The idea of economics too, is oversimple. Even such obvious issues as the cost of maintenance and depreciation have only recently been made the subject of architectural consideration.[133] As for the cost of social overheads--the milkman's rounds; the laundries and TB sanatoria which have to cope with the effects of smoke from open fireplaces--even the economists are only just beginning to consider these.[134] Yet the cost of the form is found in all these things. The true cost of a form is much more complicated than the word 'economy' at first suggests.

'Function' too, as it is usually understood, expresses none of the subtlety it should. The so-called functional efficiency of form does not stand alone, but depends entirely on the context within which the form is found. (The lack of a bath is a functional failure in the United States, but not yet in peasant Mexico). Yet the variety of minor variations caused by shifts in context are missed in the crudity of the concept 'function'.

In this fashion the selfconscious individual's understanding is constantly mis[illegible] The idea that in order to

1500-1700", Penguin 1954, pp. 234, 237. John Summerson, "Architecture in Britain, 1530-1830", Penguin 1954, pp. 258-60.

[133] J. C. Weston, "Economics of building", RIBA Journal, April 1955, pp. 256-7; May 1956, pp. 268-78; June 1956, pp. 316-29.

[134] Ben Higgins, "Economic development", New York 19[illegible], pp. 254-6, 660-1.

Early and Unpublished Writings of

CHRISTOPHER ALEXANDER

Thinking, Building, Writing

Edited by

HOWARD DAVIS

ROUTLEDGE

Early and Unpublished Writings of Christopher Alexander

This book brings together key works of the noted architect and architectural theorist Christopher Alexander (1936–2022), many of which have not been published before. The book contains twenty-five essays and other works, many chosen from the newly organized Christopher Alexander archive, providing a view of the ideas and thought process of one of the most innovative architectural thinkers of the twentieth century. The items span Alexander's fifty-year career, beginning with an early version of his PhD dissertation based on fieldwork in India, continuing to fifteen years in the development of *A Pattern Language*, one of the best-selling books in the history of architecture, and proceeding to the writing of *The Nature of Order*, Alexander's four-volume masterwork, and beyond. The writings combine theory and descriptions of practice, and together support a blueprint for the development of a new, humane way of building, while also providing a window into the mind of an extraordinary thinker, teacher and professional.

Howard Davis is Professor of Architecture at the University of Oregon. He is the author of three books: *The Culture of Building*, *Living Over the Store: Architecture and Local Urban Life* and *Working Cities: Architecture, Place and Production*. Davis worked with Christopher Alexander for seven years, was the co-author with Alexander and others of *The Production of Houses*, and is presently an advisor in the development of a comprehensive archive of Alexander's work.


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Early and Unpublished Writings of Christopher Alexander

Thinking, Building, Writing

Edited by
Howard Davis

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Preface

In 1983, while teaching in Edinburgh, I was invited to speak at the annual meeting of the Royal Incorporation of Architects of Scotland, the Scottish equivalent of the RIBA or the AIA. The meeting, held in Inverness, attracted about two hundred people. One of the other speakers was a London-based architect, who spoke about his work and what he saw as the philosophy behind it. During the question-and-answer session afterward, an architect stood up and asked: "Sir, I very much appreciate what you had to say. And, I very much appreciate what you had to show." And he continued, in a firmer voice, "But could you please, sir, tell us the connection between what you had to say and what you had to show?" Whereupon he sat down.

HD

In a conversation between Christopher Alexander and Rem Koolhaas in about 2006:
CA: "Look, my real aim is, I want the earth to be beautiful again."
RK: "That's a very beautiful statement."[1]

I wanted to be able to do the real thing – and for that I had to know what the real thing is. The reason was not intellectual curiosity – but only the practical reason that I wanted to be able to do it myself.[2]

Christopher Alexander

This book contains a selection of early and unpublished writings of Christopher Alexander, for whom "saying" and "showing," thinking and doing, were not separate activities, but intimately related parts of a singular quest. One of the most influential – and controversial – architectural thinkers and practitioners of the last half century, Christopher Alexander has been responsible for buildings and writings that have been transformative in their impact on the way architects, builders, planners, clients and many other people think about and act toward changing and re-creating the built environment. He combined designing, building, teaching and writing – activities that he saw as being aspects of



Christopher Alexander, 1993.

1 The conversation took place in 2006. A transcription is in Chapter 17 of this book.
2 Christopher Alexander, *The Nature of Order, Book One: The Phenomenon of Life*. Berkeley: Center for Environmental Structure, 2001, p. 2.

the same effort to change the way we think about buildings and cities, to make them places where people can flourish and which heal the earth in profound ways. Toward these ends, he has been responsible for dozens of building projects; over twenty books; upward of 100 articles; myriad lectures, interviews, broadcasts, unbuilt designs, paintings, full-scale prototypes of construction details, and thousands of as-yet-unavailable works that are becoming available through the development of a public archive of his work.[3]

Christopher Alexander and I first developed the idea for this book in 2013. We were in the kitchen of Meadow Lodge, the house of Chris and his wife and collaborator Maggie, in the village of Binsted, south of London in West Sussex, a few miles from Chichester, where Chris grew up. The house, expanded and renovated with a Georgian, brick façade in the eighteenth century, had been built as a half-timbered farmhouse two or three centuries before that, and was surrounded by gardens and meadows. I spent a few days there every year, relishing the peaceful countryside and stimulating visit that I looked forward to at the end of my hour-and-a-half train journey from Victoria.

Our discussions led to the idea of a collection of articles that were instrumental to the development of his work, but which were no longer generally available. The idea was recorded as a very preliminary table of contents but then put aside until we both had more time to work on it. But after several years, three or four years ago, a new context began to take shape – the organization of an archive of Chris's work. This caused the project to be revived, but in a different form from that with which it was originally conceived.

The material for the archive consists of tens of thousands of items from Chris Alexander's long career, beginning roughly in 1958 when he left England for Harvard. These items include manuscripts, transcripts of lectures, letters, book drafts, records of seminars, drawings, rough sketches, design and building contracts, project correspondence, academic correspondence, legal documents, photographs, copies of newspaper and magazine articles about Chris and his work, negatives, slides, paintings, audio tapes, full-size building details, and computer hard drives. Chris seemed to have thrown away little that was associated with his work and that of his office, the Center for Environmental Structure (CES).

When I first saw the material, before the work to organize the archive began, I was stunned and fascinated by its extent and by the richness of its content. Although I worked with Chris for several years in the place where much of the material was also stored, I had never looked at it – it was contained in boxes and filing cabinets

3 The influence of someone like Christopher Alexander cannot be measured like that of a scientist, for whom one standard measure of influence is citation counts in journals. Nevertheless, such counts exist; see for example Christine E. Wania, "Investigating an Author's Influence Using Citation Analyses: Christopher Alexander (1964–2014)," *ASIST* 2015, November 6–10, 2015, https://asistdl.onlinelibrary.wiley.com/doi/pdf/10.1002/pra2.2015.145052010029. Accessed October 21, 2021. (Thanks to David Week for pointing out this article to me.) Alexander's influence is different from that of people who only write and publish (*even so, A Pattern Language* is one of the best-selling architecture books of all time, and was bought by clients perhaps more than architects); in the way he supported various alternatives when architectural modernism was being criticized; in the way his ideas influenced students; in the way architects were influenced, sometimes not explicitly so, by his writings and ideas.

that I never had reason to examine. When I did see the material for the first time, the potential for the archive's usefulness seemed vast.

So began a project to organize and digitize the archive. An office was rented; archival experts consulted; an Athens-based information technology firm engaged to develop the workings of the digital filing systems and user interface; and people familiar with the material employed to identify and classify all of it, so that it could be made available through computer searches using multiple criteria.

This book represents a small window into the archive (plus a few early published articles) and difficult decisions had to be made in developing the table of contents. There are many ways with which this book could be organized: as a simple chronological sampling, as a chronological sampling emphasizing the principal themes of particular decades, as a work that would demonstrate the wide-ranging nature of Chris's thought, as a work that would demonstrate how he worked, as a work that would focus on drafts of the published work, as a work that would entice readers and researchers to delve more into the archive itself.

In the end, it is all these things. At one point I was advised by a colleague not to see the book as a way for me to offer a personal interpretation of CA's work, but to keep it as "neutral" as possible and to organize it by sampling a few items from each decade, for example. But any choice at all involves a value judgment of some kind, and a very limited choice (the book contract called for 150,000 words) from a large and highly varied collection cannot possibly be neutral. The user of the archive will have access to everything.[4] But the contents of this book are to large extent a personal choice, arranged in roughly chronological order, in which I have on one hand tried to satisfy the need for a kind of "overview" of the work but in which, on the other, I have chosen items that I see as representative of my own interpretations of Chris's ideas, ways of thinking and ways of working. At the same time, I have relied on suggestions from my friends and colleagues Artemis Anninou and Hajo Neis, both of whom also worked for CA for many years – but even those suggestions have helped me give focus to my own interpretations.

Directness

Chris's writings and lectures were direct and plainspoken. Chris always used simple language, even when it was being used to describe what was otherwise a complex idea. He once said that he preferred English words with Germanic rather than Latin roots. This comes through both in the text and in the corrections to the text. This directness also showed itself in other ways also, most notably with how – and why – he created visual means of communication: sketches, diagrams, rough models, full-scale construction mockups. Any of these items, although they looked incomplete and "sketchy," often were intended to illustrate *a very precise feeling* that needed to be taken seriously and preserved as the design moved forward. The accuracy of the subsequent

4 But even the archive is being organized in two ways. The first is indeed as "neutral" as many archives are, with searches available according to subject, date, kind of item, person, project, etc. The other is based on an interpretation of the major themes of CA's work, and puts different kinds of items, different dates, etc., together under similar themes as defined by the archives' organizers. Both systems of classification are accessing the same material.

more-detailed drawing or built detail was measured partly by its success in reproducing that feeling. This sketch may have been of a plan, façade, detail, or other physical aspect of a building – but always represented a strong essence that needed to be maintained and reinforced. The archive contains many such sketches.

Differently from work that is polished and published, many of the archive items show how CA worked minute by minute – evident in many rough drafts and pages with corrections pencilled in. The diagrams that appear in many early drafts of patterns (and even in final versions in *A Pattern Language*[5]) are direct and expressive; the language is as well. A few of those pages are reproduced in the book. With their handwritten additions, they show the directness and desire for clarity that helped drive Chris's work.

Future orientation

Although CA frequently used pictures of historic buildings and places to illustrate his points, those pictures were always carefully chosen to illustrate ideas that were much harder to find evidence of in the modern built environment. He was always looking toward the future when he used examples from the past: contrary to what some critics have asserted, he was not fundamentally a romantic wishing to turn back the clock. He respected technology and modern science, as well as a society built on equality and justice. And by maintaining a skepticism or distrust of things that would take away the basic humanity that he respected in every human being, he had a view of architecture in which one purpose of building is to remove the physical constraints that hinder people from being themselves. This is a radical agenda because, as his work showed, achieving this would in fact require major transformations not only of the content of architecture and the built environment but even more significant transformations in the ways the processes of architecture and building are carried out.

The prescience of early work

The bibliography in *Notes on the Synthesis of Form*, based on CA's Harvard PhD dissertation, included material from many different fields: art and architectural history and theory, building research, psychology, sociology, biology, anthropology, material culture, folklore, philosophy, mathematics, linguistics.[6] CA is an intellectual synthesizer, understanding well that architecture and building, while unique as disciplines, are also manifestations of something much larger, and that understanding the built environment ultimately requires that its links to all of knowledge need to be understood as well.

One fascinating thing about the archive is how early rough drafts and tentative ideas came, relative to the time they were ultimately published. In several places many years after the fact, Chris refers to an experiment he conducted while a PhD student at Harvard, published as "Subsymmetries," as evidence of people's ability to see wholeness –

5 Christopher Alexander, Sara Ishikawa, Murray Silverstein, Max Jacobson, Ingrid Fiksdahl-King and Shlomo Angel, *A Pattern Language: Towns, Buildings, Construction*. New York: Oxford University Press, 1977.

6 Christopher Alexander, *Notes on the Synthesis of Form*. Cambridge: Harvard University Press, 1964.

a concept central to *The Nature of Orde*r, published forty years later. That work appears in Book One of *The Nature of Order* (NoO), *The Phenomenon of Life*,[7] in the chapter on "local symmetries," where CA writes a detailed explanation of the experiment;[8] that excerpt is reprinted in this book. It also appears in a note in Book Four of NoO, *The Luminous Ground*:

> One early experiment which describes the difficulty of seeing wholeness accurately is described in appendix 3 of Book 1. The experiment describes, too, the extraordinary difficulty of teaching a person to see wholeness. It is a process which essentially requires that person to give up all categories, give up focused forms of perception, and give way instead to a wide-open, all embracing form of perception in which he/she "drinks in" the wholeness.[9] This training, which I discovered in a series of laboratory experiments at Harvard, is very similar indeed, to the many religious techniques used by Zen, by Sufism, and by other mystical branches of religion.[10]

So this one psychological experiment, done in the early 1960s, appears in at least three places in *The Nature of Order*.

In 1977, Chris wrote a short, unpublished paper called "Centering," printed in this book. It is a brief but cogent summary of what later appeared in volume 2 of *The Nature of Order*. In 1977, *A Pattern Language* was only being published for the first time, but this short document was apparently already being developed the year before, in 1976, when CA taught a seminar about this new formulation – during alternate weeks in Berkeley, while he was also directing the housing project in Mexicali.[11]

There was a lot of overlap – not "multitasking" but working simultaneously in realms of his work that had otherwise seemed more distinct from each other in time. In 1978, I co-taught a course on the pattern language with CA – and in that course, even before the publication of *The Timeless Way of Building*, Chris gave one of the first lectures on the new formulation of centers, focused on form and bringing the focus away from the emphasis on function in the pattern language.

The idea that CA went through several distinct phases of thought may be true in one way: he certainly changed his emphasis from reliance on computation to respect for personal judgment; from emphasis on function to emphasis on form; from less to more

7 Christopher Alexander, *The Nature of Order, Book One, The Phenomenon of Life*. Berkeley: Center for Environmental Structure, 2001, pp. 186–194.

8 Christopher Alexander and Susan Carey, "Subsymmetries", *Perception and Psychophysics*, Vol. 4 (2), February 1968, pp. 73–77.

9 The experiment was also published in Christopher Alexander and Bill Huggins, "On Changing the Way People See", *Perceptual and Motor Skills,* Vol. 19, 1964, pp. 235–253.

10 Christopher Alexander, *The Nature of Order, Book Four, The Luminous Ground*. Berkeley: Center for Environmental Structure, 2004, 48, note 8.

11 When we were working in Mexicali on the project that was later published in *The Production of Houses*, I regularly picked Chris up at the Imperial County Airport near El Centro, where he had flown down from Berkeley. He often got off the plane carrying a large loose-leaf binder, containing the typewritten-with-pencil-corrections manuscript of *The Timeless Way of Building,* that he had spent the flight editing. So he had several things, representative of what are now seen as different phases of the work, going on at the same time: *The Timeless Way of Building*, the housing/building experiment in Mexico, and the seeds of *The Nature of Order*.

emphasis on drawings and models; through different modes of the architect-builder relationship. But these transformations did not represent a fundamental rejection of what had come before, and in fact some things very deep in him never changed. The idea of wholeness as a goal; the idea that people have in them the ability to recognize beauty; the idea that at a certain level beauty itself is an objective matter; the idea that people's everyday needs deserve respect – all of these things were taken seriously over CA's several-decades-long career and form an ever-present but sometimes unspoken basis for experiments, projects and writings.

Within an understanding that CA had a clear set of goals from the very beginning of his career, there were nonetheless major themes that guided his work, and that form a rough overall chronology of this book. Part 1, "The large and small details of everyday life," includes work done during his doctoral thesis years and a decade and a half afterward, when very specific studies on the relationship between people and the built environment, informed by various projects, supported the development of pattern languages. The second part, "From the center to the universe," is concerned largely with work that ultimately led to the theoretical frameworks explained in *The Nature of Order*, and what CA saw as major implications for contemporary thought, and for science itself. And the final part, "Theory into Building," is focused on implementation of the new theories in the actual work of making the built environment. It ends with excerpts from an unpublished chapter for the book about the Eishin School project in Japan – a chapter that recognizes, after decades in which CA criticized contemporary building production, that there may be a valid role for it in large-scale projects.

These three parts deeply interlock with each other. Building happened early (CA's first building was built during his village research in India); the use of patterns was still essential in projects that also depend on the formation of centers (the Eishin School is probably the prime example, but this was also the case in settlement plans like that of Guasare in Venezuela); as mentioned the idea of wholeness was connected to the psychological experiments that CA carried out during his PhD years at Harvard. Instead of a change of course, each of these phases might be better understood as a further enrichment of the theoretical and practical frameworks that consumed CA for his entire career.

The importance of perceptions

CA insisted on taking his own observations and perceptions seriously and listening carefully to the "little voice" inside, as he put it, that is the voice of doubt, or all not being resolved, of not yet being sure but needing to be sure before proceeding. In the conversation with Rem Koolhaas, CA talks about the importance of careful observation and taking observations seriously. This is the empirical side of Chris, connected with his scientific training and perhaps with his connection to Trinity College Cambridge, where Isaac Newton had also studied three hundred years before. In a conversation with me about his teaching in the Department of Architecture at Berkeley, Chris said of his early work:

> I felt that I was like a person wearing very slippery boots on a skating rink. What could I say (about the problem, for example, of designing 100 houses) that was unquestionably true? I didn't want to say anything that was fantasy; I wasn't certain about big things, only little things. Starting in 1963, my focus was always a

> very, very detailed analysis of what was happening in a building, to make that building well. I was influenced by the anthropologist, Malinowski, and also by Virginia Woolf, with her minute attention to smaller things and how they built up to form reality.[12]

And in a conversation reported in the same chapter, CA tells a personal story about the difficulty that such an attitude might cause:

> Chris once told about his scholarship entry examination to Cambridge, when he was put in front of an experimental apparatus and asked to measure the earth's magnetic field at that place. He knew what number to expect, but could not get the experiment to work, to produce that number. So he was faced with a dilemma on which hung his scholarship: to present the 'right' answer or what seemed to be a faulty experiment. He chose the latter – and it turned out that the examiners knew that a large electromagnet in the basement of the building was causing the apparatus to be thrown 'off.' He was awarded the top scholarship.[13]

The importance of the ordinary

The idea of looking, of keeping ones' eyes open and being serious about the ordinary things one sees, was also a strong feature of the work of Jane Jacobs, who of course also saw the city in ways that were direct and experiential.[14] Chris was seeing buildings and the built environment of cities and towns in ways that were big and small, theoretically powerful and most ordinary,[15] in ways that were at once of "high art" and the ordinary acts of daily life. These dualities pervade the work.

This duality plays out in another way: in terms of language. In the late 1970s, Chris showed me a letter he had drafted in answer to a question concerning his use of language.[16] Why did the language seem to go back and forth between poetic expression and rational scientific explanation? His answer was that since the time of Descartes, the growing split between science and art, between mind and body, was accompanied by a split in the way that language was itself used – and Chris was using both, going back and forth, to try to weave them together in the reader's mind.

12 Howard Davis, "Christopher Alexander at Berkeley", in Waverly Lowell, Elizabeth Byrne and Betsy Frederick-Rothwell, eds., *Design on the Edge: A Century of Teaching Architecture at the University of California, Berkeley, 1903–2003*. Berkeley: College of Environmental Design, University of California, Berkeley, 2009, p. 179.

13 Howard Davis, *Design on the Edge*, p. 183.

14 Jane Jacobs, *The Death and Life of Great American Cities*. New York: Vintage, 1961. I met Jane Jacobs in Portland in 2004, two years before she died, and at that brief meeting she told me how much she appreciated Chris's work. At the beginning of *Death and Life*, she explained its lack of pictures: "The scenes that illustrate this book are all about us. For illustrations, please look closely at real cities. While you are looking, you might as well also listen, linger and think about what you see." This desire for active involvement of the "user" was shared also by Chris.

15 To explain the centering process in design, Chris often used the analogy of decorating a birthday cake.

16 The letter was to Stephen Grabow, who was then writing a biography of CA. Stephen Grabow, *Christopher Alexander: The Search for a New Paradigm in Architecture*. London: Routledge & Kegan Paul, 1983.

