Part four
Theoretical syntheses

4

Chapter ten

Space is the machine

Of what things is space the cause? None of the four modes of causation can be ascribed to it. It is neither cause in the sense of the matter of things (for nothing is composed of it), nor as the form and definition of things, nor of ends, nor does it move things.
(Aristotle: Physics book iv chapter 1)

Forms and functions, buildings and societies

Common sense affirms, and the ordinary use of language confirms, that there is an association between the form and function of a building. If we name a kind of building – say 'school' or 'house' or 'church' – and try to disentangle what we mean, then we find at least two sets of ideas present in the word. One is the idea of a particular form of social organisation. The other is the idea of a particular form of building. Perhaps an organisation and a form is too specific. A family of possible organisations and a family of possible forms might convey more accurately what is in our minds. These seem in some way to be bound up with each other in the intuitions of 'school' or 'house' or 'church', so that we think we recognise one from the other. This association of ideas is not confined to cognition. It affects behaviour. By recognising types as form-function pairings, we anticipate how to behave in the kinds of spaces that we expect to find in a building. We are pre-programmed by our intuitions of building types to behave in ways appropriate to the form.

However, in spite of the apparent closeness of the association, the relation between form and function in buildings has always proved resistant to analysis. Although the relation seems intuitively clear on a case by case basis, and architects design buildings to fit different functions for the most part without too much difficulty, it is very hard to be explicit about what it is that distinguishes the form-function relation as it appears in one type of building from the way it appears in another. One might say that a designer will design a possible version of the form–function pairing for a certain purpose, but that does not mean that any aspect of what is designed is necessary for that purpose. Knowledge of what is necessary implies knowledge of the limits of possibility. Such limits are not at all well understood. In the present state of knowledge, it is not unreasonable to doubt their existence. The form-function relation may not be well defined enough to allow such knowledge. The fact that buildings so easily change their function support these doubts. The form-function relation may not be quite as specific as the uncritical use of the language of building types suggests.

To some extent this state of affairs may be due to failure to distinguish between the specific functions buildings perform, and 'generic function', as set out in the last two chapters. Generic function implies that what makes buildings functionally interchangeable is what buildings must have in common spatially in order to fulfil any function. The more generic function is sufficient to account for spatial organisation in any particular case, then the more we would expect functional flexibility. However, this does not solve the problem in hand. Intuition clearly anticipates, and language institutionalises, specific functions and warns us that in some important sense a school is a school, and a house a house. Are intuition and language then wrong in this affirmation?

There are two aspects to the problem. First, our ideas about buildings already come replete with social ideas. Second, our ideas about social institutions come with ideas about buildings attached to them. Each presents a problem for architectural theory. The first leads to the form-function question as we have described it. Does common sense deceive us in affirming a well-formed typological

Space is the machine

relation between the form a building takes and what it is for? If it does not, is this association contingent, in that it just happens that this function leads to this form and that function another? Or is there some more systematic sense in which variation in functions are associated with variations in form? If the latter is the case, then there can be a form-function theory in architecture. If not, there cannot be. The second leads to questions about buildings as social objects. Does it matter that our ideas about social institutions come with ideas about buildings attached to them? Is the building in some sense a part of the definition of the social entities we name as schools, monasteries, and so on? If so, is this simply an association of ideas, or is there some well-defined sense in which variations in social forms are expressed through variation in the forms of buildings?

On reflection, our reaction tends to be against the idea of systematic relations. At first sight, a social organisation – say a school – is a set of roles and relations that can be fully described without invoking a building. However, the matter is not so easily settled. The *idea* of a school, if not its organisational diagram, implies more than roles and relations in the abstract. It implies roles and relations realised in spatial form in some way. There must, for example, be spatial interfaces of some kind between teachers and taught. Such interfaces define a kind of minimal spatial content not simply to the building, but to an organisation and therefore to the building. These spatial dimensions of organisation arise not from the form of the organisation but from its functioning. An organisation can be described without reference to space, and therefore without reference to buildings, but the way in which the organisation works usually cannot.

The idea of a school does after all seems imply some type of realisation in space. It was a recognition of this minimal spatial context in organisations that gave rise to the theory of buildings as 'interfaces' between 'inhabitants' and 'visitors', (such as priests and congregations, teachers and taught, families and guests), and between different categories of inhabitant that was set out in *The Social Logic of Space*[1]. Interfaces seem to define the essential spatial 'genotypes' of the buildings we name as belonging to this or that functional type. However, this leads to a difficult question: If societies regularly produce spatial genotypes in buildings, then is there some sense in which these genotypes are necessary to, and even a part of, society? An even more difficult question follows. If we find it hard to conceptualise how a building can have necessary social dimension to it, is it even harder to conceptualise how a society can have a necessary built dimension to it?

Our puzzle is then two-fold. Buildings seem to be physical things, and societies and organisations seem to be abstractions. Yet our ideas of buildings seem to contain social abstractions, and our idea of social organisations seems to contain ideas of buildings. The common coin of both relations seems to be the idea of space. Space both gives the form to the social abstractions which we name in buildings, and space seems to be the content of the building that can be taken back to the more abstract conceptions of society and organisation. The first defines the form-function problem in architecture. In what sense is there a regular relation

between the forms of buildings and the ways in which the bits of society that inhabit them work? The second is the problem of the building as a social object. Is there any real sense in societies needing buildings to make them work? These two related problems will be dealt with in turn, beginning with a little recent history.

Recent history

It is sad, but true, that the theoretical nature of the form-function relation in architecture mainly comes to public attention through failure. When an architectural scheme – say an inner city redevelopment or a large housing estate – goes wrong in a public way, it is common to blame architects for their crazy theories. It is a one-sided game. Buildings and places that work rarely attract such epistemological comment. Good buildings and places are taken to be as nature intended rather than as artificial products of thought. No one ever praises architecture for the excellence of its theories. Only failure, it seems, alerts the man or woman on the upper level walkway or in the empty piazza to the highly theoretical nature of architecture.

But what exactly is it about architecture that these theoretical critics are referring to? They seem not to be talking about construction, since that would be regarded, rightly or wrongly, as a matter of fact, of knowable technique, and therefore a matter of competence rather than theory. Nor do they seem to be talking about aesthetics or style, since that would be regarded as a matter of taste or of art, and therefore a matter of sensibility rather than theory. Theoretical criticism of architecture seems squarely aimed at the second term of the Vitruvian triad of 'firmness, commodity, and delight'.[1] It addresses the way in which the physical and spatial form of buildings impinges on the way we live our lives – that is, the form-function relation.

As we have seen, the form-function relation is easy to talk about in a generalised way, but difficult to talk about precisely. It is not even clear how we should talk about it. The form-function relation, unlike construction, does not seem to belong to architecture as science, since there seem to be no clear facts, let alone explicit and testable theories. Nor does it belong to architecture as art. We cannot seriously see the North Peckham estate or Pruitt Igoe as failures of art. Yet the form-function relation does seem to be what people expect architectural theories to be about. On reflection, we might find that both architects and their theoretical critics agree that this is right. Architecture is a technique and an art with social consequences which are intrinsic rather than extrinsic. They lie in the nature of the object itself, as well as in its associations and symbolic meanings. Architectural theories do not therefore in general take the form of propositions about construction or propositions about art: they are in essence propositions about the relation between architecture and life; that is, about what architecture is for in relation to what it is. This is perhaps the distinctive feature that makes architecture unlike anything else that human beings do. At least part of its social implications lie in its very form, and our notions of what a theory is reflect this.

A great deal more of the current public debate about architecture than we allow is aimed at the form-function relation. People are worried about places that seem not to work; about developments in cities that lack the life that is the source

Space is the machine

of urbanity; about housing estates that do not seem to generate the elementary decencies of community life. They believe, rightly or wrongly, that architecture is in some way implicated. This creates a problem between architecture and its public that is more than one of communication, because, in spite of the fact that designing forms to fit functions is one of the foundations of architectural practice, the fact is that most of our usable knowledge about it comes from precedent and individual experience. There is very little theoretical understanding of the form-function relation. We even find it difficult to talk about in a consistent and rational way. Fortunately, when push comes to shove, the theoretical critics on the upper level walkway share our incoherence, and need only a little encouragement to conspire with us in talking about the problem as though it could be reduced to construction or aesthetics, or maybe the lack of shops, or transport, or nursery facilities.

The idea that there is so little theoretical understanding of form and function in architecture may surprise many, since it is widely believed that the failures of twentieth-century architecture are largely to be laid at the door of a 'functionalist' theory.[2] The conventional wisdom is that modernism failed because it was more concerned with the relation between form and function than with the relation between form and meaning, and that this was so because architecture, under the peculiar social pressures of the post bellum decades, had become more preoccupied with social engineering through architecture than with architecture itself. The subsequent disillusion with functionalism as the normative basis of design also became a rejection of the form-function relation as the primary focus for a theory of architecture, in favour of the form-meaning relation. Modernist functionalism was rejected not only as a false theory, but as a theory aimed at the wrong problem.

In retrospect, it is far from obvious that the rejection should have been so thoroughgoing. It was always clear that the 'failures' of modernism were not simply failures of a functionalist philosophy, but also functional failures. The new housing forms simply did not work to meet the benign social engineering objectives – community, interaction, identity, and so on – that were written into their programmes. The proper inference from this would seem to be that the functionalist theories used by the designers were wrong, but that functional failure had confirmed the central importance of the form-function relation. There could, after all, be no functional failure if the relation between form and function were not powerful. The call should then follow for a new theory of function. Instead, there was a abandonment of functional theory in general and an intellectual abandonment of the form-function problem at exactly the moment when functional failure had brought it dramatically to public attention.

To understand this apparently perverse reaction – and also see that in a certain sense it was justified – we must understand exactly what it was that was rejected. What was rejected, it will be argued, was not the form-function relation *per se*, since that continued to play the same practical role in architectural practice that it has always played, but a specific formulation of the form function problem that provided the foundation for architecture as social engineering. This we will call the 'paradigm of the machine'. The paradigm of the machine was the necessary foundation for the

practice of architecture as social engineering, and originated in a debate between architecture and the social sciences. As a result, certain theoretical problems in the social sciences pertaining to the relation between the social world and the material world, were transmitted into architecture. To the extent that architecture became social engineering, the paradigm of the machine invaded architectural thought, took over its language and its institutional structures, and became pervasive and destructive.

The metaphor of the machine and the paradigm of the machine

We must begin by making a clear distinction between the paradigm of the machine and the metaphor of the machine. The most famous – some would say infamous – proposition of architectural theory in the twentieth century is probably Le Corbusier's 'A house is a machine for living in'.[3] On the face of it, this seems to assert a direct analogy between buildings and machines. In fact, a closer reading quickly suggests this is not to be taken seriously. A machine is an organisation of matter that transforms other matter through its operation. Nothing like this conception is to be found in Le Corbusier's text. Translating from machines to buildings would have to centre on the plan as the organiser of the life that goes on in a building. If the building is to be seen as a machine, then this implies that relation between the plan and the life that takes place in the plan is in some sense mechanistic, and that the former is either determinative, or a strict expression, of the latter. This belief is not to be found in Le Corbusier's text. On the contrary, when in his 'Manual of the dwelling' he explains in more detail 'the house as a machine for living in', he describes rooms, and exhorts clients to demand a whole range of rooms for new functions, but he does not discuss the organisation of rooms into a plan in any way.[4] It is clear that his preoccupation is not with the machine as formal analogue for the organisation of the dwelling, but with the machine as the metaphor for a style uncluttered with the decorative detritus of the past.

This interpretation is confirmed when, later on in the book, Le Corbusier does talk of plans. His approach is passionate, historical, and preoccupied with the symbolic potential of space.[5] It is clear that Le Corbusier sees the plan as part of architecture, and the space that is organised by the plan as a prime expression of architectural creativity. His spatial philosophy is specific: the principle spatial element is the axis. The organisation of the building is the organisation of its axes, that is, of its sequences of experience. The axis is fundamental because the experience of architecture is an experience of movement. 'Arrangement is the grading of axes, and so it is the grading of aims, the classification of intentions'.[6] There is no determinism in this view, only a strict rationalism by which the mind imposes its geometric self on the geometric potential of the external world, and calls it architecture. One finds in Le Corbusier then the metaphor of the machine, but not the paradigm of the machine. In general we will find this is the case in high architecture. One scours the architectural manifestos of the twentieth century in vain for a thoroughgoing statement of the determinism from spatial form to function, or its inverse, that would be the true architectural embodiment of the paradigmatic, as opposed to metaphoric, idea of the building as machine.[7]

Where then do we find the notorious functional determinism for which twentieth-century architecture has become famous and for which modernism has

Space is the machine

been so commonly blamed? The answer is that it is to be found in the social and political theorising that increasingly became the intellectual context of the practice of architecture as architecture moved towards a social engineering practice. The central proposition of architecture as social engineering is that specific social outcomes can be engineered by manipulating architecture this way and that. In other words, the relation between form and function in architecture is analogous to similar problems dealt with by engineers. If architecture is indeed social engineering then it needs a theory to explain how it works. The paradigm of the machine filled this need. We should call this the paradigm of the machine, not the theory of the machine, because a paradigm is a set of model ideas and assumptions about the fundamental constitution of a field of phenomena which tell us what there is to theorise about. It functions as a framework for thought and for the setting of objectives, both theoretical and practical. It tells us in effect what kind of a problem we are dealing with. A theory tells us how phenomena work, and therefore suggests how we might solve problems[8]. The paradigm of the machine, it will be argued sets up the form-function problem in such a way that it could never generate a credible form-function theory.

The reader might object at this point that the possibility of pursuing social objectives through architecture has been reaffirmed throughout this book, since spatial form in architecture has been shown to have social determinants and social consequences. This is a correct accusation. But the substance of the proposal here is different. The central argument in this book is that the relation between form and function at all levels of the built environment, from the dwelling to the city, passes through the variable of spatial configurations. The effects of spatial configuration are not on individuals, but on collections of individuals and how they interrelate through space. All that is proposed, in effect, is that a pattern of space in a complex can affect the pattern of co-presence and co-awareness of collections of people who inhabit and visit that complex. This is a very obvious thing to say. The most likely answer is: 'Well of course ...' One is more likely to object to its triviality than to its metaphysics. All that has been done in earlier chapters is to show very carefully exactly how this occurs, and how these low-level effects link to more interesting, more obviously social effects.

Now the essence of the social engineering approach to the form-function relation in architecture was that it had no conception of spatial configuration, and without this the effects we will find ourselves looking for are not effects from one type of pattern to another, but from physical forms directly to individuals. The building itself is seen as the machine, and the physical form of the building the determinant of behaviour. Such relations do not exist, or at least not in any interesting sense. Belief in their existence really does violate common sense. How can a material object like a building impinge directly on human behaviour? Even so, it is exactly this that we are expected to believe if we abandon spatial configuration as the intervening variable. The paradigm of the machine in effect asks us to believe that the relation of form to function in architecture passes not, credibly, from a pattern of space created by the building to a pattern of co-awareness and co-presence, but, incredibly, directly from building to individual.

There are many versions of this belief. Some assume that direct relation between building and behaviour should take the form of 'fitting' activities to spaces. Others stress the intervening role of cognition, for example, that the built environment acts as a series of 'clue and clues' to behaviour or as a kind of theatrical back cloth which is 'appropriate' for the activity happening in front of it. All have in common that they presuppose a relation between built form and behaviour unmediated by spatial configuration.[9] That such relations do not really exist in any systematic sense seems amply confirmed both by the lack of research results which show such relations, and by the fact that the only relations we can find are those that pass through spatial configuration. The effect of the paradigm of the machine on the theory and practice of architecture was therefore to base architectural practice on a theoretical foundation which generated no research results and could predict no outcomes from design. Architecture as social engineering was in effect founded on a postulate of a relation between built form and human function which could not be verified because it was not there.

It was this naïve formulation of the form-function relation in architecture that was rejected with the demise of modernism. Unfortunately, by then it had become, through its normative role in design, so fully enmeshed with the whole idea of the form-function problem in architecture, that the rejection of the paradigm became, for a while at least, the rejection of the problem, and consequently of the need for a form function theory in architecture at all. This chain of events is evidence of the ability of paradigms to exert covert power on human thought. The paradigm of the machine was always strange to architects, but it became the foundation for modernism in action, through its role in the programmes of social engineering that architecture was enjoined to carry out in the post-war decades. The paradigm of the machine was an idea about architecture that never became a properly architectural idea, for the simple reason that the relations on which the paradigm were posited simply do not exist. Their hypothetical existence was an illusion of the paradigm.

Once we have located the paradigm of the machine as the necessary belief system of architecture as social engineering, we can begin to trace its origins and understand its true nature. Its origins turn out to be a great deal older than we might think, and link up to a much wider spectrum of ideas that began to prevail in intellectual life towards the end of the eighteenth and in the early part of the nineteenth century. This broader underlying scheme of thought that gave rise to the paradigm of the machine constitutes what I will call the 'organism-environment paradigm'. To understand its nature we must understand the origins of its key conceptual constituent: the idea of 'environment'.

