A CITY IS NOT A TREE

PART 2

BY CHRISTOPHER ALEXANDER

In the first part of this article, we saw that the units of which an artificial city is made up are organized to form a tree. So that we get a really clear understanding of what this means, and shall better see its implications, let us define a tree once again:

Whenever we have a tree structure, it means that within this structure no piece of any unit is ever connected to other units, except through the medium of that unit as a whole.

The enormity of this restriction is difficult to grasp. It is a little as though the members of a family were not free to make friends outside the family, except when the family as a whole made a friendship.

In simplicity of structure the tree is comparable to the compulsive desire for neatness and order that insists the candlesticks on a mantlepiece be perfectly straight and perfectly symmetrical about the center. The semi-lattice, by comparison, is the structure of a complex fabric; it is the structure of living things; of great paintings and symphonies.

It must be emphasized, lest the orderly mind shrink in horror from anything that is not clearly articulated and categorized in tree form, that the idea of overlap, ambiguity, multiplicity of aspect, and the semi-lattice, are not less orderly than the rigid tree, but more so. They represent a thicker, tougher, more subtle and more complex view of structure.

Let us now look at the ways in which the natural, when unconstrained by artificial conceptions, shows itself to be a semi-lattice.

A major aspect of the city's social structure which a tree can never mirror properly is illustrated by Ruth Glass's redevelopment plan for Middlesborough, a city of 200,000 which she recommends be broken down into 29 separate neighborhoods. After picking her 29 neighborhoods by determining where the sharpest discontinuities of building type, income, and job type occur, she asks herself the question: "If we examine some of *the social systems* which actually exist for the people in such a neighborhood, do the physical units defined by these various social systems all define the same spatial neighborhood?" Her own answer to this question is, *no*.

Each of the social systems she examines is a nodal system. It is made of some sort of central node, plus the people who use this center. Specifically she takes elementary schools, secondary schools, youth clubs, adult clubs, post offices, greengrocers, and grocers selling sugar. Each of these centers draws its users from a certain spatial area or spatial unit. This spatial unit is the physical residue of the social system as a whole, and is therefore a unit in the terms of this paper. The units corresponding to different kinds of centers for the single neighborhood of Waterloo Road are shown in **Figure 1.**

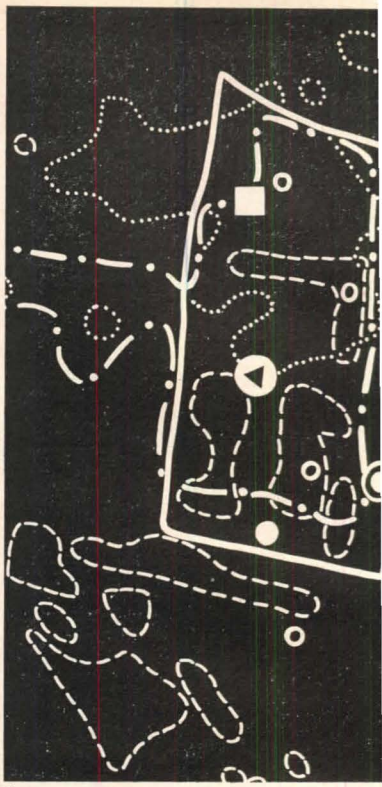
The hard outline is the boundary of the so-called neighborhood itself. The white circle stands for the youth club, and the small solid rings stand for areas where its members live. The ringed spot is the adult club, and the homes of its members form the unit marked by dashed boundaries. The white square is the post office and the dotted line marks the unit which contains its users. The secondary school is marked by the spot with a white triangle in it. Together with its pupils, it forms the system marked by the dot-dashed line.

As you can see at once, the different units do not coincide. Yet neither are they disjoint. They overlap.

We cannot get an adequate picture of what Middlesborough is, or of what it ought to be, in terms of 29 large and conveniently integral chunks called neighborhoods. When we describe the city in terms of neighborhoods, we implicitly assume that the smaller elements within any one of these neighborhoods belong together so tightly that they only interact with elements in other neighborhoods through the medium of the neighborhood to which they themselves belong. Ruth Glass herself shows clearly that this is not the case.

Below are two pictures of the Waterloo neighborhood. For the sake of argument I have broken it into a number of small areas. **Figure 2** shows how these pieces stick together in fact, and **Figure 3** shows how the redevelopment plan pretends they stick together.