But this was not necessarily the case at the beginning of his career. Hajo Neis pointed this up very strongly: "Just a few days ago I read again 'On changing the way people see,' just to see my current reaction. And I must say that I would have liked to be part of the experiment to understand better what actually is happening. The description is very dry . . . more what one would think what factual science is [like]."[17] Indeed, during the early 1960s, when CA worked with computer scientists and experimental psychologists at Harvard and M.I.T., he was still a modernist from a methodological point of view. But this was the case even as, at the same time, he was beginning to clearly articulate the deficiencies in the built world that modern methods were producing. In his own way, CA was affirming Thomas Kuhn's analysis of how current systems of scientific thinking try to incorporate anomalies into their orbits until the anomalies become so pervasive that the systems themselves break down.[18]

The archive has evidence of all this – of the emergent ideas, of the ways of working, of the use of language. But multiple interpretations, ambiguities and contradictions are likely to remain. These are more complex than the simple dichotomy that is sometimes understood about CA – that he was always trying to reconcile two potentially conflicting aspects of his own history: on one hand his upbringing as a Catholic and his attraction to mystical branches of religion, and on the other his English-empiricist education in mathematics and science, beginning with the Oundle School in Northamptonshire and continuing at Trinity. There is something to this, but there is also something even more present, and that is CA's deep-seated skepticism about established theories, ways of working, techniques, commonly-accepted ways of seeing the world. Everything he saw and did was based on his own "figuring it out" from scratch. The difficulty in exercising this skepticism as a matter of everyday practice, was behind his unending work and uncompromising work ethic.

And in the end he did not reconcile the contradictions, the different ways of seeing and understanding the world, to his own complete satisfaction. The Epilogue in Book Four of *The Nature of Order* is titled "Empirical Certainty and Enduring Doubt," and ends, remarkably, with the four short sentences, "It is something like this that I hang onto. I want to believe it. I cannot believe it. But I believe it must be true."

What I do know is that CA was serious when he told Rem Koolhaas his intention of "wanting to make the world beautiful again," and it is my hope that this book, as an introduction to the extensive scope and variety of his work, will help spur people to understand more completely and deeply what he meant by that statement.

•••

Thanks to several people who are central in the development of the archive: Maggie Moore Alexander, Chris Alexander's wife and the president of the Center for Environmental Structure; Lily Alexander, Chris's daughter; Hajo Neis, who is managing the archive operations in Berkeley; and Artemis Anninou who, as the overall project manager for the archive, knows more about its contents than anyone, and who was able to suggest several items for this book that I would otherwise not have known to include. The initial idea for the archive came from Maggie and Lily, and was further

17 Hajo Neis, email, September 8, 2021.

18 Thomas Kuhn, *The Structure of Scientific Revolutions*. Chicago: University of Chicago Press, 1962.

developed through conversations that Artemis, Hajo and I enjoyed, with wine and feta and olives, on the Greek island of Tinos.

Thanks also to Fran Ford and Trudy Varcianna at Routledge (once again), to the external reviewers of the book proposal, and to Jack Wakeley for helping with the final production of the illustration files.

But my greatest thanks goes of course to Christopher Alexander, whose friendship and mentorship for almost fifty years opened my own eyes to the possibility of an emerging world of simple humanity and profound beauty.

HD
Eugene, Oregon
August-September 2021

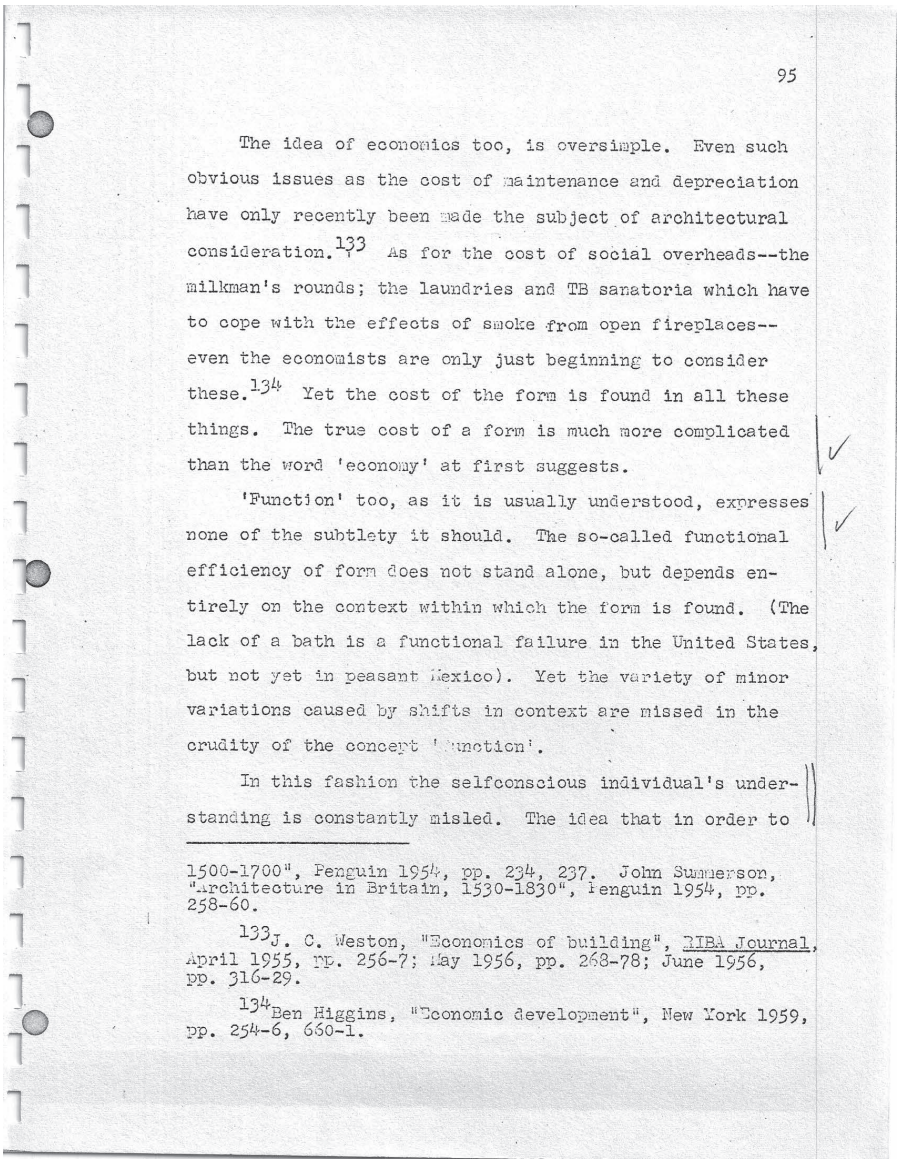
A note on editing and permissions: The texts of a few items have been shortened from their originals in ways that maintain the principal ideas. Material not included for this reason or because of defects in original manuscripts or audio tapes is indicated by (. . .). Footnotes in the originals have remained as footnotes and endnotes as endnotes. Illustrations have been reduced in number, and when possible (but unfortunately not always) those not included are indicated in footnotes with original captions. This has sometimes resulted in changes to the numeration of footnotes. All items except for the early patterns illustrated in Chapter 7 have been given a consistent typographic format. Illustrations are printed with permission of the Center for Environmental Structure unless otherwise indicated.

Postscript: Christopher Alexander died on March 17, 2022, at his home in Binsted, West Sussex, just as this book was going into production.


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PART ONE

The large and small details of everyday life



95

The idea of economics too, is oversimple. Even such obvious issues as the cost of maintenance and depreciation have only recently been made the subject of architectural consideration.[133] As for the cost of social overheads--the milkman's rounds; the laundries and TB sanatoria which have to cope with the effects of smoke from open fireplaces--even the economists are only just beginning to consider these.[134] Yet the cost of the form is found in all these things. The true cost of a form is much more complicated than the word 'economy' at first suggests.

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In this fashion the selfconscious individual's understanding is constantly misled. The idea that in order to

1500-1700", Penguin 1954, pp. 234, 237. John Summerson, "Architecture in Britain, 1530-1830", Penguin 1954, pp. 258-60.

[133] J. C. Weston, "Economics of building", RIBA Journal, April 1955, pp. 256-7; May 1956, pp. 268-78; June 1956, pp. 316-29.

[134] Ben Higgins, "Economic development", New York 1959, pp. 254-6, 660-1.

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1 Perception and modular coordination, 1959

This was the first article published by CA, when he was twenty-three years old. It deals with geometric and arithmetic ordering systems such as the golden section, and tries to dissociate them from myth and "mysticism," making the argument that other ordering systems may also produce the perception of order. Even this early work represents CA's critical position with respect to commonly accepted ideas, and his insistence on taking empirical evidence seriously: "In this discussion we shall only use 'order' where we can give the word operational definition, where we can point to the order, where we can say 'This is what makes it ordered'." It also begins to introduce the question of order itself, preceding even the formulations that led to the pattern language in discussing an issue that would form the center of his work decades later.

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'La, tout n'est qu'ordre et beauté, Luxe, calme et volupté'

Perception and modular coordination

THE USE of geometrical or arithmetical systems to provide internal order in buildings was favoured by the Greeks, by the Renaissance Italians, and even, if we are to believe Mr. Lesser, by the Gothic masters. The conviction that an order of this kind plays a major part in producing the experience we call beauty, is a deep-rooted one.[1] The conviction has, however, never been dissociated entirely from mysticism and tends either to be rejected altogether by 'reasonable' people for its air of black magic, or to be countenanced for quite the wrong reasons by the mystically inclined.

It will turn out, I hope, that it is possible to accept the conviction with some confidence, but for good reasons instead of bad. Our inquiry will of necessity be humble – since work is almost never done in this field, and there are no secure foundations. But the problem can be discussed, if we think clearly and get rid of the confusion that besets it.

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We shall deal with it as follows:

1 We shall consider this generally accepted view, that order is visually desirable; discuss the view in the light of recent theories of perception, and indicate how the view might, in fact, be justified.
2 We shall examine the cult of the golden section; and show that the claims made for it are in large part exaggerated – that the order this system *does* provide can be provided just as well by countless other systems which are only less well known because no attempt has been made to mysticise them, to make religions of them.
3 We shall see that the golden section and other current module-centred systems are particular cases of a *general* system – which may indeed be connected with the facts of perception as we understand them. We shall develop this general system, and make it workable.
4 Finally we shall see that this general system is, as it happens, closely connected with modular coordination – that technology, in fact, is developing a system that is intimately related to ours. We shall discuss ways in which these two systems, one the result of technological discipline, the other of a theory of visual order based on perception, can be used conjunctively.

Visual order is taken to be some quality in the patterns that make up a building. (We see patterns wherever the components of which the building is made are visually distinct.)

First, then, we are interested in the part played by such visual order in the experience of someone who finds a building beautiful. Whatever we find, it is never going to be responsible for a great deal of the experience – structure, materials, space enclosed, are all much more important. But it does play its part. And it is this part that we are interested in.

Before we can go any further we must be entirely clear about our use of the word 'order'.

When one of Mondrian's paintings, for example, is said to possess a high degree of order it is not at all clear what is meant. 'Order' is used much as 'excellence' might be – it tells us hardly more than that the painting is a good one of a certain sort. (This is not to say that Mondrian's paintings are *not* ordered. Only that their order is too elusive for us to understand it; we are too stupid yet, perhaps, to see just what it is.) In this discussion we shall only use 'order' where we can give the word operational definition, where we can *point to* the order, where we can say *'This* is what makes it ordered'.

The obvious meanings of 'order' refer to some kind of simplicity, symmetry perhaps, lack of complication, lack of distraction. It is not difficult to decide on an operational criterion according to which we can make up our minds whether to call an object ordered or not. Suppose we decide on some such criterion. Is it then true to say that those objects that are 'ordered' are easier on the eye than those that are not 'ordered'? And if we *assume* this to be the case, is there anything in the mechanics of perception that justifies the assumption? Or, to put the question another way, is there anything about objects that are ordered that might lead us to expect them to be visually satisfactory?

We must admit right away that there is no conclusive evidence one way or the other. But there are some indications.

All three theories of perception that we shall examine (and they are among the most important current accounts), have this in common: they maintain that seeing involves an effort, and that the perceptual mechanism works in such a way as to minimise this effort.

It is no great step from here to the answer we want. For if the object being seen is simple (or 'ordered'), the effort that the mechanism needs to make is particularly small – and the situation is, from the point of view of the lazy brain, *satisfactory*.

The gestalt account of perception is ruled by the principle of isomorphism.[2] The theory suggests that whenever an object is perceived, its form re-occurs somehow in the nervous system. That is to say, the form of the physiological configurations in the brain is isomorphic to (structurally analogous to) the form of the object. This explains, for instance, why ambiguous figures are always seen in the simplest possible way – the brain seeks to organise itself in the least complicated fashion, so a trapezium is not seen as a trapezium in the frontal plane, but rather as a rectangle in perspective. And it is quite clear that in terms of this account an 'ordered' object will allow the brain more rest than a complicated one. If the object itself is simple, so will the situation in the brain be – and the state of affairs in the perceptual mechanism will be satisfactory.

In Hebb's account of perception the ruling idea is one of aggregation.[3] There is no overall or field theory, but instead, the suggestion that we see figures as the result of a complicated learning process which goes on through cell assembly in the visual cortex. The basic assemblies are formed very early in our seeing life, and later we combine these basic ones in order to see more complicated patterns, possibly adding still further cells.

Again, it is the simplicity of the figure that gives the brain an easy job. If the brain can use a particularly small set of basic assemblies, and does not need to add further cells to them, there will be a low level of activity in the visual cortex – the figure will be easy on the eye.

The information theory account, given by Attneave, is most interesting.[4] Most patterns are highly redundant, in respect of the information they give. Thus, if we describe the visual field in terms of a minute grid, each square of which is monochromatic – like the grain of a photograph – and if we tell somebody the colour and tone of these tiny squares one at a time, not all our information will surprise him. In the case of a simple pattern he will anticipate the colour and value of most of the squares we come to (as soon as he realises what pattern it is that we are describing, he will know the values of *all* the remaining squares), while with complicated patterns he may be kept guessing most of the time. The complicated pattern is said to contain more information than the other – in fact, the number of errors he makes in predicting future squares is an index of the amount of information carried by the pattern. Attneave implies that each error costs the observer an effort, so that simple patterns, which carry less information than complicated ones, cost him a smaller effort than the complicated ones. Again then, a pattern that is 'ordered', since it costs the brain less effort than others, is more satisfactory to the eye.

Each one of these tentative 'explanations' of the fact that ordered things are more apt to please the eye than others depends on the fact that the brain (or eye, if you prefer) is lazy.

And, of course, this view is not unarguable. There are ways in which just the contrary seems to be true – where it is suggested that the eye has to be kept *busy*.[5] Goodyear's account of the refinements of Greek and Egyptian architecture suggests that the architects

of these periods used entasis and similar devices, not to correct optical illusions, as is so often thought, but to achieve something positive. To see lines that are curved as straight, or unequal intervals as equal, the brain has to make compensatory efforts, and strain itself far more than when it sees *equal* intervals as equals. It may be that this very effort is pleasurable, and that the refinements titivate the eye and keep it happy, so to speak.

And there is certainly something to be said for this idea. But it does not exclude the other, and much older view, that simplicity rests the eye and is therefore beautiful. Many, many societies have held this view – and of them, many made it into some kind of system. Both in Japan and India, for example, it has long been regarded as important.[6] In Europe the idea has been several times attached to the whole of religious thought. The Greeks, the Gothic builders, and the Renaissance scholars, all valued some such theory (though possibly it was no more than a desire to simplify measurement that made it attractive in the Middle Ages); and now, at the moment when hope of understanding visual aesthetics is just appearing, the architectural world has been inundated by further mysterious writing on the golden section and geometry. Instead of trying to account for the effect of order in a way appropriate to our time, the majority of writers have returned to an almost primitive acceptance of magic and ritual.

Those that have promoted this return to the golden section are, unfortunately, often distinguished enough in their own fields to make it inconceivable that they should be mistaken. The absence of even the beginnings of careful analysis in this subject is attributed, not to the inability of its exponents, but to the nature of the subject itself.

Yet we have only to examine the work in detail to see how flimsy its foundations are. The failure of writers to appreciate the true reason for the visual efficacy of the golden section has led them to shelter in a maze of obscurity. It is clear from their whole approach to the subject, and from the vagueness of their so-called proofs and demonstrations, that they themselves are quite uncertain – that they are unable to account adequately for the facts.

Let us examine some of these 'proofs'.

First of all, throughout the writings we are concerned with, there seems to be deliberate intention to hoodwink the reader. While this *need* not have any bearing on the value of the idea itself, we cannot help wondering why it is so common; whether it is not, in fact, because the only way to prove things that are incorrect *is* by false argument. Or perhaps it is simply that the writers are too ignorant to know what they are doing. Le Corbusier, for instance, reverently reproduces facsimiles of two pages of arithmetic a mathematician did for him.[7] The arithmetic involved could have been done by many schoolboys, and to suggest that it is difficult by showing readers the original manuscript is sheer deceit. Similarly, Matila Ghyka glibly invokes Ockham's razor at a point where the razor principle has no application and does not in any way help the idea which he intends it to support.[8]

Its use is a pretence.

Another attempt to hide behind mathematics and impressive words is made by Jay Hambidge when he explains his devotion to the golden mean by saying that it is a dynamic ratio rather than a static one.[9] He means, it later turns out, that the dynamic ϕ is an irrational number like π while the static numbers are integral fractions.[10] Now, although there is no harm in putting this forward as new terminology, it is senseless to describe the difference as significant when discussing the way people react to patterns.

The irrational numbers make no sense as physical lengths. Physical lengths, which are by definition commensurable, must not be muddled with numbers that are entirely abstract.

Think of this another way: as regards physical lengths, since there can be no irrational ones, it makes no sense to distinguish between 'static' and 'dynamic' ratios. There is NO way in which this might be done, since there is always a rational number as close as you like to any irrational one.

Even disregarding this logical point (vital though it is), the business is *still* absurd. The limitations of visual acuity make nonsense of it. In general, people cannot distinguish between two rectangles whose height-breadth ratios are 6 per cent apart. That is to say, if we have two rectangles, one *a* by *b*, the other *a* by 1.06*b*, observers cannot tell one from the other.[11] Thus, though observers can distinguish between a square and a ϕ rectangle, and even between a 1:1.5 rectangle and a ϕ rectangle, the 1:1.66 rectangle and the ϕ rectangle are visually the same. For an exceptionally acute observer we might need to make the difference finer – but the point remains. When we see, we see, not a rectangle with the mathematical properties that $(1-\sqrt{5})/2$ has, but a shape whose sides are in a ratio somewhere between 1.6 and 1.65.

To make distinctions between rectangles whose ratios are static and rectangles whose ratios are dynamic, is to befuddle ourselves.

Closely related to the facts of visual acuity is another favourite device of golden sectionists. We are confronted with (and convinced by) analyses consisting of hundreds of lines ruled across plans and elevations. Now both the lines of the analysis, and the headings, mouldings, frames, etc., of the object itself, are so thick (in relation to the object's overall dimensions), and the intersections can be so variously made, that any consequent deductions and results are valueless.

A perfect example of the way in which line thickness variations can be used is the famous 'paradox' of the rectangle and the square. The first, consisting of 65 unit squares, appears to be made of the same elements as the second, which contains only 64. In fact the lost unit is taken up by the area of a line – but imperceptibly, because the lines are all thick enough to cover the deceit.

But the fact that line analyses prove nothing does not daunt the mystic. He has far more impressive evidence for the uniqueness and special qualities of the golden mean.[12]

The occurrence of the golden mean in nature. The Fibonacci series and the geometrical figures associated with it, pervade, so it would seem, the world of natural forms. And this is taken to be a clear indication of the mystical qualities of ϕ.

It is true that we find pentagons, five-petalled flowers, equiangular spirals, serial arrangements of leaves on branches. But all these patterns are governed by the way in which they have been made. They are not the result of nature striving for some high ideal – simply the outcome of a certain kind of growth.[13]

No more remarkable than the fact that the two halves of a dicotyledonous seedling are the same – it is a result of the way these plants develop. This was made clear as early as 1872, when it was pointed out that unless we can give literal sense to the idea of a plant 'aiming at something', the idea is absurd.[14]

Yet almost 100 years afterwards we still find people writing as though nature uses the golden section in order to be harmonious.[15] The numbers actually found in nature (ratios like 5/8, 3/5, 2/3, 1/2), are not at all close to ϕ, while those that *are* close to ϕ (3/21, 89/144, and so on) are never found.