The origins of the environment

'Environment' is one of those curious words which we assume have always been around, but which are in fact quite recent additions to our vocabulary, and to our system of common concepts. It is an interestingly complex idea. It implies not only the milieu in which we exist, but a milieu which surrounds us. Environing means to surround, so an environment is not only a physical milieu but one which actively

and significantly surrounds, so that the environed thing in some way is aware of, or affected by, its 'environment'. Environment as a surrounding thing implies an experiencing subject at its centre. In the late twentieth century, we confirm this complexity in the term environment by using it to express not only a new awareness of the importance of our milieu, but also of our relation to it.

In this form, the idea was barely present in common consciousness until well past the turn of the century, and it is only in the past three decades that it has become a dominant element in our view of ourselves and our place in the world. Because of the importance of the concept in current thinking, the argument that is about to be proposed needs very careful definition. In being critical of the effects of the concept of environment in the formation of certain paradigmatic schemes, there is no implied criticism of the change in our awareness of our surroundings that the idea of environment has helped to bring about. There are however, hidden dangers in the concept. In particular, we must investigate the origins and meanings of the word if we are to fully understand the origins, and the malign effects of the paradigm of the machine in architecture.

According to Canguihem[10], we must look for the origins of the concept of environment in its modern sense in the eighteenth century, and some very significant developments that took place then in the development of scientific thinking about the natural world. To understand the scientific developments, we must know the problem to which they were addressed, and for this we must go all the way back to Aristotle. In looking at the natural world, especially those areas which are covered by such modern sciences as biology and zoology (but also including the areas now covered by physics and chemistry), what Aristotle saw in nature was a general form-function problem: how was it that the forms of species (or other natural forms) were so well adapted to how they functioned? We might say that for this reason Aristotle saw nature as a design problem, and sought an answer which would explain how nature managed to design such successful form-function relations.

Aristotle answered by making an analogy with architecture. This analogy is so pervasive in Aristotle's accounts of nature that it should be thought of as Aristotle's paradigm. The form of a house, Aristotle argued cannot be explained by a purely material process of laying stone on stone. This 'material' process had to be guided by a pre-existing idea of the form the house was to take. What is the nature of such ideas and where do they come from? They are, according to Aristotle, purposes. The form of a house arises from human purposes. Forms are therefore expressions of purposes and indeed, in a sense, are purposes. As it is in architecture, Aristotle argues, so it must be in nature, since we find the same agreement between form and apparent purpose. Aristotle then generalises. Material causes explain little. Final causes are purposes. The source of order in nature must therefore be purposeful design. It would not be too much of an exaggeration to say that the entire Aristotelian system of nature was erected on this architectural foundation.[11] Its flaws are well known. From a scientific point of view, arguing from design explains nothing. It does no more than remove one mystery by invoking another, and explain one kind of order by assuming another anterior to it.

Space is the machine

Now the reason these ideas are an important background in the eighteenth century is that in key areas of science, such as physics, theories had arisen which seemed not only to be true, but also showed how it was possible to explain order without the assumption of anterior order. How surprising this apparent emancipation of human thought seemed can best be explained by a contrast with Aristotelian physics. The fundamental assumptions of Aristotelian physics were common sense. If something moved, it was because something else had moved it. All our experience confirms this. Yet it leads to an impossible physics. For example, according to these assumptions, it was self evident that the forces that impelled movement could not work in a void. From this it followed that space was a plenum, rather than a vacuum. In such a universe, the chain of movement must be endless. Whatever moves, something else must itself be moved. What then is at the end of the line? Aristotle answers with a verbal conjuring trick: the unmoved mover.

Newton's solution to the paradoxes of Aristotelian physics is as well known as it is extraordinary. Following earlier incomplete formulations by Galileo and Descartes, he proposes a principle which contradicts all experience available at the time, the 'principle of inertia' which states that all bodies move 'in a right line' forever until impelled by some external force to change their course.[12] This reformulation puts motion 'on the same level of being as rest',[13] so that motion is no longer a change, as it was in Aristotle, but a state. This is why it can continue forever, and this is why the principle of inertia can be used as the fundamental assumption of a mathematical physics, whose task was then to describe how forces work on inert bodies to produce the patterns that we see in the universe.

Of course, some of Newton's contemporaries objected that in eliminating common sense Newton had also eliminated physics, and was offering a mathematical description but not a physical theory.[14] On the other hand, Newton's theory, with the minimum of assumptions and with the greatest simplicity, gave an astonishingly accurate account of a vast range of previously disparate phenomena, and permitted a uncanny accuracy of prediction across many fields. In other words, although it did not show why the world worked the way it did in any way which satisfied common sense intuition, it showed how it worked with unprecedented precision. Most important of all, Newton's theory showed how there could be observable order in the universe without invoking some pregiven order which gave rise to it. To accept that the universe worked mathematically needed no stronger presupposition than that a soap bubble is spherical because that represents the most probable distribution of forces.

It was this discovery of order without anterior order that provided the conceptual model for the attempts in the century following Newton to make a parallel emancipation in our understanding of other natural phenomena. From this point of view, the problem that had originally motivated Aristotle, the forms of species in nature and their relation to function, seemed intractable. How could there be a theory of the origination of order in natural species without anterior order, or design in some guise, the more so in view of the fact that in this vastly rich and diverse area of forms Aristotle's original objection that mathematics could not be the language of science because it was too precise and

abstract, seemed still to hold force, despite the conquest of physics by mathematics.

The modern concept of 'environment' took its form essentially as the first attempt to formulate a solution to this problem: namely, the environmental determination of species. In different parts of the world – and therefore in different ambient conditions – very different patterns of speciation had occurred. The idea of the environmental determination of the forms of species quite simply turned the problem into the solution. If different speciation was to be found in different regions, what more natural proposition was there than that it was the conditions prevailing in these regions that had led to differential speciation in the first place? There were many variants on this underlying scheme of environmental determination, and no clear idea was proposed of how the mechanism of environment determining form might actually work.[15] But since Newton we did not need to be sure of mechanism before we believed in a theory, and the idea of environmental determination had great force because it showed for the first time how in the perplexing world of natural forms order could, in principle, arise from a natural process without the existence of pregiven order. In that sense, the epistemological force of environmental determinism captured something of the glamour that surrounded the theories of the physicists. It is within this scheme of thought that our modern notion of 'environment' originates. An environment not only surrounds: it affects and influences. The idea of environment is closely bound up with the idea of a being or organism at its centre drawing in to itself these effects and influences, and also creative contributing from its own interior nature to the interactive process by which its form, and hence the relationship between its form and its behaviour, is developed.

The organism-environment paradigm

This scheme of thought is so important in the history of western cultures that it deserves a name – perhaps the 'organism-environment paradigm'.[16] By this is meant not simply the idea of environmental determination but also the vitalistic and subjectivistic objections to it which sought to involve the organism itself in the process of the evolution of its form,[17] since these ideas are virtually called into existence by environmental determinism. The organism-environment paradigm is the scheme of ideas that forces us to choose between objective determination by the 'environment' and the subjective objections to this. It is an intellectual framework which still influences certain fields of scholarship much more than it ought, since within a century of its inception, the whole scheme of thought had been replaced in the field where it has originated by the far more sophisticated paradigm of evolution theory, in which the environment was no longer seen as mould, but as a selector, and the relation of organism to environment not as a direct physical relation of cause and effect, but as an indirect relation, mediated by what we would now call genetic information structures, passed from one generation to the next, and gradually evolving, but not on the timescale of individuals. The Darwinian scheme is not an adjustment within the organism-environment paradigm, but a replacement of it by another paradigm, one in which the dominant process is not an interaction between the physical organism and its environment but an abstract statistical mechanism in which informational structures built into organisms diffuse and decay in

the evolving population according to the probability of randomly generated mutations leading to greater success in leaving progeny.[18] The substitution of random variation of forms for the environmental determination of forms has, we may note, exactly the same epistemological function as the substitution of inertia for caused movement in Newton's theory. Through this it shows the way to order without pregiven order in nature, and to an emancipation of the study of nature on to the level of physics.

From the point of view of the origins of the machine analogy in architecture, we have to understand that the organism-environment paradigm, while showing little scientific explanatory power in the late eighteenth and early nineteenth centuries, had great metaphorical power. Well before Darwin, through that little understood process by which scientific ideas become absorbed into culture, we find the organism-environment idea diffusing with paradigmatic force well beyond the bounds of 'natural history' (as it was then called). Balzac, for example, used it explicitly as one of the guiding ideas in his *Comedie Humaine*, seeing social species as products of milieu, and his novels as their natural history. 'The idea (for his *Comedie Humaine*)' wrote Balzac 'originated in a comparison between humanity and animality...As we read the writing of the mystics who studied the sciences in their relation to the infinite, and the works of the greatest authors on Natural History...we detect in the monads of Leibnitz, in the organic molecules of Buffon, in the vegetative force of Needham, in the correlation of similar organs of Charles Bonnet...we detect I say the rudiments of the great law of Self for Self, which lies at the root of Unity of Structure. There is but one animal. The creator works on a single model for every organised being. 'The Animal' is elementary, and takes its external form, or to be accurate the differences in its external form, from the environment in which it is obliged to develop. Zoological species are the result of these differences...I for my part, convinced of this scheme of nature long before the discussion to which it has given rise, perceived that in this respect society resembled nature. For does not society modify Man, according to the conditions in which he lives and acts, into men as manifold as the species in Zoology?...If Buffon could produce a magnificent work by attempting to represent in a book the whole realm of zoology, was there not room for a work of the same kind on society?'[19]

It is in Balzac's novels that we find some of the earliest examples of that exact, atmospheric description of physical environments, presaging personages and their misfortunes, and creating in the reader's mind a quasi-naturalistic association between environment and human being, which is so characteristic of the technique of the nineteenth-century novel.[20] More significantly for our present theme, environmental determinism provided the intellectual spark for the late eighteenth and early nineteenth-century fashion for 'architectural determinism': the mechanistic idea that architectural design could, if handled right, directly cause beneficial effects on the moral and social lives of people. This became a pervasive influence on social reformers of the period, as well as on the builders of prisons and asylums.[21] It was this that established the paradigmatic idea that architecture could be both understood and exploited by direct analogy to machines, a reconciliation attractive and understandable to early nineteenth-century thought. Architectural determinism

seemed to normalise the problems of architecture by making them look like problems of engineering. Through its association with the expanding social engineering purposes of early nineteenth-century architecture, and the increasing sponsorship of the state, architectural determinism came to be seen as a powerful, scientific and action-orientated reformulation of the form-function relation in architecture.

Architectural determinism, of course, is no more true than environmental determinism had been, nor should we expect it to be. As with Lamarkism, no results have been produced which even begin to compel our belief. However, unlike environmental determinism, architectural determinism survived Darwin. There were probably three reasons for this improper survival. First, environmental determinism was a scientific error, and therefore refutable, whilst architectural determinism was a more diffuse cultural paradigm, often below the level of conscious thought, and not exposed therefore to direct refutation. Second, because it was a cultural belief, it tended to become institutionalised. If you spent money on architecture as moral engineering, then you had to believe in it. Third, the Darwinian revolution left many of the cultural by-products of environmental determinism behind because the metaphorical impact of Darwinism on culture lay elsewhere, in the survival of the fittest and the descent from monkeys, with the reformulation of the form-function problem in nature only in the small print read by the specialist.

For whatever reason, the organism-environment paradigm survived into the twentieth century. Partly through its association with the determinism associated with architecture as social engineering, it became the default position for the formulation of all problems dealing with the relation of human beings and their built environment. This default survival takes many forms; the study of human 'response' to the built environment; the study of cognitive schemes by which we represent the built environment to ourselves; the study of built environments as theatrical sets or back cloths providing cues and clues for the activity that is intended to take place in the foreground; the study of 'territory', that is, the study of the space exterior to the individual insofar as it is constructed and interpreted through drives emanating from inside the individual – all these use the same underlying paradigmatic scheme of an individual surrounded by an environment which that individual seeks to interpret or affect.

It is through engagement with this default intellectualisation of the form-function problem that architecture, as it engages in social engineering, also engages the paradigm of the machine, and the assumption it implies of the direct and mechanistic relation between an individual and that individual's immediate environment. The metaphor of the machine, we might say, met the paradigm of the machine, and the prison of ideas was complete. Through the powerful effects of customary language on our habitual patterns of thought, this has become the natural and inevitable formulation of a whole class of problems, so much so that the appeal of writers like Giddens[22] to bring space and time back into the 'constitution of society' are in effect largely forbidden by the continuing invisible effects of this paradigmatic background, because they make it appear as a return to nineteenth-century mechansim.

Space is the machine

The covert power of the paradigm is reinforced by the ease with which the organism-environment scheme ingests and reinterprets more ancient dualities. For example, the Cartesian duality of *res cogitans*, the thing that thinks, and *res extensa*, the thing that is, is re-expressed as the relation between abstract, individual minds and concrete surrounding environments. Similarly the distinction between subject and object becomes the experiencing mind and the experienced environmental object. Even the rival historical speculations of rationalism and empiricism find a resting place in the superordinate, apparently empirical concept of an individual mind, receptive and constructive, surrounded by a material environment, emanating and malleable. A history of errors is, it seems, confirmed as a progressive orthodoxy by the new formulation.

However, the worst outcome of the paradigm of the machine, and its intellectual parent the organism-environment paradigm, is that by representing the human subject as the object of concern at the centre of an influencing and influenced environment, the appearance is set up of a humane science concerned with understanding the effects of built environment on the social, cognitive and emotional life of people. But within this formulation no such effects are discoverable, other than those that do arise from the simple physical presence of an individual in an environment, such as the effects of air pollution on health, or the effect of sun on diseases of the skin. The appearance of the humane science is, in the last analysis, an inhumane deception.

At root, these consequences follow from the fact that the paradigm of the machine sets up the built environment as no more than an inert physical background to the behaviour and experiences of people. In effect, the artificial environment is being treated as a natural environment. This blinds the inquirer to the most significant single fact about the built environment: that it is not simply a background to social behaviour – it is itself a social behaviour. Prior to being experienced by subjects, it is already imbued with patterns which reflect its origin in the behaviours though which it is created. These patterns are reflected first and foremost as spatial configurations. As we have seen in earlier chapters, it is only when we understand the configurational nature of space and the origins of spatial configuration in the built environment in social behaviour, that we can begin to understand its effects on social behaviour. Both of these fundamental facts – the fact of spatial configuration and the fact of the social construction – the paradigm of the machine renders invisible.

What the paradigm of the machine defines instead is a quest for material, cognitive or symbolic influences that, as it were, emanate from the built environment surrounding individuals, and somehow 'cause' behaviour or response in those individuals. Yet the built environment that is expected to do this has no history, no immanent social content and no relation to the larger-scale society. The relation of people to environment is thus reduced to one that is both localised in physical space and decontextualised in logical space. The effects sought are for those individuals in that space at that time, free of spatial or social context. There is no evidence that any such systematic effects are anything but imaginary.

Space is the machine

Wherever architecture sought interaction with the social sciences – that is, to the extent that architecture sought social engineering objectives – this was the dominant paradigm within which questions were formulated, and research initiated. It is this mechanistic formulation of the form-function problem as one of a mechanistic relation between an experiencing subject and an objective environment, unmediated by spatial configuration, that was decisively rejected with the fall of modernism. It was rejected because it had led architectural practice and theory into an impasse in which the form-function relation seems paradoxical. The paradox is that if architectural determinism is true then effects should follow from design that simply do not follow in reality. Yet if architectural determinism is untrue, then design does not seem to matter since no adverse or beneficial social consequences can follow whatever we do. This paradox was eventually crystallised by the architecture that most thoroughly embodies the idea of architecture as social engineering: the innovative housing estates of modernism. These estates were the embodiment of the benign intentions of architecture as social engineering. Yet it was exactly as social engineering that they seemed to fail. Architectural determinism had failed. Yet architecture it seemed had determined the failure.

Unfortunately, by the time this became clear, the invisible effects of paradigms to take over language, and guide thought by unconscious constraint, had made this seem the only possible formulation of the form-function problem. The abandonment of form and function as the central problematic of architectural theory, and its substitution by the form-meaning problem, was the result. In architectural polemic, the metaphor of the machine was succeeded by the metaphor of language, and in research the fallacious paradigm of the machine was succeeded by the – as we will see in a future text – equally fallacious paradigm of language. The paradigm of the machine had effectively 'structurally excluded from thought' exactly the pattern relations between space and people that are the essence of the form-function relation in architecture.

