BRYAN**LAWSON**

DESIGN
EXPERTISE

KEES**DORST**

DESIGN EXPERTISE

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BRYAN **LAWSON**

DESIGN EXPERTISE

KEES **DORST**

ROUTLEDGE

Architectural
Press

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1

JOURNEYS THROUGH DESIGN

"

The artist is not a special kind of man.
Every man is a special kind of artist.
ERIC GILL

"

Engineers like to solve problems. If there
are no problems handily available, they
will create their own problems.
SCOTT ADAMS

WHAT IS THIS BOOK ABOUT?

Designing is one of the most complex and sophisticated things we can do with our minds. Many of those who design for a living find it to be so addictive that when they do not have a current commission they may invent one for themselves. And yet designing remains one of the least well understood of all our cognitive powers and most difficult to teach. Part of the excitement of designing is that you never really know how good a job you can do; each project is unique and there is no comfortingly repeatable process that will guarantee success. Above all designing is creative and unpredictable. The comments on the opposite page by the British architect, Richard MacCormac summarise this duality with the feeling born of experience. This book explores the process of becoming a designer, the creation of design expertise. What knowledge, skills, attributes and experiences are necessary in order to design fluently and to good effect?

In one sense we are all designers. Many of us design parts of our homes, gardens, and workplaces. At the very least we make decisions about how to dispose and arrange items; we all make decisions about which clothes to buy and design our own appearance every day. And yet we admire, seek out and pay for the work of the world's most outstanding professional designers. There seems a huge gulf between what they do and the everyday design of ordinary people. Exactly what does it take then to become such an expert designer? What is the real nature of design expertise and how do we create and develop that expertise? Throughout the book we shall discuss these questions and offer some answers.

Implicit in much design education and criticism is the idea of the 'talented designer'. Behind this notion rests an assumption that some people have an innate ability to design and others do not and might as well give up. We shall challenge that notion throughout this book. While it may well be the case that some people design without apparent effort, we shall argue that for most of us design is, like so much other human cognitive activity, a skill. In fact we shall argue that it is a complex collection of skills.

That simple notion leads us inevitably to the consequence that these skills can be identified, learned and taught. It also suggests that there may be some ways of doing all these things that are more likely to be effective than others. Although it is possible to teach and learn sophisticated skills such as a sport or playing a musical instrument, this sadly does not mean we can all become world ranked or a virtuoso. But most of us can improve significantly if we can only find the best way for us of learning and creating expertise. So it is for design.

Fig 1.1 Fitzwilliam College Cambridge Chapel by Richard MacCormac—a fine example of his sensitive approach to university buildings

JOURNEYS THROUGH DESIGN
RICHARD MACCORMAC

" This is not a sensible way of making a living, it's completely insane. You agree to do this job with no idea really that you can come up with anything worthwhile... no idea how much it will take to do it... there has to be this big thing that you're confident you're going to find, you don't know what it is you're looking for and you hang on, it's a journey really, I mean the analogy of a journey is a very interesting one... the design process is a journey, an episodic journey towards a destination which you don't know about, which is what life is and what writing and all arts are like; a journey. "

RICHARD MACCORMAC

Richard MacCormac studied architecture at Cambridge and the Bartlett School in London. He was heavily influenced by the work of Leslie Martin and Lionel March. He admits to having an 'almost obsessive interest' in the Prairie Houses of Frank Lloyd and has developed an almost equal respect for Sir John Soane. After setting up his own small practice he soon formed a partnership with Peter Jamieson and eventually also David Prichard. They became known for a series of influential low rise housing schemes including student accommodation as well as a number of academic university buildings at both Oxford and Cambridge. Richard MacCormac has written and lectured extensively on his approach to architecture, and taught architecture at Cambridge and Edinburgh Universities. He was elected president of the Royal Institute of British Architects in 1991 and championed high quality design. His presidency was celebrated by the 'Art of the Process' exhibition at the RIBA that showed the evolution of designs by a series of well-known British architects. His more recent work includes a major centre for Cable and Wireless, an underground station on the Jubilee Line and the redevelopment of Broadcasting House for the BBC.