ϕ itself plays no part in natural growth; but the first few members of the Fibonacci series, and the structure of this series, do picture the serial growth of certain forms. This is not mysterious in any way. And what is more, there is no reason (except a Platonic one) to consider the series particularly significant. The fact that it is associated with a certain principle of growth says nothing about the visual effects of the results.



Fig. 1

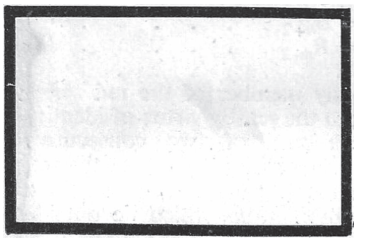


Fig. 3

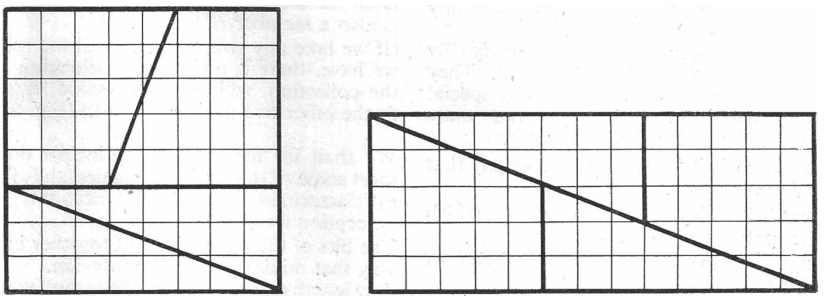


Fig. 4

Figure 1 The illustration reproduced here contains three figures, Fig. 1, Fig. 3 and Fig. 4. from the original article. Their captions are as follows:

1. We can barely distinguish between these two rectangles, one 1: 1.6, the other 1: 1.65.
3. The inner rectangle is 1:1.57. The outer rectangle is 1:1.51.
4. (No caption in the original)

Nor should it dictate anything to us as formbuilders – unless the ways in which we made forms were based on the same principle. And they are not.

A further, quite different, example of confusion is to be found in all the statistical experiments on the golden mean. A number of rectangles, among them a ϕ rectangle, are shown to people who are asked to say which is the most pleasant.[16] Often it does turn out that the ϕ rectangle is preferred by the largest number of people – which shows that, within very broad limits (owing to the bounds of visual acuity), rectangles of about this shape are pleasing to the eye.

So far so good. The confusion occurs when efforts are made to account for this attractiveness by appealing to the formal properties of ϕ (like, $1+\phi=\phi^2$ for example). The 'reasons' of this kind that are offered are far more obscure than the phenomenon they are called on to explain.

In fact the situation is as follows.

1 It is an unaccountable empirical fact that *this* particular shape pleases the eye.
2 A number of rectangles have certain formal properties which account for the fact that they can be nested to form rather simple patterns.

These two facts are, as far as we know, unconnected. The second does not explain the first (except in a disorderly and mystical fashion), and moreover there are all sorts of rectangles that can be nested – the property is not confined to the ϕ rectangle, as it would need to be if there *were* any connection between 1 and 2. However, these nested patterns *are* visually agreeable, for a different reason. They please the eye, not because of any special shape associated with them, but more probably because they are *ordered*.

Now what is it we mean when we say that they are ordered? What is it such nested patterns have, which other patterns do not? What are the special characteristics of order? There is a lack of confusion. A certain simplicity. Relations between the parts. These are the traditional ways of defining order, aren't they? Let's not scorn them, but try to see what the definitions say.

Essentially a pattern of this kind is characterised by the lengths of the lines that make it up. Imagine yourself making such a pattern from a number of straight rods. If all the rods were of the same length, the pattern would have a very obvious character, and an obvious kind of order too. If there were two lengths of rod available, the pattern would be characterised by the ratio of the two lengths. And so on up. It is the relation between the various rods you play with that gives the pattern you produce its character.

Or think of starting at the other end: if you were allowed rods of as many different lengths as you liked, and used a great variety, the patterns you produced would have no order at all – over and above their rectilinearity. Gradually, as you reduced the number of different lengths, the patterns would grow clearer and clearer. Rectangles of similar shape would begin to appear, the relations between parts of the pattern would become apparent.

If you are making rectilinear patterns of this kind, the number of different rods, and their respective lengths, are the only variables – they are the only things you can change.

It is in this way that we make patterns on the surfaces of buildings – only instead of rods we have the edges of adjacent building components. It is the sizes of these components that characterise the patterns. And it is the relations between the sizes that is responsible for what we have called 'order'. But what do the relations need to be; just how should we control the component sizes so as to produce order of the kind that is effective, visually?

We can't, of course, answer this question altogether. But we can suggest an answer – an answer that turns out to explain the efficacy of all the order systems in current use.

It depends on the following additive principle. Think of the set, S, of different component dimensions (in our example, the set of different lengths of rod). And give this set the property that if we take any two lengths from the set, the *sum* of these two lengths is also a member of the set.[17] (If we take any two rods from all the rods we have, there is a third rod belonging to the collection, which has the same length as the other two put end to end.)

We shall see first that this principle does meet some of the rather vague demands for satisfactoriness made by the accounts of perception we discussed: The bits of the pattern will fit together in a way that minimises visual confusion. Any length can be expressed in several ways as the combination of smaller lengths. Combinations and their variants recur throughout the pattern. Relations between different lengths will be apparent just on account of the frequency of their occurrence. Bits of the pattern will appear several times, arranged and rearranged. The relations between bits, and the reappearance of similar bits, will make the whole pattern easy to grasp, easy to recognise. All these facts will contribute to the well-being of the lazy perceptual mechanisms. That is as much as we can say.

We cannot be certain that order is pleasing to the eye. But we believe it to be so, and the belief does not seem altogether foolish. When we examine order systems, we shall find that they have the property discussed, so we can say, at least, that *if* they are visually effective, it may well be on account of this property.

The two most prominent systems of recent years have been 'Le Modulor' devised by Le Corbusier, and the 3 ft. 4 in. and 8 ft. 3 in. planning grids used by the Hertfordshire school designers after the war. Both were concerned with the actual lengths that appeared in the building's components, so that, ultimately, these components might be standardised.

Both start with certain lengths, and base on them a set whose members fulfil the condition specified: 'That if any number of lengths are added together, their sum is also a length from the set'.

In the planning grid method the set is constructed as follows: The basic length is *M*, the module. And the set of lengths used is the set of all integral multiples of *M*, which satisfies the condition, clearly. If we have a number of lengths from the set, each will be of the form *nM*, where *n* is an integer. Their sum, consequently, will be $(n_1 + n_2 + n_3 \ldots + n_k)\mathrm{M}$, which is of the same form, and therefore belongs to the set also.

With the 'Modulor' the set is arranged differently. And we shall find that while its lengths satisfy the condition often enough for the relations between them to tell, they do not satisfy it always. The set consists of lengths that are members of two interlocking Fibonacci series, the blue series and the red series, which we may denote by:

$\mathrm{B}_1, \mathrm{B}_2, \mathrm{B}_3, \mathrm{B}_4, \ldots$ and $\mathrm{R}_1, \mathrm{R}_2, \mathrm{R}_3, \mathrm{R}_4 \ldots$ where

$$B_n + B_{n+1} = B_{n+2} \qquad (a)$$

$$R_n + R_{n+1} = R_{n+2} \qquad (b)$$

$$2R_m = B_m \qquad (c)$$

Now twice any member of the red series does belong to the set, by virtue of identity *(c)*. And the sum of two consecutive members of either series belongs to the set, by virtue of identity *(a)* or *(b)*, But there are many combinations which lie outside the set, and sooner or later we shall be forced to use such combinations, as Le Corbusier himself has been forced to do.[18]

But, essentially, both systems are sets of numbers with what we have called the additive property – a property that can be written down quite simply:

> *S* is a set of numbers such that if *x* and *y* both belong to *S*, then *x* + *y* also belongs to *S*. It can easily be shown that such a set is uniquely defined by

its lowest two members, *a* and b, say; and that all other members of the set may be expressed as linear combinations of *a* and *b* – that is, in the form *na* + *mb*, where *n* and *m* are whole numbers greater than or equal to zero.

Consider, for example, the following set: 7 11 14 18 21 22 25 . . . This set, which fulfils the condition of additivity, may be defined by the pair 7, 11 – for:

14 = 7 + 7, 18 = 7 + 11, 21 =7 + 7+7, 22 = 11 + 11, 25 = 7 + 7 + 11, etc. The set contains all possible linear combinations of 7 and 11. It seems then, that the order produced by such a set is entirely dependent on a pair of numbers (lengths) *a* and *b*.

So we could equally well define the system by specifying *a* and *r, r* being the ratio *b/a*. And indeed, it is in this form that the theory proves most interesting, for, by giving the parameter *r* different values we can reduce the general system to particular ones, some of which we know already.

If we put $r = \phi$, or $b = \phi a$, and remove several members of the ensuing set of linear combinations, we are left with the double Fibonacci series of the Modulor. The initial set is:

a ϕa 2a $(1+\phi)a$ 3a $2\phi a$ $(2+\phi)a$ $(1+2\phi)a$ . . . . which,

since $1+\phi = \phi^2$, $1+2\phi = \phi^3$, etc., we may rewrite as:

a ϕa $2a$ $\phi^2 a$ $3a$ $2\phi a$ $(2+\phi)a$ $\phi^3 a$ from which we select a ϕa $\phi^2 a$ $\phi^3 a$ . . . . and $2a$ $2\phi a$ $2\phi^2 a$ . . ., which are Le Corbusier's red and blue series.

If we put $r = \sqrt{\phi}$ we arrive at the system underlying the ground plan of Mies' Farnsworth house. For here the set of linear combinations is:

a $\sqrt{\phi a}$ $\left(1+\sqrt{\phi}\right)a$ $2a$ $2\sqrt{\phi}a$ . . .., which contains all the lengths that occur in the basic plan, not because Mies chose these lengths numerically, but because the plan is constructed in a certain additive way that has the same effect.

Finally, if we put *r* = 1 or *a* = *b*, we arrive at the familiar modular planning grid. The set of linear combinations is nothing more than:

a 2a 3a 4a 5a . . ., the set of multiples of a single module *a*.

Each value of *r*, then, gives us a different system – each one a particular example of the general system we have proposed.

An aspect of these systems that we have not yet examined is their scale. We have said nothing of the units to be associated with such sets – for clearly we can assign any units we please to their members. They can be millimetres, inches, feet, miles. We must decide what sort of units will best achieve the purpose under discussion – that of making visually effective patterns.

a and *b* must not be too large – or the lengths would be too great for us to perceive the relationships between them. (Moving round a building, the eye most readily picks up lengths between 3 ft. and 10 ft. – the scale of windows, doors, panels, floor to ceiling heights, and so on.)

But what is not so clear is that *a* and *b* must not be too small either. This depends on the fact that the eye is only able to grasp a very limited range of relationships. We do not see 20 objects as 20, but as a large number. And we see no relation between a length of 19*k* and one of *20k* (whatever the units). They appear simply as two almost equal lengths – the relation is too obscure for the eye to pick it up.

If our basic lengths were 4 in. and 7 in., for example, the set would contain: 4 in., 7 in., 8 in., 11 in., 12 in., 14 in., 15 in., 16 in., 18 in., and every succeeding inch, so, as we have seen, the eye would notice no relations among the higher members of the set.

a and *b* will need to be as large as possible, therefore – of the order of three feet, probably.

The final choice of *a* and *b* will be determined by their HCF. (The HCF of 3 ft. and 5 ft. being 1 ft., that of 3 ft. and 5 ft. 4 in. being 4 in., that of 3 ft. and 4 ft. $10\frac{1}{2}$ in. being $4\frac{1}{2}$ in.)

When we select the set of linear combinations of *a* and *b*, we are in fact picking out certain lengths, which we believe will be visually effective in combination, from all the multiples of their HCF. For, if this HCF is *k*, then:

1 *Any* member of the set is a multiple of *k*.
2 But the set does *not* contain all multiples of *k*.

It happens that modern technological theory is also based on a small module like our *k*, and we shall examine the possibility of making *k* the same as this manufacturers' module, which has been fixed, after considerable research, at 4 in. (approximately 10 cm.).[19]

In what follows it is essential to distinguish clearly between the two aspects of such a modular theory – between the economic approach of the manufacturer and the aesthetic approach of the architectural theorist. From the manufacturer's point of view it is desirable to provide the architect with as big a range of sizes as economics allow. The module is introduced only as a standard that will allow all the parts made by different manufacturers, in different areas, for different purposes, to be used successfully in conjunction with one another. Any interest the manufacturer has in selecting particular lengths from the set of multiples is governed by his desire to cover the maximum number of modular spaces with the minimum number of elements. He will choose certain multiples of *k* (like our *a* and *b*), and find out what ranges of the set of all multiples can be covered by combinations of them. This problem has been examined recently, with the help of a well-known number theorem which states that *every* multiple of *k* above (a – *k) (b – k)* can be expressed as a linear combination of *a* and *b*.[20]

The architect who wants to introduce some kind of visual order is concerned with almost the opposite problem. He is concerned with the lengths *below (a – k) (b – k)*. The visual effect associated with a number pair and its set is powerful just because, below (a – *k) (b – k), we cannot* cover all multiples of *k* with linear combinations of *a* and *b*. We can only cover a limited set of these multiples, and it is this very limitation that makes the pattern tell.

In spite of this difference the two views of the situation are quite compatible. The 4 in. module is enough to make them so. The manufacturer will select his component sizes on economic grounds, and then, for a particular building, the designer will choose

from these components a set that has the restriction discussed, (a and *b* may be chosen from any of the components available – their HCF will always be 4 in., or a multiple of 4 in., because of the 4 in. module used by the manufacturer.) In this way it will be possible to use the order principle.

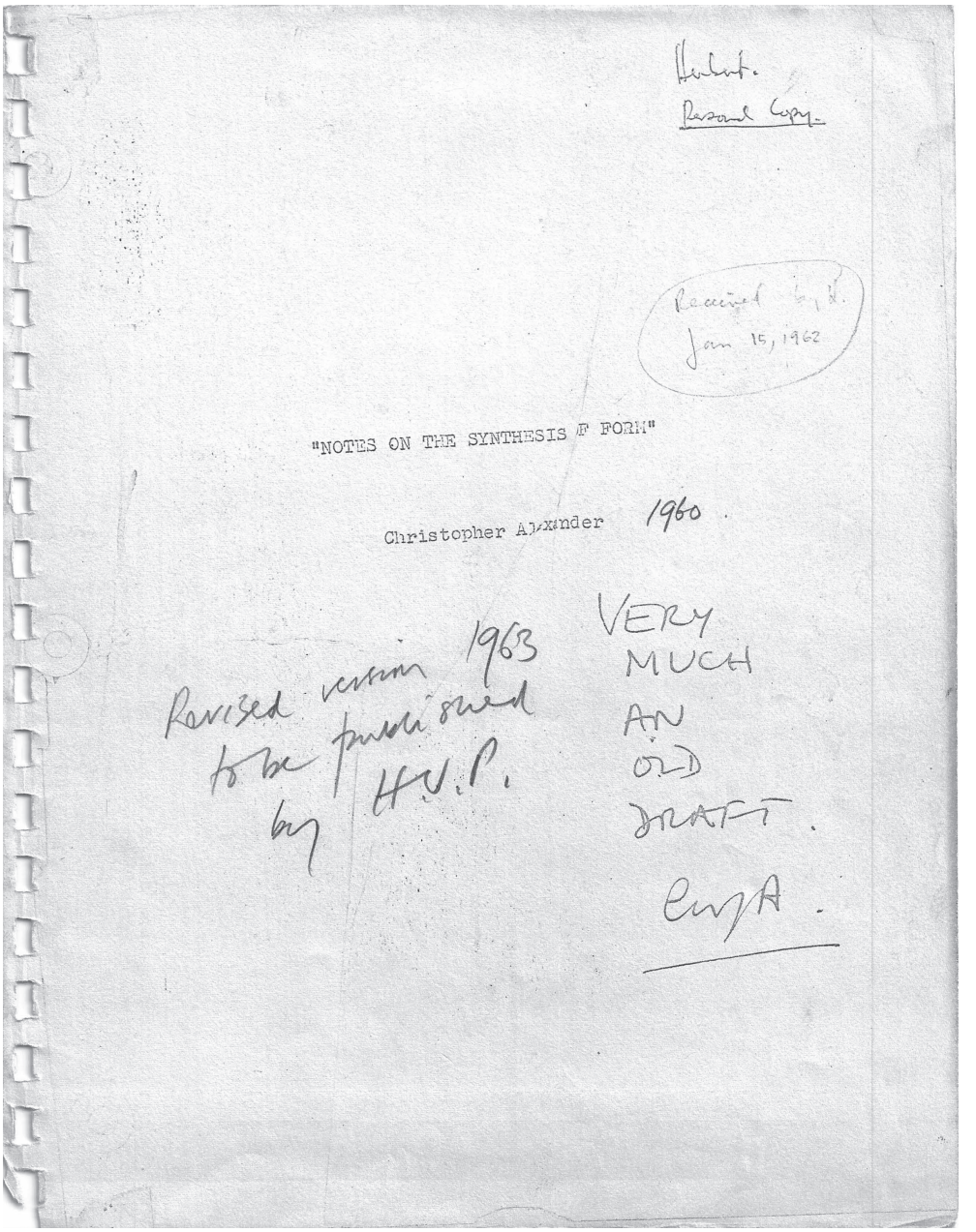
The connection between perception and modular coordination that has been established could influence a practising designer, certainly. It could be made use of as a tool. But the connection was established, principally, in the belief that we should know what we are up to and in the hope that it will increase our confidence in modular coordination.

It indicates that *if* the various technical organisations succeed in their aim, establish the 4-in. module, and the manufacturers adopt it, we shall be able to design, using this 4-in. module and the traditional principle of order.

And our faith in the visual order we produce will no longer need to be mysterious, but may be in some measure understood.

Notes

1 See, for example, Plato's, *Theaetetus, Timaeus, Philebus; Architectural principles in the age of humanism*, by Rudolph Wittkower, London 1952 throughout. *Gothic cathedrals and sacred geometry*, by G. Lesser, London 1957.
2 For this account see *Principles of Gestalt psychology* by K. Koffka, London 1935; for its use in art criticism see *Art and visual perception*, by Rudolph Arnheim, London 1956.
3 The account of D. O. Hebb is contained in his *The organisation of behaviour*, New York 1949.
4 See *Some informational aspects of visual perception* by F. Attneave, in Psychological Review 61, 1954, pp. 183–193.
5 This implication is found throughout the writing of W. H. Goodyear, as, for example, *Greek refinements,* New Haven 1912.
6 We find this in most writing on Eastern architecture: for instance – *India*, by Richard Lannoy, Norwich 1955, p. 8.
The lesson of Japanese architecture, by Jiro Harada London 1936, pp. 45–51.
7 *Le modulor*, by Le Corbusier, Boulogne 1950, pp. 233–234.
8 *Geometrical composition and design*, by Matila Ghyka, London 1952, p. 7.
9 *Dynamic symmetry, by* Jay Hambidge, New Haven 1920.
10 $\phi = \dfrac{1+\sqrt{5},}{2}$ is the limit of ratios of consecutive members of the Fibonacci series.
11 The result of some unpublished experiments done at the Building Research Station.
12 See, for example, *The geometry of art and life*, by Matila Ghyka, New York 1946, Chapter 6.
13 *Growth and form*, by D'Arcy Wentworth Thompson, Cambridge 1952, pp. 912–933.
14 See a paper by P. G. Tait, *Proceedings of the Royal Society of Edinburgh*, VII, 1872, p. 391.
15 See note (12). It is never put quite so naively, but the implication is always there.
16 Such experiments were done, for example, by G. T. Fechner who reported them in *Vorschule der Aesthetik*, Leipzig 1876, pp. 190–202. More recently by T. R. Austin and R. B. Sleight, Journal of Applied Psychology, 35, 1951, pp. 430–431.
17 This is the first and most important axiom that defines a *commutative additive group*, in algebra.
18 To construct a satisfactory bay width at Marseilles, for instance, he adds 53 cm. to 366 cm., making 419 cm., which does not belong to either series. See *Modulor* 2, London 1958, p. 237.
19 See *Modular co-ordination in building*, published by the European Productivity Agency, Paris, August 1956.
20 *Geometrical aspects of modular co-ordination*, by J. W. Harding and L. S. Vallance, The Builder, 27 September 1957, pp. 552–555.



Title page of early draft of *Notes on the Synthesis of Form*.