Let us then review the idea we wish to dispense with. Architectural determinism, the paradigm of the machine, and the organism-environment paradigm are all different names for the same underlying scheme of thought whose foundations we have hopefully now fatally undermined. Architectural determinism is the way in which the scheme of ideas appears within architecture, and confront its practice and its theory. The paradigm of the machine is the invisible scheme of thought which history implanted in architectural discourse as the framework within which the form-function relation, seen as social engineering, should be defined. The organism-environment paradigm is the broader and older master scheme of quasi-scientific ideas on which the whole fallacious structure was erected. The three-level scheme constructs an apparatus of thought within which neither the form-function relation in architecture, nor the role of space in society, can be formulated in such a way that research can be defined and progress made in understanding.

This whole tripartite edifice of thought is dissolved by the proposition that the form-function relation in architecture, and the relation of space to society, is mediated by spatial configuration. Spatial configuration proposes a theory in which we find

Space is the machine

pattern effects from space to people and from people to space that in no way invokes mechanistic determinism. At the same time, the configuration paradigm saves the idea that architecture has social effects. By changing the design of a building or complex we do change outcomes. There is after all some kind of mechanism between the built world and people. But the machine is not the building. Space is the machine.

Space is the machine

We saw in Chapter 2 that every theory must exist within a broader paradigmatic scheme of ideas that defines the nature of the field and what types of problems are to be opened up to research. How then should a general paradigmatic scheme for this redefinition of the relation between buildings and people be formulated? One thing is clear. Previous definitions of the relation have been based on analogy with fields other than architecture. The redefinition proposed here has no external analogue. It is, shall we say, the paradigm of architecture and, if we are right, the paradigm of architecture is a configuration paradigm. How may the configurational paradigm of architecture then be formulated as a general scheme of ideas? Let me suggest what may seem at first an odd manoeuvre: a thoroughgoing comparison between buildings and machines. It turns out that this may after all be illuminating, especially in the light of the research results reported in earlier chapters.

If we think of form and function in a machine, then it is clear that a description of the form would be a state description of a system of differentiated parts that make up the machine, and a description of function would be a dynamic description of how the parts move in a co-ordinated way to impel and process some material. Conceptually, we might say a machine has three aspects: what it is, how it works, and what it does to something else. If we try to apply this to built forms (obviously leaving aside the building's mechanical plant, which is a normal machine) then we encounter difficulties in all three aspects. First, as spatial elements the parts of a building tend to be weakly differentiated. There is a more or less universal list of space types – rooms, corridors, courts and so on – which vary in their size and shape but not in their basic nature. In Chapter 8 we saw how this came about, and that these spatial types were essentially configurational strategies. Even so, for practical purposes, this also shows why the apparent lexicon of spatial types is so limited. This, we saw, was one of the reasons why buildings designed for one set of activities are often easily adapted for others. Second, the parts of buildings don't move. There is only a state description of them. Third, people, the hypothetical processed material, do move, but not under any impulse from the buildings. On the contrary they move independently and under their own motivation. To caricature Aristotle, in buildings people are unmoved movers. As we will see in a moment, this reference back to Aristotelian physics is not idle.

However, through configurational analysis and empirical investigations we now know a number of things about buildings which bear directly on the differences between them and machines. First, although the types of space in a building are fairly universal, they differ significantly when seen from the point of view of configuration. How the rest of the building is available as a configuration

Space is the machine

from a space, as shown by an 'integration value' is one of the most marked types of differentiation between spaces. Configuration, it seems, does after all turn the building into a system of differentiated parts, not in a machine-like sense, but in a quite unique, architectural sense.

Now, we also know that there are two ways in which these differences relate to function. First, function can use configurational differences to give a picture of itself in the spatial form of the building, so that the building comes to embody social and cultural information in its form. The building thus is no longer a mere physical object, any more than (after Darwin) an organism was a mere physical object. Through configurations, buildings, like organisms, both contain and transmit information. Second, we know that although the parts of a building do not move, through their configurational differences they do affect the pattern of movement, in that, other things being equal, the degree to which spaces are used for movement is a function of their configurational position. This is not an effect of the building on individuals, but a system effect from the space structure of the building to the probabilistic distribution of people. We do not therefore need hypotheses about how the building enters the mental state of individuals and compels them in this or that direction, as would be required by architectural determinism. We have transformed the mechanism from the Aristotelian to the Newtonian mode. Natural movement is a kind of inertia theory: it says not how individuals are impelled by buildings to move in this or that direction, but that, given that they move, then their distribution in a spatial configuration will follow certain mathematical and morphological laws, given only that movement is from all – or at least, most – parts to all others, and follows some principle of economy in route selection.

Now in the first, Darwinian, sense that buildings are, through their spatial configurations, embodiments of social information governing what must happen and where, we can then say that the building is a dependent variable in a social process. Its spatial form is, in a well-defined though limited sense, a product of its social function. However, in the second, Newtonian, sense that spatial configuration is generative of movement configuration, and thus of potential co-presences among people, then we can also see that the building as an independent variable is a social process. Its function is, in an equally well-defined sense, created by its spatial form. In other words, buildings can both receive information from society through spatial configuration, and also transmit effects back to society through configuration.

How do these bifurcating tendencies relate to each other? There are two aspects to the answer. The first is that, the two tendencies are dynamically interrelated. A functional genotype in a building is a temporary fixation of cultural rules in configurational form. But its expression has already been constructed within the laws of 'generic function' as discussed in Chapter 8, that is, on the one hand, by local-to-global laws by which local physical changes have, both in themselves and when applied successively, global effects on spatial configuration; and, on the other, laws which link these local-to-global effects to generic function, that is, the properties of intelligibility and functionality that permit a spatial complex

to be adapted in principle for human occupation and movement. In other words, the building in its 'Darwinian' mode as a spatial complex embodying social information already embodies the 'Newtonian' laws by which a building already constitutes, in itself, a field of potential movement and co-presence. For example, an integrated space for everyday living is one in which generated movement is natural to its function, while a segregated space for use only on special occasions is one where generated movement is not.

Thus the genotypes which order cultural patterns of space use already tend to reflect the generative laws of space. Where they do not, it may be a failure of design, or it may simply be a reflection of the fact that cultural patterns tend to be more complex than the possibilities offered by space, and it may not be possible to give a spatial form to all the social rules that operate in a situation. In either case, we find that the shortcomings of space tend to be compensated by reinforced behaviours of individuals to ensure that the cultural pattern survives. In spite of the lawfulness of space, and its relation to human life in space, there is still some degree of interchange between the structure of space itself and human activity realised in space, in that if space does not provide adequately for the realisation of some set of rules for social relations in space, then this lack may be compensated for by special behaviours. For example, as Justin de Syllas showed in a pioneering study[23] (which still remains unpublished because of the reluctance of professional journals to allow serious analytic criticisms of architects' buildings), in a children's assessment centre the failure of the building to provide for natural surveillance of the children by the staff through everyday patterns of activity, combined with the excessively complex and permissive layout of the building, created a situation in which staff had to compensate for the lack of spatial controls by behaving like gaolers themselves, continually locking doors, and attempting to police restrictive rules.

The second aspect of the answer is that the two contrary tendencies are unequal, in the sense that the 'Newtonian', or generative, properties of the building will always operate unless there are social rules and practises to restrict their operation, whereas the 'Darwinian', or informational, properties of buildings usually require the support of social rules and practices. In other words, spatial configurations will naturally tend to follow the generative laws except insofar as they are restricted by social rules. We thus find that, as discussed in Chapter 7, buildings vary between those which tend to express and restrict social relations and those which tend to generate social relations. Where we find strong genotypes, we find them associated with strong rules of behaviour, because the form of the building is already a mapping of that behaviour. But when the social rules decay, or are no longer enforced, then the spatial configuration reverts to the generative mode. Its spatial patterns will generate only the patterns of co-presence that would be expected by the theory of natural movement. Thus a courtroom stripped of judges and judged, and set in a funfair, ceases to be a courtroom and becomes a pure expression of the generative laws of space. The relation of spatial configuration to people is unmediated by social rules. The only effect of that space will be the effect

of those patterns on patterns of movement even though they were originally created to express social rules. The system is, as it were, reduced to its own inertia. This inertia, however, is still lawful.

Buildings are thus probabilistic space machines, able to absorb as well as generate social information through their configuration. In a very restricted sense then, we can say that buildings are machine-like, in that they are physical systems which through their spatial properties produce well-defined functional outcomes. In another, equally restricted sense, buildings are language-like, in that they embody, impart and transmit social information. But we would not understand either of these restricted truths unless we had first understood that, in their essential nature and dynamics, buildings are neither machine nor language. In that they are probabilistic space machines, buildings resemble nothing else.

As probabilistic space machines, buildings are subject to three types of law. First, there are the self-contained 'laws of space', which take the form of implications from local physical design moves to global spatial configurational effects. Second, there are laws which link the field of possibility created by the first type of law to 'generic function', that is, to basic intelligibility and functionality, especially natural movement. Third, there are laws by which social formations, and the patterns of rule-governed spatial activity they give rise to, make use of these two types of law to give a picture of themselves in space-time, and through this to give rise to the sense that buildings are in some far-reaching sense, social objects, and as such important to society, and even, in some sense, part of it. This points us to our second question.

Buildings as social objects

Through the mechanism of the form-function relation, as it has just been described, it has been shown how, starting from the building as physical objects and society as abstraction, through the intermediary of space, social abstractions become embedded in buildings and can also be influenced by buildings. This led to an answer to the question: how is it that buildings are replete with social ideas? We will now consider the reverse question: how is it that social institutions contain ideas about buildings, and does it matter that they do? What, in short, is the role of buildings in society?

We may begin by reminding ourselves of a basic distinction made in Chapter 1, a distinction that was the foundation on which the whole configurational theory was erected. This is the simple proposition that human beings inhabit two types of co-existent world; a continuous material world of objects and spaces which we occupy and move about in physically; and a discontinuous world of expressive forms, signs and symbols which we occupy cognitively. The former is 'real' space, the latter logical space. The act of building, through the creation of configuration in space and form, converts these into a single world. A configurational world is a continuous spatial world constructed so that expressivity also has become continuous. Building is the meeting point of the two worlds, where real space is converted into logical space.

Through their combination of the real and expressive worlds, buildings convert the material world which we inhabit into a non-discursive world of culture,

indeed into culture's densest locus. Through this conversion, the material world becomes for us information and idea rather than thing. Because culture functions non-discursively, and makes the artificial appear natural, the built world we have made into information and idea comes to appear natural to us. We become less and less aware of it precisely because it supports our cultural identity by acting as its embodied basis. The building becomes seemingly dematerialised into non-discursivity and therefore into culture, while remaining at the same time the physical and spatial milieu in which we live bodily.

Through this assimilation of the material world in the cultural world, building becomes a puzzle for us. We become so used to its autonomic culturality that we are taken by surprise when we remember its physical nature. We begin to make distinctions between house and home, and between building and dwelling[24], protesting that building is 'mere material' while something else, some immaterial human stuff, is the essence of what appears at first to be a physical object. Underlying these distinctions is a serious philosophical difficulty: how can the material world be involved in our social and cultural lives when our experience of society and culture seem centred in our minds? We encounter the same difficulty when we try to separate social institutions from the buildings they occupy. It is clear that the centre of what we mean by a social institution is an arrangement among people. Such an arrangement can surely exist without a building. Thus we say that a church is 'mere bricks and mortar', nothing without priest and congregation. The truth of this seems affirmed by the abandoned church building without either.

But the fact that a church building without its social set up is no longer 'really a church' does not imply that with its social set up the building is a mere physical appendage.[25] The fact that the social set up 'gives a meaning' to the building is more than an association of ideas. Once a social set-up with its building exists, then the building is much more than a stage set or background. In itself it transmits through its spatial and physical form key aspects of the form of the social set up. The case of the church is particularly clear, since the entire form of the building is dedicated to the support of a spatialised ritual of some kind, and the provision of an audience for that ritual. By providing a spatial form adapted to a particular ritual the building becomes part of the means by which that ritual is enacted by its community. Since rituals only survive insofar as they are enacted in real space-time, the building becomes a powerful part of the means by which that ritual is perpetuated, and transmitted into the future.

However, the matter is yet more complicated. The difficulty in understanding how a house is an aspect of a home, and a building an aspect of an institution, reflects our inability to understand how what appear to naïve perception as abstractions and physical things – that is, social institution and buildings – can be genuinely interrelated. In fact, this is only one aspect of a more general difficulty. We have the same problem in trying to decide whether social institutions, or whole societies, actually exist, or are simply common ideas in the minds of collections of individuals. How can the abstraction we call society take on physical form, as it

seems it must do if it is to be real in the normally accepted senses of the word? If society does exist, then in what sense does it exist? Clearly, there is a problem in assigning society a material existence in the same sense that we assign an individual a material existence. Yet if societies do not exist in a material sense, then in what sense can they be said to 'really exist'? This problem is a further obstruction in the way of understanding the relations between buildings and society. If we do not assign society some kind of material existence it seems unlikely that we can formulate answers to questions as to why and how spatialisation through the house as home and the church building as an aspect of the church institution should be so consistent an aspect of society. We may pose it as a question: if society does not require spatialisation, then why does it give itself spatial form in such consistent ways? If society is immaterial, then surely it would not require this consistency of materialisation.

Fortunately, the idea of society 'really existing' is not exhausted by the possibilities of existing in the same sense that individuals, or material objects, exist, that is, as continuous, finite entities occupying a well-defined region of space-time. Once again we find paradigmatic ideas obstructing the formulation of the problem, and indeed once again these ideas are essentially ideas which are overly mechanistic, and obscure the relation between the abstract and material world. At root our inability to conceptualise society as a thing has its origins in the most fundamental of our materialistic prejudices: the idea of a thing. Things, it will turn out, are not as simple as they seem.

We may begin with a famous problem in philosophy, allegedly originating with Heraclitus and discussed at length (and recently by philosophical standards) by Quine,[26] about the definition of rivers. How can we say that a river is a thing when its constitutive elements – water molecules – keep changing, and will be found now here, now elsewhere in the river, then in a nearby sea, then as falling rain? Once said, the difficulty ramifies. Perpetual elimination and replacement of parts is also true of human beings. We should see ourselves not as things, perhaps, but as processes. The common sense definition of individuals as things, and even of things in general, seems after all to be illusory, the result of a naïve perception of the world.

But where does it end? Is all 'flux and change', and are all assertions of the 'thingness' of the world just temporary fixations? Or can we save the idea of thingness by a more careful definition? Consider three entities which seem to have different degrees of thingness: a one-metre cubed empty box lying on the ground below a tree on a warm summer evening with a light wind; a swarm of gnats three metres above the box; and a cubic metre of gnat-free air three metres to the east of the swarm. The box is clearly a thing, the cubic metre of air not, even though it is a finite physical entity in time and space. The swarm we instinctively name as a thing, even though it seems dubiously to satisfy common sense criteria. Can we then arrive at a general definition which clarifies what is and is not a thing?

First, what does the swarm have that the cubic metre of air does not? Let us reflect on how the swarm comes into existence. The swarm appears random

but it is not. It is a partially random system subject to at least one restriction: that individual gnats move randomly only until they see a field of vision empty of gnats, when they turn and fly back in the direction of gnats. This rule, followed by each individual gnat, is enough to convert a set of individuals into a swarm. Every now and then a gnat will be lost and another gained, but this does not affect the existence of the swarm because the swarm does not depend on any individual. It arises from certain consistencies in the behaviour of a collection of individuals, without any individual needing to have a conception of a swarm.[27]

However, we do have a conception of a swarm, and are inclined to call it a thing. Why? How can we conceptualise this sense of thingness? The answer requires two stages. First, the sense of thingness appears because we note through time relational persistences among gnats, that is, ways in which gnats relate to other gnats, that manifest themselves in space and persist through time. Because these relations are multiple and simultaneous we may call them configurational persistencies. Second, these configurational persistences have the quite objective effect that the thing we think we see, the swarm, offers some resistance to determination by forces external to itself, for example the light wind that we noted was blowing. In both these senses, the swarm differs from the cubic metre of air. There are no relational persistences arising from the air molecules such that these persistencies resist determination by external forces. The light wind blows away the air molecules and replaces them with others, but leaves the swarm of gnats. Of course if the wind were a strong wind, then both the cubic metre and the swarm might be blown away. But that does not eliminate our point. The configurational persistence of the swarm offers a certain resistance to externalities that manifests itself as a temporary stability in space-time, and this seems enough to call it a thing.

By these criteria, the cubic metre of air is clearly not a thing, but the box on the ground clearly is. Its configurational persistences are of a more durable and fixed kind than those of the swarm, but nevertheless it is clearly these persistences that lead us to call it a box rather than a collection of pieces of wood. As with the swarm, also, these configurational persistences, while stronger than the swarm do not offer endless resistance to externalities. A major explosion for example could disperse the box sufficiently for us to say that it no longer existed. The passage of sufficient time would have a similar effect. Taking the definition of things farther afield, it seems to work for rivers, which we can see as configurational persistencies amongst banks, water molecules and land gradients, rather than simply as water molecules. From here, it clearly works for less difficult cases such as human beings. If it has configurational persistencies, we might say, then it's a thing.