There is nothing in the nature of the various centers which says that their catchment areas should be the same. Their natures are different. Therefore the units they define are different. The natural city of Middlesborough was faithful to the semi-lattice structure they have. Only in the artificial tree conception of the city are their natural, proper, and necessary overlaps destroyed.



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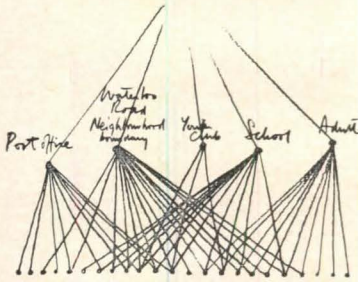

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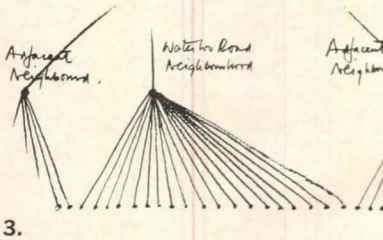

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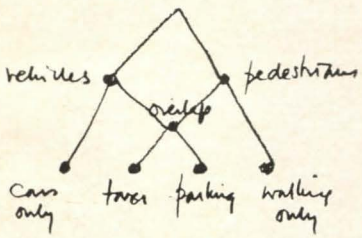
Take the separation of pedestrians from moving vehicles, a tree concept proposed by Le Corbusier, Louis Kahn, and many others. At a very crude level of thought this is obviously a good idea. It is dangerous to have 60-mile-an-hour cars in contact with little children toddling. But it is not *always* a good idea. There are times when the ecology of a situation actually demands the opposite. Imagine yourself coming out of a Fifth Avenue store; you have been shopping all afternoon; your arms are full of parcels; you need a drink; your wife is limping. Thank God for taxis.

Yet the urban taxi can function only because pedestrians and vehicles are not strictly separated. The prowling taxi needs a fast stream of traffic so that it can cover a large area to be sure of finding a passenger. The pedestrian needs to be able to hail the taxi from any point in the pedestrian world, and to be able to get out to any part of the pedestrian world to which he wants to go. The system which contains the taxicabs needs to overlap both the fast vehicular traffic system and the system of pedestrian circulation. In Manhattan pedestrians and vehicles do share certain parts of the city, and the necessary overlap is guaranteed **(Figure 4).**



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Another favorite concept of the CIAM theorists and others is the separation of recreation from everything else. This has crystallized in our real cities in the form of playgrounds. The playground, asphalted and fenced in, is nothing but a pictorial acknowledgment of the fact that "play" exists as an isolated concept in our minds. It has nothing to do with the life of play itself. Few self-respecting children will even play in a playground.

Play itself, the play that children practice, goes on somewhere different everyday. One day it may be indoors, another day in a friendly gas station, another day down by the river, another day in a derelict building, another day on a construction site which has been abandoned for the weekend. Each of these play activities, and the objects it requires, forms a system. It is not true that these systems exist in isolation, cut off from the other systems in the city. The different systems overlap one another, and they overlap many other systems besides. The units, the physical places recognized as play places, must do the same.

In a natural city this is what happens. Play takes place in a thousand places—it fills the interstices of adult life. As they play, children become full of their surroundings. How can a child become filled with his surroundings in a fenced enclosure? He cannot.

The isolated campus

A similar kind of mistake occurs in trees like that of Goodman's Communitas, or Soleri's Mesa City, which separate the university from the rest of the city. Again, this has actually been realized in common American form of the isolated campus.

What is the reason for drawing a line in the city so that everything within the boundary is university, and everything outside is non-university? It is conceptually clear. But does it correspond to the realities of university life. Certainly it is not the structure which occurs in non-artificial university cities.

Take Cambridge University, for instance. At certain points Trinity street is physically almost indistinguishable from Trinity college. One pedestrian crossover in the street is literally part of the college. The buildings on the street, though they contain stores and coffee shops and banks at ground level, contain undergraduates' rooms in their upper stories. In many cases the actual fabric of the street buildings melts into the fabric of the old college buildings so that one cannot be altered without the other.

There will always be many systems of activity where university life and city life overlap: pub-crawling, coffee-drinking, the movies, walking from place to place. In some cases whole departments may be actively involved in the life of the city's inhabitants (the hospital-cum-medical school is an example). In Cambridge, a natural city where university and city have grown together gradually, the physical units overlap because they are the physical residues of city systems and university systems which overlap **(Figure 5).**

Let us look next at the hierarchy of urban cores, realized in Brazilia, Chandigarh, the MARS plan for London, and, most recently, in the Manhattan Lincoln Center, where various performing arts serving the population of greater New York have been gathered together to form just one core.