2 Contents, Preface and Part One in early draft of *Notes on the Synthesis of Form*, 1960

CA's PhD dissertation, The synthesis of form; some notes on a theory,[1] *was finished in 1963 and published by Harvard University Press the following year as* Notes on the Synthesis of Form[2]. *The 1960 draft excerpted here has the later title. But more important is the fact that it was done before CA's stay in India and the highly detailed analysis of the Gujarati village of Bavra that formed the major case study in the dissertation and the subsequent book. This draft, along with the book that was published a few years later, show the scope of CA's reading and his ability to synthesize material from diverse fields of study.*

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1 This is how the dissertation title is listed in the Harvard University Library catalog (accessed 7/20/2021).
2 Christopher Alexander, *Notes on the Synthesis of Form,* Cambridge, MA: Harvard University Press, 1964.

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PREFACE

> To be practical, mathematics must tell us facts. But do these facts have to be the mathematical facts? Why should not mathematics, instead of teaching us 'facts', create the form of what we call facts?
>
> Ludwig Wittgenstein

This thesis is devoted to discussions about the development and invention of architectural form. For the sake of clarity, and to make my argument specific, I have restricted myself to discussing house forms. Yet even so, a great deal of the discussion is abstract and theoretical. While of course the architect's first gift is his capacity to recognize and handle form, I hope his eye is not so jaundiced that he has become exclusively devoted to the visual qualities of form, and blind to the other sorts of relations between events and circumstances and things. The time is over when we can keep architecture at its present level – even (or especially) when we do recognize the colossal power of intuition.

Part one

The need for rationality

Wherever a house form is inadequate, there is a point of stress, and that stress can be felt by almost anyone who comes in contact with the form. The fact that children are in danger from the car, the fact that the house is too hard to maintain, that the rooms are the wrong size for what goes on in them, that the house is hard to find, that there is no sense of privacy, that the neighbours' noises are intolerable, that the house is too expensive, that it is ugly, ill-arranged, the materials inappropriately chosen, the structure misconceived. Each one of these features of the house form, and each of a thousand others we might mention, is a point of stress. The designer's task is to invent a form so organized that it avoids all possible points of stress.

The difficulty is that since many of them are in opposition, their fusion presents almost insoluble intricacies. Consider, for example, the number and variety of the materials to be used in the construction of a single house. Elegance of form demands a certain economy in the number of materials used. This conflicts at once with the fact that the form will function better if we choose each best material for each separate purpose. But then, on the other hand again, this functional diversity of materials makes the joints between components difficult (expansion rates uneven, maintenance less easy).

Further still, all three issues mentioned, elegance, performance, and jointing, are at odds with purely economic factors. For if we choose the cheapest material for each separate task, we shall not necessarily have elegance, nor optimum performance, nor materials which may be cleanly jointed.

In this simple situation there is already fiveway conflict – only in one case out of six (elegance and jointing) do any two have similar implications. There is a growing need for some new method of organizing form in relation to such complexities. For the perfect resolution of several thousand conflicts is every day more difficult – and its difficulty is beginning to be critical.

First of all the house is in itself far more elaborate than the house was yesterday. It is more complex technically, the variety of activities which it accommodates is greater, the net of culture which it has to fit more intricate, altogether the issues which the form-maker has to encompass grow more numerous, more complicated, every day.

To match the growing complexity of the forms themselves, there is growing up a body of information, data, and specialist experience to cope with the complexities involved. But this information is hard to handle, the data are widespread, diffuse, unorganized.[3] Moreover, not only is the quantity of data and information itself by now beyond the reach of single architects, but the various specialists who retail it are narrow and unfamiliar with the form-makers' peculiar problems, so that it is never clear quite how the architect should best consult them. As a result, although ideally all the data should find itself reflected in the form, in fact the average architect scans whatever information he happens on, consults a consultant now and then when faced by extra special difficulties, and introduces this randomly selected information into forms otherwise dreamt up in the artist's studio of his mind. The technical difficulties, of grasping all the information needed for the construction of such a form, are out of hand – and well beyond the fingers of a single individual.

At the same time as the data increase in quantity, complexity, and difficulty, they also change faster than before. New materials are developed all the time, social patterns alter quickly, the culture itself is changing faster than it has ever changed before. In the past – even after the intellectual upheaval of the renaissance – the individual stood to some extent upon the shoulders of his predecessors. And although he was expected to make more and more of his own decisions as traditions gradually dissolved, there was always still some body of tradition which made his decisions easier. Now the last shreds of tradition are being torn from him. Since cultural pressures change so fast, any slow development of form becomes impossible. Bewildered, the form-maker stands on his two feet, alone. He has to make forms of quality without the possibility of trial and error over time. He has to be encouraged, now, to think his task through from the beginning, and to 'create' the form he is concerned with, for what once took many generations of gradual development, is now attempted by a single individual.[4] But the burden of a thousand years falls heavily on one man's shoulders, and this burden has not yet materially been lightened. So far apparently, man has been unable to invent devices which might help him overcome its weight. (As we shall see, the conceptual devices that he has invented, though they help to some extent, bring so much of their own confusion to the problem that at best their victory is pyrrhic.)[5] The intuitive resolution of so many conflicts simply lies beyond a single individual's integrative grasp.

3 D. Bullivant, "Information for the Architect", *Architect's Journal*, 1959, pp. 504–521, et al.

4 [2]L. Moholy-Nagy, *The New Vision: From Material to Architecture,* revised trans. Daphne Hoffman, New York: Wittenborn, 1947, p. 54. Walter Gropius, *The New Architecture and the Bauhaus,* trans. P. Morton Shand, London: Faber & Faber, 1935, pp. 17–20.

5 See Part II, Chapter 6.

Of course there are no certain limits to his grasp – especially in view of the rare cases where a genius breaks all bounds. But if we look at the forms around us, it is clear that their design does tax most men's capacity well beyond the limit. The fact that the limit varies from man to man, does not mean that there are no limits at all. It would be surprising, after all, if there were none. In other fields we admit readily that there are bounds to man's capacity. Limits to the difficulty of a problem which he can solve.[6] To the number of issues he can consider simultaneously.[7] To the complexity of a decision he can handle wisely.[8] In none of these cases are there any definite limits (or any scale on which such limits could be specified), and yet in practice we admit that there are limits nonetheless. Similarly we may take the very apparent failure of individual architects to produce well-fitting forms, as sufficient evidence for the existence of limits on the individual's capacity; and as sufficient grounds for searching for new methods.

Now the production of form – the shaping of form – is not something that is obviously susceptible to logical analysis: indeed, the steps involved have not been clearly formulated, ever. And there is likely to be strong prejudice against such an analysis. It is important, therefore, that enthusiasm for systematic approaches to design should not lead to lack of caution. Formulation is a lengthy business – one that may well take centuries to finish. If we can make the first few steps in the right direction, so much the better. But we must be careful – we must not force problems that we do not fully understand into an oversimple quasi-logical framework. That will only antagonise the sceptics, can only reinforce their view that in this field logical formulation is impossible.

It is most important, first of all, that the term logic is not here misunderstood. It is in no way similar to the so-called logic of Jacques-Francois Blondel.[9] Nor is it similar to the 'logic' of Mies van der Rohe. These men used the word simply to suggest the rigidity of a certain kind of architecture – of a certain sort of form. (In Mies' case, for instance, it has come to suggest little more than stern rectangularity.) One thing logic will not do for us is to prescribe physical form.

Nor must the word logic (or any other words like rational and systematic), be taken to suggest that we shall set up premises, trace through a series of deductions, and arrive at a form which is 'logically' determined by the premises. Nothing of the sort. This kind of extreme naivete has made one or two appearances in the world of design. And quite rightly, designers have quickly rejected it as ludicrous. Not only are architectural

6 K. Duncker, "A Qualitative (Experimental and Theoretical) Study of Productive Thinking (Solving of Comprehensible Problems)", *Journal of Genetic Psychology*, 1926, 33, pp. 642–708. K. Duncker, *On Problem Solving*, trans. Lynnes Lees, Psychological Monographs, No. 270, 1945. Max Wertheimer, *Productive Thinking*, New York: Harper & Brothers, 1945.

7 George A. Miller, "The Magical Number Seven, Plus or Minus Two; Some Limits on Our Capacity for Processing Information", *Psychological Review*, 1956, 63, pp. 81–97. D. B. Yntema and G. E. Mueser, "Remembering the Present States of a Number of Variables", Journal of Experimental Psychology, July 1960, 60, 1, pp. 18–22.

8 Alex Bavelas and Howard Perlmutter, classified work done at the Center for International Studies, MIT, quoted in *The Relation of Knowledge to Action* by Max Millikan, in *The Human Meaning of the Social Sciences*, ed. Daniel Lerner, New York: Peter Smith, 1959, p. 164.

9 Jacques-Francois Blondel, *Cours d'Architecture*, Paris: La Veuve Desaint, 1771, Book IV.

problems far too complex to allow such simple treatment, but they are of quite a different sort.[10]

When we speak of logic, we need not be concerned with processes of inference at all. It is true that most of what is generally understood to be logic is concerned with deduction. But logic in the widest sense, refers to something far more general. It is concerned with the form of abstract structures, and is involved the moment we make pictures of reality and then seek to manipulate these pictures so that we may look further into the reality itself. It is the business of logic to invent purely artificial structures of elements and relations. Sometimes one of these structures is close enough to a real situation to be allowed to represent it. And then, because the logic is so tightly drawn, we gain insight into the reality which was previously withheld from us.

Here, in our ability to invent logical arrangements as close to any actual situation as we wish, lies the starting point for the use of logic. (Though we do not usually insist on too fine a closeness since the more stringent our demands in this direction, the more complicated the logical arrangement, and the less usable.) The name we give to all behaviour which makes use of such arrangements, and exploits the similarity between the structure of the logic and the structure of the facts, is rationality.

While as I shall try to show, logical patterns do deserve attention and should not be scorned, it must be made very clear that there are no 'logical' grounds for accepting them. No decision, no decision pattern, can be wholly rational. There is a circularity in the motion of reason that is unavoidable. To be called rational, as we have seen, the decision must be linked to a model or picture of the situation. And such a model cannot possibly reproduce every aspect of the situation (the only thing that contains every aspect of a thing is that thing itself). It is in the nature of pictures and models that they select only certain aspects of the situation modeled – this is true of diagrams, of photographs, of verbal descriptions, even of the most perfect models. However good they are, there is some difference between the model and the thing it is a model of.

Models are made by simplification and selection. It is up to us to see which simplifications we wish to make, which aspects to select as significant, which model to adopt. And this decision is logically arbitrary. However sound the model is internally, the choice of a model must be, in the end, irrational. For even if we can give reasons for choosing one model rather than another, these reasons only imply that there is another decision model behind the first (very likely not explicit). Perhaps there is still another behind this second one. But somewhere there are decisions made that are not rational in any sense, that are subject to nothing more than the personal bias of the decision-maker. So that logical models simply rearrange the points in the decision pattern at which personal bias is to be introduced. My purpose here is only to avoid its introduction to architectural design at those points where it causes the breakdown of quality.

It is also true – and this is quite another matter – that there is no rational justification for the whole attitude called rational. In the end it is only personal commitment that can justify the rational attitude. For to convince someone of rationalism we should

10 For a recent statement of the view that architecture is more complex than simple logic allows, see Reyner Banham, *Theory and Design in the First Machine Age*, London: Architectural Press, 1960, pp. 320–330. The disparity between architecture and architectural theory is also brilliantly discussed by John Summerson in "The Case for a Theory of Modern Architecture", *RIBA Journal*, June 1957, pp. 307–311.

need to use reasonable argument – and this kind of argument could not convince someone who was not already committed to the view that reason was worth listening to.

However, it is likely that whoever reads these lines is committed to reasonable argument, or he would not have read so far. I simply wish to be certain that there is no misunderstanding here. I am not proposing to use a logical pattern because this is, in itself, a good thing to do. No claim is made that there is something inherently desirable about a rational approach (though we do most of us, as a matter of fact, share an irrational faith in the efficacy of reason). I am setting up a rational decision pattern only because there is no other kind, we cannot set up an irrational one for instance. If we are to change the present unsatisfactory situation, if we are to substitute a new process of design for the present one which does not work, then we must think about our actions, we must make our thoughts explicit, and what we do will straightaway be rational.

The suggestion that a design process be set up which does not rely exclusively on the intuition of designers may lead some of us to cries of horror. The very rationality of such a tool, in spite of the fact that it can give man further power to shape form, seems dangerous, alarming. It seems to intrude on the humanity of man, it encroaches on what we think of as the individual's preserves. It seems as though a rationally conceived process of design must lower the dignity of man, will simply be another (undesirable) chapter in the decline of humanism and the subjection of man to science.

These thoughts, leading at first to fears, lead further then to skepticism. For the fear of what such rational tools may do to man finds its appeasement in the skeptical expression of the view that no such tool can possibly achieve what has been claimed for it. And this view can in the end be answered only by the success of the process invented. But the earlier objection, that such tools are a threat to humanism, can be answered more directly.

What looks dangerous is the possibility that man's intelligence, creative power, or inventive capacity, may be amplified, and made more powerful, and that thereby man may overreach himself and shrug off his humility. Just as the increase of his physical capacity looked dangerous to the humanists of the industrial revolution.[11]

But on examination this objection turns out to be feeble. For though it seems to spring from humanism, the thought which sustains it is an idle one. If our humanism is so weak that it is endangered by analysis and other tools, it is to the humanism that we must look. We cannot be erewhonians and stop the growing power of analysis.

To criticise analysis and reason for destroying humanism, while factually appropriate (it is true, after all, that they are largely responsible), is useless. It is a fact that widened understanding is responsible for our loss of humanism. But since we shall not check its widening, it can do no useful good to harp on its responsibility. Criticism of this sort will only lead to the hopeless wish that science stop developing. If we are to regain our humanism we must work within the scientific framework we have made ourselves. We must establish a situation where human beings are not endangered by their tools, whether machines, techniques, or theories.

11 William Morris, *Collected Works*, London: Longman Greens & Co., 1915, especially volumes 22 and 23. See also such works as Samuel Butler, "Erewhon", New York: Modern Library, 1927, the famous novel dealing with the effect of machines on the human race, first published 1872.

Our blind criticism of these tools suggests an appalling lack of faith in man. It implies that we regard the destruction of humanism as inevitable unless the development of tools is stopped. And since there is no prospect of stopping this development, the criticism amounts to straight prophecy of the end of humanism.

If man is too weak to cope with his tools, it will not be worth lamenting him – nor fair to blame the tools. Man is his own master. He must find an importance that does not derive, feebly, from condemnation of the machine and of analysis, but that accepts these tools and stands, in spite of them. If we cannot manage architecture except by condemning reason and retracting from it, we are rejecting just that gift which can extract us from the morass of fumbling ignorance we worship too often in the name of creative individuality.

Possibly protests made in the name of humanism may have a deeper source in the fear of intellectual responsibility. If we look carefully at the unfolding of architecture under developing selfconsciousness, the facts suggest this strongly. For while there have always been men with what we call an intellectual conscience, who wish to be responsible for their own actions and decisions (and have often fought bitterly for the privilege of that responsibility), most men have been much lazier.

Responsibility is difficult to bear. It is much easier to allow the bulk of one's decisions to be made by tradition and taboo, and to release oneself thereby from the burden of decision. Even in the various cases where selfconsciousness emerged, the current ways of building were only rarely questioned seriously. Question and self-criticism were possible, so that changes could be made, and were made from time to time. But for the most part architecture put little intellectual stress upon the architect. The strain of such responsibility has only been felt widely and acutely in quite recent times.

It was in the eighteenth century, for the first time, that the feeling of intellectual responsibility for one's design became unmistakeable and serious. Certain men were no longer content to borrow from outworn tradition, or to accept the views of the academies, or to toy with formalism. They began, at that time, to have serious doubts as to what they were doing, and raised questions of just the sort that led (150 years later) to the modern revolutionary ideas on form.[12]

Oddly enough, however, once these serious doubts had been expressed, architecture did not develop from them in the direction indicated. The doubts and questions were forgotten. Instead we find evidence of quite another atmosphere. Suddenly towards the late eighteenth century architects became obsessed by 'style'. Chinoiserie, neo-tudor, neo-classicism, neo-gothic, were the orders of the day.

It is possible to see in this event a desperate attempt to ward off the insecurity of selfconsciousness. The men who raised the questions wanted to know what they were doing as makers of form. But the search for this knowledge only made the difficulty of the questions clear, and made the form-maker's position very delicate. Indeed if he asked himself what he was doing, honestly, he found little justification for his current actions. So rather than face the responsibility of these difficult decisions, he hid

12 Chief among these men were Carlo Lodoli and Francesco Algarotti in Italy, and the Abbe Laugier in France. Their work and ideas are fully discussed by Emil Kaufmann in *Architecture and the Age of Reason*, Cambridge: Harvard University Press, 1955, pp. 95–99, and p. 134. None of Lodoli's writings remain, but see F. Algarotti, "Saggio sopra 1'Architettura", in *Opere*, Livorno, 1764. Marc-Antoine Laugier, *Essai sur 1'Architecture*, 2nd ed., Paris: Duchesne, 1775. Idem, *Observations sur 1'Architecture*, The Hague, 1765.

in resurrected 'styles'. Work within a style was comparatively easy. The architectural decisions made within such a style are of the same kind once more as those made under the traditions and taboos of unselfconsciousness. And it is no coincidence, I feel, that while the renaissance offered free recombinations of classical elements, neoclassicism stuck as closely as it could to the precise detail of Greece and Home. By leaning on correctness, it was possible to alleviate the burden of decision. To make the secession from responsibility effective, the cony had to be exact.

The attempt to lean on borrowed styles continued through the nineteenth century. But with the coming of the modern movement it was suggested once again, this time more loudly than before, that there should be no styles, that each building should be thought of on its own, made appropriate to its peculiar place and time.

One has the impression that again the fear of intellectual responsibility is turning out to be too strong. This time though, the fear makes itself felt quite differently. After the attacks made by the modern movement, it is no longer possible to escape the responsibility of considered action by working within borrowed styles, but the designer, unequal to his task, and unwilling to face the difficulty, can save himself in other ways. He relies more and more on catchwords, personal idiom, and fashionable intuition – for all these relieve him of some of the burden of decision, and make his problems manageable. Driven on his own resources, unable to cope with the complicated information he is supposed to organize, he hides his incompetence in a frenzy of artistic individuality. As his capacity to invent well-fitting forms is exhausted further, the intuition and the individuality grow wilder. The last stronghold against selfconsciousness.

We may already see the beginnings of this second secession from responsibility in the remarks of the pioneers themselves. They saw the damaging effects of artificial styles and intellectual selfconsciousness, but instead of trying to cure this by making their architectural thinking subtler, they retracted from it – and even at the very start they cut the cloth for cloaks of intuition. They recommended that the architect stop thinking of his work as architecture, that he become a builder once again, a master builder, that he go to the site, learn the craft of building, work with his hands.[13] Gropius and Wagner diagnosed the intellectual sickness of the form-producing system, just as Morris had diagnosed correctly the misuse of machines.[14] Just as Morris had, however, these men too proposed an unrealistic remedy. They wanted to recapture innocence. And could not accept its loss whole-heartedly, or any of its implications.

What we must face is that we are on the brink of times, where man may magnify his intellectual and inventive capability, just as in the nineteenth century he used machines to magnify his physical capacity.[15] Again, as then, our innocence is lost. And again the loss demands attention, not denial.

The secession from responsibility will lead to nothing positive. On the contrary. Total reliance on man's intuition is in its way only another hopeless refusal to accept selfconsciousness. In denying the possibility of understanding reasonably the processes

13 The impulse of William Morris' thought led both Otto Wagner in *Die Baukunst unserer Zeit*, Vienna, 1895, and Walter Gropius in "The new architecture and the bauhaus" to propose that the new architect should once more be a master-builder.

14 Nikolaus Pevsner, *Pioneers of the Modern Movement*, London: Faber & Faber, 1936, pp. 19–43.

15 The principles of amplifying intelligence have already been made clear by W. Ross Ashby, "Design for an Intelligence Amplifier", in *Automata Studies*, ed. C. E. Shannon and J. McCarthy, Princeton, 1956, pp. 215–234.

of form-production, it is closely parallel to various other famous attempts to shelter from the loss of innocence under the wings of magic and taboo.[16]

And while my attack on intuition is perhaps not entirely fair (the advocates of intuition propose it, after all, largely because they think rational methods too crude), it does point to an important aspect of their attitude. They refuse to face the problem. If we too turn our backs on it, there are others who will rush in regardless. The technologists are already gnawing at the door, and in their naive scientism will certainly do damage if they are not forestalled.