Now an interesting aspect of this definition of what we see and say is a thing is that what we are defining is a process, or, more precisely, a particular stage of a process, with the particular attributes of configurational persistence. In other words, we have made our problem in defining things – that what we see appears to be process rather than fixation – into the centrepiece of our definition. We can now see that the philosopher's problem arose in the first place because, believing

Space is the machine

that at any moment in time we see states, we form the naïve notion that states are primary, and that processes are interesting only in that they give rise to states. This is to misconceive what we see. When we see a universe, a human being, a box or a swarm, what we see is a constructive process unfolding in space-time under morphological necessity. It is from this conjunction that the appearance of the stable states arises that in turn gives rise to the notion of things.

Let us agree to call these configurational persistencies 'structures', noting that they are invariably stages of processes, and that named thingness seems to arise from such structures. How does this allow us to reformulate the question: does society 'really exist', that is, is it some kind of thing? We may begin as usual by noting what we see and experience in space-time. What we see of society in space-time – apart from its physical and spatial milieu – is individuals interacting, transacting, encountering and perhaps also seeking refuge from all these. Is society then the sum of the interactions that we see in space-time?

It cannot be so. Whatever society is, one thing about it is clear: it must persist through time. Whatever interactions are, they cannot in themselves be society since they do not persist. Even allowing for social change, societies relate not only individuals at one point in time, but also individuals across time. Even when all individuals currently alive in a society are dead and replaced by their descendants, something survives as a 'society' which is recognisably descended from the original society, even though it may have changed considerably. Society is, at the very least, something that outlasts individuals. In spite of the claimed realism of those who reduce society to individuals, this reduction is in fact the one thing we logically cannot do, since it fails to explain the primary property of society, namely its persistence beyond the lives of any collection of individuals who make it up at any point in time. It follows that we cannot reduce society to individual interactions.

If we are not talking about interactions in space-time when we say 'society' then what are we then talking about? On the basis of our reflections about things in general, the question can be better put: what persists under the myriad of human interactions that we observe in space-time? The answer is almost immediate from the formulation of the question. What persists is not interactions, but certain configurational patterns underlying the interactions. Individual interactions are endlessly replaced. But certain underlying petterns in these interactions persist. It is these patterns that we name as 'society'. The patterns can be the result of any number of different pattern formers: forms of production, social institutions, and so on. But it is the patterns themselves that we name as 'society'. Usefully, this distinction allows us to include the spatial form of society among the pattern formers. Space is one thing that can generate and restrict encounter and interaction probabilities, indeed this is how space becomes involved in society.

Society then is not the space-time manifestations of society as the interaction fields that continually occur in space-time, but the configurational persistences underlying interaction fields. There is an unavoidable inference from this: the entity which we name as 'society' is not a thing but an abstraction. Does this then mean

that society is imaginary, a virtual product of consensus among individuals, without physical affirmation in the world? It does not. It is real. Where then does this reality come from? The answer is stunningly simple: from being realised in space-time. The observable material world of interaction in which we live is not itself society but it is the means by which society, the abstraction, realises itself in space-time and thus projects itself from past to future. The realisation in space-time is the means by which society as a system of configurational persistence achieves this persistence and transmits itself across time.

Now the important thing about this definition of society from our present point of view is that it immediately allows us to see the role of buildings and physical environments. Our sense of being separated from our physical circumstances is founded in the very nature of our social existence whose nature is to overcome space, by forming this abstract configurational entity, society, whose existence seems not in itself spatial but beyond and above space. Society is in this sense an abstraction. It is the genotypes of social arrangements that are reproduced through time, and which are therefore recognisable in the relational complexes which are realised in a specific form at one point in time. Society is in this sense a dematerialised thing, and this is why we find it hard even to acknowledge its existence as a real thing.

However, although society is this dematerialised genotypical thing, the means by which it is projected through time is anything but dematerialised. On the contrary, while the material form of society at any moment of time is not that society, it *is the means by which that society is transmitted into the future*. The material form of a society as a system of relations at a point in time is not that society and certainly not its structure, but, by being a realisation of the underlying genotypes of society, the material form is the means by which the society as an abstraction is realised in space-time and then reproduced. Society is not in itself its material form, but even so only exists through its material form. This curious double-take is why all social practices take the form of abstract structures, like the grammars of languages, which are never seen as part of any material reality, but nevertheless dominate that reality by structuring what can happen in it, and by creating the real space-time events through which those structures are themselves perpetuated.

Buildings happen within this double-take. Like the social events which they contain, they themselves are space-time realisations of abstractions. They are less than social events, in that they are not made up of acting and thinking human beings, but they are also more in that they are long lasting, almost permanent, transformations of the real world in the image of the abstractions that govern their form. Buildings are not maps of human interaction. They are maps of the social genotypes, of human interaction. This is what makes them so powerful. Social interactions as spatial events are momentary realisations of abstractions, of which they are therefore the phenotypes. Buildings only contingently house the phenotypes of human interaction. The most fundamental error of the paradigm of the machine was to seek order in the relation of people to the built world precisely

in these localised phenotypes. The built world fixes in stone not the phenotypes but the genotypes of social behaviour.

The mystery of the social nature of the building now becomes clear. Manifestly a physical object, its essential nature is to give form to an abstraction, and through this to give that abstraction the realisation which enables it to be projected through time. Buildings do not reflect the particular materialisations of society that occur at any moment in time, but aspects of the generic abstractions which constitute society itself. It is these abstractions rather than any particular realisation of them, that need to be transmitted through time. Buildings make this doubly powerful by building these genotypes into the very materiality of our existence, and at the same time, through the omnipresence of configuration, rendering these same social 'things' non-discursive.

Buildings are thus among the most powerful means that a society has to constitute itself in space-time and through this to project itself into the future. In this sense, societies in spite of being in themselves a-spatial, are thoroughly dependent on space. The act of building is, as a consequence, inevitably a social act. As such it entails risks; risks that the forms will not be those that permit the society to reproduce its essential forms. In a modern society, these risks are carried between architecture and the social agencies through which architecture is legitimated and controlled. Architecture persists both because society changes and must change its built world in order to perpetuate itself in a slightly different way to its predecessor, and because the risks to society are not posed at the level of the individual buildings or particular projects. These must always experiment with the future. The real risk is in the persistence of error through time, so that forms inconsistent with the perpetuation of a good society become dominant. It is exactly from such high risks that we, in the late twentieth century, seem recently to have made our escape.

Notes

1 Or 'durability, convenience and beauty' in the translation by Morris Hickey Morgan as Vitruvius, *The Ten Books on Architecture*, Book 1, Chapter 3 originally Harvard University Press, 1914, Dover edition, 1960.

2 But for important comments on this view see Stanford Anderson, 'The fiction of function', *Assemblage* 2, February 1987; and also J. Habermas, 'Modern and post-modern architecture', 9h, no. 4, 1982; and A. Colquhoun, 'Typology and design method', in Meaning in Architecture, eds. C. Jencks and G. Baird; Barrie & Rockliff, 1969.

3 Le Corbusier, *Vers une architecture*, 1923; translated by Etchells F., *Towards a New Architecture*, Architectural Press, 1927; Version used: 1970 Paperback of 1946 edition, p. 89.

4 Le Corbusier pp. 114–5.

5 Ibid., p. 173 et seq.

6 Ibid., p. 173.

7 In fact, the clearest statement of the basic ideas behind the philosophy are probably retrospective. For example, Sir Leslie Martin's classic 'Architect's approach to

architecture' in the *RIBA Journal* of May 1967 is probably the most lucid account. However, even here there is a certain amount of confusion. Martin announces at the beginning of his text that he does not intend to talk about forms, but about the processes that give rise to them, then goes on to talk about little apart from forms. It may indeed be that one has to wait for the nineteen sixties when modernism was taking over the schools of architecture for a proper academic formulation of a modernist form-function theory, as set out for example in the *Notes on the Synthesis of Form* of Christopher Alexander, 1964, which will be discussed in detail in the next chapter.

8 For a post-Kuhn discussion of the nature of 'paradigms' see M. Masterman, 'The nature of a paradigm' in ed. I. Lakatos & A. Musgrave, *Criticism and the Growth of Knowledge*, Cambridge University Press 1970.

9 The most extensive treatment of this issue is in Necdet Teymur's complex and difficult, *Environmental Discourse*, ?uestion Press, London, 1982.

10 G. Canguilhem, 'Le vivant et son milieu', in *La Connaissance de la Vie*, 1971, Librairie Philosophique J. Vrin, Paris, 1971. See also 'Machine et organisme' in the same text.

11 The two most important references to the 'architectural analogy' in Aristotle are probably in the 'Physics', Book 2, Chapter 8 pp. 250–2 in the McKeon edition of 1941, and in the 'Parts of animals', Book 1, Chapter 5, pp. 657–9 in the same edition. But the idea is pervasive throughout Aristotle, as shown by the conceptual importance assigned to it in the references cited.

12 'The *vis insita*, or innate force of matter, is a power of resisting by which every body, as much as in it lies, continues in its present state, whether it be of rest, or of moving uniformly forward in a right line' I. Newton: Definition III from Definition & Scholium Book 1, *Principia Mathematica*, Version used: ed. H. Thayer, *Newton's Philosophy of Nature*, Haffer, New York and London, 1953.

13 Koyre's excellent formulation in 'Newton and Descartes', in A. Koyre, *Newtonian Studies*, Chapman & Hall, 1965 p. 67.

14 See A. Koyre, 'Huygens and Leibniz on universal attraction', Appendix, *'Attraction an occult quality?'* p. 140.

15 For a discussion on this see C. Gillispie, *The Edge of Objectivity*, Princeton University Press, 1958, Chapter 7, 'The history of nature'. For example, Gillispie discusses the highly developed version of the scheme of thought due to Lamarck who saw the organism as itself contributing to the evolution of its forms through the interaction between the creative forces emanating from the organism itself and the moulding effect of the environment, making an analogy to the geological processes of erosion that gave rise to rivers and valleys (p. 275).

16 See my earlier (with Leaman) 'The man-environment paradigm and its paradoxes'; Architectural Design August 1973. I see the earlier term for the paradigm as technically incorrect, rather than simply politically incorrect.

17 See Gillispie, *The Edge of Objectivity.*

18 Again, one of the best accounts of the history of this idea is to be found in Gillispie, Chapter 8, 'Biology comes of age'.

Space is the machine

19 H. Balzac, Author's Introduction (to La Comedia Humaine) 1842; available in English as 'Author's Introduction' in *At the sign of the Cat and Racket and other stories,* Dent, London, 1908.

20 The best example is probably the opening pages of *Eugenie Grandet.*

21 See for example D. Rothman, *The Discovery of the Asylum*, Little, Brown & Co Boston-Toronto, 1971 – for example on p. 84: 'As a result of this thinking, prison architecture and arrangements became the central concern for reformers of the period. Unlike their predecessors, they turned all their attention inward. to the divisions of time and space within the institution. The layout of cells, the methods of labour, and the manner of eating and sleeping within the penitentiary were the crucial issues. The most influential benevolent organisation devoted to prison reform, the Boston Prison Discipline Society, appropriately considered architecture one of the most important of the moral sciences. 'There are', the society announced, 'principles in architecture, by the observation of which great moral changes can be more easily produced among the most abandoned of our race...There is such a thing as architecture adapted to morals; that other things being equal, the prospect of improvement, in morals, depends, in some degree, upon the construction of buildings'. Those who would rehabilitate the deviant had better cultivate this science...As with any other science, the advocates of moral architecture anticipated that the principles which emerged from the penitentiary experiment would have clear and important applications in the wider society. An arrangement which helped to reform vicious and depraved men would also be effective in regulating the behaviour of ordinary citizens in other situations. The penitentiary, by its example, by its discovery and verification of proper principles of social organisation, would serve as a model for the entire society'. Pessimists might be tempted to conclude that this is exactly what happened at least to public housing in the late nineteenth and twentieth centuries. See also the late Robin Evans, *The Fabrication of Virtue*, Cambridge University Press, 1983.

22 See A. Giddens, *A contemporary critique of historical materialism*, MacMillan, 1981, Chapter 1, 'The time-space constitution of social systems'.

23 J. de Syllas, *Aesthetic order and spatial disorder in a children's home*: *a case study of the Langtry Walk Children's Observation and Assessment Centre in the London Borough of Camden*, January, 1991; base on research carried out for an MSc thesis for the MSc in Advanced Architectural Studies in the Bartlett, ucl, 1981.

24 M. Heidegger, 'Building, dwelling, thinking' in: *Basic Writings*, Routledge & Kegan Paul, 1987, pp. 319–39. Originally in German.

25 This basic fact is now increasingly recognised through important new studies such as those reported by Tom Markus., *Buildings and Power; Freedom and Control in the Origin of Modern Building Types*, Routledge, 1993.

26 W. Quine, 'Identity, ostension, hypostasis' – in From a *Logical Point of View*, Harper and Row, New York, 1953, pp. 65–79.

27 See R. Thom, *Structural Stability and Morphogenesis*, Benjamin, 1972, pp.318–19.

Chapter eleven

The reasoning art

An intention is embedded in its situation, in human customs and institutions. If the technique of the game of chess did not exist, I could not intend to play a game of chess. In so far as I do intend the construction of a sentence in advance, that is made possible by the fact that I can speak the language in question.
Ludwig Wittgenstein, Philosophical Investigations 1, 337.

My present belief, formed over the past six years, is that there exists a designerly way of thinking and communicating that is both different from scientific and scholarly ways of thinking, and as powerful as scientific and scholarly methods of enquiry when applied to its own kinds of problem.
L. Bruce Archer (1984 p. 348)

The creative paradox

There is, in architecture, a certain creative paradox. Most architecture is made by individuals, and the more significant the architecture, the more it is valued as the product of a unique individual creativity. Yet with the passage of time, even the most innovative architecture comes to be seen also as a product of the time and society within which it was created. This does not lead to a lower valuation of individual architects, but it does add to the appreciation of architecture a sense of the social and intellectual milieu in which the architecture was brought into existence, which may not have been clear at the time of its creation. Such effects are not confined to style and appearance, where they are most obvious. Many writers, most notably the late Robin Evans,[1] Mark Girouard[2] and more recently Tom Markus,[3] have noted similar effects for space organisation.

It might be said that this retrospective shift in perception arises simply because architecture is a 'social art', and that it is only with the social distance brought about by time that what was always present can be seen clearly. But this is to restate rather than resolve the puzzle. Architecture is a social art in two senses: in the narrow sense that buildings have social purposes, and in the broader sense that built environments seem to reflect society. At the time of its creation, it is usually clear that a work of architecture is a social art in the first sense, but not always in the second. We see easily that a building is an expression of social purposes, but not how the forms of this expression are in some sense a product of time and place. It is only with the passage of time that the second effect seems to emerge with any clarity.

The puzzle is that the individual act of architectural creation seems able not only to express the social purposes of a building but also to carry within it messages from the society in which it was created which only become clear with the passage of time. How, then, we may ask, does society get into the head of the designer during the process of creative design, and come out in the form of the building? We have, of course, seen how this can happen in the vernacular. Consistency of cultural and social expression is maintained through vernacular buildings, in spite of the great variation between individual cases, because the process of making the building is guided by configurational ideas to think with. These govern the ways in which forms and spaces are assembled into a whole, and it is this that conserves some level of configurational affinity from one building to the next. But architecture is, at the very least, the taking into conscious and reflective thought of exactly those configurational aspects of space and form by which cultures reproduce themselves through buildings. How can architecture be at once an individual expression and an expression of society, if the essence of architecture lies in transcending the conventions that tie buildings into the idiosyncrasies of particular cultures?

Intentions and realities

This question has been posed in an extreme form by events in the twentieth century. From about mid-century, massive changes were brought about in cities in the name of architecture. Vast swathes of what had previously been plausible

The reasoning art

urbanity were excised and rebuilt as residential zones which were, in comparison to the urban tradition they replaced, as strange as Teotihuacan. In most languages, these areas have a special name – in English it is 'estates' – to distinguish them from the rest of the urban fabric. These linguistic distinctions express fundamental differences in spatial form. Continuity with context is in general sharply broken, if not by barriers then at least by changes in formal and spatial arrangement. The effect is that no one goes into these areas unless they have to. They become, in Alison Ravetz's accurate term, 'reservations'.[4]

Within the areas, differences are even more pronounced. Public space is no longer constructed in smoothly changing yet readable patterns by the careful alignment and orientation of buildings. Instead, at the small scale, there are endless courts, plazas, greens and walkways, apparently intended to create an intimate sense of locale through the zealous pursuit of neighbourliness, but seeming to have the effect at the aggregate level of contributing to a general sense of fragmentation in space. At the larger scale these fragments are linked into abstract patterns in which space seems the accidental by-product of a geometric order beyond the reach of experience, graspable in the plan, but not at the experiential scale of architectural reality.