We hope that those who are reading this book, whether they are students, practitioners, educators or researchers, will find help and inspiration here in developing their own particular way of understanding designing.

WHAT IS IN THE BOOK?

We begin in Chapter 2 by rehearsing our contemporary understanding of the nature of design problems and the activities that, taken together, constitute the act of designing. Even the most cursory examination of design reveals that it is not a simple singular activity but involves a complex array of tasks. Design is not like some physical skills such as riding a bicycle or swimming. Designing is not a matter of doing one thing but of doing many things. Designing depends not only on some clearly defined and well understood set of knowledge but also makes use of apparently remote and wide ranging ideas. Our more detailed analysis will show that design depends upon skills, knowledge and understanding. The design student then is challenged by having to acquire all three, and the educator bears the responsibility of assisting in that process. Professional designers must keep developing the skills, knowledge and understanding that make up design expertise through their professional practice.

Some of the skills that designers rely upon can be isolated and studied in their own right and this book will not dwell extensively on those. An obvious example would be the skill of drawing. There are many excellent books to help the student learn to draw and this book will not tread on their territory. However, there may well be some issues to do with drawing that impact on the more central cognitive processes and activities of designing and that will definitely be of interest to us here. Similarly, designers obviously need substantial chunks of knowledge. They need to know about the technicalities of constructing the things they are designing. They may need to know about the relative costs of different ways of manufacturing and operating the objects or systems they are designing. They will need to be able to calculate and compare some features of the technical performance of their objects, or at least work with other professionals who specialise in such matters. Again it is not the job of this book to explore, teach or research such areas. As with skills, it may be that certain ways of knowing about such matters do indeed impact on the very business of designing, and we shall be interested in that.

In Chapter 3 we shall begin to turn our attention to the issue of expertise in general. One of the key common characteristics of generic expertise models suggests that experts do not necessarily do the same things as novices. Whether we look at the playing of chess, the solving of mathematical

EXPERIENCE
RICHARD MACCORMAC

"

I think that my role in the practice is to initiate the design processes in all the major jobs, not so much in building types like housing where I think we have established a kind of repertoire, a typological repertoire, which is to do with density... it's sort of vernacular if you like, we do quite a lot of it for housing associations and so on... vernacular in the sense that it's a language that's the common language...

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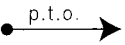
problems or the flying of aeroplanes, we find that it is not simply a case of experts working faster, more effectively or better than novices. What we find is that they operate differently. We shall explore the implications of this for design. It strongly suggests that there are several modes of designing. These modes depend upon different levels of experience and knowledge enabling designers to think in different ways. Some modes may suit some individuals better than others and some may be difficult to operate on without considerable practice and experience.

One example of this being explicitly recognised is given by Richard Mac-Cormac who tells us that his role in the design practice changes when the job involves an unfamiliar building typology. He clearly feels that he should adjust the way he relates to the design team according to the extent of their experience. Effectively MacCormac is telling us the way the design process is organised even within his own practice depends upon the level of expertise available. Designers are thus aware of the development of expertise through their practice and yet relatively little has previously been written about the nature and growth of expertise in design.

Design research is now maturing as an area of study and in recent years we have begun to understand more about this process of creating expertise. Design has been taught as a central subject in the degree courses for such disciplines as architecture, interior design, industrial design and graphics. More recently, other areas of design have become popular including urban and landscape design, theatre design, fashion and textile design, and have been joined by web and interface design. Of course there have always been those who wanted to understand and improve design but as a serious field design research is a relative newcomer. In the middle of the twentieth century there were enough people working in the field to begin to hold conferences and publish their proceedings.

Even so it would not have been possible to write this book until recently. While the output of the world's greatest designers has always been examined in the greatest detail and endlessly argued over, their processes have been relatively neglected. Around the turn of the century, a number of studies began to appear that focused specifically on outstanding designers.