If architecture is to produce forms of quality again, its whole method needs to be changed. At present the great gift of man, his ability to shape a plastic form, is being nullified by the size of the tasks in front of him, and mocked by the efforts of the 'artists'. If the great gift is to be allowed to show itself again, and architecture to regain its stature, the process of producing form needs serious revision. It needs understanding developed from the specific point of view of form. So that one day we may rely on carefully found insight, instead of tradition, intuition and taboo. The only tradition with any place in architecture – as we must insist from the beginning – is that of patience, patient intellectual inquiry, and constructive criticism.

16 Such attempts are well described by Sigmund Freud in *Das Unbehagen in der Kultur*, Vienna: Internationaler Psychoanalytischer Verlag, 1930, or by K. R. Popper in *The Open Society and its Enemies*, Princeton: Princeton University Press, 1950.

3 *The Nature of Order, Book One*, section on local symmetries, 2001

The experiment described here, done at Harvard by CA and Susan Carey in the early 1960s, was originally published in 1968 in the journal Perception & Psychophysics[1]. *But different aspects of it were reported by CA in several different places, including in* The Nature of Order, *excerpted here. A detailed account of the experiment is used to describe local symmetries, one of the fifteen properties of wholeness identified in the book. That it played such an important role in* NoO *helps speak to how CA's early work persisted, and how ideas like wholeness, central to the later work, were already present at the beginning.*

Christopher Alexander, The Nature of Order, Book One, The Phenomenon of Life. *Berkeley: Center for Environmental Structure, 2001, pp. 186–194. Republished by permission of the Center for Environmental Structure.*

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2.7 / Local symmetries

We have seen that each strong center is a microcosm of the widespread wholeness which can occur in space. In many of the examples, it has been implicit that the presence of a strong center in the field depends, to a great degree, on various interlocking and overlapping LOCAL SYMMETRIES. This happens, most obviously, because the existence of a center and the existence of a local symmetry are closely related. Wherever there is a local symmetry, there tends to be a center. Where a living center forms, it is often necessary to have some local symmetry.

However, the exact relation between life and symmetry is muddy. Living things, though often symmetrical, rarely have perfect symmetry. Indeed, perfect symmetry is often a mark of death in things, rather than life. I believe the lack of clarity on the subject has arisen because of a failure to distinguish overall symmetry from local symmetries.

Observe, first, that *overall* symmetry in a system, by itself, is not a strong source of life or wholeness. This Rorschach ink-blot, for instance, is a rather weak whole; it has

1 Christopher Alexander and Susan Carey, "Subsymmetries". *Perception and Psychophysics* vol. 4(2) Feb. 1968, pp. 73–77.

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relatively little life as a structure; its centers are poorly developed. The one large symmetry it has, by itself gets you very little.[2]

Observe further that over-simplified *overall* symmetry in buildings is most often naive and even brutal. The neoclassicist buildings of Mussolini's fascist era are often perfectly symmetrical but, like the ink-blot, have little life in them. Albert Speer's design for Zeppelinfeld is another example. And the plan for the Renaissance Center, Detroit, actually proposed by a real architect, has a similarly rigid and exaggerated symmetry. Obviously this place would not have had much life, if it had been built as drawn. There is powerful overall symmetry in the large composition and in the parts. But we do not experience subtle wholeness. Instead, we experience almost insane rigidity – the very opposite of life.

In general, a large symmetry of the simplified neoclassicist type rarely contributes to the life of a thing, because in any complex whole in the world, there are nearly always complex, asymmetrical forces at work – matters of location, and context, and function – which require that symmetry be broken.

We see this clearly in the Alhambra – a marvel of living wholeness. It has no *overall* symmetry at all, but an amazing number of minor symmetries, which hold within limited pieces of the design, leaving the whole to be organic, flexible, adapted to the site.[3]

To understand to what a deep extent the beauty of the Alhambra plan lies in the loose and subtle inter weaving of local symmetries, we may compare it with the plan of the Detroit Renaissance Center I have referred to. In the Alhambra, we sense that each room, court, garden, hall, works in its own right – because its local symmetry helps locally to make better space. In the Renaissance Center plan we feel something quite different: the various aspects of symmetry that appear seem not to be governed by the local needs of each space, but are, rather, extensions of some huge symmetrical scheme which is irrelevant to the character of any particular room or garden, and instead merely reflects automatic and totalitarian reach of a larger scale order which is ultimately irrelevant to life as it arises locally. Thus the real binding force which symmetry contributes to the formation of life is not in the overall symmetry of a building, but in the binding together and local symmetry of smaller centers within the whole.[4]

The fact that *local* symmetries work to create coherence, while *overall* symmetry rarely does, was dramatically illustrated by an experiment I did many years ago while working at the Harvard Center for Cognitive Studies. In this experiment, I compared a number of black and white paper strips, and measured their coherence as felt,

2 Two un-numbered illustrations near here. First caption: "A Rorschach blot; perfect overall bilateral symmetry, but no others." A rather weak center. Second caption: "Zeppelinfeld by Albert Speer: brutal overall symmetry of a very simple-minded type, but few local symmetries."

3 Two un-numbered illustrations near here

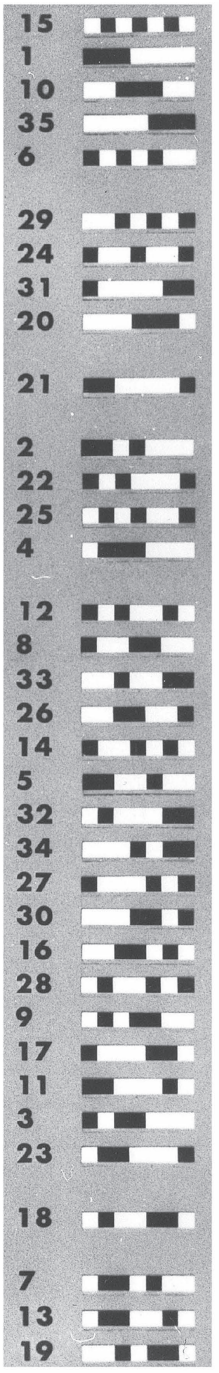
First caption: "The plan of the Alhambra: the plan is a marvel of centers formed in a thousand combinations, and yet with beautiful symmetrical local order at every point in space

Second caption: "Rigid and exaggerated local symmetry in an urban plan: the Renaissance Center, Detroit. Here the symmetries are crude and totalitarian. They arise from a conceptually imposed order, not from natural adaptations within a whole."

4 Two un-numbered illustrations near here

First caption: "Granada: the Alhambra and the gardens of the Generalife. The order is entirely asymmetrical in the large, but is covered with a multitude of local symmetries."

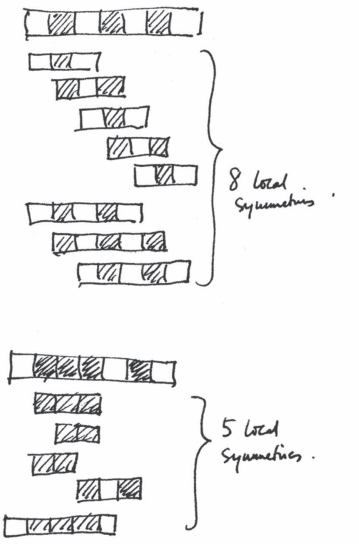
Second caption: "Previously shown fragment of the Alhambra tilework: its local symmetries are evident."



The 35 strips, in order of decreasing coherence, as measured by experiment

9 local symmetries
9 local symmetries
7 local symmetries
9 local symmetries
7 local symmetries
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5 local symmetries

The number of local symmetries in each of the strips



Two of the patterns, shown with their local symmetries. The upper pattern has 9 local symmetries and appears high on the order of coherence; the lower pattern has 6 local symmetries, and appears low on the order of coherence.

Figure 3.1 The illustration at the left is from the original experiment; the right is an analysis by CA, done for *The Nature of Order*, of the original experiment.

experienced, perceived, remembered, by different experimental subjects. The black and white strips I used are shown on page 189, in order of their coherence (as measured by my experiments).

I was able to show that the coherence of a strip depends on the number of local symmetries which appear in its pattern (a local symmetry being defined as a shorter segment of black and white squares within the strip as a whole, which is itself locally symmetrical). Apparently, the perceived coherence of the different patterns depends entirely on the number of symmetrical segments which they contain. Since each of the segments, when symmetrical, is a "*local* symmetry," I summarized this experimental result, by saying that the most coherent patterns are the ones which contain the largest number of local symmetries.

In another series of experiments my colleagues and I very strongly established the vital role of local symmetries. (In fact the experiments go rather deeper, and provide confirmation for the existence of the wholeness as an overlapped structure of centers, as I have defined it in chapter 3. But above all, they focus on the key role which local symmetries play in the creation of wholeness.)

The experiments were performed with 35 black-and-white strips seen on a neutral gray background (this page). Each strip was 7 squares long, and was composed of 3 black squares and 4 white squares, arranged in different arrangements. There are 35 possible strips of this kind.

First, we established that the relative coherence of the different patterns – operationally defined as ease of perception – was an objective quality that varied little from person to person. That is to say, the coherence is not an idiosyncratic subjective feature of the patterns seen differently by different people. It is an objective measure of cognitive processing, roughly the same for everyone.

Second, we were then able to identify the structural feature of these patterns which *caused* this perceived "coherence." It turned out that the perceived coherence depends, simply, on the number of local symmetries present in the pattern. However, since most of the symmetries are hidden, this feature is far from obvious, and is a deeply buried structure in the patterns.

We first devised various different experimental tasks which were designed to find out which of the patterns people saw as most orderly, most coherent, or most simple, or "as having the most structure." The experimental tasks varied. They ranged from simply asking people which patterns they found most orderly to ways of establishing which ones could be seen, and recognized, most quickly, at very high speeds; from ways of testing which ones could be most easily described in words to ways of testing which ones were objectively easiest to remember, under difficult memory conditions.

We found that, whether we used ease of description, ease of memorization, subjectively judged "simplicity," or ease of recognition in a tachistoscope, the relative coherences as measured by these different experiments were very strongly correlated. It was therefore possible to combine the rank orders in the different experiments to create an overall rank order of perceived cognitive coherence for the 35 strips.

From this first series of experiments, two important results emerged. First, in any one experiment, the relative degree of coherence seen in different patterns was rather constant from person to person. This means that the coherence is not a subjective thing seen differently by different people. People agree about it. Second, the relative

coherence of the different patterns, as measured by the different experiments – even though these experiments were based on widely different kinds of cognitive processing – remained roughly the same.

Taken together, these two results indicated that the relative coherence of the patterns is an objective matter of cognitive processing, independent of the person who is judging, and independent of the particular kind of experimental judgment which is used to measure it. It is therefore possible to construct a single overall order of coherence for the 35 patterns. The photograph on page [26] shows the strips in order of perceived coherence, the most coherent at the top, the least coherent at the bottom.

For three or four years after completing this experiment, I worked almost continuously to find some structural feature of the 35 black and white patterns which would explain the rank order of coherence of the different patterns. What do the more coherent ones have in common? What do the less coherent ones have in common? To solve this problem, I would try some measure of orderliness, then calculate this measure for the 35 different patterns, and then see if the rank order which this measure generated was the same as the one we had obtained earlier, experimentally.

It was an extremely difficult thing to do. The crux of the problem lay in the fact that, among the 35 strips, the "good" ones are of very different types. One, for instance, is completely symmetrical, and has the black and white squares alternating. Another is completely asymmetrical, and has all the black squares together in a lump, and all the white ones together in a lump. Others have both lumpiness and overall symmetry. Others have neither.

Since lumpiness and symmetry were two of the main explanations for cognitive simplicity in common currency around 1960, it was hard to get beyond these features. I tried various combinations of the two, but always concentrated on lumpiness and on *overall* symmetry in some combination.

It took me three or four years to find the right answer. The reason is that local symmetries (as opposed to overall symmetry) were not under discussion at all in the literature. Further, the local symmetries are nearly invisible in the pattern – they do not jump out at you, but are lost, rather as children's tiger-in-the-trees pictures confuse the eye and make you lose the tiger.

Further, it was quite unclear how to unite the idea of symmetry with the idea of large lumps. It was this that finally gave me the key, when I realized that both overall symmetries and large lumps actually contain more local symmetries inside them. For instance, a lump of white that is four squares long is symmetrical, overall. But it also contains three symmetrical segments that are two squares long and two that are three squares long, making – with the four-square long lump itself – a total of six local symmetries. Five of them are hidden. But, even though hidden, the local symmetries are capable of being counted and measured to show both the presence of overall symmetry, and the presence of large lumps. Two other examples are shown on the opposite page.

So, after four years of work, and hundreds of tries, I found a very simple measure which correlated very strongly (in fact almost perfectly) with the ranked coherence of the different patterns.

This measure is *the number of local symmetries which the pattern contains*. To count the local symmetries in one of these strips, I considered the strip as made of seven adjacent squares. There are, within a strip, twenty-one connected segments made of two, three, four, five, six, or seven adjacent squares (just one segment that is seven squares

long, two segments that are six squares long, three that are five squares long, four that are four squares long, five that are three squares long, and six that are two squares long – twenty-one connected segments in all). In any particular strip, with a particular pattern of 3 black and 4 white squares, we can examine each of these twenty-one segments, one by one, and ask if it is symmetrical or not within itself. I called each symmetrical segment a subsymmetry of the pattern. Among the 35 strips made of 3 black and 4 white squares, the strip with the highest number of internal symmetries has nine subsymmetries among its twenty-one segments. The strip with the lowest number has five subsymmetries.

I have displayed the number of subsymmetries that are in each strip opposite the picture of the strip, in the photograph on page [26]. The 35 strips are arranged in the overall combined order of perceptual coherence. To the right of the photo is the number of subsymmetries the strip contains.

As we see, the strips which are most coherent experimentally also have the highest numbers of subsymmetries to within a high degree of correlation. Those strips which are least coherent experimentally have the lowest number of subsymmetries. The number of local symmetries the pattern contains essentially predicts how "good" it is.

The measure is subtle and refined. Even in the most coherent patterns only 9 of the 21 segments are symmetrical. And in the least coherent patterns 5 of the 21 segments are symmetrical; so the number of subsymmetries varies only modestly from pattern to pattern. Nevertheless, the way it varies mirrors, almost perfectly, the actual cognitive coherence as measured by experiment.

It is important that I stress once again that this result has little or nothing to do with the *overall* symmetry of the design. At the time I analyzed the original experimental data and first discovered the relation between local symmetries and perceived coherence, I also tested another criterion, in which the symmetrical segments are weighted by their length. In this second criterion, the longer a symmetrical segment is, the more points I gave it, and the strips with large overall symmetries thus got extra points in this measure. I found out that this second criterion correlates *less* well with the experimentally measured coherence. Apparently large symmetries do little to contribute extra coherence to a pattern: what matters more is the *number* of smaller – i.e., local – symmetries.

Why does the presence of many local symmetries in the design make it coherent and memorable? It is as if the symmetrical segments act as a kind of glue – the glue which holds the space together. The more glue there is, the more the space is one, solid, unified, coherent. And notice one more detail: for the glue to be effective, it seems that many of the symmetrical segments must overlap. They are by no means discrete or disjoint. One symmetrical segment overlaps another – and it is not only the number of symmetrical segments, but also their continuous overlapping which makes the glue that makes the design "whole."

These experiments played a very big role in my own effort to find a theory of wholeness, since it strongly confirmed my growing suspicion that the wholeness in the world is in some fashion a structure of overlapping wholes. Note that the subsymmetries are not distinct, but overlap within any one pattern. It is this overlapping structure of perceived entities, in this case defined by their local symmetry, that forms the salient wholeness which is perceived and felt. In later years the entities (seen in the experiments only as local symmetries) were extended to be wholes, and later centers, to

provide the underpinning of the theory in its entirety. What is essential is that the local symmetries in these patterns play a decisive and quite unexpected role. Though hidden from view, they essentially control the way the pattern is seen and the way it works.[5]

Look again at the plan of Alhambra. It illustrates the point magnificently. The Alhambra's plan, overall, is wildly asymmetrical, it has nothing in common with the excesses of neoclassicism – it is free, free as a bird. Yet in its detail, it is simply *full* of symmetries at many levels. There are courtyards which are internally symmetrical, rooms which are symmetrical, pieces of wall, windows, columns, which are symmetrical – the plan is a maze of intricate and subtle smaller symmetries, symmetries of segments or subsymmetries, yet none of this ever creates that dead and lifeless overall neoclassicist symmetry of which we should rightly be afraid.

On a smaller scale we see the very same thing in a row of Amsterdam canal houses. The row of houses as a whole is not symmetrical. Nor is any one house, taken by itself, perfectly symmetrical, neither in its plan, nor in its front facade. Yet both in plan and in elevation, each house, and the row of houses as a whole, contains vast numbers of powerfully symmetrical elements put together, so that the feeling of symmetry and order pervades the structure. It is the *local* symmetries which cause its beautiful order.

What is the relation between symmetries and centers? How do symmetries allow centers to intensify each other? In many cases, a symmetry is used to establish an elementary center. Indeed, an overwhelming majority of centers are locally symmetrical. Each local symmetry establishes a symmetry between two smaller centers to create a larger center. Indeed, one might almost say, "When in doubt, make it symmetrical." Most centers become stronger when symmetrical, except, of course, that symmetries must not be used to smooth out real asymmetries in external conditions, and must always be true to the local conditions.[6]

However, provided that the irregularity of the local context is not violated, local symmetries provide a glue which binds the field of centers, thus making centers more coherent. We see this in the primitive and beautiful pattern of the 9th-century illustration from the Book of Kells, where an apparently irregular field is disciplined by the powerful presence of many symmetries and symmetrical structures – yet the whole thing is strongly asymmetrical, bent by its own laws, formed by the process of growth in the draftsman's hands.

If we want to create or intensify a center, we can always most easily do it by making a local symmetry between other centers. And, in practice, the easiest way to make a complex thing is often to make it up out of regularly shaped pieces, and then patch in any irregularities.[4] This method of composition is illustrated by the incredible Persian tile work on the left, where very simple symmetries are chained together in this wild and powerful composition, replete with new centers which the symmetries have formed.

5 In the original, Figs 3.10 and 3.11 were here. Caption to Fig. 3.10: "Canal houses in Amsterdam." Caption to Fig. 3.11: "Detail of a page from the Book of Kells. Although the swirls and grotesques are curvilinear, when we look closely at them we see that they are filled with overlapping local symmetries, and this is, in large part, the source of their beauty."

6 Illustration near here. Caption: "Tile-work from the mosque in Gazur-Gah'"

4 On changing the way people see, 1964

This article, published in the journal Perceptual and Motor Skills, *reports on a different aspect of the experiment reported in "Subsymmetries," previously. Here, the question of different kinds of perception, and the conditions under which subjects "can be brought to change their perceptions from 'sequential' to 'figural,'" were reported. It is another aspect of the idea of wholeness published almost forty years later. This article provides detailed descriptions of the details of the experiment.*

Although the text retains references to the original illustrations, only one illustration is included, as a sample of the experimental results. A. W. F. Huggins was co-author. The work was supported in part by a grant from the National Science Foundation No. NSF Grant G-16486

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Summary. – Ss see black and white linear patterns either as sequences ("sequentially"), or as wholes ("figurally"). The object of this study was to determine under which conditions, if any, *Ss* can be brought to change their perceptions from "sequential" to "figural." (1) *Ss* tended to see the patterns sequentially at first, but (2) the task of searching for single patterns in disorderly arrays of many patterns forced Ss to see the single patterns figurally. (3) Other kinds of experience, expected to have the same effect, induced little change.

It is well known that certain linear patterns are first perceived as sequences, and only later, when the perceiver has more experience, seen as "wholes." Examples occur in music, language, morse-code, telegraphy, painting, arithmetic, the analysis of sequential data from an experiment. In all cases a naive perceiver hears, reads, or sees step by step, building up the pattern from very small units, and is at first unable to appreciate or even sense the larger whole. As the perceiver becomes experienced, he is able to take in larger units at a time, and thereby get a better sense of the whole organization – so much better, indeed, that the ability to see large patterns in such a sequence is always taken as a mark of sophistication.

It is naturally important to know how to induce this sophistication artificially. In particular, it is important to invent ways of inducing it that do not rely on specific

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demonstrations of what the larger units are, but somehow force the perceiver to become aware of them by himself.

