alike in their relatedness to the whole. More seriously, it makes space unintelligible in that it is difficult to gain useful information about the configuration of the whole from any of its constituent parts, particularly in the segregated areas.

Taken as a set, the designs illuminate many of the preoccupations of town planning discourse and practice today. Hooke's twin assumptions, that his concerns stop at the boundary of the site while within the site the grid guarantees a degree of order, are reminiscent

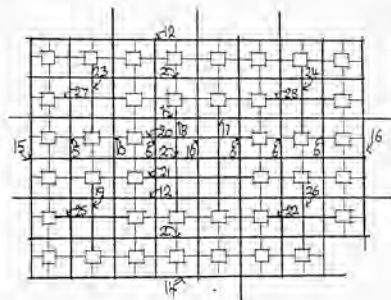


Fig. 30: London — 10 percent integration core for Newcourt's design, numbered in order of integration from the most integrated axial line.

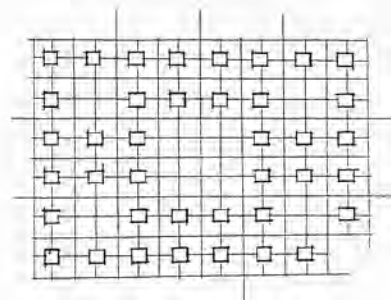


Fig. 31: London — 50 percent of segregation in Newcourt's plan.

of a generation of post-war planners. Evelyn's preoccupations with lending individuality to the local intersections of streets while ignoring the way in which these are configured globally reminds us of Krier. Wren is a syntactician in the Hillier mould, Newcourt articulates an identical social philosophy to that which produced the "neighborhood unit" of Perry and Stein, while Knight chases the illusive idea of generating urban form from the design of the perfect, ubiquitous and self-contained urban block. That this is the case suggests that there are fewer strategic alternatives to the design of urban space than there are realizations of it and that these are generated by the logical possibilities for design at least as much as by the particularities of historical circumstances.

The phoenix arises

The process by which the City was reconstructed in the decade after the Great Fire has been well-documented elsewhere.⁴² From the point of view of the public space structure which resulted from the rebuilding, a visual inspection suggests continuity with the pre-fire period (fig. 32). The Roman walls still present an obstacle to movement in and out of the City by channelling traffic through the City gates. The disorderly appearance of the urban blocks which make up the fabric within the walls remains, and the island blocks perpetuate the variety in shape and size and composition which was a feature of the pre-fire City. With the improvements in surveying techniques and the adoption of a true ground plan after the Fire this has actually become more pronounced as the level of resolution and detail in the plan has risen.

The street grid shown in the open space map (fig. 33) is highly deformed and irregular. The clearance of markets from the major thoroughfares is achieved by the post-fire reconstruction and the City is rebuilt in accordance with

a road widening and straightening program. All this is achieved without any major dislocation in the complex network of land and property ownership which had shaped the physical form of the mediaeval plan. Thus, although some streets which were designated as major thoroughfares are substantially widened and minor lanes are made at least 14 ft wide (approx. 4 m),⁴³ there is no attempt in the rebuilding to geometrize the City in line with the principles of town planning exemplified by the set of ideal plans looked at earlier and the plan of the City published a decade after the Great Fire by Ogilby and Morgan displays a remarkable continuity with the Leake map.

The complete axial break up of the City at the time of Ogilby and Morgan is shown in figure 34 and the subset of thoroughfare streets is shown in figure 35. This map, roughly speaking, picks out the structure of streets, lanes and alleys from that of closed courts and yards and presents a realistic picture of the complexity of the public street network of the City of London at the time of the Restoration.⁴⁴ The addition of a new strip of wharfing down to the river can be picked out⁴⁵ and the hinterland of the blocks to the north of Cheapside is much more fully developed, but the preservation of a family likeness with the mediaeval City is striking, particularly when the longest and straightest axial lines are compared.

However, identity in general shape does not necessarily guarantee a reproduction of the precise connections of streets, so any differences in configuration brought about by the post-fire reconstruction are best considered in relation to the build-up and the overall shape of the integration core. Figure 36 is the integration core of the Restoration City at 36 lines, the same number as shown in the Leake core (fig. 6) and just short of 5 percent of the total number of axial lines in the plan. As a result of its straightening Cheapside has moved into the most



Fig. 32: Ogilby and Morgan's map of London.