In Chapter 4 we look at the start of the journey. We investigate the kinds of skills and ways of thinking and seeing that those starting out as designers need to acquire and develop. In particular, we look at the changes that take place as people are transformed from everyday designers into students of design. This is often a time of great confusion and some doubt for many design students. Not only do many of them need to develop new skills for

WRITING THIS BOOK

The first significant international conference to explore the nature of design expertise took place in Sydney in 2003 (Cross and Edmonds, 2003). This built on attempts to understand the whole idea of expertise that in turn had been driven by attempts to develop artificial expert systems and the consequent need to capture human expertise in symbolically coded digital environments. Design however remains a human activity beyond the capability of artificial intelligence and therefore poses some interesting challenges to the computational theory of mind that lies behind such work. While some have argued that it is merely a matter of time before computers will be able to design, others including the authors of this book argue that there is something essentially human about this highly creative activity.

representing design externally, such as drawing and modelling, but they also have to restructure the way they represent design in their minds. They have simultaneously to begin gathering knowledge and creating meaningful mental structures and concepts with which to evaluate and order that knowledge.

In Chapter 5 we turn our attention to the higher levels of design expertise as found in professional practice. Our model of design expertise developed in Chapter 3 will show that a graduate can normally only expect to have reached the lower levels. Design is something that has to be at least partly learned in practice. However, because of the essentially creative, experimental and unpredictable nature of design this makes learning on the job a little hit and miss. We will look at just why it takes time to acquire higher levels of design expertise and the kinds of knowledge that designers create through extended practice. We will explore the very different ways of working that are often developed by experienced designers.

In the final two chapters of the book we shall return to a more detailed investigation of design education and practice. We shall assemble together many of the questions that have been thrown up by our investigation of design expertise in order to develop a theoretical critique of current design education. One of the extraordinary features of the design education system is the consistency with which it is organised. We may look at the education of industrial designers, architects or urban designers, for example, and see remarkably similar patterns. We may travel to the continents of North and South America, Europe, Africa, Asia or Australasia and see these patterns repeated. Why is this? Has design education evolved into a well honed and highly effective system, or are there some commonly accepted practices that we have simply stopped questioning because they are so firmly embedded? We are convinced that the latter is the case, and will argue for a critical reappraisal of some of the 'sacred cows' of design education.

Finally, we shall investigate how the ideas in this book help us to understand the continuing journey that designers all make through their practice. We shall look at both individual personal development and the creation of expertise in design practices. Both here and earlier we will be informed by the words of real practicing designers who often have remarkable insights into their own practice.

Throughout the book we will continue to investigate the nature of design research. Does it cover the field well or does it have some blind spots? Have we investigated the really critical features of designing, or just those most amenable to observation and experimentation? A clue here is the rather large

Fig 1.2 Architectural design studio—University of Sheffield 1930s

Fig 1.3 Architectural design studio—University of Sheffield 2007

proportion of design research that uses students as a source of data. Could it be that we might learn new things about designing if we can study much more experienced and expert designers? Many of the issues we touch on throughout this book suggest new and interesting research questions that can only be answered by taking a more holistic approach to design expertise.

WHAT THIS BOOK IS NOT

This is not an instruction or training manual. This book cannot and will not attempt to teach a design method or process. Research in design has shown that there are many ways of designing well and successfully. Indeed, current thinking about design sees every single project as unique and special. We have come a long way since the early, rather prescriptive, ideas about design methods. We do, however, take the view that design skills can be learned, practised and improved. This book then is no more a guarantee of success than membership of a gym would guarantee to make you fit. Perhaps the ideas in this book should be seen as the equipment in the gym. If the reader takes them seriously and reflects on how they might be applied then we would expect some results.

The key here, however, is reflection. Designers all have their own unique background and collections of skills, attitudes, values and interests. Designers work on their own set of problems and circumstances. For this reason it is impossible to give some generic advice which will be uniformly helpful across all circumstances. On the other hand, it is usually accepted that being able to draw well is generally likely to help a designer to perform better. This book extends that idea and principle of identifying the things that are generally helpful for the development of design expertise. The book then provides some intellectual equipment but the reader will still have to do all the really hard work.