The experiments presented here deal with the visual perception of 35 black and white linear patterns, and three ways of forcing *Ss* to perceive these patterns as wholes.

To decide whether experience changes *S's* mode of perception, we must first find some objective means of describing the way in which S sees the patterns. The obvious ways of doing this are based on similarity judgments, on confusions, or on concept formation experiments (Alexander, 1960; Heidbreder, 1924; Hull, 1920; Miller & Nicely, 1955; Osgood, Suci, & Tannenbaum, 1957). However, all these methods have two serious drawbacks. (1) They require a large number of judgments, in fact so many that *S's* mode of perception may change during the course of the experiment. (2) The results still need interpretation – through factor analysis, clustering techniques, or guessing.

We believe that we have discovered a much easier and neater way of describing S's manner of seeing. If S lays all 35 of our stimulus patterns on a board, and arranges them to make them as easy as possible for him to find, the board soon has a definite, orderly character. But different *S*s by no means agree about the kind of order or arrangement which works best. Indeed, we find that each S has his own way of doing it.

The arrangement S makes on his board gives us a beautifully explicit account of the way he perceives the patterns. He groups together those patterns which he perceives as similar.

Experimental arrangements

Materials

For stimuli we used horizontal rectangular patterns, each one in effect a strip composed of three black and four white squares. Adjacent squares of the same color were not separated. There were 35 different patterns of this kind [7!/(3!×4!)]. They are illustrated in Fig. 1. They were made from high-contrast photostatic copies of black and white card masters. Each pattern was ⅜ in. high, and 2⅝ in. long; it was protected by a strip of transparent "Scotch" mending tape which overlapped the pattern on the bottom edge so that the bottom of each pattern was marked, clearly but unobtrusively, by a greyish semitransparent strip.

These patterns were always seen against a board whose top surface was an achromatic grey paper. The paper was selected from those available so that neither the black nor the white portions of the patterns seemed to stand out more clearly than the other. (The reflectance of the white was about 0.9, that of the grey about 0.3, that of the black about 0.05). The board was 18 in. by 24 in., with a grid drawn on it in pencil. This grid contained 7 columns and 15 rows, making 105 rectangular cells, each 1 in. high by 31/4 in. wide. The cell size was chosen so that patterns placed in adjacent cells were close enough to be taken in at one glance, but not so close that they interfered with one another visually.

The third item of equipment was a set of 35 different slides. Each slide was a photograph of one pattern, lying on the achromatic grey paper mentioned above. The slides were back-projected on a milk-glass screen so that a pattern, projected from the slide onto this screen, looked like a pattern seen on the board, both in size and over-all brightness.

The illumination of the board remained constant throughout the experiments, to avoid any difference in black-white-grey relationships affecting the results.

(The photographs are misleading in this respect. They were taken under conditions of uneven illumination, different from the laboratory conditions.)

The 35 slides were in the projector in a fixed order, originally determined by a random process, but left unchanged throughout the experiments.[1]

The fourth item to be described is what we call a random-like array. This is an arrangement of the 35 patterns in a rectangular block, 5 cells wide, by 7 cells high, in which there is no discernible order or regularity. An arrangement generated by a random process would of course contain all kinds of minor regularities. The random-like array was made by laying the patterns out in a rectangular block five columns wide.[2] Each relationship that could be seen was then destroyed, until there were no orderly connections between any pair of patterns in adjacent cells. The random-like arrays are shown in Fig. 2.

Subjects

Ss for all the experiments to be described were undergraduate girls from Radcliffe College. None of them had seen this material before.

Test procedure

When *S* came in she sat down at a table. The ground glass screen was in front of her, about 2½ ft. away, and beyond it was the projector. Between her and the screen, on the table, was the board. On it a random array (No. 1) was laid out. As soon as she sat down she was given the following instructions.

> *Instructions for test.* – There are 35 patterns here, all different. I am going to show one of these patterns to you at a time, there on the screen, and as soon as I show it to you I want you to find the pattern among those on the board. All the patterns I shall show you will be on the board; there are no tricks. I may show you the same pattern more than once, or even several times.
>
> Every time I put a new one on the screen, I shall start this clock, and I want you to find the corresponding one on your board as fast as you can. It must be the same way up as the one on the screen. When you find it point to it. When you point to the right one, I shall stop the clock.
>
> Now as you see, the patterns are loose and may be moved (demonstrating). Each time after I stop the clock, you will have about 15 or 20 sec. of free time. During this time you may move the patterns if you wish so as to make it as easy as possible for you to find the ones I show you. You may put them wherever you wish, except for two things. (1) You must keep all the patterns the same way up that they are now. (2) You must always place them one per compartment in the middle of the compartments marked on the board.
>
> You need not keep them in the tight rectangular array they are in now. In fact, if you do you'll probably make things rather hard for yourself.

1 The original has Figs. 1a and 1b here. Captions: "Fig. 1a. Sequential example" and "Fig. 1b, Figural example."

2 The original has Fig. 2 here. Caption: "Fig. 2. Random arrays."

As soon as *S* understood the instructions, the test began, so as to give her no time to examine the random array and develop any special kind of set due to preconceptions. *E* projected the first pattern on the screen by a remote control connected to the automatic slide projector which carried the tray of all 35 slides. When the slide came onto the screen, E started a clock. The pattern remained on the screen until *S* found it. If *S* pointed to the wrong one, E said so, and let the clock run until she found the right one.

When the right pattern had been found and the clock switched off, there was a pause of about 20 sec. during which *S* might rearrange the patterns on the board. She was warned before the next pattern appeared on the screen.[3]

After about half the patterns had been presented, E called a temporary halt, and explained that he wanted to ask some questions about the arrangement *S* had so far produced on the board. The questions were of the form: "Suppose I were to interchange these two patterns, would this make any difference to how easily you find the patterns?" "What about if I changed the order of these six?" etc. Before this procedure was started, it was made clear to *S* that the questions were all neutral. Some of the changes mentioned might improve her arrangement, whereas others might not. All that we wanted to know was: would the suggested change make any difference to *her*. None of the suggested changes were actually made, though *S* was free to make them later if she wished; in practice, the questions never led to radical reorganization.

The reason for this question period was twofold. First, we wished *S* to clean up any "loose ends" in her arrangement and consolidate the ideas she was developing. For our purposes we naturally wanted as explicit a statement as possible about *S's* perception, and therefore wanted the arrangement to be as unambiguous as possible. Secondly, the questions helped to clarify for *E* what *S* was doing. Often a large block of patterns which were grouped together (say 10 or 12 of them) would be thought of by *S* as made up of several subgroups. Although there was no physical separation between the subgroups, it was possible to detect the presence of these divisions by means of the questions.[4] If *S* thought of two adjacent patterns as being in the *same* subgroup she didn't mind interchanging them; if she thought of them as being in different subgroups, however, she would not allow them to be interchanged.

After this question period, the test went on as before. When the last slide had been presented, *S* was told not to make any more changes and was asked to give a verbal account of what she had tried to do, so that we could be quite sure we understood the grouping of patterns on the board correctly.

All *Ss* took this test. However, for the 16 *Ss* who form the control group, this was their first and only exposure to the material. The arrangements produced by the control group are shown in Fig. 3.[5]

3 One or two *Ss* began to separate the patterns which had appeared already, from those which had not. These *Ss* were reminded that any pattern might appear more than once, and were asked to make an arrangement that did not discriminate between patterns that had been shown and those which had not. In fact, since there was just one slide for each pattern, and the slides came in a fixed order, *S* saw each pattern just once. However, as far as we know, no *S* ever realized this.

4 The original has Figs. 4.4 and 4.5 here. Captions: "Fig. 4.4. Control group (half) and Fig. 4.5. Control group (half).

5 It should be noted that the numbering of *S*s arrangements in the figures is for ease of reference, and is not the order in which *S*s were run.

Experience I: random search experience

The purpose of this experience was to investigate the effects on perception of searching in totally unstructured and unstructurable situations. The experimental procedure was the same as that described for the test, except that in this case *S* was not allowed to move the patterns about on the board at all. She thus had to find each pattern, as it was presented, by searching for it in the fixed random-like array. S searched for each of the 35 patterns, in each of two arrays. These two random-like arrays, Nos. 2 and 3 in Fig. 2, were both different from the one which starts off the test situation but they were constructed in the same way, and were intended to be as different from one another as possible to avoid any position learning effects. The patterns appeared on the screen in the same order as in the test. *S* was given the following instructions:

> There are 35 patterns here, all different. I am going to show one of these patterns to you at a time, there on the screen, and as soon as I show it to you I want you to find the pattern among those on the board.
>
> All the patterns I shall show you will be on the board; there are no tricks. I may show you the same pattern more than once, or even several times.
>
> Every time I put a new one on the screen, I shall start this clock, and I want you to find the corresponding one on your board as fast as you can. It must be the same way up as the one on the screen. When you find it, point to it. When you point to the right one, I shall stop the clock. You may not move the patterns on the board.

After this experience, which lasted about 1/4 hr. for each array (a total of ½ hr.), *S* was given the test; the 8 *S*s produced the arrangements illustrated in Fig. 4.

Experience 2: tachistoscopic experience

The purpose of this task was to give *S* experience with the patterns, but under conditions in which they were available to her as input for such a short time that she had to work hard to identify them. *S* was given the following instructions to read.

> This is an experiment in perception. In the first part of the experiment, I shall flash patterns on the screen in front of you, one at a time. They will appear inside this frame. The patterns are very simple. At the end of each presentation, there will be a short, very bright flash.
>
> What I want you to do is to fill in the pencilled outline on the strip of paper, until it looks like the pattern you have just seen. Try to work fast, but draw them accurately, so that you would be able to select the pattern from some others like it, if you were asked to later. When you have finished, fold it under so that you cannot see it, and tell me, so that I can flash the next pattern. Are there any questions?

S sat in front of the screen, and the patterns were projected on it one at a time, in the usual order. They appeared inside an outline pencilled on the glass so that *S* knew where to look. The exposure was controlled by a photographic shutter,

and lasted about 20 msec. As the shutter closed, it fired an electronic photoflash which was directed at the fixation outline from behind the screen. This served to kill the after-image, thus ensuring that we had control of the effective duration of the image.[6]

S was given a strip of paper on which appeared pencilled outlines of about the same size as patterns appearing on the screen. Her task was to reproduce the pattern she had just seen, in pencil, within the outline. After each drawing was completed, it was folded under so that *S* did not have any opportunity to look at her previous efforts. After the 35 slides had all been presented in the usual order (this took about ½ hr.), *Ss* were given the test. The 10 *Ss* produced the arrangements illustrated in Fig. 5.

Experience 3: play experience

The purpose of this procedure was to investigate the effects of "creative" play on S's perception. S sat down, and was given the following instructions:

Here are some patterns. I want you to play with them and get to know them.

Then, as S began to make a pattern of some sort with the pieces, as she inevitably did, she was told further:

> If you want to make a larger pattern with them, don't feel constrained; make any kind of pattern you feel like. Imagine you're an artist and "doodle" with them.

When she had finished, we photographed the arrangement, and then scrambled the pattern up on the board. She was then told:

> Now please start all over again. This time make a pattern as different from the first as you can.

This arrangement was photographed and the patterns scrambled. The third time she was told:

> Now please start again, and make a pattern as different as possible from the other two. Please give a good deal of thought to each individual pattern this time. Before you decide just where to put it, in relation to the other patterns, look at it very carefully, and try to decide in your own mind just where it 'belongs.'

This arrangement also was photographed. After this play period which lasted about ½ hr., S was given the test. Two examples of play arrangements are illustrated in Fig. 6. The arrangements that the 12 *S*s produced in the test period are illustrated in Fig. 7.

6 Compare work of Baxt (1871) and Sperling (1960a, 1960b). A piece of plain glass extracted some light from the projector beyond the shutter, and this was used, by means of a photosensitive resistance element and two Mercury relays, to fire the flash gun when the shutter closed.

Results

Tabulation and analysis of data

We first describe our method of classifying the test arrangements. We wish to discriminate between perceivers who see a black and white strip as a sequence, and those who see it as a whole. We do this by examining the groups of patterns which *S* creates. It is usually easy to identify these groups, because they occur in different columns on the board, or because they are separated from one another by empty cells. However, essential supplementary information about the groups S considered herself to be using was obtained during the question time in the middle of the test (cf. Test Procedure above). To help the reader understand how the distinction between sequential and figural is based on the groups, we have constructed two arrangements as examples, one based on sequential groups, the other on figural groups (Fig. 1).

A glance at Fig. 1 will make it clear that in the sequential arrangement, those patterns which start with black are separated from the ones which start with white. Within the "black" group, the patterns that start with a single black square are separated from those which start with two black squares. Within each of these subgroups the patterns are further grouped according to the length of the second block, and so on. This leads to an arrangement essentially isomorphic with the binary numbers. Search for a pattern is based on a left-right reading of the color and size of the individual blocks within the pattern. *The pattern is seen as a sequence of units*.

In the figural arrangement the sequential position of blocks in the patterns is less important than the type of structure each pattern exhibits as a whole. Each pattern is seen as black figure on white ground, so that those patterns that have the same figure are grouped together (whichever way around the figure is, and wherever it appears in the pattern). Within these groups, patterns are further grouped according to the position of the figure in the ground. *The pattern is seen as a single unit*.

The two arrangements shown in Fig. 1 are easy to classify as sequential and figural, respectively. They are unambiguous. Many of the arrangements produced by *S*s were equally unambiguous. However, there were some in which both sequential and figural groups of patterns occurred, and these introduce a need for an objective method of classification. Instead of trying to give a general rule for what constitutes a figural group, it is easier to define the concept extensionally, by listing the following possible groups. (Notice that in every case the property must hold for *all* patterns in the group.)

1 Every pattern in the group contains a single long black block, and no other black. (See, for example, Fig. 3, Control 16.)
2 Every pattern in the group contains three black squares (e.g., Fig. 4, Random Search 4).
3 Every pattern in the group contains two black blocks, one short and one long; and some of these patterns are related systematically to their mirror-images, or to the patterns that contain mirror-images of their figures, so we are sure that it was the figure that was important, not the sequence (e.g., Fig. 4, Random Search 5).
4. Every pattern in the group has the same number of black-white boundaries (e.g., Fig. 7, Play 6).
5. Every pattern in the group is symmetrical (e.g., Fig. 4, Random Search 1).

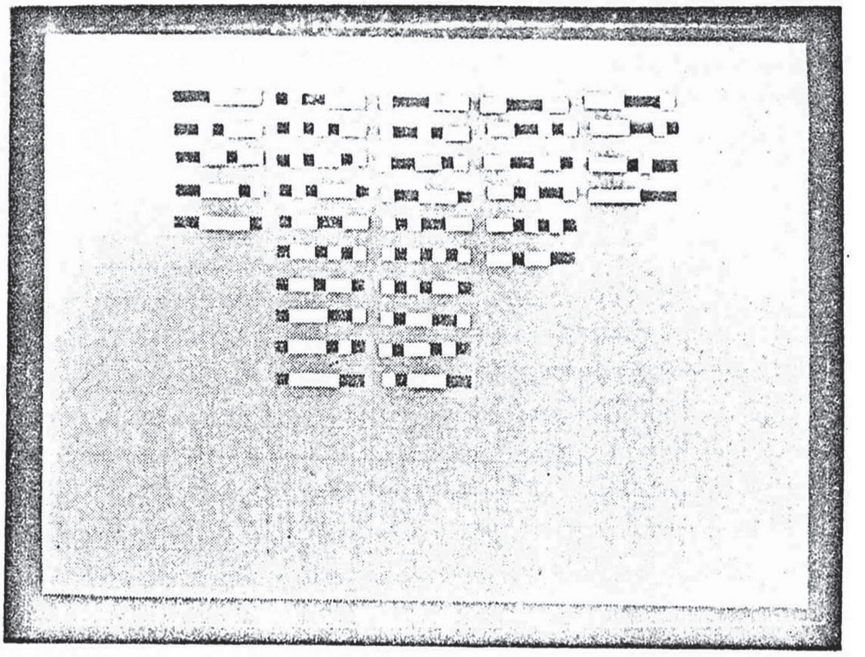


FIG. 1a. Sequential example

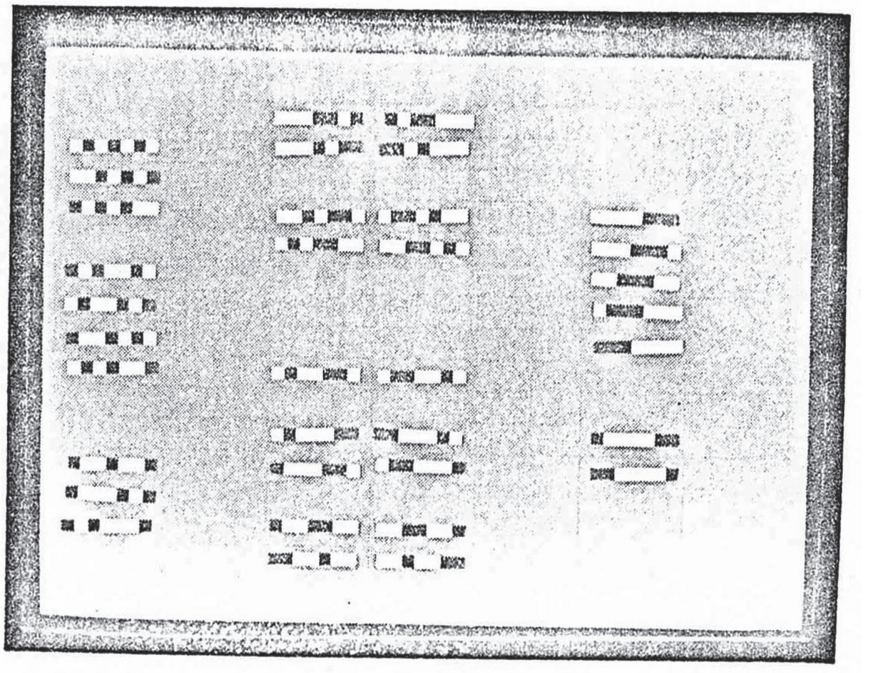


FIG. 1b. Figural example

Figure 4.1 Example of the illustrations of experimental results that appeared in the original article.

6 Every pattern in the group has its white broken into the same number and size of pieces (e.g., Fig. 7, Play 11).
7 For every pattern in the group, the mirror-image is also in the group (e.g., Fig. 5, Tachistoscope 10).
8 For every pattern in the group, the pattern obtained by reversing just the black figure is also in the group (e.g., most of the groups in Fig. 3, Control 14, but especially the group of four in the middle of the right hand column).
9 All of the patterns in the group are "simple" i.e., contain three or less blocks, or are symmetrical (e.g., Fig. 4, Random Search 8).

We classify a group of patterns as figural if it meets one of the above nine criteria; otherwise we classify it as sequential. The number of groups of each kind in the different arrangements, are shown in Table 1.

We classify each arrangement as a whole, as figural, sequential, or intermediate, according to its constituent groups, as follows. An arrangement is classified as figural if all the groups in it, with at most one exception, are figural. An arrangement is classified as sequential if all the groups in it, with at most one exception, are sequential. If an arrangement contains more than one figural group, and more than one sequential group, it is classified as intermediate.

We give a summary of Table 1, and the probabilities of these results, in Table 2 below. The probabilities given in the last column permit us to reject the null hypothesis that all groups are drawn from the same population.[7]

Findings

The random search procedure has a strong effect on the way people see. About three quarters of the *S*s who would (judging by the control group) have seen the patterns as sequences, after exposure to the random search experience instead see them figurally.

The Play experience and the Tachistoscopic experience have a smaller effect, the effect they do have is in the same direction as the effect of Random Search. They tend to make *Ss* see figurally.

Discussion

The most striking aspect of these experiments is the definite direction of the perceptual changes which occur. The three kinds of experience, "search on a random-like array," "exposure to tachistoscopic presentation," and "play," were chosen to be free from any explicit bias toward figural perception. What is more, sequential perception, according to remarks made by *Ss* during the experiment, is a very neat, systematic way of dealing with the patterns. Since all three kinds of experience induce a tendency in *Ss* to abandon this mode of perception and to learn to see the patterns as wholes, rather than as sequences, we must infer that the figural mode is in some way more efficient than the sequential.