Fig. 33: London — The open space map of the City as rebuilt after the Great Fire, with a 100-meter scale indicated.

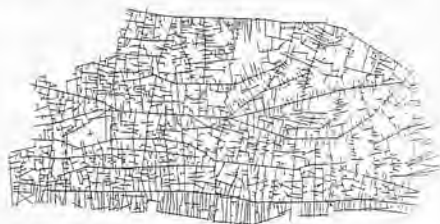


Fig. 34: London — The complete axial break-up of the City as rebuilt after the Great Fire.



Fig. 35: London — Axial map of the through streets of the City as rebuilt after the Great Fire.

integrated position, and the new street connecting the Guildhall to the river is the second most integrated space, entering the core before the fan of streets radiating from Cornhill. The significance of Eastcheap and the north-south link from Bishopsgate to the Bridge are reduced, the line of the Walbrook maintains its prominence while that of the east-west route along Thames Street is increased by the concentration of new wharves leading down to the river. Otherwise, the shape and coverage of the two cores is almost identical. Raising the core to 10 percent of lines (fig. 37) first increases the density of lines in the vicinity of Cheapside, and then expands the scope and coverage of the core around Eastcheap and in the area to the south-east of the cathedral.

The integration core of the City in 1676 is relatively



Fig. 36: London — integration core of the 36-line map of the City as rebuilt after the Great Fire, numbered in order of integration from the most integrated line.

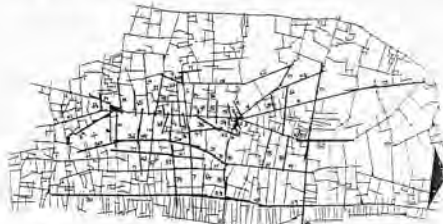


Fig. 37: London — 10 percent integration core in the City as rebuilt after the Great Fire, numbered in order of integration from the most integrated line.



Fig. 38: London — 50 percent of segregated lines in the Ogilby and Morgan plan.

restricted in its size and scope. It reaches the edge of the City at only one point, London Bridge. The mode of growth of the core is through a series of waves of expansion, where long axial lines push the coverage of the core out from the center, followed by consolidation where lines are added to fill out the density within its established coverage. The thrust of the core is excentric, loaded towards the south and east. Compared with its mediaeval counterpart it is more ringy and more evenly distributed through the center of the City. St. Paul's in the west, the Guildhall in the north and the Woolchurch Market at Cornhill all acquire concentrations of well-integrated axial lines. The siting of the Royal Exchange on Cornhill ensures its accessibility.

The 50 percent segregated map of the 1676 City (fig.

38) is equally revealing. First, there are still almost no segregated spaces in the heart of the City between St. Paul's and the north-south route from Bishopsgate to London Bridge in the area south of the Guildhall. Those which exist are isolated singletons or small groups distributed across the surface rather than forming clusters of segregated lines.⁴⁶ In the area close to the walls, the converse remains the case. There are no lines which are more integrated than average and those which exist are singletons rather than clusters of connected shallow and accessible streets. Blackfriars, the Cripplegate area, the streets to the rear of the Guildhall, the north-east corner of the City and the vicinity of the Tower are all strongly segregated, as is the new market at Newgate to the immediate west of St. Paul's. The effects of the pre-fire plan are exactly reproduced.

It might appear from this that little changed with the Great Rebuilding. This is an understandable inference from looking at the structure of the street grid of the City. The urban grid seems merely to have been finetuned, and the opportunity taken to increase the prominence

a face which was, for the first time, not merely urban but urbane (fig. 39).

Conclusion: Natural and artificial cities

It is customary today to discuss the morphological properties of organic, vernacular or "natural" cities as if they are a completely different, and therefore incommensurable phenomenon from planned or "artificial" cities. It has even been argued⁴⁸ that this is the case because the mind operating reflexively is incapable of conceptualizing complex overlapping socio-spatial realities like cities and has therefore to clarify them by reducing them to simple organizing principles in order to design.