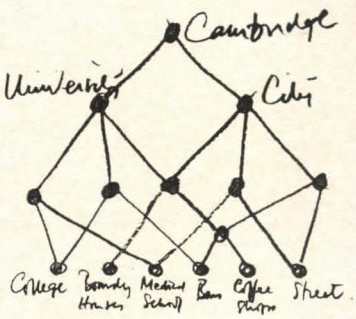
Does a concert hall ask to be next to an Opera House? Can the two feed on one another? Will anybody ever visit them both, gluttonously, in a single evening, or even buy tickets from one after going to a concert in the other? In Vienna, London, Paris, each of the performing arts has found its own place, because all are not mixed randomly. Each has created its own familiar section of the city. In Manhattan itself, Carnegie Hall and the Metropolitan Opera House were not built side by side. Each found its own place, and now creates its own atmosphere. The influence of each overlaps the parts of the city which have been made unique to it.

The only reason that these functions have all been brought together in the Lincoln Center is that the concept of performing art links them to one another.

But this tree, and the idea of a single hierarchy of urban cores which is its parent, do not illuminate the relations between art and city life. They are merely born of the mania every simple-minded person has for putting things with the same name into the same basket.

The total separation of work from housing, started by Tony Garnier in his industrial city, then incorporated in the 1929 Athens Charter, is now found in every artificial city and accepted everywhere where zoning is enforced. Is this a sound principle? It is easy to see how bad conditions at the beginning of the century prompted planners to try to get the dirty factories out of residential areas. But the separation misses a variety of systems which require, for their sustenance, little parts of both.

Jane Jacobs describes the growth of backyard industries in Brooklyn. A man who wants to start a small business needs space, which he is very likely to have in his own backyard. He also needs to establish connections with larger going enterprises and with their customers. This means that the system of backyard industry needs to belong both to the residential zone, and to the industrial zone—these zones need to overlap. In Brooklyn they do **(Figure 6).** In a city which is a tree, they can't.



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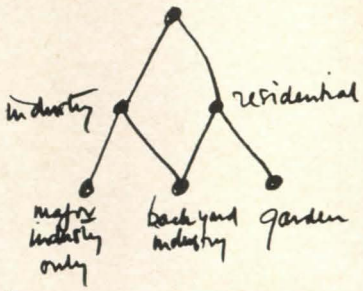

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Finally, let us examine the subdivision of the city into isolated communities. As we have seen in the Abercrombie plan for London, this is itself a tree structure. The individual community in a greater city has no reality as a functioning unit. In London, as in any great city, almost no one manages to find work which suits him near his home. People in one community work in a factory which is very likely to be in another community.

There are, therefore, many hundreds of thousands of worker-workplace systems, each consisting of a man plus the factory he works in, which cut across the boundaries defined by Abercrombie's tree. The existence of these units, and their overlapping nature, indicates that the living systems of London form a semi-lattice. Only in the planner's mind has it become a tree.

The fact that we have so far failed to give this any physical expression has a vital consequence. As things are, whenever the worker and his workplace belong to separately administered municipalities, the community which contains the workplace collects huge taxes and has relatively little on which to spend the tax revenue. The community where the worker lives, if it is mainly residential, collects only little in the way of taxes, and yet has great additional burdens on its purse in the shape of schools, hospitals, etc. Clearly, to resolve this inequity, the worker-workplace systems must be anchored in physically recognizable units of the city which can then be taxed.

It might be argued that, even though the individual communities of a great city have no functional

significance in the lives of their inhabitants, they are still the most convenient administrative units, and should, therefore, be left in their present tree organization.

However, in the political complexity of a modern city, even this is suspect.

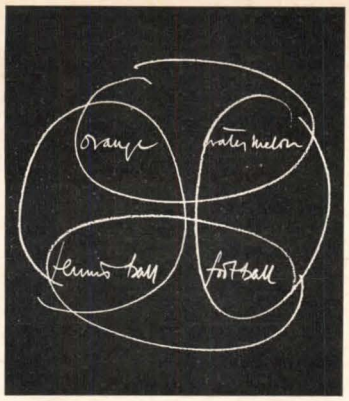
Edward Banfield, in a recent book called *Political Influence,* gives a detailed account of the patterns of influence and control that have actually led to decisions in Chicago. He shows that although the lines of administrative and executive control have a formal structure which is a tree, these formal chains of influence and authority are entirely overshadowed by the ad hoc lines of control which arise naturally as each new city problem presents itself. These ad hoc lines depend on who is interested in the matter, who has what at stake, who has what favors to trade with whom.