Why does Random Search induce this change? The first and most obvious hypothesis is that mere exposure to the patterns tends to make *S* see them figurally. However,

7 A modified Fisher exact probability test was used; see Appendix for details.

Table 1 Data for each group and individual

Control group (Fig. 3)																
S identification	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Total groups in *S*'s arrangement	8	9	8	7	6	6	7	7	1	8	8	7	10	10	7	6
Number of figural groups	1	0	0	6	1	0	0	0	0	5	1	0	9	9	7	6
Number of sequential groups	7	9	8	1	5	6	7	7	1	3	7	7	1	1	0	0
Classification†	S	S	S	F	S	S	S	S	S	I	S	S	F	F	F	F
Random Search Group (Experience 1) (Fig. 4)																
S identification	1	2	3	4	5	6	7a*	7b*	8							
Total groups in *S*'s arrangement	7	7	9	6	11	10	8	8	6							
Number of figural groups	7	7	9	6	11	2	1	7	2							
Number of sequential groups	0	0	0	0	0	8	7	1	4							
Classification	F	F	F	F	F	I		I	I							
Tachistoscope groups (Experience 2) (Fig. 5)																
S identification	1	2	3	4	5	6	7	8	9	10						
Total groups in *S*'s arrangement	8	7	8	10	6	8	8	10	7	9						
Number of figural groups	7	7	0	6	5	4	1	10	0	8						
Number of sequential groups	1	0	8	4	1	4	7	0	7	1						
Classification	F	F	S	I	F	I	S	F	S	F						
Play group (Experience 3) (Fig. 7)																
S identification	1	2	3	4	5	6	7	8	9	10	11	12				
Total groups in *S*'s arrangement	7	11	8	8	9	6	9	9	7	4	11	11				
Number of figural groups	1	1	4	6	9	6	9	9	0	0	11	11				
Classification	S	S	I	I	F	F	F	F	S	S	F	F				

†Classification as Sequential (S), Intermediate (I), Figural (F).

*Subject 7 stopped in the middle of the test, to say: "There are two ways of doing this," and demonstrated by making both arrangements 7a and 7b. We have illustrated both arrangements, but have classified them as a single intermediate.

Table 2 Probabilities associated with data of Table 1

	No. of Ss classified as: P*			
	Sequent.	Inter.	Figural	
Control group	10	1	5	
Random search	0	3	5	0.006 <P< 0.018
Tachistoscope	3	2	5	0.11 < P < 0.14
Play	4	2	6	0.11 < P < 0.13
Pooled total	7	7	16	0.010 < P < 0.014

*This group was drawn from the same population as the controls.

the weakness of the Play experiment makes it clear that this is not the main part of the effect. In all three procedures *S*s dealt with the patterns for about the same length of time (½ hr.), yet the effect of Play is noticeably weaker than that of Random Search.

A second hypothesis that suggests itself, is that perceptual 'hard work' favors the most efficient mode of perception, and so induces a change towards figural (Allan, 1961). This would explain why Play, which is 'easy' perceptual work, has little effect and why Random Search has a strong effect. *S* searching on the random array has to work extremely hard. For each stimulus presented, *S* has to look at several patterns, some perhaps more than once, rejecting each one until she finds the one presented. Under time pressure, *S* is forced to work as hard as, and for much longer than, even in the Tachistoscope presentation. Yet this is still not an entirely satisfactory explanation for the success of Random Search. If the "hard work" hypothesis were entirely correct, we should expect Tachistoscope procedure, which also makes *S* work hard perceptually, to have a stronger effect than Play. Yet it does not. Apparently there must be some further reason for the effect of Random Search.

We make the following suggestion. When faced with a novel array, the perceiver tries to organize it. He looks for groupings of patterns within the array. In the case of a random array, he is prevented by the nature of the array, from establishing any groups on the basis of adjacency; so instead he tries to establish groups by the geometry of their location. For example, take the two patterns which contain just two blocks each, one black and one white. These two patterns, which are mirror images of one another, stand out very strongly as a pair; one remembers their position, not as individuals, but as a pair. In Random Array 1, they occupy the two cells; row 5 column 3, and row 7 column 5. It is these two cells together, and their relative positions, that one remembers; not which of the cells contains which pattern. Another set of patterns that are remembered as a set rather than individually, are the three in which there is a regular alternation of black and white squares. In Random Array 1 they occupy the three cells: row 4 column 1, row 3 column 3, and row 5 column 4. Random Search *S*s quickly became aware of these groupings, and of others;[8] but the patterns seen to form these spatial groupings were always figurally similar, and never sequentially similar. Why

8 We know this from Ss' verbal reports and from watching their perceptual confusions.

was it not also possible for *S* to see patterns that were sequentially similar in such geometrically extended groups?

The reason is very likely this. Any search task demands that *S*s mode of perception for the whole board be the same as her mode of perception for the individual patterns. In her own arrangement, *S* was free to choose whatever mode or rule she pleased. But it is not possible to invent a rule which makes sequential perception of the arrangement an efficient search procedure in the random array: it takes too long. In order to save time, *S* is forced to take a figural approach to the random array as a whole. She cannot integrate this approach with a sequential approach to the individual patterns. From a sequential point of view, the salient part of a pattern is its left-hand end. Yet in the random array there is nothing to make the left-hand ends of the patterns stand out from the right-hand ends. S is forced by the disorderliness of the random array to look at the array as a whole, and therefore has to find, in the patterns, recognition units whose saliency is not destroyed by this holistic approach. Only the black figures have this property. Only a figural perceiver sees these as units.

The Random Search experience makes *S* see the patterns as whole, or as figures, because she has to integrate her perception of individual patterns with her perception of the random array as a whole.

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Statistical appendix

The Fisher exact probability test is used to analyse frequency data that can be represented in a two-by-two contingency table, when the expected frequencies are too small to allow the use of a chi-square test. The Fisher test asks the question: what proportion of all possible frequency distributions having the same marginal totals are as extreme as, or more extreme than, the observed distribution? The same question can be asked when the data fall into more than four cells, but a problem arises. It is not obvious, as it is in a two-by-two array, which distributions *are* more extreme than the observed distribution.

The data from any one of the present series of experiments fall into a two-by-three array as follows:

Table **2** Probabilities associated with data of table 1

	No. of Ss classified as:			
	Sequent.	Interm.	Figural	
Control Group	A	B	C	A+B+C
Experimental Group	D	E	F	D+E+F
	A+D	B+F	C+F	N=A+B+C+D+E+F

The probability that *N* objects are distributed in this way, given the marginal totals, is given by the hypergeometric function:

$$P = \frac{\binom{A+D}{A}\binom{B+E}{B}\binom{C+F}{C}}{\binom{N}{A+B+C}} = \frac{(A+D)!(B+E)!(C+F)!(A+B+C)!(D+E+F)!}{N!A!B!C!D!E!F!}$$

Since B and E refer to an intermediate category, the extremeness of a distribution is determined solely by the relationships between A, F, C, D. With the marginal totals fixed, the values of A and F completely determine the values of C, D, B, E, so that we may distinguish only three cases: those in which A+F is larger than in the observed distribution, those in which it is smaller, and those in which it is the same. Any distribution in which A+F is larger (with C+D consequently smaller) is clearly more extreme than the observed distribution. Any distribution in which A+F is smaller (with C+D

consequently larger) is, at least for the present range of frequencies, less extreme than the observed distribution. A distribution in which A+F (and consequently C+D also) is the same as in the observed distribution, is neither more nor less extreme. It is not clear which of these middle cases should be included when we compute the probability. We have therefore computed an upper and a lower bound on the probability, the upper bound including all the middle cases, the lower bound including only the one middle case corresponding to the observed frequencies, and excluding the others.

5 From a set of forces to a form, 1966

This article, one of several that help explain the theoretical foundation for the pattern language, describes three methods to translate needs into form: numerical, analog and relational. It is based partly on work that CA did at MIT, when he was working toward his PhD at Harvard, and published as "The Use of Diagrams in Highway Route Location," written with Marvin Manheim.[1] *In the work printed here, diagrams representing the physical manifestation of different variables are superimposed to produce a single diagram that would in turn form the basis for design. This idea was also applied to landscape design by Ian McHarg in* Design with Nature[2]*, first published in 1969.*

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From a set of forces to a form

There are more and more man-made objects in our environment. Each one is made to meet certain needs, but unfortunately they often fail to meet the needs. This raises the question: "Given a set of needs, how can we generate a form which meets those needs?"

In this paper I shall describe three fundamentally different ways of doing this: by numerical methods, by analog methods, and by relational methods. Numerical methods and analog methods are in common use. Indeed, most of the research now being done on "systematic" methods of design is based on these methods. However, I believe that they are almost entirely unsuited to environmental design: they are far too simple. The complexity of the needs which enter into the design of an object like a house demands much more general, and more powerful, methods.

1 Christopher Alexander and Marvin Manheim, "The use of diagrams in highway route location: an experiment." Paper no. 161, Department of Civil Engineering, Civil Engineering Systems Laboratory, Massachusetts Institute of Technology, March 1, 1962.

2 Ian McHarg, *Design with Nature*, New York: Published for the American Museum of Natural History, Doubleday/Natural History Press, 1971.

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In the last section I shall deal with a class of methods which I call relational methods. I believe they are, in principle, capable of generating form even in answer to the great complexity of human needs. But they are so far almost unexplored. I have written this paper in the hope that it may persuade some of the people now working on numerical and analog methods to shift their attention to relational methods.

Let us begin by extending the concept of a "need."

The concept of a need has several faults. It can easily be unobjective, it gives no indication of the kind of form which satisfies the need and, worst of all, it is too narrow. It leaves out many other factors which must influence the form of buildings: the force of gravity, the tendency for heat to flow across a temperature gradient, the fact that people tend to walk in straight lines, the social forces which make it necessary for a housewife to keep a "tidy room" for visiting strangers, the economic forces which cause a steady drift of population from rural into urban areas, the processes of production and distribution which force builders to use pre-assembled factory components, and the deeper psychological demands of human nature.

I shall therefore replace the concept of need, by the concept of "force." A force is an invention. It is an invented motive power which summarizes some recurrent and inexorable tendency which we observe in nature.

All systems, whether they are individual human organisms, or social systems, or mechanical systems, share the following property: when in certain states, they have inexorable tendencies to seek certain other states. If the system is human, we summarize these tendencies in terms of needs. If the system is mechanical, we summarize the tendencies in terms of Newtonian forces. If the system is thermodynamic, we summarize the tendencies in terms of thermodynamic potential. If the system is social, we summarize the tendencies in terms of social forces. Etc., etc.

The fact that people need a certain light level for reading, summarizes the fact that, if they have the opportunity, they tend to switch the light on, or to dim the lights, or to move toward the window, when they find it hard to read.[3]

The force of gravity summarizes the inexorable tendency for two large masses to move toward each other.

Thermodynamic potential summarizes the inexorable tendency for heat to flow across a temperature gradient (like that between the inside of a building and the outside).[4]

The fact that people walk in straight lines summarizes their inexorable tendency to take the shortest path between two points.[5]

When we speak of a woman's need to protect herself symbolically against invasion, we mean to summarize the fact that she tends to enclose herself – for instance, with elaborate window curtains.[6]

These kinds of tendency, and many other kinds, all play their part in shaping the environment. We must therefore choose a single word to summarize them. I have chosen the word *force*.

3 R. G. Hopkinson, *Architectural Physics: Lighting,* London: H.M.S.O., 1963, p. 15.

4 In the thermodynamics of irreversible processes, these tendencies are actually called "forces." S. R. de Groot, *Thermodynamics of Irreversible Processes,* Amsterdam: North Holland Publishing Co., 1961, p. 5.

5 Tyrus Porter, B. Arch. Thesis, Dept. of Architecture (1964), University of California, Berkeley.

6 Theodor Reik, *Of Love and Lust: On the Psychoanalysis of Romantic and Sexual Emotions,* New York: Farrar, Straus and Cudahy, 1957, pp. 476–491.

In order to define a tendency we must define:

1 The exact circumstances under which the force arises.
2 The exact conditions which the force is seeking.

Forces generate form. In the case of certain simple natural systems, this is literally true. In the case of complex, man-made systems, it is a metaphor. Let us look at a simple system first.

When a constant wind blows across a sandy surface, it forms wave-like ripples in the sand (Fig. 1). There are five forces at work.[7,8]

1 If there is any irregularity in the surface, the number of grains arriving on its windward slope (the slope facing the wind) is greater than the number arriving on the leeward slope (the slope facing away from the wind). The windward slope therefore tends to "catch" grains, and to grow.
2 The wind picks up grains and carries them a certain distance. For a given wind speed, this distance tends to be approximately constant.
3 The wind picks up more grains on a windward slope than on a leeward slope, and since it carries the majority of grains the same distance, any irregularity tends to be repeated one "path length" downwind.
4 When the grains land, their impact pushes other grains forward, causing creep. The impact is usually not enough to carry a large grain beyond the crest of a ripple, but it will carry small grains beyond the crest, so that the larger grains tend to accumulate at the crests.
5 On the crests, where the wind velocity is higher than in the dips, small grains tend to get blown off, and only heavy grains stay put.

These five forces make any level surface or any unevenly spaced pattern of bumps unstable. The slightest bump will grow into a ripple; and the ripples will repeat at regular intervals downwind, so that gradually a "wavelike" pattern of ripples is built up. With the wind blowing, the level sand surface is an unstable form because it gives rise to forces which ultimately destroy it. The rippled form is stable because the forces which it gives rise to maintain the form.

Let us now contrast this simple system with a complex system in the man-made world – a family and the house it lives in.

Although its evolution has made it partially stable, this system is still, in a larger sense, unstable. Periodically, it gives rise to forces whose repercussions threaten to destroy the harmony and stability of the whole.[9]

People in the house will tend to try and escape from neighbor noise. But the house may not allow them to escape it, so the tendency has repercussions. People close bedroom windows and make the bedroom stuffy. They turn up the volume of the radio

7 R. A. Bagnold, *The Physics of Blown Sand and Desert,* London: Chapman & Hall, 1941, pp. 144–153.
8 In the original, Figure 1 was here, with caption "Sand ripples. Reproduced from Vaughan Cornish, *Ocean Waves,* Cambridge: Cambridge University Press, 1934".
9 I have previously called this kind of runaway unaccommodated force a "misfit": *Notes on the Synthesis of Form,* Cambridge, MA: Cambridge University Press, 1964, Chapter 2.

to drown the noise, making more noise in the neighborhood. Or the tendency goes underground altogether, until it finds an outlet in bad temper.

Again, people tend to try and store things on open level surfaces at about waist height. When there is no provision for this tendency, things get put on the kitchen stove and start a fire; or they get stored in a forgotten place and cannot be found when wanted; or, they get left on narrow window sills, and then knocked down and broken.

The forces which are not provided for do not disappear. They always find an outlet in an unexpected way. The deeper psychological and social forces, if not provided for, can easily have repercussions which lead to drastic kinds of instability. They do not, of their own accord, create a stable state.

Unlike the forces in a simple system, which always steer the system to a stable state, the forces in a complex man-made system are often impotent. The tendency to escape neighbor noise does not, of its own accord, create a quiet building. The tendency to store things on open level surfaces does not provide a house with large amounts of open level surface.

This is the basic difference between a natural object and a man-made object. A natural object is formed directly by the forces which act upon it and arise within it. A man-made object is also formed by certain forces; but there are many other latent forces which have no opportunity to influence the form directly, with the result that the system in which the object plays a part may be unstable. The form can be made stable with respect to all these forces only by artificial means. The most usual artificial method is that known as "design," in which an individual designer tries to generate the form intuitively. But "design" is only a particular way of doing this; there are other ways. We may state the problem of design, in its most general form, in two parts:

1 Given a system, how can we assess the forces which act upon it and arise within it?
2 Given a set of forces, how can we generate a form which will be stable with respect to them?

I shall not deal with the difficult problem of assessing forces here. Let us assume that they have been established by some reliable and objective means.[10] There are then various ways of generating form from them. I shall now describe three ways of generating form.

1. Numerical methods

All numerical methods of generating form rely on three essentials:

1 Each "force" can be represented by the variation of a one-dimensional numerical variable. One of these seeks minimization (or maximization). The others are held constant, and are called constraints.

10 For the problem of assessing forces, see Sim Van der Ryn, *The Ecology of College Housing,* Berkeley: Department of Architecture, University of California, 1965, and forthcoming publications from Barry Poyner and Ian Moore, *Directorate of Development,* London: Ministry of Works, 1966.
See also Henry Murray, "Toward a Classification of Interactions," in *Toward a General Theory of Action,* (Talcott Parsons and Edward Shils, editors), Cambridge, MA: Cambridge University Press, 1962, pp. 434–464.

2 Equations or inequalities relate the values of the different variables to the configuration of the system and to one another.
3 There exists a theorem, or an algorithm, which defines the configuration in which the chosen force reaches its minimum (or maximum) value, under the constraints provided by the others.

Here are three examples of numerical methods:

The calculus of variations. The calculus of variations defines curves and surfaces on which some chosen integral reaches a maximum or minimum.[11]

Suppose, for instance, we have a system in which material slides down a chute, from one point to another, and suppose there is a tendency to minimize the time it takes the material to slide down the chute. The time can be expressed as an integral along the curve. The calculus of variations then shows that in order to minimize time, the chute must have the form of a cycloid.

Plant layout analysis and linear programing. Given any organization in which there is a lot of movement, like a hospital or an industrial plant, there will be certain tendencies for people and materials to move from one department to another; there will also be a tendency to try and cut down the total amount of daily movement in the organization as a whole.

The (nearly) best layout for such an organization can be generated by a simple algorithm. This algorithm is based on the idea that you can compute the total daily movement, for any given layout, and then make successive improvements in the layout, by exchanging departments, until no exchange of departments leads to an improvement. This method has been widely used for laying out of both industrial plants and hospitals.[12]

The Michell Theorem. In the design of a loadbearing frame structure, the principal forces are the loads themselves (with their magnitude, position, and direction specified), and the tendency to try and reduce the weight of the structure to a minimum.

A theorem by A. G. M. Michell makes it possible to generate the form of the least-weight structure almost uniquely, from a specification of the loads. The theorem shows that all the members of the least-weight structure must lie on one of two families of orthogonal curves (the compression members on one family, the tension members on the other), and places strong restrictions on these families of curves.[13]

11 For a very simple account, see L. A. Lyusternik, *Shortest Paths,* New York: Macmillan, 1964. For a more complete discussion, see Charles Fox, *An Introduction to the Calculus of Variations,* Oxford: Oxford University Press, 1950.

12 Frederick S. Hiller, "Quantitative Tools for Plant Layout Analysis," in *Journal of Industrial Engineering,* vol. 14, no. 1 (Jan.–Feb., 1963), pp. 33–40; Lynn Moseley, "Rational Design Theory," in *Architects Journal*, vol. 11, no. 9 (1963); J. J. Souder *et al., Planning for Hospitals: A Systems Approach Using Computer-aided Techniques,* Chicago: American Hospital Association, 1964, pp. 113–162.

13 A. G. M. Michell, "The Limits of Economy of Material in Frame Structures," in *Philadelphia Magazine,* ser. 6, vol. 8 (1904), p. 589. H. L. Cox, *The Design of Structures of Least Weight,* New York: Pergamon, 1965, p. 90.

For example, in the case of a simple cantilever, carrying a single load, the families of curves are near spirals, as shown in Fig. 2; and the least-weight cantilever which they generate is the fish-like structure illustrated in Fig. 3.[14]

These kinds of methods are beautiful as far as they go. But they are very limited. There is no guarantee that the forms they generate are stable, since it is likely, indeed, almost certain, that there will be other forces in the system which have not been represented. The Michell theorem, though it minimizes the weight of the structure, does not take into account the need to use steel sections which can easily be transported, or the fact that the cantilever will need periodic repainting. The hospital layout, though it minimizes movement, does not take into account the patients' need to feel secure in the hospital, or the need for conditions which speed up cure. We must remember that numerical methods only work for forces which can be represented by the optimization of a single one-dimensional numerical variable. Most of the subtler human forces cannot be.[15]

II Analog methods

Analog methods actually generate form physically. As we know, the forces which occur in a system are often too weak to take the system to a stable state, of their own accord. It is sometimes possible to find a second system, which is a model or analog of the first, in which the forces model the forces of the first system, but are this time strong enough to take the system to a stable state. If the analog is well chosen, the form of this stable state will also be a stable form for the original system.

Analog methods rely on one essential: each force can be represented by some "active" force in the analog.

Here are three examples of analog methods:

The use of weights and strings to locate an elevator. Perhaps the simplest analog device of all is the use of weights and strings to generate the best position for an elevator on an office floor.[16] The analog consists of a board with holes drilled in it, one for each office, in its proper plan position. A piece of string is threaded through each hole. The lower end of each string has a weight tied to it. This weight is proportional to the number of people going to and from the office. At their upper ends all the strings are tied together. If the weights are allowed to hang free, the tension in each string is an active force which corresponds to the force of people's movement to and from the elevator. These active forces will move the knot to the most stable position for the elevator.