If little headway appears to have been made in this debate, it is perhaps because it is predicated upon a fundamental confusion of order concepts with structure concepts. In the absence of tools to investigate structure in natural cities, there is no way to approach the framework



Fig. 39: London — Early 18th century view of the City as rebuilt by T. Bowles after J. Donowell. (Source: G. Milne, *The Great Fire of London*, Historical Publications Ltd., 1986).

of major buildings both syntactically and visually. However, this view does not survive inspection of the built form of Restoration London and morphological continuity is accompanied by a radical transformation in the appearance of the City both in public and in everyday buildings. Order concepts found a place not in plan but in elevation, and the City of Restoration London presented

of urbanization which is given by the pattern of streets and urban blocks other than by addressing those features which are immediately available to visual inspection. For the most part this results in a negative discourse: one which identifies and focuses upon what is absent in organic cities — lack of order — rather than what might be present. This is no less true with visually well-ordered

designs where the very transparency of the visual order renders geometrically designed, planned cities opaque in terms of how they actually structure space. Here, the struggle to appear profound all too often seems to state the obvious at the level of order in the plan, and yet to miss the point. This is becoming increasingly clear in the "post-modern" period where geometricity holds sway in urban design and yet many proposals appear curiously unrealistic. Discourse does not provide the tools to criticize, yet scepticism increases in the face of architectural striving for greater and more elaborate visual arrays.

Cities like the City of London which grew up by accretion may look different because they have few readily identifiable ordering principles but they may be well-structured. Planned cities may be more obviously ordered but order does not guarantee structure any more than its absence is indicative of chaos. An understanding of both, looked at separately and together, is a necessary first step to unify the field of urban morphological studies. Looking at cities in this way may even make the terminology of the "natural/artificial" debate obsolete.

Both order and structure are present to some degree in all urban configurations. The problem is not to classify them in terms of "either/or" but to capture the degree to which either or both are necessary to make a working, pleasing town. Because they are different dimensions of the morphological field, rather than opposite poles of a one-dimensional reality, order and structure can work hand in hand or in opposition, to create different kinds of town. Wren's plan reproduced much of the structure of mediaeval London, but it was visually more order-rich. Newcourt's plan, although highly visually ordered, concentrated all structural differences between levels in the socio-spatial hierarchy thus leaving each layer relatively unstructured and homogeneous. Hooke's design displayed a correspondence between structure and order in that the remnants of the naturally-evolved City and the more differentiated and individuated public buildings were both segregated in relation to the highly ordered, but internally homogenized grid. Knight's design related visual order to spatial structure almost arbitrarily so that, had it been built, the working life of the town would have undoubtedly proved a puzzle to its residents. In Evelyn's design the effects of the two were actually opposed, so that the very places where he envisaged that the public life of the town would be concentrated were the most inaccessible to the natural pattern of use and movement.

These reflections on the relative impact of structure and order in design are entirely consistent with an understanding of how organic cities both order and structure public space to different degrees. The Restoration City gains in order at the global level, but loses it at the local level when set alongside its mediaeval counterpart. Its structure, however, is largely unaffected. It is feasible to set both alongside the proposals for rebuilding and compare them all in terms of structure, and to reflect on the source and nature of differences which lie below those surface appearances which are captured and represented in the plans.

A more complex view which attempts to isolate the impact of order and structure in generating and controlling the framework of a city leads not just to a more informed debate about the relationship between history and morphology, but also to a more liberating view of

design. Architecture may not be doomed to a perpetual inadequacy resulting from an assumed inability to grasp complex overlapping realities. There is another way. Raising structure to a level of conscious investigation alongside order may lead to a situation where claims made at the drawing board are capable of translation into well-structured and therefore liveable urban places.