This second structure, which is informal, working within the framework of the first, is what really controls public action. It varies from week to week, even from hour to hour, as one problem replaces another. Nobody's sphere of influence is entirely under the control of any one superior; each person is under different influences as the problems change. Although the organization chart in the mayor's office is a tree, the actual control and exercise of authority is semi-lattice-like.

Trapped in a tree

Now, why is it that so many designers have conceived cities as trees when the natural structure is in every case a semi-lattice? Have they done so deliberately, in the belief that a tree structure will serve the people of the city better? Or have they done it because they cannot help it, because they are trapped by a mental habit, perhaps even trapped by the way the mind works; because they cannot encompass the complexity of a semi-lattice in any convenient mental form; because the mind has an overwhelming predisposition to see trees wherever it looks and cannot escape the tree conception?

I shall try to convince you that it is for this second reason that trees are being proposed and built as cities—that it is because designers, limited as they must be by the capacity of the mind to form intuitively accessible structures, cannot achieve the complexity of the semi-lattice in a single mental act.



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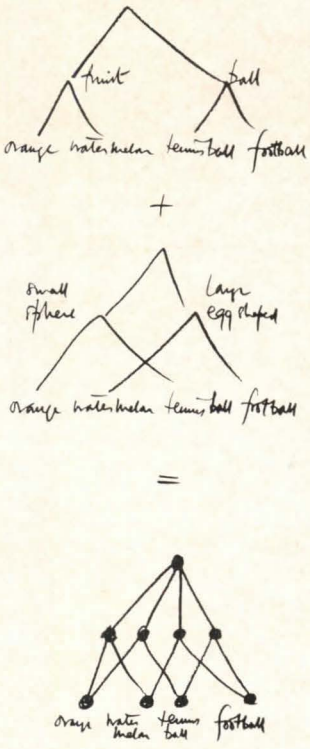


Let me begin with an example.

Suppose I ask you to remember the following four objects: an orange, a watermelon, a football, and a tennis ball. How will you keep them in your mind, in your mind's eyes? However you do it, you will do it by grouping them. Some of you will take the two fruits together, the orange and the watermelon, and the two sports balls together, the football and the tennis ball. Those of you who tend to think in terms of physical shape may group them differently, taking the two small spheres together—the orange and the tennis ball and the two larger and more egg-shaped objects — the watermelon and the football. Some of you will be aware of both.

Let us make a diagram of these groupings **(Figure 7).**

Either grouping taken by itself is a tree structure. The two together are a semi-lattice. Now let us try and visualize these groupings in the mind's eye. I think you will find that you cannot visualize all four sets simultaneously —because they overlap. You can visualize one pair of sets and then the other, and you can alternate between the two pairs extremely fast, so fast that you may deceive yourself into thinking you can visualize them all together. But in truth, you cannot conceive all four sets at once in a single mental act. You cannot bring the semi-lattice structure into a visualizable form for a single mental act. In a single mental act you can only visualize a tree.

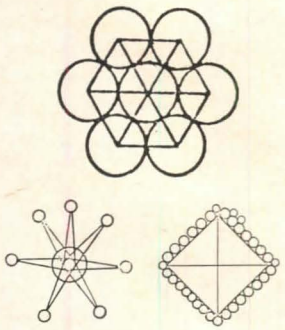
This is the problem we face as designers. While we are not, perhaps, necessarily occupied with the problem of total visualization in a single mental act, the principle is still the same. The tree is accessible mentally, and easy to deal with. The semi-lattice is hard to keep before the mind's eye, and therefore hard to deal with.

It is known today that grouping and categorization are among the most primitive psychological processes. Modern psychology treats thought as a process of fitting new situations into existing slots and pidgeon holes in the mind. Just as you cannot put a physical thing into more than one physical pidgeon hole at once, so, by analogy, the processes of thought prevent you from putting a mental construct into more than one mental category at once. Study of the origin of these processes suggests that they stem essentially from the organism's need to reduce the complexity of its environment by establishing barriers between the different events which it encounters.