These are the forms of 'pathological' space which were examined in detail in Chapter 5. As we saw, the spatial nature of social experience was decisively altered by these architectural interventions. Within the areas created the inhabitants (whose experience could, because of their structural isolation, never be shared by those outside), witnessed the destruction of the everyday normalities of urban life and their replacement by a caricature urban lifestyle in which fear and alienation in empty spaces became as normal as the decent anonymities of the populated spaces of urbanity had been previously.

These outcomes were never of course intentional. In fact the intentions were exactly the contrary: to use new forms of space to create new forms of community. These intentions mutated with time, first taking the form of futuristic visions, then of a more technical enterprise of the invention of community by spatial engineering, then finally of nostalgia for a – probably imaginary – urban past. One after another, all these visions failed, leaving wherever they were attempted the same sense of an urban landscape despoiled of its essential features and replaced by a landscape as puzzling as it was unwelcome. If an architectural intention is a proposal to create a social outcome through a form, there was, at the very least, a monumental mismatch between architectural intentions and lived realities.

However, these intentions were never purely architectural. Belief in the possibility of new forms of communal existence through spatial engineering were shared widely amongst the multiplicity of political and executive agencies that brought about the re-structuring of the urban landscape. The apparent causes, as well as the outcomes, of these architectural changes were profoundly social. It is this that puts our question about the relation of architectural creation to society into sharp focus. Were the changes authentic architectural products, in which case

The reasoning art

the mismatch of intentions and realities is architectural error? Or was architecture somehow subverted by social forces of which it became for a time a willing agent and advocate? We have the question of how architecture can be at once a creative and social act in its most extreme form. Did society get into architecture and come out in built form? If so, then it is a matter of urgency to know how this can happen, the more so if we are to save our definition of architecture as the taking into conscious thought of the non-discursive, and therefore social, content of building.

To understand that this was indeed possible, we must understand much more than we do about the nature and origins of architectural intentions, and how architects convert these into built realities. That is to say, we must understand how architects do what they do: design. Understanding the process of design has been one of the vexed themes of architectural theory in the second half of the twentieth century.[5] However, questions about design have always been posed in terms of the process of design: how do architects go about their task of designing, and can it be improved to provide a greater likelihood of success?[6] In this chapter we will try to pose the question in an entirely new way: that is, by inquiring into its products: how is it that these products can be – or at least seem to be – at once individual and social? What is the nature of design, that it is at once a creative individual activity and at the same time capable of influence, even subversion, by social forces and values?

Is design reason or intuition?

Interest in design as an activity arose initially in the nineteen sixties, partly through a general interest in the possibility of applying 'scientific methods' in the pursuit of social objective in architecture,[7] partly because the possibility of using computers in design seemed to be predicated on a better understanding of how designers worked – but mostly perhaps because the possibility of design fields such as architecture being constituted as formal disciplines seemed to stand or fall on the possibility of a theoretical understanding of the design process.[8]

It would cause little offence to those who have written in this field to suggest that in spite of these efforts the design process today remains largely opaque. As a consequence, enquiries into the nature of design and the polemics to which they give rise are frankly unfashionable, and have been stagnant for some years. For the academically minded, enquiry into the objects of design rightly seems to offer more promise than enquiry into the nature of design. However, if we are to answer the question we have set ourselves, we cannot avoid reopening this enquiry in a limited way and reconsidering at least some of the key issues that past attempts to analyse design have highlighted. We cannot, for example, avoid the principal stumbling block to previous enquiries into design: is the activity of design a process of reasoning, and therefore one which can to some extent be explicated, or is it a purely 'intuitive' process, and one which must therefore remain a mystery?

At first sight, the claim that architectural design is 'intuitive' is likely to be greeted with some caution. Whatever else it is – and the more so if we follow the definition of architecture set out in the first chapter of this book – architectural design seems to be the imposition on the material world of the ordering activity of the

The reasoning art

human mind. Through architecture, we come to see, in the built world in which we live, patterns of order whose origins lie in human thought. It might then be expected that architects would see design as a process centred on those ordering powers of human minds which we, for want of a less general term, call reason. But if we listen to architects talking about design, they rarely talk about reason. If pressed to describe the mental process of design, they are more likely to invoke intuition.

We might of course take a cynical view and see this preference for the art over the science of architecture as no more than a trick to maintain professional mystique, since art is a mystery and science, by definition, accessible to open enquiry. However, I suspect there is a deeper and more justifiable reason for stressing intuition in design, one which has to do with the nature of design itself as an activity. For purely technical reasons, I believe, what we normally call intuition is unavoidably the motor of the design process. It is not a question of whether we should prefer an intuitive approach to design or a reasoning approach. It is simply that for design to take place at all mental structures must be deployed and used in such a way as to make the use of the term 'intuition' hard to avoid in any reasonable account of the process.

This does not mean that reason is not involved in the design process. On the contrary, I will try to show that reason is also intimately involved in design activity. It is the polarisation between intuition and reason that is wrong. Reason is involved in design for much the same reasons as intuition is. Architecture, I will try to show, is the deployment of intuition within a field structured by reason, and in this sense we may call architecture the reasoning art.

At first sight, this may seem a strange idea. Reason and intuition are usually opposed, even seen as incompatible, in our accounts of human thought processes. A typical dictionary definition is 'immediate apprehension by the mind without reasoning ... immediate insight'. Reason, used to describe processes of thought (as opposed to innate faculties), stresses externalisation of the structure of arguments as in to 'form or try to reach conclusions by connected thought'. The question: is design a matter of intuition or reason? refers to this distinction. How far is design carried out through inchoate, 'black box' processes inside the mind which cannot be made explicit? And how far is it carried out by forms of externalised reasoning which in their very nature are, or can at least be made, explicit and therefore open to enquiry?

This question has, for two decades, had practical urgency since it might well prescribe limits to the ways in which we might seek to use computers to support architects in the creative aspects of their work. Unfortunately, efforts to solve this problem have led at best to a wide gap between theory and practice, and at worst to downright paradox. The fact is that as soon as we try to look at it closely the process of design becomes more and more puzzling.

Design as a process

At first sight, the process of design seems straightforward enough. It is usually initiated with a 'brief', which describes, summarily or at length, what the building must do. It then passes through a series of stages during which a possible building

is first sketched and then gradually realised in more precise form, and ends when the designer hands over a proposal for a building, drawn and explained in such a way as to show what the building will be like and how it will provide what the brief asks for, or something better.

This seems simple enough. But if we look a little more closely, matters are not so clear. The 'brief' which initiates the process may be a lengthy formal specification, or it may be a few spoken words, but whatever form it takes, the essence of a brief is that it describes not a building but what a building must do, that is, what functional programme it must satisfy. The brief specifies the functional programme rather than the building because what the building will be like, visually and spatially, is the speciality of the architect; the reason we employ one in the first place. If we know what the building is to be like, as opposed to what it must do, then we do not seek the help of an architect.

Finding the form that satisfies the functional constraints set out in abstract form in the brief is then a reasonable way of describing the architect's useful skill. The brief initiates the 'design process', at the end of which – and often after much trial and error – the designer hands back to the client a proposal for a building, drawn and explained in such a way as to show both what the building will be like and how it will do what the brief asks for. This has led many to believe that to understand the design process we must show some process of thought by which a formal and spatial object may be derived from written instructions about function. Initially, this sounds innocuous enough, but on reflection it raises profound difficulties. By what possible means could there be a mental process which translates from written instruction to physical and spatial forms? The two domains are not commensurable. The same applies to the idea of translating from notions of function to notions of form. The 'form-function' relation is, as we have seen, perhaps the least understood problem in architectural theory. No wonder the design process appears mysterious. It is not at all clear that there could be an explicit process by which these two translations between incommensurable domains could be achieved.

However, many who have sought to explain the design process in terms of what goes on – or should go on – in the mind of the designer have taken this as the definition of the outline of the design process, and set up the question as one of explaining by what form of reasoning, or other thought process, designers go from information about function to a proposal for a physical and spatial object. It is worth examining this idea closely, since in doing so we will at least expose the full difficulty of our problem.

Design as a procedure

The most powerful statement of the procedural view of design is probably still Christopher Alexander's Notes on the synthesis of form[9] and it is worth commenting on, even thirty years after it was written, because although wrong, and known by its author to be wrong, it is sufficiently rigorous in its conception and execution to raise in a stark and simple way the profoundest problems in conceptualising the act of design.

The reasoning art

The argument in the Notes is grounded in one of the fundamental polemics that modernism had introduced to architecture: how far it was satisfactory to regard design as an intuitive process, dominated by imagination and perhaps impeded by reason, and how far could the intuitive process be progressively replaced by a reason-based procedure in which the architect could draw on ever expanding knowledge? The fundamental argument against intuitionism in design was that it was through the unquestioning reliance on intuition that architecture was tied both to imagism – the domination of architecture by the visual rather than by the functional – and to historicism – the domination of architectural creativity by the forms of the past.[10]

Alexander's was the first utterly serious and formal attempt to put this into effect. It was based on seeing the design process, from the abstract statement of function in the brief to the crystallisation of a physical form, as a process of analysis of information followed by synthesis of form. Several models were proposed at the time, but all shared the central notion that a process from abstractly stated function to concrete architectural solutions could and should be a process of the analysis of the problem followed by a synthesis of the solution. Analysis-synthesis seemed the natural scheme of thought by which we could seek to replace an intuition based process with a reason based process.

It would not of course appear so now. With hindsight, it is easy to see that analysis-synthesis is not at all a natural scheme of thought but something more akin to a paradigm of thought, an understanding of which requires a minor excursion into the history of ideas. We tend to think of 'analysis-synthesis' as a very twentieth-century idea (we make the same error over 'architectural determinism'), but it is not. It was first set out clearly in the seventeenth century by the mathematician philosopher René Descartes in his *Discourse in Method*.[11] Descartes's objective was very similar to that of the twentieth-century design theorists. Descartes wanted to rid the mind of the clutter of preconceptions embodied in natural language, and, starting only from indubitable, simple notions, rework the whole structure of human knowledge. His model was geometry, where we begin from a small number of indubitable (as he thought) postulates and axioms, and use them to create chains of reasoning (theorems, lemmas, proofs, and so on) and eventually large structures of secure knowledge.

Descartes believed that by starting equally simply and working with similar rigour, all fields of knowledge could be rendered as well-structured and secure as Euclidian geometry. Descartes's metaphor for the restructuring of language was the well-ordered town, laid out on geometrical principles, which he contrasted with the town that had grown up, like the human knowledge embodied in language and habit, by a chance process of accretion.[12] In Descartes, we find all the elements in the modernist philosophy: the desire to get rid of preconceptions, to make a break with the untidy past, and to derive a whole new structure of ideas through analysis of foundations and rigorous development of more complex ideas.

The reasoning art

Alexander's version of this in the Notes was to propose 'the analytical nature of the programme, and the synthetic nature of its (architectural) realisation'. He summarised this in a pair of related hierarchical diagrams. On the one side is the 'downward' hierarchy of the analysis of 'needs', in which the broadest statement of 'need' is first broken down into its major components, then these are broken down, and this is repeated until the most elementary level of need is reached. The 'upward' hierarchy of architectural forms then work the other way, with the most basic level as the foot of the pyramid, then the next level in which these are combined, and repeating this till the whole form is 'synthesised'.

Alexander offers a worked example of his method: the redesign of a village in India. His procedure was first to list all the 'misfit variables' (that is, the things that could potentially be put into the wrong relationship) as 'needs or requirements that must be satisfied in a properly functioning village'. These include all those 'explicitly felt by the villagers as needs', those 'called for by national and regional economy and social purpose' and those 'already satisfied implicitly in the present village (which are required but not felt as needs by anybody)'. Examples of the 141 needs identified were: 'Harijans regarded as ritually impure, untouchable etc.', 'Efficient and rapid distribution of seeds, fertiliser etc. from block HQ', 'Simplify the mobility of labor, to and from villages, and to and from fields and industries and houses', and so on. All the interactions between the needs are then listed, so that we have a graph made up of the 'needs' or elements of the graph and the 'interactions' or links in the graph.

The graph is then analysed and decomposed into 'four major subsets' each made up of between two and four 'minor subsets'. Minor subsets are groups of interrelated needs, and major subsets are groups of groups. Each 'minor subset' is then translated into a 'constructive diagram' indicating approximately how the subset of need could be satisfied by a spatial arrangement. These diagrams are then grouped together into more complex 'constructive diagrams' representing the 'major subsets' of needs, and the four major subsets are then grouped to form a constructive diagram for the whole village. In this way, Alexander claims to have begun with the analysis of needs as a field of information and ended with the synthesis of a design solution, that is, an outline of spatial design for the village as a whole.

Many modern readers will be as repelled by the ethnocentric arrogance of the time as by the bizarreness of the solution proposed. But this is not the point at issue here (though it may well be epistemologically linked to it). The issue here is what Alexander has actually done. Has he actually derived an object, the village, from information, the abstractly stated needs, by means of a formal procedure? If the answer is yes, then he can truly claim to have succeeded in his aim of replacing intuitive design with a systematic procedure.

In fact, there is a devastating flaw in Alexander's procedure, one which entirely vitiates his aim of replacing intuition with reason, and leads him only to conceal intuition – even prejudice – under a veneer of reason. This is not a single flaw but a pervasive flaw. It vitiates every stage of the argument. The flaw can be stated as follows. What Alexander is opposed to is intuition based design, which, he

The reasoning art

argues, leads the designer away from a proper understanding of functional needs and the subsequent synthesis of a solution on the basis of that understanding. In practical terms this means that he is opposed to the idea that to be asked to design a 'school', say, immediately activates in the mind a range of given solutions to that design problem, solutions in which the functional patterns of a 'school' such as having classes, assemblies, teachers and taught, head and teachers, and so on are already arranged in specific ways according to certain conventional patterns through the ideas of built form which the word 'school' immediately brings to mind. Alexander objects, in effect, to the fact that in the ordinary use of language, words like 'school' already associate intuitively what the architect seeks to relate analytically and synthetically, that is, the functional and spatial pattern. This immediacy of association between function and form is precisely the means by which past conventions are reproduced. Alexander's programme therefore depends on doing something different from this.

Does he? Of course not. This is exactly what his procedure cannot do. However much you disaggregate the 'programme' analytically, there are no analytic means to move from a programme or functional element to an architectural or spatial element. This can only be done by using pre-existing knowledge or assumptions about how functional ideas translate into spatial ones. In other words, to make the crucial step in the whole procedure, that is, to go from information to object and from function to form, Alexander has recourse to exactly what he said he was avoiding: the use of intuitively held assumptions about what the relation is or should be.

Alexander does not, however, draw the proper conclusion from this, that is, that his technique does not avoid intuitive design, but in fact conceals the use of intuition and assumption under the guise of a procedure. This is probably because he is overly impressed by the technique he uses in order to make the transition from information and function to spatial and physical design, that is, the 'constructive diagram'. Alexander introduces this through a disingenuous example. He shows that if you draw vehicular movement at a road intersection, representing the amount of movement by the thickness of the lines, then both the lines of movement and the thickness are a representation of the actual spatial solution required. However, this is almost the only kind of case where such a close correspondence of 'constructive diagram' and reality can be found, and it is so because it is a matter of engineering, not culture. The idea that this can be duplicated in to cases where the passage from function to form involves cultural patterning can only have the effect that Alexander proposes to ignore cultural patterning and impose his own cultural assumptions through the design.

By this disregard of culture and covert imposition of his own Alexander betrays the whole essence of his technique: at every stage of moving from function to form he has no alternative but to have recourse to his own existing, taken-for-granted knowledge of how function relates to form, and therefore how information relates to objects. In other words, however much he disaggregates the design problem, Alexander still proceeds in the way he originally objected to: that is, by

already 'knowing' the relation between form and function. This prior knowing covers exactly those aspects of design that we called 'non-discursive' in Chapter 1, where we noted that they were handled in the vernacular as the unconscious relational by-products of the manipulation of objects. We can then say of Alexander's procedure that, far from replacing intuitive design with a procedure, he has retreated to a vernacularistic mode of design but only in order to transmit – and covertly – highly personalised values at the expense of those sanctioned by a culture.

Once this is seen, then it clearly also applies to the relationships among elements in the analysed programme, and to the relations among spatial elements in the 'synthesised' built form. In other words, in spite of all the 'methodology', it is intuitive knowledge that has actually done the entire design. The curious thing is that Alexander seems to have known this, and actually discusses it to some extent in his book: 'The designer', he says, 'must already have some physical ideas about the problem in his mind when he starts.' Indeed the designer must, and in fact they are invoked at every stage of the process. It is clear that these objections must afflict any non-trivial version of the analysis-synthesis model. To make the transition from information to object or from function to form we must use knowledge that we already have. This has an important implication: that design as a process of cerebration is not simply a procedure that draws on knowledge, but one where the process is actually based in knowledge and how the designer handles it.