WHO SHOULD READ THIS BOOK?

This book is for design students and practicing designers as well as for educators and researchers.

The book is intended to help students who are trying to develop their own ways of designing. It does not offer a set of procedures which, if followed, guarantee or even promise a successful process. Rather it is a commentary on the things that more expert designers know, do and understand. One of the problems facing design students is the way that role models may be held up for them; the magazines are full of heroes. However, it may be very

Fig 1.4 'Soft Urn' by Hella Jongerius (1994)—explores the relationship between the archetypal shape of the vase, the unexpected material (soft PU) and the 'hand-made' quality of the imperfections that are carefully managed in the production process. Air bubbles in the material become decoration

IT DRIVES ME MAD
HELLA JONGERIUS

" I can change my ideas all through the day, for some reason it has to be that way. It drives me mad, but in the end I know something will emerge. I know it will. I just let this happen, I have been working like this for three years and it goes well. I think I will never be able to work in a design agency, because I am too chaotic. "

HELLA JONGERIUS

Hella Jongerius (1963) started her design career in the early 1990s with products for the iconic Dutch designers' collective Droog Design. She now has her own studio JongeriusLab in Rotterdam. Her work concentrates on the application of new materials within an archetypal shape language. Craftsmanship and imperfection arisen during the process of production create a new kind of decoration that is part of her aesthetic. She thus explores the boundary between mass production and the qualities of the craft object, between modernism and the decorative arts. Her works can be considered 'conversation pieces', in which she instigates discussions about the contrast between the struggle of making and the self-centred, easy process of consumption. She finds that designers don't do enough to question and explore the nature of the products they are making, and contribute to a world where the clutter of smooth and easily marketable products reduces our creativity. Her work is represented in the collections of the major museums around the world, and she has created objects for companies like Vitra and Ikea.

difficult for novice students to learn from such distinguished internationally famous exemplars. It is also often the case that what students see is not the process but the product of their role models. Simply copying the output of distinguished designers is also unlikely to guarantee a successful process, though such an exercise may have some value. This book is intended to show the stages of development through which we believe most designers progress. The developing student may find it helpful to review the book at various stages and to use it to help reflect on their own progress and the challenges that remain ahead.

One of the important lessons of this book is that it takes many years for most of us to become good professional designers. The graduate student has really only just begun the journey which must be continued into and throughout professional practice. Throughout this book we shall explore why it is that the process takes so long and there are special chapters devoted to how both students and professional designers develop their expertise through practice.

This book is also directed at those who teach and tutor design. A paradox of design education is that those involved are usually fascinated by the highly tangible outcome of the design process. It is good design that interests them and motivates them. We shall see later in the book that this is a perfectly understandable and, in many ways, highly desirable trait in tutors. However, simply showing students good design is not necessarily the most helpful way of enabling them to develop their own expertise. This book offers a resource for those who teach design to reflect upon the kinds of experiences, exercises and material that they might place in front of their students and at what stage.

Those who conduct design research should find many of the arguments in here of interest. This is not a complete theory but rather a map of the acquisition of design expertise as we currently see it. There are no doubt sections which are less well developed than others and we fully expect the design research community to help to develop them. However, a key argument in the book is that we need more research to disaggregate design expertise so that we can understand and develop it better.

HOW TO USE THIS BOOK

Throughout the book the central lines of argument will appear in the main text area on the left hand page. Interspersed with this on the right hand page the reader will find many provocations. These include examples of design thinking from students, and professional designers. Many of these quota-

tions come from interviews with notable designers and the first time each designer is introduced the reader will also find a brief biography to set the contents into context and usually an illustration of their work. The example here from Hella Jongerius tells us that even successful designers can find the business of designing simultaneously rewarding and yet frustrating as they continue to develop their expertise. In fact, she is really confirming what Richard MacCormac told us right back at the start of this first chapter.