References

1. At this time London had a population of some 200,000 residents which made it the largest city in Europe, and in the western world.
2. Private bazaars within which many traders each occupied a small retail outlet, some only little larger than would contain a chest. The sellers dealt in leather goods, gloves, rare textiles, spices, jewellery, clothing, and imported luxury goods.
3. All the printed maps of London published before 1666 are "map views" which combine a linear ground plan in which every building is seen from a theoretically vertical viewpoint, with a bird's eye view in which the town is drawn pictorially and obliquely from an elevated position. This technique exaggerates scale, so that details of alleys and yards are obscured and it is impossible to gauge accurately the true width of streets. In short, precision of measurement is sacrificed to visual impact.
4. Leake's plan was commissioned by those responsible for the rebuilding as a basis for ascertaining the extent of the damage, and as a means of providing an accurate record of land ownership and the extent of building plots at the time of the Fire. It does not record every alleyway, but the main street grid is shown accurately and to scale. The unburned area is portrayed as a more conventional map view.
5. The fact that this was the lowest bridging point of the Thames was the reason for the siting of Roman London in this location.
6. This was a marshy area which could only be negotiated by boat at certain times of year.
7. The City had 109 churches shown hatched on Leake's map, each the focus of a small spatially defined parish community, and about the same number of guilds or trade associations, shown as shields on Leake's map, which drew members together from all over the City.
8. An axial map shows the fewest and longest lines of sight and access which cover the public open space of the plan. It does not necessarily correspond to named streets. The axial map does not include the large number of wharves leading down to the Thames.
9. Integration is a mathematical measure which expresses the extent to which a street or axial line draws all other streets to itself and renders them shallow as destinations from that point. A 5 percent integration core is shown here.
10. The banqueting hall of the Guildhall was used for great feasts at which the magnificence of the Lord Mayor and the twelve great Companies of the City were displayed.
11. A more local measure which computes integration up to three spaces around every roof space. It shows which spaces are strategic locally in drawing the street network together.
12. When the first Jewish colonies were founded in London in Norman times, providing the only source of ready capital to the inhabitants at the exorbitant interest rates of 40-60 percent, they settled in this area and in the vicinity of the Tower.
13. St. Paul's began as a monastic foundation, and the monasteries and friaries which arrived in London during the thirteenth century were offered sites by wealthy patrons, including those previously occupied by the Norman castles in the south-west. The south-western area thus became a place of sanctuary where criminals could not be arrested and brought to trial, and as a result it acquired the reputation of being one of the most vicious and deprived areas of

the City until that right was revoked in 1697.

14. This has been demonstrated by empirical observational studies in the modern City of London, as well as in numerous other examples.
15. There was at least one other plan prepared by Peter Mills, the Surveyor of the City which is unfortunately no longer in existence.
16. Robert Hooke was Curator of Experiments at the Royal Society and Professor of Geometry at Gresham College at the time of the Great Fire. His plan was submitted to the Royal Society on 19th September 1666 and met with their approval. The original has not survived but the version reproduced here, shown in Doornick's view of the Thames in 1666, has been attributed to Hooke. Hooke was nominated as one of the six Commissioners for the Rebuilding, along with Peter Mills, and Edward Jerman, the architect of the Royal Exchange.
17. Little is known of Valentine Knight except that he was an army officer, whose submission took the form of a printed broadsheet dated 20th September 1666 with a written description of how the City was to be parcelled up, and an accompanying freehand drawing. His design is rudimentary and incomplete and his representation of the plan is hurried and inaccurate. He suggested that the King might raise revenues for the military by rebuilding the City upon his more economical lines, and as a result was imprisoned for his temerity in suggesting that the King should derive profit from the disaster.
18. John Evelyn was a wealthy, educated nobleman who lived for his hobbies and divided his time between aesthetics and practical matters. He is best known as a diarist, courtier, and confidante of King Charles II. He first submitted his design to the King on September 17th and was received favorably. Evelyn drew on contemporary architectural theory, and was more knowledgeable than his contemporaries about European architectural tastes, having travelled extensively on the Continent.
19. Sir Christopher Wren's design was the first to be received by Charles II, on September 10th 1666, scarcely after the fire had ceased raging. He was a scientist of some reputation and had "taken up" architecture four years previously. Wren had visited Paris the previous year where it is known that he studied architecture including the Louvre, then under construction. He was Deputy Surveyor of the King's Works at the time of the Fire and had been commissioned to produce a plan for the restoration of Old St. Paul's which was in a state of disrepair. After the Fire, he was the architect to the new St. Paul's and many of the City churches.
20. Little is known of Richard Newcourt, except that he was a surveyor of some repute who had been one of the authors of a map of the City produced eight years before the Fire. He had extensive experience of the mediaeval City, and his design should be viewed as a critique of the human misery and overcrowded housing conditions which he recorded while making his earlier survey.
21. The Great Fire extended westwards well beyond the Roman walls, to engulf the extra-mural suburb where the lawyers had established their Inns of Court in the early thirteenth century. All the schemes included proposals for rebuilding this suburb.
22. A major traffic artery at the time, particularly from Westminster.
23. They were almost certainly aware of each other's designs at the "drawing board" stage.
24. In contrast to the other plans; Wren elevates the position of the Royal Exchange — an instrumental and practical trading center — and diminishes that of the Guildhall — the locus of predominantly symbolic forms of social organization and solidarity. Wren's Guildhall is sited in a block to the north of the rectilinear grid but he does not even bother to depict it as a building.
25. The central square alone measures 570 x 520 yards (approx. 521 x 475 m).