On reflection, perhaps, we may see where the error lay in the analysis-synthesis model of design. The process from written brief to the proposal for an object describes the externalities of the process and how it is embedded in a wider social scheme of things. There is no reason to suppose that it is at the same time a description of the internalities of the process, that is, of the thought process by which the designer conceives the object. From what we have seen of Alexander's methods, and from what we may infer from vernacular and intuitive design, the internalities of design are centred not around a procedure but around knowledge. The procedure proposed by Alexander may conceal knowledge, but it does not eliminate it. On the contrary, as we have shown, it is at every point based on knowledge of a certain kind. If we are to understand the internalities of design, then it is clear that we need, as a starting point, a model of design which acknowledges the centrality of knowledge rather than concealing it. How then can such a model be constructed?

Design as conjecture-test

The first step is easy. The analysis-synthesis model is, at root, a misunderstanding about scientific method, and the twentieth century has seen a revolution in the notions of 'scientific methodology'. Our conception of science has moved on from one in which scientists were data gatherers who proceeded by 'inductive generalisation' (if the sun rises often enough, then we may assume it always rises) to construct theories which were 'certain' because they had been derived by 'induction'. We now see science as a highly imaginative activity in which 'data' is not so much seen as the foundation for theory, as the means of testing and eliminating theories[13] and as the source of intuitive theoretical leaps.[14] Karl

The reasoning art

Popper has been the most influential philosopher in this revolution. He argued that induction was not only unreliable, but also that one could not logically 'induct' complex models of the inner working of nature. Such models have to be first imaginatively conjectured, then refuted, or supported, by rigorous testing against data. No theory can ever be 'proved'. Every theory is forever uncertain, and likely to be replaced by a better one. Even if the induction of theories (as opposed to simple statements about suns rising or sequences of numbers) were logically possible, then it would still be of little use to science since if theories were argued as having been derived from data, there would never be any further need to test them against data. Since often rival theories were supported by all but a very few items of data, then it followed that science could never progress unless it used those few items of data to refute, rather than the many to support, theories.

If then, science remains a rational activity in spite of being led by imagination and intuition, it is not clear why should we seek a stronger model for rationality in design. On the face of it, design looks much more like a process of conjecture-test than a process of 'analysis-synthesis'. The usefulness of this argument (which I and others proposed in the early seventies[15]) is that it relates intuition and reason in a lifelike way, and also suggests that design is not so very different from other types of human activity. For example, conjecture-test seems a reasonable model for speaking: one first conjectures a semantic complex, then tests it out by trying to say it.[16] What distinguishes design from other activities is not its procedure but its object, and what makes design difficult is what is to be designed. Theorists should therefore, it was argued, shift their attention from the process of design to its product if their efforts were ever to be useful.

Now this argument is helpful as far as it goes. But it is clearly pointless to claim to have solved the problem of the design process simply by proposing an analogy to science. Design is a process which those who undertake it find quite different, and indeed it is clearly quite different in its outcome. All we have learned from the analogy with science is to dispense with an illusion: that rationality in thought is necessarily and only the rationality of a process or procedure. How may the argument then be developed further?

In fact, the relevance of the analogy with science is not yet quite exhausted, and we may usefully extend it a little. Just as a scientist cannot 'induct' a complex theoretical model from a series of 'inductive generalisations', so, as we have seen through Alexander, a designer cannot 'induct' a building from an analysis of the parts of a programme. The reason is simple and fundamental. Seen either as space or as form, a building is a configuration, and it is as a configuration that it works and is experienced. Now we know that the fundamental characteristic of a configuration is that every time it is changed, say by the addition or subtraction of an element or part, then the properties of the whole configuration change. The effects of regular changes, that is, those made by following consistently applied rules, can be broadly predicted, but the effects of small or inconsistent changes where no rule is applied from one to the next, cannot be predicted. There is, as we saw in Chapter 9, some degree of local indeterminacy from configuration to its structure.

The reasoning art

It follows that designers must think configurationally, and of course this is exactly what they do. The very centre of architectural design is the bringing together of parts to form a whole. Design is, manifestly, a configurational activity. Two consequences follow. First, since a configuration is a 'whole', whose properties may be significantly changed by quite minor changes, it follows that the designer must on the whole tend to design top-down. The object of the architect's thought is a configuration, and a configuration is a whole entity, not an accumulation of parts. This of course is what we mean by a design conjecture. It is a configurational guess. It cannot be otherwise, since configuration cannot be arrived at by an additive process. Second, because a conjecture is configurational, and we know that configuration is handled by the human mind non-discursively, it follows that configurational conjectures are likely to be generated non-discursively. This of course is why architects talk of intuition. A process of configurational conjecture cannot proceed other than non-discursively. It cannot therefore either follow a reasoned procedure, nor can it proceed additively from the bottom up. Design is by nature a holistic, intuitive process, and this conclusion follows from a reasoned analysis of the process of design.

We therefore have a problem. If design is both a process of non-discursive conjecture, and at the same time a knowledge based process, how can these two facts be reconciled? How can we, that is, construct a model of the internalities of the design process which both 'saves' the apparent priority of intuition over reason in design, while at the same time saving the idea of design as a knowledge based process in which human reason is, *par excellence*, deployed?

The answer, as we will see, will lie in exploring the implications of the non-discursive in building – that is, the putting together or composing of a formal and spatial structure – for design as a cognitive process. We have already noted in a previous chapter that, in the vernacular, the non-discursive aspects of the building, that is, the pattern of form and the pattern of space which give the building its cultural character, are recreated unconsciously through the manipulation of objects. The form, the spatial pattern and the functional pattern – the form-function relation, in short – are known in advance and need only be recreated. Because architecture of its nature unlinks the pattern aspects of the building from their dependence on social knowledge, then it is these non-discursive aspects which become uncertain. It follows that the problem we must solve in understanding design as a knowledge based process requires us to show exactly how those non-discursive aspects are handled, those aspects, that is, that Alexander concealed so thoroughly in his procedural theory.

The design process closely observed

Let us then define architectural design as a knowledge problem as clearly as we can. We must begin with a basic fact: a design is a representation, not a thing. To design a building is to create a representation of an unknown and original object whose properties must be well enough understood in advance in order for the act of building to proceed with confidence. The properties that must be predicted include of course all 'technical' aspects, that is, those aspects which are governed

The reasoning art

by some kind of physical laws, such as the structural or climatic performance. However, they also include the non-discursive properties, that is, the putting together or composing of a formal structure and a spatial structure. The former is a matter of foreseeing the aesthetic and cultural significance of the proposed building, the latter a matter of foreseeing how the building as a spatial entity will work for the programmes of activity that are projected to take place in it (as well as others, as yet unforeseen, that might in time be added).

In architecture, it is these non-discursive aspects to which attention is most drawn since it is in these areas that architecture claims to create an entity 'over and above building'. This means that in the design process there are two non-discursive problems: the generation of the proposed form, and the prediction of its functional properties. Our problem is to explain how each of these can happen, and in particular how each draws on and uses some kind of knowledge.[17] The best way to begin might be actually to examine what happens – or what seems to happen – during the course of the design process. What can be seen to happen should at least be an outward and visible sign of the interior process of design.

If we observe the design process as it happens, then we find ourselves noting two apparently very different but closely interrelated kinds of activity. One is the proposing of conjectural forms as possible solutions to the problem in hand, usually through a series of sketches or drawings. The other is talking about forms, that is, explaining them, defending them, criticising them and proposing modifications, in effect discussing what they will be like if built. We may usefully note that the conjecturing of forms appears to happen largely in non-discursive mode, but that reasoning about forms happens primarily in discursive mode.

Let us look first at the more discursive aspects of the process, that is, at the issue of prediction. How is it possible to predict the performance of an unknown and original object? Considering the problem in the abstract, it would seem that the possibilities are limited. Prediction can either be made on the basis of analogy with known cases, or by appeal to principle, that is, to what is held to be true of all possible cases, or perhaps some mixture of both of these such as 'experience' which usually takes the form of a provisional principle based on personally known cases.

We will find this a useful guide in listening carefully to what is being said in the studio, and in particular, to how designers comment on design conjectures and predict what they will be like. One kind of inchoate comment, for example, tends to reflect non-discursivity quite directly. For example, 'This is great' or 'I really go for this.' However, this is rarely all that is said when offering such evaluations. Quite commonly it will be followed by some remark like: 'Am I right in being reminded of ...?', or 'You seem to have in mind such and such.' In other words, there is usually some attempt in talking about projected forms to invoke existing forms.

Noting this allows us to formulate a useful thought. Even if the spatial and physical forms of buildings are non-discursive, this does not mean that the process of pointing to comparisons between them is non-discursive. On the contrary, a process of comparison can be conducted without violating the non-discursivity of

form. One does not have to describe a form to make a comparison. A comparison can be agreed or disagreed with verbally on the basis of appreciations of the form which remain in non-discursive mode. Therefore, even though the object of evaluation remains non-discursive, we still find discursive reasoning being employed explicitly in a way in which it does not seem to be – or at least is not manifested – in the process of generating design conjectures. Designers rarely claim 'I got this bit from here, that from there', since this would suggest pastiche rather than originality. But discursive comparisons are a legitimate aspect of the process of design evaluation and prediction once the conjecture exists.

This tendency to invoke existing buildings becomes much more noticeable when it comes to predicting the functional performance of the building as opposed to evaluating its form aesthetically. We commonly find that the most persuasive and powerful arguments are comparisons with known cases which in some sense or in some aspect the design proposal resembles. There is an obvious reason why we should expect this to be the case. Architects design form, but hope for function. The most difficult aspect of prediction from an architectural conjecture is the prediction of function from form. It is only in existing buildings that function as well as form can be seen. By an empirical appeal to cases, then, function, the key unknown in the design process, can become part of the predictive reasoning about forms which characterises the design process.

For this reason, the forms of discursive reasoning that are used in foreseeing the architectural nature and predicting functional performance tend to be of an empirical kind. All other arguments seem to be weak compared to these, and in practice we find that empirical appeals are often the final arbiters. This is why, in the discursive or predictive phases of design, we note the predominance of reasoning, which is at once empirical and discursive. Indeed, it is their empiricism that makes these phases discursive.

It is good that it should be so. If design conjectures were justified by appeal to principle, then there could be little effective critique of designs on the one hand, and little development of principle on the other. The situation would be analogous to the pre-Galilean situation in science when, under the influence of the Aristotelian methodology, science attempted to proceed from general axioms to particular phenomena, with the effect that no learning from unexpected phenomena was possible. In design, the situation is analogous. The testing of designs against known cases will always be the most flexible and potentially undermining technique for the evaluation of design conjectures. Through it, the real world is brought into the world of design, and is held there in much the same way and for much the same reasons as it is in science.

We have then it seems defined at least one phase of design as a knowledge based process, and one kind of knowledge that is deployed in the design process. Empirical knowledge of the non-discursive aspects of buildings, especially the relation of spatial form to function, are fundamental to the predictive or discursive phases of the conjecture-test sequences which characterise the design process. We

may also note that, as we learn from Hacking,[18] in science empirical phenomena may also be the spark for theory, not by any logical procedure but by exactly the kind of non-discursive leaps which characterise scientific theorisation. In architecture, similarly, existing cases – that is, known architectural phenomena – can be the spark for a new and original design.

Where do architectural ideas come from?

But what about the first non-discursive phase of the process, that is, the generation of conjectural forms? Let us begin again by looking at the evidence that design shows of the process of conjecturing forms. Observing the process, what we usually see is a series of drawn conjectures. We rarely find a single conjecture and quite rarely a single kind of conjecture. More commonly we find families of conjectures reflecting different possible strategies in solving the problem in hand. What we actually see, then, is a range of possible forms, a range which clearly derives from a much greater possible set and which will in time be reduced to a single proposal.

In other words, on the face of it, what we see evidence of in the conjectural phases of design is not a translation from information to object or from function to form, but something much more easily conceptualised: a translation from architectural possibility to architectural specificity. It may of course be objected that this proposition is self evident. But from the point of view of how we conceptualise design as a knowledge-based process it is very important. It implies that the generation of form, the most problematic of all aspects of design from the point of view of the analyst, is not a matter of translating between incommensurable domains, but a process contained, in the main, within a single domain: the domain of architectural form. If this is the case, then it follows that the most important element in the process will be how the designer understands the field of formal and spatial possibility.

This is not all that we see on the surface of things. A design conjecture is not simply a conjectural form but a formal conjecture embodying a functional conjecture. The formal conjecture in effect comes to us already replete with a functional prediction which offers a solution to the problem posed by the brief. We must then conclude that notions of function and their relation to form are also present in the designer's understanding of architectural possibility, at least in such a way as to support a formal conjecture which is at the same time a function prediction. In effect the designer is mapping not only from knowledge of formal possibility to a conjecture for formal specificity, but also from knowledge of functional probability to a functional prediction.

We might say that seen as a cognitive act the conceptualisation of a form seems to be a matter of translating from knowledge of formal and spatial possibility to formal and spatial actuality, and from functional probability to functional prediction, in the light of an abstractly stated brief. In other words, design is not a matter of translating between incommensurable domains, but a process of transformation within domains, exactly those domains which are linked in the very nature of buildings. If follows that the knowledge that designers use in the generation of design conjectures is, like the knowledge used in testing conjectures,

in some sense knowledge of buildings, but in this case, knowledge of possibility rather than actuality. The question is: what is this knowledge like? In the testing phases the knowledge was clearly empirical knowledge of real cases, and it was possible to argue that this was the best form for the necessary knowledge to take. Does the same hold for the generation of design conjectures?

Let us immediately set up a guide post. We saw in analysing the vernacular that the creation of a vernacular form meant holding steady ideas to think with about relational structures in order to manipulate the ideas we think of, that is, the physical and spatial elements that are composed into a building. The analogy was with language where the creative act of language is only possible by holding steady these relational ideas to think with that we call grammatical and semantic knowledge. It was also suggested that architecture meant taking these non-discursive structures into the realm of reflective thought, in much the same way as the scientist takes into conscious reflective thought the conditions for the existence of phenomena presupposed by the craftsman. Through this transformation of knowledge, architecture meant not simply reproducing a culturally sanctioned non-discursive pattern, but by reflective abstraction on the possibilities of such patterns, to create new non-discursivities.

But how does reflective abstraction come to be embodied in the act of design? To understand this we must first recognise that design is not itself an act of reflective abstraction. On its own, reflective abstraction can only lead to the understanding of forms. Design is about the creation of forms. It is a process of concretion dependent on abstraction but not in itself a process of abstraction. This process of concretion must incorporate reflective abstraction, but not in itself be simply reflective abstraction. How can this happen? The answer is simple, and, once stated carefully, quite obvious. *It is in the nature of creative acts of concretion, like design, that some set of ideas to think with must be held steady, temporarily at least, in order to manipulate and experiment with the ideas the designer thinks of in searching the field of possibility.* This is because the act of – let us call it non-discursive concretion, the creation of a non-discursive conjecture for a physical and spatial form – is not in itself a simple application of reflective abstraction, but a deployment of reflective abstraction to construct and search a field of possibility, in such a way that the reflective abstractions construct that search and inform the designer when he or she might be near what is being sought.

In other words, in architecture the reflective abstractions are inserted into the design process as ideas to think with to be temporarily taken for granted in order to construct and search a field of possibility in terms of those reflective abstractions. In design, ideas to think with are necessary because they inform the designer what he or she is looking for and constructs the field in such a way as to allow it to yield to his or her efforts. A good designer in effect constructs his or her own ideas to think with and deploys them as structuring mechanisms to search the field of possibility and guide him or her as to the degree of success or otherwise of the search. The act of design is such that it must, temporarily at least, hold steady ideas to think with in order to manipulate and experiment with the ideas that a

The reasoning art

designer needs to think of. It is necessary in the logical structure of the act. In order to propose such and such a form and such and such an outcome the designer must know, or believe he or she knows, not only the non-discursivities of form and space but also what in general is the effect of forms on outcomes.

Solution typologies

The question is: what are these ideas like? And where do they come from? Again we can most usefully begin by looking at the evidence provided by the design process itself in action. This time we should look at the earliest stages, since it is the sources of design conjectures for which we are now looking. We cannot begin earlier than the brief itself, that is, the information that initiates the design process in the first place.

We have already discussed the problem that when we name a kind of building, says a 'school', we are already referring to a very complex set of ideas which include not only buildings with certain characteristic appearances, but also certain patterns of activity carried out by people with well-defined social roles in certain kinds of spatial arrangements. In other words, the common sense use of a word to name a building already describes possible relations among exactly those non-discursive aspects of buildings which the designer will seek to relate through design: that is, a functional programme, a spatial pattern for that functional programme and an expression of 'schoolness' through the physical form of the building. On reflection, we must expect this. It is the other side of our analysis of the vernacular. All of us, not only builders, already take part in an ongoing building culture, through which we are able to understand and use buildings, for more or less the same reasons that builders are able to build them. As with the builder, however, the cultural knowledge of building that we have is non-discursive insofar as it deals with the building as a relational complex of form and space. We must note also, that, as with the vernacular builder, non-discursive knowledge, because it is relational, is essentially abstract, although we may hold it together by images of physical objects, just as the builder reproduces it by manipulating physical objects.