Also on the right hand page will be illustrations, diagrams and other items to provoke the reader into thinking more deeply. Occasionally too, we will summarise models and taxonomies that have been developed and will be central to the argument in later chapters. Some of the key models developed in the book are identified by simple diagrams or icons and these will appear whenever the model is referred to so the reader easily refers back to the place where it was first introduced and most fully discussed. However, it is important not to read these icons too literally. We have deliberately tried to make them roughly represent what we are saying and also to be memorable and recognisable. Nevertheless, these should not be taken to be completely accurate representations. In fact, we are not confident that most of the rather complex phenomena connected with designing can ever be represented by simple diagrams.

This book does not necessarily have to be read from beginning to end. The chapters are in what seems to the authors the most logical sequence. They relate to progressively more sophisticated design approaches. It may therefore suit some readers to approach the book from where they feel they are themselves. Alternatively, readers may find that as they scan through the book, items on the right hand page catch their eye and they could read selectively from there. One way of reading the book is to flip through looking for all the icons that refer to a particular model or issue and read the sections of text about it. We see the creation of design expertise as a journey. There is no one right or wrong way of taking this journey. The reader may like to see the various ideas in this book as signposts along their own personal journey through design.

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2 UNDERSTANDING DESIGN

> Everyone designs who devises courses of action aimed at changing existing situations into preferred ones. The intellectual activity that produces material artefacts is no different fundamentally from the one that prescribes remedies for a sick patient or the one that devises a new sales plan for a company or a social welfare policy for a state.
> **HERBERT SIMON** (THE SCIENCES OF THE ARTIFICIAL)

> We can't solve problems by using the same kind of thinking we used when we created them.
> **ALBERT EINSTEIN**

INTRODUCTION

'Design' is a fundamental human activity, as well as the name of a number of quite specific professions. Since we suppose that most of our readers are practicing designers, design students or educators already involved in the field of design, we do not need to dwell on the vexed question of what would be a good definition of design. Nevertheless, we need a few words to explain what we see as the salient features of the design activity, to avoid confusion, set the stage for developing models of design and prepare to explore the creation design expertise.

DESIGN UNDEFINED

The fact that 'design' is such a confusing term, widely used and misused in common parlance, has been problematic in the development of the design professions. If we are not careful, the mere use of the word makes any discussions about design in general flawed, muddled and unproductive. We will use this chapter to put words to our understanding of what design is, and thus steer clear of this trap.

We need to establish what we mean when we say 'design'. But how can we do that? Often we tend to clarify things by defining them; that is by naming their constituent parts. But this will not do for design which is an activity and a way of thinking that is spread across many professional fields. Perhaps looking at what these fields have in common will give us an inkling of the kernel of design expertise? Yet when we look closely we see that the work of these professional fields does not necessarily exhibit one single common trait.

Their range and diversity are huge. However, these various design activities do display what Wittgenstein would call a 'family resemblance' (Wittgenstein, 1953, pp 31–32); there is a variable series of traits that some members of the family will have in common to a varying extent. Thus, within the wide range of activities one could validly call design we might see that the extremes hardly resemble each other at all, but lurking under the surface there are indeed common and characteristic traits.

To confound our problems, we have to admit that design not only encompasses a broad range of activities across many professional fields, but that these activities are also very complicated; perhaps designing is one of the most complicated things we humans do. Since we have just relied on the philosopher Wittgenstein it is worth remembering that he became very interested in architecture and expressed this complexity in a conversation in

THE FAMILY OF DESIGN

In his classic treatise, 'The Concept of Mind', Gilbert Ryle compared thinking with farming (Ryle, 1949). They are both what he called 'polymorphous concepts'. Any two farmers we meet may share almost nothing in common; one may rear sheep for wool while another may grow crops for food. And yet we have no problem seeing them both as 'farmers'. Since design is an advanced form of thinking we should not be surprised that it shares this polymorphous characteristic.

1930: 'You think philosophy is difficult enough, but I tell you it is nothing to the difficulty of being a good architect' (Wilson, 1986).

If we abandon the attempt at a direct definition of design, but we still want to distinguish some different kinds of design, we end up in trouble too. If we split design up along the lines of professional fields we might think of the fields of architecture, engineering, interior design, interaction design, software design, graphic design and product design. But if we think of these as separate categories of design practice, we miss the way the boundaries between these design disciplines are vague and tending to become more so.