26. This was not the case in the mediaeval City where the boundaries of the wards and parishes were unclear. Sometimes they ran along the line of party walls while on other occasions they followed the line of the streets. The "shapes" formed by these civic and religious units resemble the pieces of a jigsaw rather than the units of a repeating pattern.
27. The exception, that of Knight, leaves dead ends in the vicinity of the Roman wall, but this was clearly not a product of the design so much as a constraint provided by the existing physical features.
28. F. Brown, "An interactive computer model of urban development: the rules governing the morphology of mediaeval London," *Environment and Planning B: Planning and Design* (1985), vol. 12, pp. 377-400.
29. This compares each example to a perfectly regular orthogonal grid with the same number of islands by the formula: $\text{grid axiality} = \frac{L(L+1)}{2} + \frac{L}{2}$ where L is the number of islands and L is the number of axial lines in the system. The result varies between 0 and 1 with high values approximating to a grid and low values to an axially deformed system.
30. Mean integration from all lines, looking in all cases just at the set of thoroughfare streets and ignoring the deepening effect of dead ends.
31. The limiting case is a perfectly regular square orthogonal grid, in which each line is connected to exactly half the others, rendering all values the same and the whole maximally shallow from each line to every other, although the actual value varies with the number of lines.
32. Integration is 10 percent of lines in all cases and segregation is 50 percent of lines in all cases except where otherwise stated.
33. Integration/segregation is the best index of the relative business or quietness of streets as they are actually used. Studies of a large number of towns from all parts of the world show that use patterns and densities of occupation and through movement are largely determined by this variable, which indexes the accessibility of a space as a destination for all other spaces in the system.
34. A proposition made by Mary Douglas, in *Rules and Meanings* (Penguin, 1973).
35. The cattle-market and slaughterhouse of the City which was located just to the north of the walled area.
36. Although this is not always the case as will be seen later.
37. The Bishopsgate area was beginning to decline in importance as a residential area for wealthy merchants who were increasingly looking to the West End of London or the high ground outside the City as a desirable place to live, while the area to the east of the Tower was by this time an overcrowded and industrial suburb. This shift forewarned of the split between the West End and the East End of London.
38. The opposite direction to Hooke's plan.
39. The Barbican is a recently-built cultural complex just outside the City which is notoriously difficult to find and negotiate as a stranger to the area.
40. In this way he replicates the phenomenon already noted in the mediaeval City.
41. Again, an artifact of the non-completion of the grid which introduces more structure, though a decrease in order, into what would otherwise be a highly repetitive design.
42. T.F. Reddaway, *The Rebuilding of London after the Great Fire* (London, Arnold, 1940); and G. Milne, *The Great Fire of London* (London, Historical Publications Ltd., 1986).
43. Before the Great Fire, major streets had been encroached upon by buildings and some had shrunk to as little as 11 ft (approx. 3 m) in width.
44. Charles II had returned from exile on the Continent in 1660 to take the throne which his father lost to Cromwell. His time abroad had exposed him to Renaissance architecture and planning and he was initially sympathetic to the idea that the City might be redesigned along Continental principles. However, the City Fathers had supported Cromwell in the Civil War and were undoubtedly sensitive to the fact

that several of the post-fire plans bore the imprint of aristocratic and courtly values.

45. Built on the consolidated rubble of the mediaeval buildings which were removed and deposited at the waterfront before rebuilding commenced.

46. The exception is still the area around the main wharves at Queenhythe.

47. These terms are due to Christopher Alexander, "A city is not a tree," *Design magazine*, Feb. 1968.

48. Jane Jacobs, *The Death and Life of Great American Cities* (Random House, 1961); and Alexander, *op. cit.*, have both argued this view while Leslie Martin, "The grid as generator" in Leslie Martin and Lionel March (eds.), *Urban Space and Structure* (Cambridge, Cambridge University Press, 1972), has cogently opposed it.