It is for this reason—because the mind's first function is to reduce the ambiguity and overlap in a confusing situation, and because, to this end, it is endowed with a basic intolerance for ambiguity—that structures like the city, which do require overlapping sets within them, are nevertheless persistently conceived as trees

The same rigidity dogs even the perception of physical patterns. In experiments by Huggins and myself at Harvard, we showed people patterns whose internal units overlapped, and found that they almost always invented a way of seeing the patterns as a tree—even when the semi-lattice view of the patterns would have helped them perform the task of experimentation which was before them.

The most startling proof that people tend to conceive even physical patterns as trees is found in some experiments of Sir Frederick Bartlett. He showed people a pattern for about ¼ second and then asked them to draw what they had seen. Many people, unable to grasp the full complexity of the pattern they had seen, simplified the patterns by cutting out the overlap. In **Figure 8,** the original



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is shown at the top, with two fairly typical redrawn versions below it. In the redrawn versions the circles are separated from the rest; the overlap between triangles and circles disappear.

These experiments suggest strongly that people have an underlying tendency, when faced by a complex organization, to reorganize it mentally in terms of non-overlapping units. The complexity of the semi-lattice is replaced by the simpler and more easily grasped tree form.

You are no doubt wondering, by now, what a city looks like which is a semi-lattice, but not a tree. I must confess that I cannot yet show you plans or sketches. It is not enough merely to make a demonstration of overlap — the overlap must be the right overlap. This is doubly important, because it is so tempting to make plans in which overlap occurs for its own sake. This is essentially what the high density "life-filled" city plans of recent years do. But overlap alone does not give structure. It can also give chaos. A garbage can is full of overlap. To have structure, you must have the right overlap, and this is for us almost certainly different from the old overlap which we observe in historic cities. As the relationships between functions change, so the systems which need to overlap in order to receive these relationships must also change. The recreation of old kinds of overlap will be inappropriate, and chaotic instead of structured.

The work of trying to under-

stand just what overlap the modern city requires, and trying to put this required overlap into physical and plastic terms, is still going on. Until the work is complete, there is no point in presenting facile sketches of ill thought out structure.

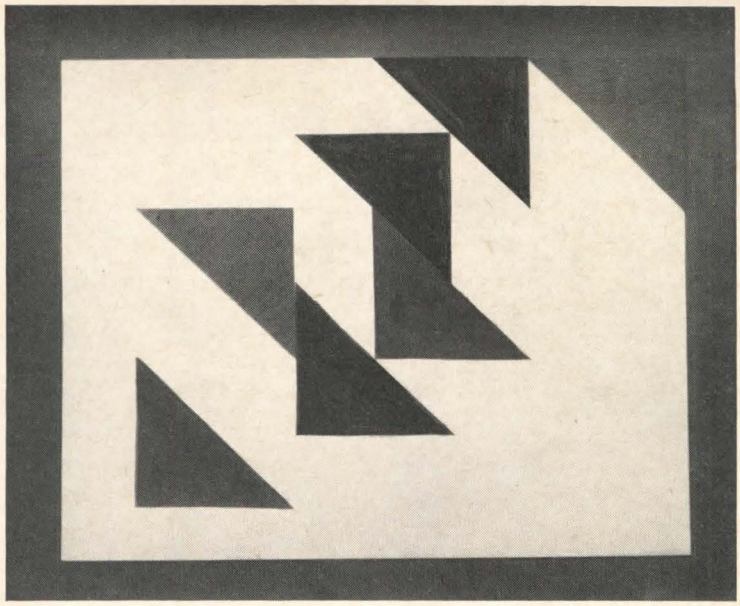
Overlapping triangles

However, I can perhaps make the physical consequences of overlap more comprehensible by means of an image. The painting illustrated is a recent work by Simon Nicholson **(Figure 9)**. The fascination of this painting lies in the fact that although constructed of rather few simple triangular elements, these elements unite in many different ways to form the larger units of the painting—in such a way indeed, that if we make a complete inventory of the perceived units in the painting, we find that each triangle enters into four or five completely different kinds of unit, none contained in the others, yet all overlapping in that triangle.

Thus, if we number the triangles and pick out the sets of triangles which appear as strong visual units, we get the semi-lattice shown in **Figure 10.**

Three and 5 form a unit because they work together as a rectangle; 2 and 4 because they form a parallelogram; 5 and 6 because they are both dark and pointing the same way; 6 and 7 because one is the ghost of the other shifted sideways; 4 and 7 because they are symmetrical with one another; 4 and 6 because they form another rectangle; 4 and 5 because they form a sort of Z; 2 and 3 because they form a rather thinner kind of Z; 1 and 7 because they are at opposite corners; 1 and 2 because they are a rectangle; 3 and 4 because they point the same way as 5 and 6, and form a sort of off-center reflection; 3 and 6 because they enclose 4 and 5; 1 and 5 because they enclose 2, 3, and 4. I have only listed the units of two triangles. The larger units are even more complex. The white is more complex still, and is not even included in the diagram because it is harder to be sure of its elementary pieces.