For instance, in all the main design disciplines, there are branches that look very much like product design; in architecture it is the design of building systems, in mechanical engineering it is the development of small, mass-produced machines and in graphic design, the development of company logos and house styles. So, the various seemingly different strands of design just have too much in common to make a clear distinction. Often it is precisely the people who work at these crossovers in design thinking that yield the most interesting results. It is vital that any single description of design should do justice to this phenomenon. We had better leave design undefined, at least for now.

DESIGN AS...

One of the difficulties in understanding design, is its multifaceted nature. There is no one single way of looking at design that captures the 'essence' without missing some other salient aspects. Moreover, what aspects would be salient of course depends on your point of view, and your goal in trying to describe and understand design. To cater for many different points of view we will resort to describing design through a series of short paragraphs that suggest how we could see design from different viewpoints. In doing so we will be using a characteristically 'designerly' way of thinking. Conceptual design has been described as the art of seeing the design situation in multiple ways or 'seeing as'. Designers are used to performing this little dance around a problem, taking stabs at it from different sides. This may sound chaotic but if done well it allows one to build up an integrated picture in the end. So in this chapter we will be taking multiple stabs at describing design itself, and hope to end up with an integrated image of design in our minds that is strong enough to carry this understanding into the next chapters, and avoid confusion in the discussions later on.

Fig 2.1 This Dutch stamp series (1976) epitomises the 'New Sobriety' in Wim Crouwel's work. The minimalism is relieved by the friendly lower-case font and colour gradient.

WIM CROUWEL

" I have to say that for me feeling and rationality are very close together. Unexplainably close. And that can bother you. I have discovered this dualism over the years. In the beginning I did not know. At the end of 1960 I was so completely convinced, that I only had one single way of working. The real discovery of dualism happened later. As I grow older, I get a sharper eye for the things I would like to do all over again, and the things I would never redo. I become more selective about my work. "

WIM CROUWEL
Wim Crouwel (1928) was trained in Groningen and Amsterdam. In his long and distinguished career he was one of the founders of Total Design (1963), the leading Dutch design firm in the modernist era of the 1960s and 70s—with a portfolio that stretched from graphic design and jewelry design to product design. He is generally regarded as a leading exponent of the 'Nieuwe Zakelijkheid' (an heir to the De Stijl movement of the 1920s and 30s—the name translates as 'New Sobriety'). In all his design work he seriously pursues the adage 'Less is more', almost taking this to extremes. He integrates form and message, graphic elements and typography in subtle, deceptively simple designs of the utmost clarity. Any unnecessary elements were rigorously removed, giving his design an unassailable puritanical beauty. In addition to his work for Total Design, Wim Crouwel has been Dean and Professor of design at the Faculty of Industrial Design at Delft University of Technology, before becoming the director of the modern art museum Boymans van Beuningen in Rotterdam.

DESIGN AS...
A MIXTURE OF CREATIVITY AND ANALYSIS

It seems sensible to begin our picture gallery by describing design from the inside, as a way of thinking. In fact this is where it gets complicated straight away; design is not one way of thinking, but several. In particular it is a mix of rational, analytical thinking and creativity. This inherent schizophrenia is a defining characteristic of design, and it directly leads to the peculiar way of working that is a common trait of practice throughout the design professions. Wim Crouwel is surely alluding to this precious characteristic of designing.

This combination of thinking modes can best be illustrated in an experiment by Bryan Lawson (1979). To investigate how designers and non-designers would tackle a design-like problem, he set a series of puzzles to two groups of advanced students. One group studied science, and the others were designers (architects). And what happened? The scientists started by analysing the structure of the problem, and once they understood it, they set about solving it.