If a whole field of non-discursivity in which forms of human activity, spatial patterns and formal expressions are interrelated is activated by the use of words like 'school', then it follows that it is also activated by the brief. The complex of ideas activated is unlikely to take the form of a single cultural type, as we would expect it to be in the vernacular, but that of a set of possibilities which reflects current, recent or historical solutions to that kind of design problem, and which manifest themselves to the designer as a field of strategic choice. We need a name for such fields of strategic possibility defined by past practice, and since elsewhere[19] it has been called a 'solution typology' we can continue to use this expression. Now the critical fact about a solution typology is that it already constitutes a set of non-discursive ideas of exactly the kind the designer requires, and so offers them an immediately available set of 'ideas-to-think-with' in searching the solution field. In exactly the same way that the vernacular builder uses the phenotypical means at his disposal to transmit abstract non-discursivities through the organisation of the form and the space, so

the designer reviewing precedent, consciously or unconsciously, absorbs the non-discursivities contained in each of the solutions. The solution typology is therefore made of genotypes, or rather of phenotypes which imply genotypes. The designer does not have to use these genotypes, but the ideas are there, and their essentially unconscious and abstract nature means that it will not be easy to be free of them. For any design problem, we may then note that there exists a pregiven historical set of non-discursive genotypes reflecting the recent history of that problem. On reflection, the existence of such historical sets is the precondition for being able to identify a 'design problem' in the first place. In spite of first appearances, a 'design problem' is a historical conception.

One way in which designers often recognise that design, even the most innovative, happens within this context of ideas defined by the history of architecture to that point is by making a review of existing solutions to the type of design problem posed by the brief. There is a well established term for the cases so reviewed. They are called 'precedents'. Precedents are existing examples of solutions to a particular design problem. Reviews of precedent rarely look at one single kind of solution. They usually show as wide a range of solutions as possible,[20] including those that are not considered good. We rarely find however that the review of precedent is followed by emulating one precedent or other. On the contrary, where the review of precedent is explicit in this way the subsequent design usually makes it clear that the purpose of the exercise was not to provide a best case exemplar to follow, but to set up something like markers in the field of possibility for a new departure. The review of precedent is not intended to reduce the originality of the new design, but on the contrary to ensure its originality by laying out precedent in a clear and explicit way. In making a review of precedent a designer is acknowledging the historical continuity not only of architectural solutions but of architectural problems. It acknowledges that in architecture at any point in time we have that kind of problem because we already have that kind of solution.

Solution typologies, because they imply a range of non-discursivity in a relatively abstracted form, can in themselves provide cognitive mechanisms though which the designers can structure the field of possibility. But they can do so in two ways, either explicitly, as we find when a conscious review of precedent is made, or implicitly, when precedent is used in an unacknowledged way to structure the search for a solution. The latter strategy will always be a conservative one, in the obvious sense that it will always tend to conserve the existing solution typology. The former strategy, by acknowledging the solution typology, will tend to be more progressive since by setting out precedent it creates architectural conditions in which the simple following of precedent is more difficult.

Now whether or not the designer makes an explicit review of precedent, it is unavoidable that existing genotypes are at least a powerful, if ghostly, presence in the process through which design conjectures are formed. Established genotypes can invade the process of architectural creation by becoming part of the ideas to think with that inform the search for a design conjecture, with or without the

The reasoning art

compliance of the architect. It is entirely to be expected then that architects will, while exploring formal possibility, find cultural genotypes attached to at least some of the ideas they are thinking with. The evidence of architectural history is that the process of cultural evolution which we call the history of architecture is to a considerable extent informed by the cultural stability induced by the use of existing solution typologies – or rather their genotypes – as ideas to think with in searching the field of possibility for design conjecture.

We could think of this type of architectural production as 'normal' architecture by analogy with Thomas Kuhn's conception of 'normal' science as 'puzzle solving' within an unchallenged paradigm.[21] The analogy is not precise. The architectural field is more fluid. There is no one paradigm. Even so the broad analogy is probably correct. The act of architectural creation transmits some degree of cultural continuity because existing solution typologies are the most powerful and naturally available ideas to think with in the generation of design conjectures. It is this that creates the sense that in spite of each building's being an individual, buildings do form gradually evolving species. We see now how the genotypes of those species are transmitted through the comparative indeterminacy of individual creation.

Solution typologies and normal architecture

There are, however, serious dangers in the use of solution typologies. Epistemologically, we can say that the existence of solution typologies and their powers to transmit non-discursive abstractions, tends to vernacularise architecture, that is, to return it from its aspiration to a universal transculturality back in the direction of socially normalised intentions and forms. Is 'normal architecture' then, defined as architecture in which the influence of prevailing solution types is paramount, the same as the vernacular, that is, no more than the transmission of culture through artefacts?

The answer is that it is not. Normal architecture uses similar cognitive mechanisms to the vernacular in producing designs, but this does not mean that the non-discursive knowledge that informs designs is of the same type. On the contrary, it is likely to reflect two fundamental new facts: first, the existence of architects as a specialised knowledge generating and knowledge using group, and, second, the fact that this specialisation is legitimised and made viable by the wider social structures of which it forms a part. This creates a new possibility: that 'architectural knowledge' may come to reflect not simply knowledge that architects share with other social members through common culture, but knowledge which reflects the fact that architects act on behalf of others in certain social situations. In other words, architecture has the potential to represent cultural partisanship as much as cultural agreement.

The degree to which this happens depends on a new factor which arises alongside the coming into existence of architects as a specialised group: the continuing debate between society and its architects about the aims and purposes of architecture. We can follow current fashion and call this 'architectural discourse'. Architectural discourse arises from the simple fact that because through building social life is constituted in organised space, and social values are represented

The reasoning art

in visible form, architecture cannot be socially neutral. On the contrary, every architectural act directly engages the social, and remains in a permanent dialectic with it. It is the intimacy of this relation that ensures a second, higher level dialectic between architecture and society: one between architectural theory and social ideology in the formation of architectural 'intentions'. Architectural intentions are the general propositions that stake out the points of aim for architectural design. They are likely to involve quite complex propositions about the relation of architecture to life. Such propositions are theoretical in that they propose, however broadly, an approach to spatial and formal configuration. As such they engage with theoretical debate within architecture. On the other hand, these propositions are also social propositions, and as such inevitably provoke and become part of wider social debate.

Because this is so, statements of architectural intent cannot and should not be taken at face value. The sheer technical intimacy of the involvement of architecture with the social leads it into a permanent danger: that the theoretical and intentional abstractions which inform design and tell it where to aim will become subordinated to prevailing social ideologies. This leads architecture into a continuing intellectual struggle. On the one hand, the closeness of this involvement of architecture with society, necessarily draws architecture into the permanent debate that every society has with itself about its nature and direction. On the other, the nature of architecture as reflective thought and action in exactly those aspects of buildings which are by their nature social, leads architecture to draw back from this debate into preoccupation with its own autonomy. This can appear paradoxical, but it is a structural necessity. Architecture is technically enmeshed in society, yet its reason for existence is to break free from this enmeshing, and to propose new forms and freedoms altering the terms of this enmeshing.

This two-sided debate is what we call architectural discourse, that is, the continuing debate about architectural ideas and their relation to social values that is conducted between architecture and its public. In spite of its need for autonomy, discourse in architecture, as elsewhere, is not a freestanding thing, but a constantly shifting bundle of ideas which reflect and contribute to more general patterns of discourse through which a society debates itself with itself. Architectural discourse is one of the means by which architecture both ties into and struggles to be free from the gradual evolution and adaptation of the cultural and institutional structures which mark every modern society. Thus although architecture is in principle a freeing of building from the specific constraints of a culture, the need to embed this freedom in discourse in order to sustain it ensures that architecture can never assume its freedom from intellectual and social context. The question 'where do architectural ideas come from?' is a question to which an undermining answer is always possible: that any architectural idea may present itself as free-standing and clear of social construction, but time may show to have been an unwitting implement of a specific ideology.

The reasoning art

A constant question-mark therefore hangs over statements of architectural intent. Are they autonomous constructs of architectural thought, and therefore constructive offerings from architecture to society, or are they ideas which are in some sense already received from society, imprinted on architecture through the common processes by which social and cultural change become normalised into social behaviour and institutions? In short, are the notions about architecture and society, that are expressed through the changing language of architectural 'intentions', in some sense socially constructed?

This question is most pressing in the matter of space. An architectural intention is usually a proposal to create a social outcome through a spatial form. Intentional statements in architecture therefore inevitably associate social values with spatial concepts, and become in effect propositions about the relation between architecture and how life should be lived in space. Theoretically, they are form-function propositions. For example, propositions about the relation between housing layout and community formation, or between open-plan offices or schools and organisational functioning, or between domestic space design and family behaviour, are all form-function propositions relating space to concepts of normal or desirable social behaviour. Sometimes such propositions are quite explicit, but quite commonly they become implicit, transmitted through the accepted forms of building and supported by the common words and terms we use to talk about them.

Because this is so, architectural theory has two objects of study, which were at the same time its primary sources. One is the objects of architecture, that is, the buildings and places that exist and could exist. The second is the study of 'intentions', and especially of the 'ideas-we-think-with' that underlie intentions in architecture, that is, the shifting array of concepts that underlie architectural discourse and which seem often to govern the broader changes in architectural forms that we see over time. Many would see the latter study as primary, arguing that discourses are prior to buildings and buildings can only be rendered intelligible as social and architectural products through their relation to discourses. However, a key lesson from architectural experimentation in the twentieth century is that there has often been a mismatch between the discourse of architectural ideas and intentions, and the actual performance of the building and spatial forms which express those intentions. We cannot proceed on the assumption that there is a tight relation between idea and reality. We may well choose to study the two in parallel, but in order to do this we must also learn to study each separately. The parallel influence of socially constructed intentions on the one hand and available solution typologies on the other together constitute a potential prison of idea through which architecture, while still pursuing its aim of freedom and autonomy, becomes in effect the inchoate and unwilling servant of social forces.

A case study

There is a paramount example of this, which concerns the origins of the strange landscapes described and discussed in Chapter 5, and which were the subject of an earlier paper called 'Against enclosure'.[22] In this paper it was reported that by

examining a large number of cases of social housing design, in the mid-twentieth century[23] a consistent set of spatial ideas could be identified, coupled to equally pervasive social ideas. The spatial idea centred around the idea of 'enclosure': that good space was enclosed space. The social idea was that such 'enclosures' had to be identified with well-defined, and preferably small, groups of people, and exclude others. The guiding idea that linked the two was that if a group of neighbours was forced into face-to-face relations, and others were excluded, then this group will begin to form a small community. The same idea was applied at the higher level of the 'enclosure of enclosures', or 'cluster of clusters', to create 'local communities'. Architecturally, these led to a preoccupation with grouping dwellings so as to associate identifiable and distinct external spaces with each group of dwellings, coupled to an overarching geometry, so that the relation of the local group element with the larger whole would be clearly manifested in the plan. The whole scheme of thought was describable in terms of three linked principles which could be applied to generate a 'layout', regardless of context: 'enclosure, repetition, hierarchy'. These three linked ideas were so pervasive, and could be found under many different types of building and spatial geometry, that they seemed in themselves to constitute a kind of 'design paradigm' – one which was constantly transmitted through the solution typologies which embodied it and which offered themselves as precedent for public housing.

Unfortunately, it was exactly this set of ideas that created the fragmented and segregated landscapes that were the object of our pathological investigations in Chapter 5. The notion that small-scale localised 'enclosures', each one corresponding to a small, identifiable community[24] should be the primary element of the new housing area, was exactly the means by which the virtual community, brought about by the natural co-presence and co-awareness arising from everyday movement in street based areas, was destroyed. The true effect was to convert what had been previously a community linked by the continuous, unbounded public space of the street system, into a series of discrete pockets, each as removed from the humanising influence of the public realm as the next – in effect to create a complex and labyrinthine zone between the dwelling and public space. As we saw in Chapter 5, the crisis of modern public housing was the crisis of this space. Whatever the declared communitarian intention of the creators of these 'estates', the effect was to remove the least privileged groups in our societies from the public realm, and consign them to zones which no outsider entered without a strong reason, and which were therefore known only to their inhabitants. This is the durable legacy of the bureaucratisation of architectural thought which brought these zones into existence.

Even at the small scale of the 'enclosure' itself, common sense, and a little more pragmatic thought, could have warned designers that their intentions were unlikely to be fulfilled. Human beings tend to have special social rules of politeness and avoidance to govern their relations to neighbours, precisely because these relations, because they are ever-present, could easily become too pressing and obtrusive. Exaggerating this face-to-face relation by spatial design, and at the same

time eliminating the leavening of strangers as found in ordinary streets, seems far more likely to reinforce these rules of control and avoidance than to alleviate them. We should expect more avoidance, and more investment in the control of over-pressing neighbourliness in these isolated face-to-face groups. The question is not so much: how did the neighbourliness paradigm fail? but: how could the fiction of forced interaction have prevailed for so long?

The historical work to trace the evolution and constant transmutation of this set of spatial and social assumptions that underpinned so much mid-twentieth century public housing has not been done, but three things can be clearly said. First, that in spite of its 'soft' expression in terms of neighbourliness and community, the essential idea of enforced face-to-face interaction is thoroughly mechanistic in exactly the sense that was argued in the discussion of the 'paradigm of the machine' in the previous chapter. Second, we can note the frequency with which the 'enclosure, repetition, hierarchy' paradigm was proposed as a novel solution to exactly the problem that it had itself created. For example, in the same year that Kirschenmann and Munschalek published their book from which so many of our cases of 'enclosure, repetition, hierarchy' were drawn, the Greater London Council published new design guidance on housing layout[25] intended to correct the errors of the past and propose new principles. In fact, in spite of much new language, what was proposed took exactly the same form as what it was seeking to replace: 'enclosure, repetition, hierarchy', dressed up in new words and diagrams. Third, each element of the design paradigm can be found at each stage of the evolution of social housing policy, and in fact can be traced back to its very beginning in the 'philanthropic' housing programmes of nineteenth-century London. So pervasive are the ideas, in fact, that it is hard not to see them as the design paradigm of social housing, a design solution which society, through architecture, imposed on certain sections of its population.

Both of these facts suggest that the design paradigm of 'enclosure, repetition, hierarchy' was a means by which those very same social engineering aims in architecture that it sought to supersede were perpetuated. We should not be surprised at this. It is in the nature of paradigms that they can guide apparently new proposals along the same underlying conceptual tramlines as those from which escape is sought. The widespread availability of a solution typology based on this scheme, linked to habitual statements of social intention legitimised by the public agencies which at the time controlled a social housing programme on a huge scale, must go some way to understanding the power of this idea to be constantly reformulated and accepted as new, when it manifestly was not.

The social knowledge embodied in the solution typologies in a society with architecture is not then the same as that which underpins the vernacular forms of societies without architecture. On the contrary, they are likely to be influenced by the types of structure prevalent in a society, and therefore to reflect its biases. The problem with such solution typologies, especially if they are sanctioned by explicit design guidance, is that their social origins tend to be as concealed from view as their theoretical nature is obscure. Non-discursivity is, as it were, turned on its head.

The reasoning art

It becomes a means not of expressing culture but of imposing culture, often for social ends which are not explicit. In such circumstances, architectural intentions become an object of legitimate enquiry, but the natural non-discursivity of solutions make it very hard to bring to the surface any concealed ideological content. However, an architectural tradition which fails to free itself from such a conceptual prison, as happened during the modern housing programme, is in danger not only of losing its identity as architecture, but also of acquiring another, more dangerous identity: that of an unwilling and servile agent of social forces of which it has as little understanding and over which is has no control.

Style as non-discursive idiolect

The essence of the 'enclosure, repetition, hierarchy' paradigm is that it substitutes a social ideology of 'desirable separation' for an analytic theory of the relation between space and community. It then works in the manner of a vernacular, in that ends – in this case, in my view, malign ends – are guaranteed through the manipulation of things, that is, the given solution typologies. At the same time, it creates the appearance of architecture, in that an illusion is set up of an architectural debate over ends in the light of means. What is really going on is vernacular in the sense that covert ends are being transmitted by the manipulation of means, but the ends are no longer those of a shared culture, but those of partisan social programmes.

This debased mode of architectural operation has played such a significant role in the twentieth-century history of architecture that it deserves far more intensive study than has so far been devoted to it. It amounts to nothing less than the subversion of architecture towards what we might call bureaucratic vernacularisation, in the name of a partisan social engineering by spatial means. The question for a theory of design in architecture is then: how may these apparent consequences of the existence of architects as a special interest group in a society with inequities be avoided? The question has two aspects. How can solutions be generated outside the prevailing influence of solution typologies, with all the dangers that their uncritical use can bring? And how may innovative solutions be predicted? Only if these questions can be answered can we see the grounds of the existence of architecture in the sense that we have defined it, that is, as an autonomous domain which debates with, responds to and creates new possibilities for society, but is not subservient to it. It follows from all our previous analysis that these are knowledge questions. What then are the knowledge conditions for an autonomous architecture?