The painting is significant, not so much because it has overlap in it (many paintings have overlap in them), but rather because this painting has nothing else in it except overlap. It is only the fact of the overlap, and the resulting multiplicity of aspects which the forms present, that makes the



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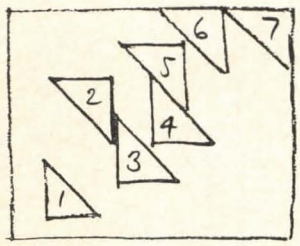

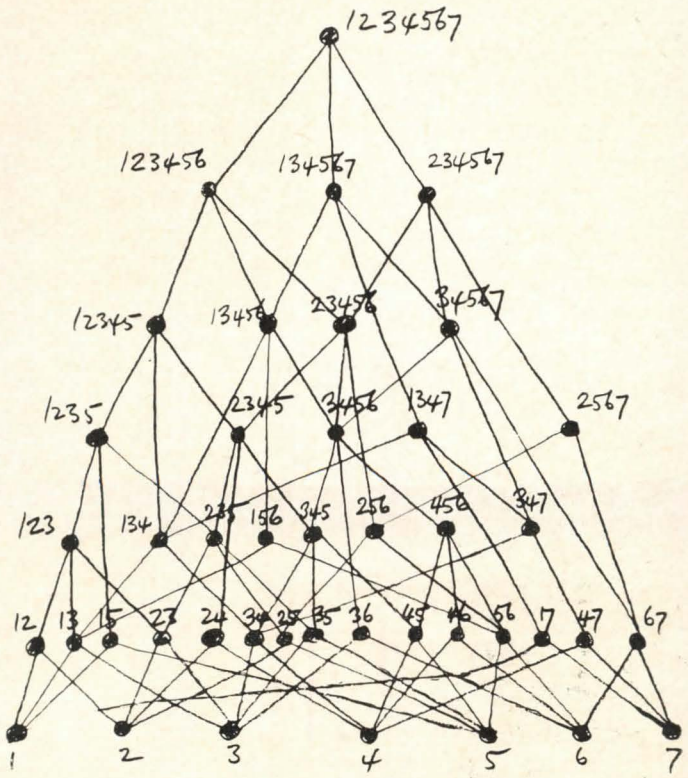

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painting fascinating. It seems almost as though the painter had made an explicit attempt, as I have done, to single out overlap as a vital generator of structure.

All the artificial cities I have described have the structure of a tree rather than the semi-lattice structure of the Nicholson painting. Yet it is the painting, and other images like it, which must be our vehicles for thought. And when we wish to be precise, the semi-lattice, being part of a large branch of modern mathematics, is a powerful way of exploring the structure of these images. It is the semi-lattice we must look for, not the tree.

When we think in terms of trees we are trading the humanity and richness of the living city for a conceptual simplicity which benefits only designers, planners, administrators and developers. Every time a piece of a city is torn out, and a tree made to replace the semi-lattice that was there before, the city takes a further step toward dissociation.

In any organized object, extreme compartmentalization and the dissociation of internal elements are the first signs of coming destruction. In a society, dissociation is anarchy. In a person, dissociation is the mark of schizophrenia and impending suicide. An ominous example of city-wide dissociation is the separation of retired people from the rest of urban life, caused by the growth of desert cities for the old like Sun City, Arizona. This separation is only possible under the influence of tree-like thought.

It not only takes from the young the company of those who have lived long, but worse, it causes the same rift inside each individual life. As you will pass into Sun City, and into old age, your ties with your own past will be unacknowledged, lost, and therefore, broken. Your youth will no longer be alive in your old age—the two will be dissociated, your own life will be cut in two.

For the human mind, the tree is the easiest vehicle for complex thoughts. But the city is not, cannot, and must not be a tree. The city is a receptacle for life. If the receptacle severs the overlap of the strands of life within it, because it is a tree, it will be like a bowl full of razor blades on edge, ready to cut up whatever is entrusted to it. In such a receptacle life will be cut to pieces. If we make cities which are trees, they will cut our life within to pieces.

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