The designers, on the other hand, began by laying out high-scoring solutions and to see if they were allowed; a completely different approach. If they were not successful they modified the solutions until they found one that was permitted. Apparently, the designers were used to problems that did not lend themselves to exhaustive analysis. They were accustomed to dealing with the chaotic problems of their profession by creating high-scoring solutions, analysing those and evaluating them. Their creativity and analytical skills were focused on the solution, not on the problem. This strategy can be recognised in all design professions. In many design situations, the generation of possible solutions and their gradual improvement is the only way forward.

In the case of this experiment, the bad news is that of course there was a structure to the problem, and the way the science students went about it was far more effective and efficient if you wanted to understand that structure. Maybe one could say that designers are defined by the way they treat a problem as if it has no structure; as if it is a design problem. This does unearth a real dilemma often keenly felt in design practice; confronted with a design problem one might tackle it in either a problem-focused (analytical) or a solution-focused (creative) way. This can be a hard choice for a designer; being too analytical can lead to an unnecessary limitation of the solution space, while being too creative and generative can launch a journey into nothingness. Experienced designers often introduce constraints of their own (their own personal 'style', or their 'way of doing things') to avoid the

BRYAN LAWSON'S BLOCKS EXPERIMENT

Subjects were given a set of blocks coloured red and blue on the vertical faces and white and black on the horizontal ones. They were asked to arrange some of the blocks on a grid to create a surrounding wall that was either as blue or red as possible. But there were some hidden rules about which combinations of blocks would be allowed. The only information available was from a computer that would say whether a submitted design conformed to the rules or not.
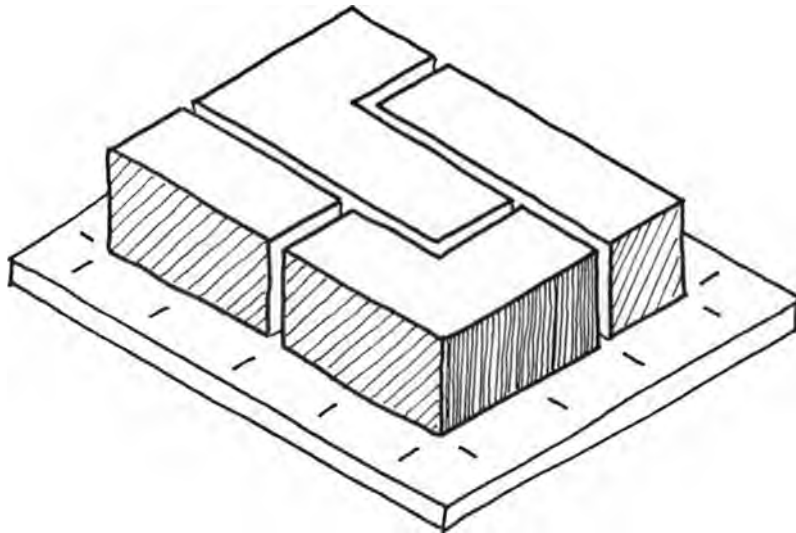

FIG 2.2 Bryan Lawson's blocks experiment

latter. Being lost in a sea of solutions is very unproductive—it is almost as bad as being stuck in a corner.

In design, we are rarely either completely free or completely bound by the problem. Designers have creatively to develop a design, but this creativity is not unrestricted. Achieving a good design is the challenge, one that solves the problems and creates value for the client and prospective user. Combining the two fundamentally different thinking styles of problem solving and creativity means that design is somewhat at odds with the normal ways in which we classify and understand the world. Traditional universities often do not have faculty structures that easily and logically accommodate design. National research funding councils are often either science or arts based. Design is an oddity. We might say it is the 'platypus' of the cognitive world. But like the platypus it is here and we had better learn to deal with it (Pirsig, 1991).

This blend of different thinking styles makes it difficult for many people to understand design. But to designers, these thinking styles are so intimately connected in a design project that they seem almost merged into one way of thinking. When steeped deeply in your design activity you just keep switching between analysis and creativity, between 'problem' and 'solution' without any effort. In practice it is often devilishly hard to distinguish between them.