Once again let us begin by looking at the evidence provided by the design process, and especially by its visible products. The most obvious thing that we notice in a creative designer's work is that it is recognisable. It constitutes what seems to be in some sense a species of architecture in itself. It has, in short, what we call style. Now style is clearly a non-discursive concept. Style exists where we note in a set of cases non-discursivities, whether formal or spatial, which appear to be unified by common principle. To use a form of words which is effective while being fashionable, we might say that by style we mean a non-discursive ideolect. Style gives rise to the sense of a species of architecture where the genotype

does not seem to arise from the transmission of a culturally normal form-function solution within the existing typology, but through a characteristic structuring of the non-discursive means themselves, again either formal or spatial. The existence of style means that what is taken into reflective abstraction is not a range of possible solutions but the formal and spatial non-discursive means by which solutions can be created. A style, in short, is a genotype of means. It creates an individualised species of architecture which cross-cuts the architecturally normal cultural typing and may indeed run across a range of building types.

Because the sense of style arises directly from the non-discursive means, and because we can be sure that we could not recognise the existence of a style through a single case – though a single case might generate a style – it follows that our sense that the non-discursive ideolect that constitutes the style is essentially an abstraction. It is the common ground of a set of cases. It is yet another instance of our ability to extract the abstract from the concrete, the genotype from the set of phenotypes, and to re-concretise the abstract genotype in a different form in a new phenotype.

Our concept of style in architecture tends, of course, to be bound to its most obvious manifestation in how a building appears to the eye, that is, to the non-discursivities of form. Such a limited view would not survive a careful examination of the works of individual architects. Good architects have spatial, as well as formal, styles. Sometimes this is quite easy to see, for example in the work of Frank Lloyd Wright. But even in such cases, it is difficult to explicate. Experimental studies[26] suggest that explicating architectural genotypes of means is rather more difficult than explicating vernacular genotypes of ends. But it can be rewarding, and is essential to our understanding of individual architects' work. For example, in a comparative analysis of five houses by Loos and five by Le Corbusier, a graduate student at UCL[27] was able to show that although in each house there was configurational differentiation of functions, there was no consistent pattern within either architect's work of the kind that one so often finds in vernacular samples (see Chapter 1). It was not that the different functions were not spatially differentiated, but that the pattern of differentiation was not consistent across cases. It was as though each recognised the principle that functions should be spatially differentiated, but that this was regarded as a matter of experiment and innovation, rather than the reproduction of a culturally approved genotype.

However, what the student was able to show was that each architect had a distinctive spatial style, in that whatever each was doing with the functional pattern, distinctive spatial means were used to achieve the ends. For example, in the Loos houses, adding visibility relations to permeability relations increased the 'intelligibility' (as defined in Chapter 3) of the space pattern, whereas in the Le Corbusier houses it did not. Similarly, in the Loos houses, the geometry of the plan reinforced aspects of the spatial structure of the plan, in that major lines of spatial integration coincided with focuses of geometric order, whereas in the Le Corbusier houses they did not. By examining the houses as sequences of isovists, the student also showed that in Loos houses the isovists are very large and complex,

but relatively uniform, whereas with Le Corbusier the isovists are more selective in the spatial relations they show from the line, with each episode tending to be dramatically different from the others. In these respects, the student argued, the two architects were adumbrating more fundamental – almost philosophical – differences through architecture: Loos to create houses which are novel expressions of culturally defined habitability, Le Corbusier to create less habitable, more idealised domains of rigorous abstraction. Neither Le Corbusier nor Loos was seen to be denying the social and cultural nature of the domestic interior. But each, by satisfying the need to give space cultural meaning through functional differentiation first one way then another, but with a consistent spatial style, is giving priority not to the functional ends of building but to the architectural means of expressing those functional ends. The genotype of these houses lay, it was suggested, not in functional ends, as in the vernacular, but in the way the architectural means are used to express the ends. But the means modify the ends by re-expressing them as part of a richer cultural realm.[28]

This distinction between ends and means is, I believe, fundamental to the definition of architecture offered earlier. It suggests that we can make a useful distinction, in architecture as elsewhere, between the realm of social meaning and the realm of the aesthetic – in this case the spatial aesthetic. The cultural and functional differentiation of space is the social meaning, the spatial means is the basis of the spatial aesthetic. The former conveys a clear social intention, the latter an architectural experience which re-contextualises the social intention. Meaning is the realm of constraint, the spatial aesthetic the realm of freedom. The spatial meaning of form expresses what architecture must be to fulfil its purpose as a social object, the spatial aesthetic expresses what it can be to fulfil its purpose as architecture. But although space moves outside the realm of specific codes of social knowledge, it does not lose its social dimension. The relation between spatial and social forms is not contingent, but follows patterns which are so consistent that we can hardly doubt that they have the nature of laws. The spatial aesthetic carries social potentials through these laws. The autonomy of architectural means thus finds itself in a realm governed by general principle, with its freedom restricted not by the specific spatial demands of a culture but by the laws of space themselves.

Two types of theory

This analysis of the notion of style suggests that it is more than a matter of recognisable appearances. It seems to go to the heart of the nature of architecture. This is the case, and a further review of the generative stages of design will suggest why this is the case. We may begin by reminding the reader of a distinction made in Chapter 2 between theories as they were used in art and theories as they were used in science. In science a theory was about understanding, and once understanding was achieved then action could follow. A theory in art is about creation, in essence about *possibility*. Theories in art work by suggesting new ways to structure the search of the field of possible forms. Such theories are not universal, but simply generative in that they use abstract thought to generate new

The reasoning art

possibilities in art that had not been seen before.

It is clear that the idea of style as non-discursive ideolect and as a 'genotype of means' has a directly analogous role. Its effect is to construct an abstract means of searching a solution space, that is, to act as an 'idea to think with' at the level of the non-discursive means of architecture, opening up routes to possible architectures through the taking hold of the means by which non-discursivity is created. Because it is so, it leads to quite new ways of searching the field of possibility. While a solution typology structures the field of possibility by identifying a series of discrete islands, so that search tends to be restricted to the vicinity of those islands, a style as non-discursive ideolect defines a continuous web within the whole field of possibility, creating a density, richness and potential originality of solutions far exceeding that of any typology. Mitchell summarises this succinctly: 'Possession of a style is essential. Without it, an architect attempting to design is like the scholars Gulliver encountered at the Academy of Lagado, who tried to write books by randomly combining words. That way, one would never get to the end.'[29] This is true in a profound sense. It arises from the nature of solution spaces and how they can be searched without the guidance of pregiven solutions. One might add of course, that this is only the case if one wants to create architecture.

But however much we complicate the idea of style, its relevance is confined to the first phase of design, the generation of a possible solution, not the second stage of predictive testing. It was suggested in Chapter 2 that the distinctive feature of architecture is that it requires both theories in the sense in which artists use the word and also theories in the sense in which scientists use the word, that is, theories of possibility and theories of understanding; theories which tell us where and how to search, and theories that tell us what we have found. We now see clearly why this is the case. It is precisely because the solution field has been searched without the functional guarantees that solution types seem to offer (however misleadingly) that the designer is now in greater need than ever of ways to solve the second aspect of design: the phase of predicting functional and experiential outcomes. The problem is now a great deal more difficult, since by definition the solutions found, because we have not been led to them by known solution types, are more likely to be remote from experience and from precedent. In such cases, the means of prediction in design must move away from precedent and towards principle. Since these are the only two possible modes of foreseeing future performance, the designer is forced, through the very nature of the freedom that has been exercised in generating solutions, into the realm of theory. The more original the architecture, the greater will be this dependence.

In a sense which is critical to the very existence of architecture, then, style and theory are parallel freedoms. Innovation can only be within the realm of the humanly possible on the basis of theoretically analytic knowledge because only this can guide the predictive aspects of design where no guarantees of cultural or ideological conformity are available through the vernacular or solution types. Theory is fundamental knowledge of possibility and therefore of limitation. There is

therefore an objective need to associate non-discursive ideolect with analytic theory. Of course this would only be the case if there were objective limitations to what is architecturally, as opposed to technically, possible. We have seen that there are such limitations. Fundamentally, theory is knowledge of these limitations.

On this basis, and only on this basis, the idea of analytic theory can be built into that transformability of culture which is architecture. Without analytic theory, as we have seen in some phases of twentieth-century architecture, architecture defeats itself by pursuing freedoms which are beyond its theoretical powers. Analytic theory is the price that architecture must pay for freedom. Without it, the two sides of architecture – that it is at once individual creation and social transmission – move into arbitrary and uncomprehending conflict. With analytic theory, the debate over architectural ends is an open debate, without it, a concealed paradigm. Analytic theory is, in short, the price of architectural freedom. What is no longer interesting is the idea that architectural freedom can be exercised outside the limitation that the laws of human spatial existence and the laws of space itself place upon possibility.

We can now at least see how important our original question was: if architecture is the taking hold of the configurational content of building, and making it the basis for reflective creation by freeing it from cultural stereotyping, how is it that the individual act of architectural creation is able to carry within it messages from the society in which it was created. The answer, we now see, is simple and fundamental. Architecture is a social art because the primary material of the art – the field of configurational possibility for space and form – is also the means by which buildings have intrinsic social contents. Space constitutes and form represents the presence of the social in the very form of the milieux in which we live and work. In the vernacular, the fit between forms of life and built forms is given by the common cultural programming of both. Architecture dispenses with the programming but it does not dispense with the relation that is guaranteed by the programming. The relation of form to life becomes a question to be resolved, no longer a matter of cultural habit. The relation can only be formulated on the basis of knowledge of some kind. The designer has to assume knowledge of the form-function relation, and assume that it is of sufficient generality to be used in a range of situations. Design can only proceed on the basis of assumed knowledge about the relation of spatial form to life. This is why most statements of architectural intention are statements of this kind, just as most architectural theories are attempts to formulate these relationships in a more general way. It is at this point, through the need for propositions, both specific and general, that link form to function, that architecture is tied to society and becomes the social art. In a sense, architecture is tied to society by its theoretical needs.

It is then a simple fact that the logic of the design process makes the link between architecture and society. But it does so either on the terms of architecture or on the terms of society. It depends on how far the guiding theoretical ideas are social knowledge or genuinely analytic knowledge. In the worst case, the takeover of areas of architecture by ideological formulations instead of analytic theories can

lead architecture into its opposite: a kind of degenerate quasi-vernacularism, lacking the natural cultural fitness of the vernacular or the considered strangeness of genuine architecture.

The only alternative form of knowledge is theoretical knowledge. Theoretical knowledge is by definition the attempt to make the non-discursive discursive, that is, an attempt to acquire knowledge of non-discursivity. Like all theorisation it is of course liable to error. But its orientation towards the explicitness of non-discursive knowledge means that its errors cannot be so easily perpetuated as are the errors institutionalised in solution typologies. This, in the last analysis, is why the project of architecture and the project of architectural theory are the same project. Theory is the precondition of the liberation of architecture from the social knowledge which dominates vernacular design and which continually threatens architecture with bureaucratic extinction through typological guidance. Architecture as we know it necessarily oscillates between these two poles of theoretical and social knowledge, sometimes not knowing when it is informed by one and by the other. One thing is clear. It is only through the theoretical study of architecture that we can begin to become truly aware of when we are being creatively free in the realm of the non-discursive and when we are, without being fully aware, following the hidden dictates of society.

This is why great architecture tends, if not to objectivity, then at least to a belief in its own objectivity. Lesser architects assert that they create. Great architects believe they discover. This difference is due to the intervention of that peculiar brand of reflective thought which stands on the foundation of theory, yet when applied in creative mode breaks bounds and changes the architecture of the past into the architecture of the future.

Notes

1 For example, Robin Evans, Figures, doors and passageways, Architectural Design, 4, 1978, pp. 267–78; also Rookeries and model dwellings: English housing reform and the morality of private space, *Architectural Association Quarterly*, 10, 1, 1978, pp. 25–35.
2 Mark Girouard, *Life in the English Country House: A Social and Architectural History*, Yale University Press, 1978; subsequently Penguin, 1980.
3 Tom Markus, *Buildings and Power; Freedom and Control in the Origin of Modern Building Types*, Routledge, 1993.
4 Alison Ravetz, in conversation.
5 Ed. N. Cross, *'New Developments in Design Methodology'*, Wiley, 1984.
6 B. Lawson, *How Designers Think: the Design Process Demystified*, Butterworth, 1990; originally Architectural Press, 1980.
7 C. Jones and D. G. Thornley, *Conference on Design Methods*, Pergamon, Oxford, 1963; eds. Broadbent G. and Ward A., *Design Methods in Architecture*, Lund Humphries, London, 1969; ed. G. T. Moore, *Emerging Methods in Environmental Design and Planning*, MIT Press, Cambridge, Mass., 1970; N. Cross & R. Roy,

Design Methods Manual, The Open University Press, Milton Keynes, 1975; ed. S. A. Gregory, *The Design Method*, Butterworth, London, 1966.

8 H. Simon, *The Sciences of the Artificial,* mit Press, 1971; and B. Hillier, *'The nature of the artificial'* in Geoforum, vol. 16, no 2, pp. 163–78, 1985.

9 C. Alexander, *Notes on the Synthesis of Form*, McGraw Hill, New York, 1964.

10 How the argument about 'design method' was intimately related to one of the key philosophical objectives of modernism, that is, to replace a historically and aesthetically dominated architecture with an analytically and socially based architecture, can best be seen in such texts as Sir Leslie Martin's lecture at the riba in April 1967 published as 'The architect's approach to architecture', *RIBA Journal*, May 1967.

11 R. Descartes, *Discourse on Method*, 1628; edition used: Trans: E. Haldane and G. Ross, *The Philosophical Works of Descartes*, Cambridge University Press, 1970, vol. 1, pp. 92–3.

12 Descartes p 87.

13 K. Popper, *The Logic of Scientific Discovery*, Hutchinson,1934; *Conjectures and Refutations*, Hutchinson,1968; and Objective Knowledge, Hutchinson, 1972.

14 I. Hacking, *Representing and Intervening*, Cambridge University Press,1983.

15 See Hillier et al., *'Knowledge and design'*, in eds. Ittlesen and Proshansky, *Environmental Psychology*; 1976; republished in ed N. Cross, above,1984. Originally edra Conference Proceedings, 1972.

16 B. Hillier B and A. Leaman *'How is design possible?'* in Journal of Architectural Research and Teaching, 3, 1, 1974.

17 The reader is also referred back to the discussion of this problem in Chapter 2.

18 Hacking, *Representing and Intervening*, p. 220.

19 Hillier & Leaman, *'How is design possible?'*

20 The terms 'problem' and 'solution' are used quite deliberately here. I am well aware that some theorists have doubted that designers 'solve problems' and even argue that this conception of design is likely to lead to an uncreative attitude and performance on the part of designers. The analysis of design set out in this chapter suggests that design, while a wholly creative act, is quite usefully thought of also as a problem solving act, not perhaps because it is an act of problem solving *tout court*, but because it includes one. The brief does pose a problem. A design does offer a solution. The key questions, and the ones with which this chapter is concerned are: what kind of problem? and: what kind of solution? and what kinds of knowledge are used in going from one to the other?

21 T. Kuhn *The Structure of Scientific Revolutions*, University of Chicago Press, Chicago,1962.

22 And which I discussed at greater length in B. Hillier 'Against enclosure', in eds. N. Teymur & T. Markus, *Rehumanizing Housing*, Butterworths, 1988.

23 For the most part drawn from Kirschenmann & Munschalek, *Residential Districts*, Granada Publishing, London, 1980; originally in German as Quartiere zum Wohnen, Deutsche Verlags-Anstalt, 1977.

The reasoning art

24 J. Hanson, 'The architecture of community', *Architecture & Behaviour*, Editions de la Tour, special issue on space syntax research, vol. 3, No. 3, 1987.

25 Greater London Council, *Introduction to the Housing Layout*, Architectural Press, London, 1978.

26 A pioneering study is by J. Hanson, 'Deconstructing architects' houses' *Environment & Planning B; Planning and Design*, 21, 1994, pp. 675–704.

27 Dickon Irwin, a student on the MSc in Advanced Architectural Studies at the Bartlett in 1989.

28 There is another account of this work in B. Hillier, 'Specifically architectural theory' *The Harvard Architectural Review*, no. 9, Rizzoli, New York, 1993. Also published as B. Hillier, 'Specifically architectural knowledge', *Nordic Journal of Architectural Research*, 2, 1993.

29 W. J. Mitchell, *The Logic of Architecture: Design Computation and Cognition*, MIT Press, 1990, p. 239.