This is where we should be careful not to descend into such a theoretical description and modelling of design that we lose all contact with the daily reality of life for designers. If designers do not feel a rift between these ways of thinking, then it does not help them much when the theoreticians tell them there is. The real issue resides with those of us who study design, based on the normal paradigms of science; the frameworks we normally use to describe and analyse human activities and cognitive processes ('creativity', 'problem solving', 'decision making', etc.) do not fit cleanly or easily with design.

DESIGN AS...
PROBLEM SOLVING

A recurring and dominant model of design used in design education relies on seeing design as a problem solving process. How does this work? In classical problem solving you pose the problem, search for a good solution by generating (perhaps all) possible next moves, explore the consequences, evaluate them and then choose. This process of pose-search-generate-evaluate-choose can clearly be recognised in design practice. If we observe designers working we can sometimes see them doing something remarkably similar to this. So

BREAKING OUT OF THE CONVENTIONAL STRUCTURES OF KNOWLEDGE

The Duckbilled Platypus created a real stir in the biological world when it was first discovered. It can only be found in a very small part of the world mainly along the east coast of Australia. A specimen was sent by Captain John Hunter, the second Governor of New South Wales, back to the British Museum in 1799. George Shaw, the keeper of the natural history section was suspicious. Quite simply this creature ought not to exist at all, he thought, since it did not fit into any of the existing structures of knowledge. It looked very odd with its duck-like beak, mole-like furry body and flat beaver-like tail. Its behaviour was even odder. Like a mammal it has a furry body and suckles its young, like a bird, it lays eggs, and it has almost reptilian venomous spurs on its legs.

Shaw wrote that it was 'impossible not to entertain some doubts as to the genuine nature of the animal, and to surmise that there might have been practiced some arts of deception in its structure'. Suspicions were heightened since the specimen had crossed the Indian Ocean and Chinese sailors were known for their ability in taxidermy.

The platypus was finally accepted not as a hoax but as a challenge to science when more specimens arrived. Yet the platypus was only an anomaly because the biologists made it so. It is only strange because it does not fit neatly into their preconceived view of what a mammal should be. Luckily, the duckbilled platypuses themselves do not seem to be particularly bothered by this. From their perspective, there is nothing wrong. They delight us by going about their business, happily paddling from pool to pool, in tune with their ecological niche.

Today the platypus is classified as one of only three species known as Monotremes.

Fig 2.3 A duckbilled platypus

seeing design as problem solving does capture some aspects of design. It may not be describing all of design, all the time, but capturing half of design in a model already represents some progress.

The idea that design is problem solving has led to the development of phase models of the design process, in which you first define the problem, analyse it to formulate requirements and then generate solutions. You choose between these solutions with the help of your requirements, and then implement the chosen solution. This model of design has worked tolerably well in many design professions, although it has also been criticised. Like any model, it highlights some aspects of design while neglecting others. Yet, it seems that as long as the design goals are explicit, clear and stable, and a set of comparable solutions can be generated, design can be treated very much like problem solving. This seems to occur more often in the technically-oriented design professions, like engineering, and also more in the latter parts of a design project, when many of the conceptual decisions have been taken. The sturdy problem solving model and its many accompanying methods then help to structure design work, allowing designers to tackle very complicated design problems. It also enables non-designers to understand design, albeit in a limited way, by relating to a common activity (problem solving is, after all, an incessant universal human activity).

But there is danger in thinking that we have captured all design activity in this model. There is no way in which all of design can be reduced to a problem solving activity. There are many factors in design situations that take us away from the rational high ground of 'normal' problem solving, into a much more marshy and murky area of design practice.

DESIGN AS...
LEARNING

When people first started modelling design, they tended to use the problem solving model of design as a clear and concise starting point for organising their thoughts and observations. Thus many of the early books about design tried to understand design in this manner. But the designers on the ground soon revolted against these abstractions, saying that while the problem solving models of design are particularly helpful for controlling and managing design projects, they remain remarkably silent when we want to know more about design than just how to control and structure it. This relative 'distance' from everyday experience has been a criticism voiced by practitioners of the problem solving view of design. Nigel Cross quotes Christopher Alexander, one of the early architectural design theo-