14 W. S. Hemp and H. S. Y. Chan, *Optimum Structures,* College of Aeronautics Memo Areo, no. 70 (July, 1965). The cantilever was designed for the Machine Tool Industry Research Association, Macclesfield, Cheshire.

15 In the original, Figures 5.2 and 5.3 are here. Caption for 5.2: "Drawing for a simple cantilever." Caption for 5.3: "Drawing for a least-weight cantilever."

16 A. G. Shaw, *The Purpose and Practice of Motion Study,* Manchester: Columbine Press, 1960, pp. 116–120.

Antonio Gaudi's models for the Guell chapel.[17] Gaudi used analog devices to generate the form of stone load-bearing structures. The forces which actually operate in these structures are compressions, and are not, of their own accord, able to generate stable forms. Gaudi used upside-down wire-model analogs in which wires stand for columns, hanging bags of lead shot stand for the eventual compressing loads, and tensions stand for compressions. The tensions are able to pull the wires into a stable form (Fig. 4). This wire form, when turned upside-down, and made of stone, is stable under the original compressions (Fig. 5).

The experimental use of lightweight furniture. My third example of an analog is an actual living room. The forces at work within a living room are complex: tendencies for people to move through the room on certain paths, tendencies for people talking to sit close together, tendencies for people to move into positions where the draft is least, and to where the light is best, and to where they face the fire . . .

Under normal circumstances the furniture in a room is so heavy that these forces are powerless to move it. However, they can be made temporarily active. When I recently bought a house, instead of starting with permanent furniture in the living room, I started with lightweight bamboo stools for seats and tables. With these bamboo pieces in it, the room itself became an analog, the forces became temporarily active, and could push and kick the system from one state to another. After a few weeks, as people used them, the pieces fell into a stable pattern. This pattern defined the best configuration for the permanent furniture.

Again, these kinds of methods are beautiful as far as they go. But, like numerical methods, they are very limited. The wire model contains no force which represents the need for adequate light. The furniture analog contains no force which represents the need for easy cleaning. Analog methods only work for forces which can be represented by some "active" counterpart. Most of the subtler human forces cannot be.[18]

III. Relational methods

I have tried to give the reader some sense of the limits of numerical and analog methods. Though they are rich and valuable for problems in engineering and economics, they are almost useless in designing houses, or any piece of the environment where people are. The reason is simple: no more than a handful of the practical, psychological, and social forces which have the most profound effect on human life can be represented by these methods. Most forces cannot be represented by the variation of any one-dimensional numerical variable. Most forces cannot be represented by "active" forces in an analog.

17 James Johnson Sweeney and Jose Luis Sert, *Antonio Gaudi,* New York: Praeger, 1960, pp. 74–91.

18 In the original, Figures 5.4 and 5.5 were here. Caption for 5.4: "Canvas and wire model for Guell chapel. The photograph of the model, which is actually suspended from the ceiling, is here reproduced upside down." Caption for 5.5: "Interior view of vaulting and supports of Guell chapel."

But there are two valuable lessons to be learned from numerical and analog methods:

1 As all methods of generating form must do, they obtain form from the *interaction* of forces.
2 They succeed in this because they establish a common ground where the forces can interact.

In numerical methods all forces are expressed as numerical variables, and the number system provides the common ground for their interaction. In analog methods all tendencies are expressed as "active" forces, and the physical analog itself is the arena where these active forces can interact.

What we need is a way of allowing a much wider range of tendencies to interact. Bearing this in mind, let me now state the problem once again: *Given a set of forces*, WITH NO RESTRICTION ON THEIR VARIETY, *how can we generate a form which is stable with respect to all of them?*

To solve this problem, we must find a common ground where all forces, of every kind, can interact. This means we must find something which all forces have in common. The only thing that all forces have in common is the fact that each of them is seeking some specific kind of end-state. In more familiar language, each force has certain physical implications. This is the basis of relational methods.[19] There are two key ideas:

1 We try to determine, as abstractly as possible, the physical relation which each individual tendency is seeking.
2 We try to combine these individual abstract relational implications, by fusion, to generate the form.

We may begin to see how the relational implications of forces can be stated, and combined by fusion, in the following example taken from work done several years ago at the Massachusetts Institute of Technology.[20]

The problem was to locate a twenty-mile stretch of highway in Massachusetts, starting from Springfield and ending somewhere near Northampton. We defined twenty-six forces which would influence the location. Each force seeks a certain kind of location for the highway. For example, force number 1, the need to reduce earthwork cost, seeks a location through the areas where the land is flat. The full relational implication of each force is represented as a pattern of grays over the terrain: each point in this pattern is dark if the force is likely to generate a highway through that point, and lighter if it is less likely to do so. All twenty-six individual relational implications are shown here. Each corresponds to the entire terrain from Springfield to Northampton.

When two or more of these drawings are superimposed, a new pattern emerges from the interaction of the individual patterns. This happens because functionally, and

19 For a very sketchy discussion of the analysis of interacting forces, *see Notes on the Synthesis of Form, op. cit.* Chapters 8, 9, and Appendix 1.

20 Christopher Alexander and Marvin L. Manheim, *The Use of Diagrams in Highway Route Location.* Research Report R62–3, Civil Engineering Systems Laboratory, Massachusetts Institute of Technology (1962). In that report we called the forces "requirements."

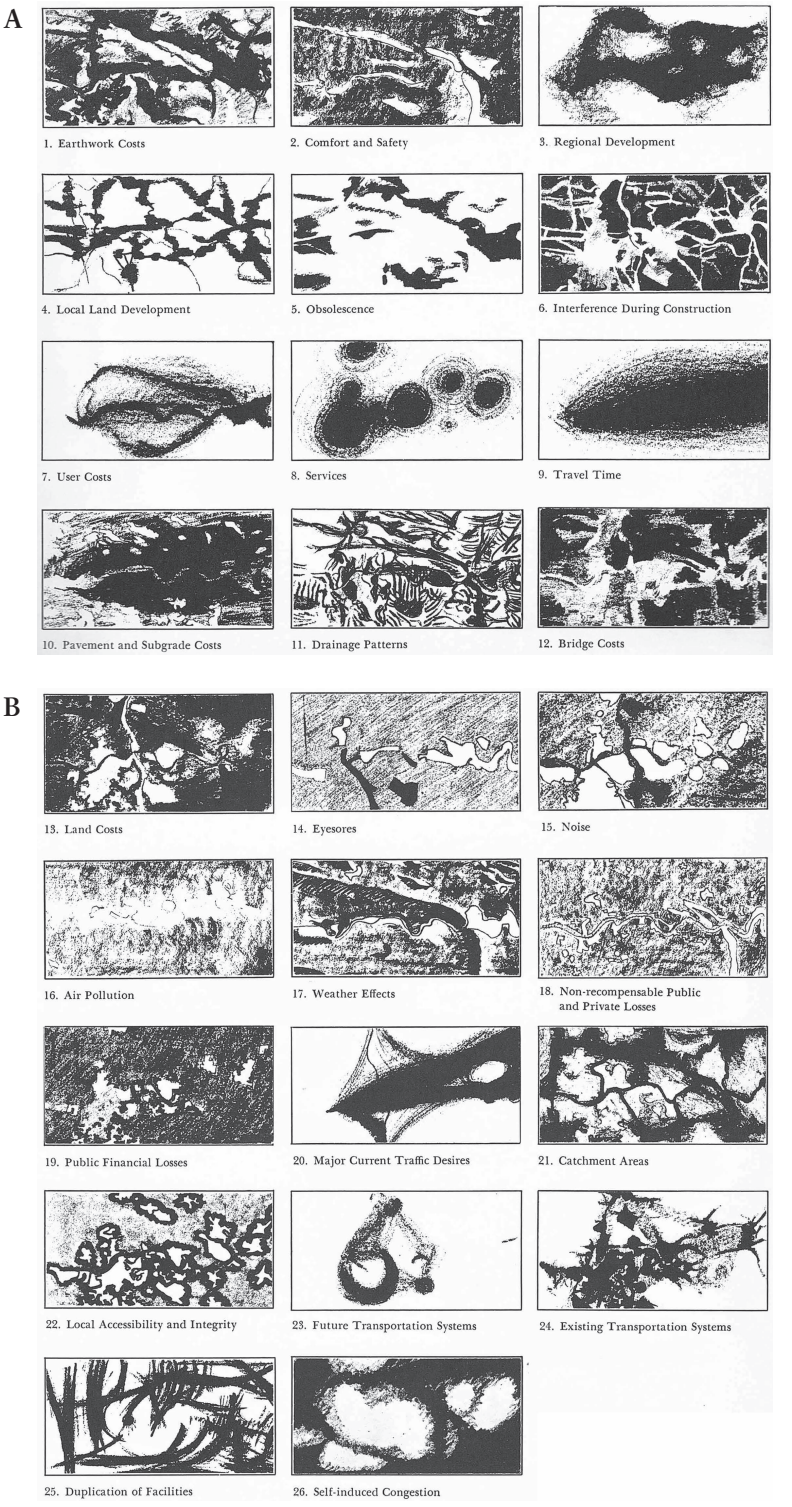


Figure. 5.6 Panels 1 through 26 are reproduced from the M. I. T. report, *The Use of Diagrams in Highway Route Location, by Alexander and Manheim.*

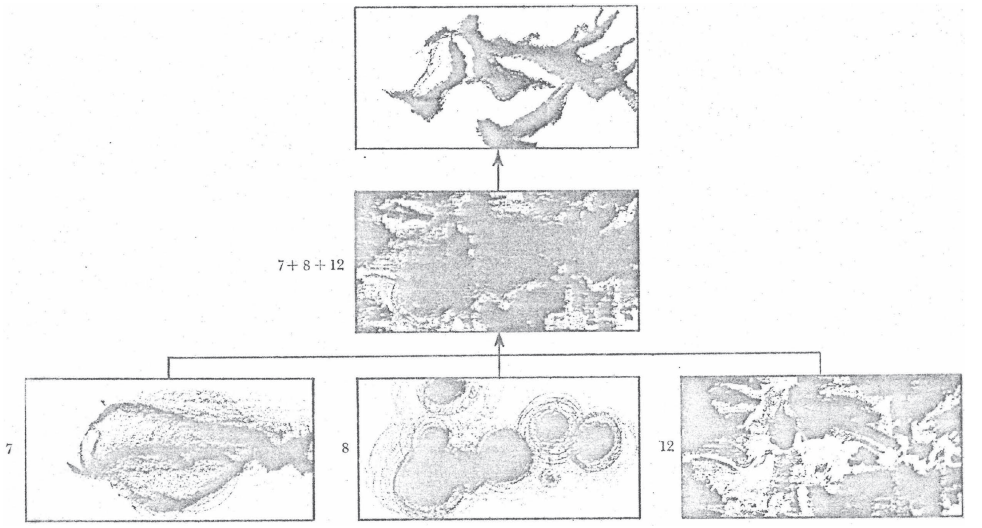


FIgure 5.7

visually, the patterns get their meaning from the continuity of density. Two patterns together may form certain continuous strands of darkness, which are not individually present in either of the individual patterns; and in the same way, patterns present in the individual drawings may be submerged in the combination of the two.

Fusion was carried out by superimposing several patterns photographically, and then, from the darkest, most continuous areas in the composite, generating a new pattern.[21] After a number of processes of fusion, the last fusion generated the pattern A shown in Fig. 8:[22] nothing remains except a pair of lines, one darker than the other. The darkest line defines the best location for the highway.[23]

This example illustrates the two key ideas of all relational methods. Let me repeat them:

1 We try to determine, as abstractly as possible, the physical relation which each individual force is seeking.
2 We try to combine these individual abstract relational implications, by fusion, to generate the form.

However, the example is unusually simple. First, we know in advance that the highway will be a thin and gently curving line, and this makes the implications easy to state. Second, the underlying terrain provides a constant framework which makes fusion

21 In the original, Fig. 7 is here. Caption: "Fig. 7"
22 In the original, Fig. 8 is here. Caption: "Fig. 8"
23 In the original, Fig. 9 is here. Caption: "Fig. 9"

easy. It will usually be much harder to define the implications of individual forces; and much harder to state them in a universal framework, so that they can easily be fused.

I shall finish by sketching a very simple example which shows these key ideas as they appear in a more general kind of problem. This example deals with the three-way interaction between three forces connected with the "living room" of a house.

I ask the reader to ignore the fact that these three forces are artificially isolated – in a real living room there are perhaps a hundred forces which must all be studied simultaneously. I ask also that he ignore the fact that the abstract relational implications of the individual forces are not clearly expressed; and that he ignore the fact that the process of fusion is not clearly explained. Neither the individual implications nor the fusion can be accurately defined, because at present we still lack any universal way of expressing them.

Lastly, I must ask the reader to remember that, since the example is based on three forces which have been arbitrarily picked out, the form they generate is itself hardly more than a relation: it needs to be fused with many other relations before it actually defines part of a building.[24] The forces are:

1 First of all, each person in a family has his private hobbies: sewing, carpentry, model-building, homework. These activities being what they are, things often need to be left lying about. People therefore tend to do them somewhere where the things can be left lying safely.
2 Second, communal places in a house have to be kept tidy, partly on account of visitors, but also so that no one person's things encroach too heavily on any of the others.
3 Third, there is a tendency for people in the family to want to be together.

Under present circumstances, these three forces are mutually incompatible. The members of the family would like to be together; but in the evenings, and on weekends, when they could be, each one follows up his personal hobbies – sewing, homework, . . . Because these things are messy, and often need to be left standing, people cannot do them in the living room – they would be cleared away too soon. Instead, to do these things each person goes off to his private area – the kitchen, or the basement, or the bedroom – and the family cannot be together.

What are the relational implications of the individual forces?

The first one demands that each person have a private space, where he can do whatever he wants, and where he can leave things, knowing that they will be safe (Fig. 10).

The second one implies that any communal living space, where people come together, must be easy to keep tidy, and people's individual bits and pieces must not encroach on it: hence, that it will be a self-contained spatially integral unit (Fig. 11).

The third implies that when the individual members of the family are following their private interests, they should nevertheless still be with the family as a whole, still be able to see each other, still be within earshot and able to be together easily (Fig. 12).

I have shown these individual relations crudely in the drawings. Fusion of these three relations generates the form shown in the larger drawing (Fig. 13). I shall describe this

24 In the original, Figs. 5.10, 5.11, 5.12, and 5.13 are here. None of them have captions.

form concretely, to make it clear. But it must not be interpreted as concrete. It is still an abstract relation – almost certain to be modified by further fusion.

It is a living room with several alcoves in it, one for each person in the family. These alcoves may be left untidy; private bits and pieces are quite safe in them. Each alcove looks into the central living room, and also looks at all the other alcoves. (The angles between alcoves are important.) People in these alcoves can see each other, they can talk to each other, and if they want to they can be together in a moment. Yet, the communal living room itself, because it is a convex whole which excludes the alcoves, is easy to keep tidy. (The alcoves might be fitted with curtains.) The bits and pieces in the individual alcoves do not encroach upon the tidiness of the whole: people can follow their private inclinations and yet be together, simultaneously.

This form, generated by fusion of the relations which each individual force is seeking, is stable with respect to all three forces.

I shall now summarize the argument. The question is: *Given a set of forces*, WITH NO RESTRICTION ON THEIR VARIETY, *how can we generate a form which is stable with respect to them?*

There are very definite limits on numerical and analog methods. It is clear that they cannot cover the full complexity of needs which an environmental problem can contain.

Relational methods, as far as I can see at present, have no such built-in limits. Though the examples I have given are obviously sketchy, relational methods do seem capable of indefinite expansion. They are, in principle, broad enough to deal with all the complexity which an environmental problem can contain. It remains to be seen whether they will be as powerful as they promise.

6 Center for Environmental Structure seminar report, excerpt, 1967

A summer seminar organized by the Center for Environmental Structure (CES), held at Inverness, California, was one of the first organized academic efforts to develop the idea of the pattern language. In addition to CA, the seminar included some of the authors of A Pattern Language, *which would be published ten years later. The document excerpted here included material on the establishment of the CES, a "pattern manual," and some of the first examples showing the detailed structure and development of patterns.*

The CES was established partly to have the benefit of a non-profit organization that was independent of the Department of Architecture at the University of California, Berkeley, without the financial burdens and administrative rules that would have been imposed by the University. At the same time, CES had strong ties to the Department of Architecture, as many of its members were faculty and students (many students came to study at Berkeley specifically because CA was on the faculty), and CA usually saw his courses as opportunities to develop and test ideas that were being generated at CES. Over the years, CES had offices and field offices in various places, including Berkeley, Tokyo and England. As a non-profit organization, CES could apply for grants and also act as an architectural and contracting firm (CA had licenses as both architect and contractor).

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PROCEEDINGS OF THE SEMINAR HELD BY THE
CENTER FOR ENVIRONMENTAL STRUCTURE
DURING JULY, AUGUST AND SEPTEMBER, 1967

1. The Center for Environmental Structure (description)
2. Pattern Manual
3. The Pattern of Streets
4. Lane Orientations in a Street System
5. Conditions for a Pattern to be Valid and Useful
6. Organization of Memory

Papers 1, 2, 3, 5, and 6 were written by Christopher Alexander, Murray Silverstein and Sara Ishikawa, based on notes from the seminar. Paper 4 was written by Alan Hershdorfer. Participants in the Seminar were Christopher Alexander, Tamas I. Bartha, Alan M. Hershdorfer, Sara Ishikawa, Roslyn Lindheim, Marvin L. Manheim, Harris Savin, Murray Silverstein and Sim Van der Ryn.

The center for environmental structure

The Center for Environmental Structure undertakes the design of prototype buildings and prototype parts of cities.

The cities and buildings we live in today do not meet human needs. In a nutshell: the environment does not form an organic whole; nor does the urban life within it.

There are two basic problems responsible for this:

1 The hundreds of social, psychological, economic and technical questions which occur in any design project are never thoroughly answered. The schematic design phase is too short for *them* to be answered in any individual project: yet there is no mechanism by which schematic solutions can be carried from one project to another, and so improve cumulatively and systematically over time.
2 Even if we design individual projects well, these individual projects will not function perfectly until they are coordinated with other projects. Today, the professions and agencies concerned with urban problems work independently, each designing one part of the city without any idea of how this one part relates to all the other parts.

The environmental pattern language

To solve these two problems, we have introduced two concepts: the concept of an environmental pattern to solve the first problem, and the concept of an environmental pattern language to solve the second problem.

An environmental pattern is an abstract solution to a restricted design problem. It can be applied many times over, and can be improved cumulatively.

The environmental pattern language is a system which coordinates the patterns with one another. It makes sure that the solutions to various projects are properly related.

These ideas are not new. Experienced designers have always used personal patterns and pattern languages. For example, a hospital designer has a personal vocabulary of prototypical solutions which he uses over and over again, modifying them slightly each time. He knows how the various elements of the prototype fit together; and he knows when to use which variants. The individual elements of the prototype are patterns; the rules which tell him how these elements fit together form the pattern language. The patterns and the language improve as he learns from his successes and mistakes; the more hospitals he designs, the better his language becomes.

This process has a fatal weakness. Since all the individual designers' languages are essentially private, the contents of these languages are never subjected to public scrutiny and criticism – and solutions are never improved. Worse still, because the languages are private, the solutions are inevitably uncoordinated. The environment as a whole stays bad.

Instead of individual designers producing essentially private languages, we need a public language of solutions for all environmental problems. This language would improve by a process more stringent and reliable than self-criticism and self-education, for it would be open to scrutiny by everyone involved with environmental problems. All designers would be able to draw on the insights in this pattern language. All designers would be able to contribute to it.

To make this possible, we have formalised the idea of an environmental pattern, and the idea of an environmental pattern language.

The effects of the formalism are these:

1 Any aspect of the environment – whether at the scale of regional land use distribution, transportation networks, the layout of building complexes, the design of individual buildings, the design of interiors, or the details of construction – can be represented as a pattern.
2 Each pattern is readily communicable.
3 Each pattern contains a precise statement of the conditions under which it can be applied.
4 Each pattern has a format which encourages criticism and feedback.
5 Each pattern becomes a viable element in a universal pattern language.

The language coordinates these patterns. It has the following functions:

6 It accounts for the functional interdependencies among patterns.
7 It guides the process of combination, so that an individual making use of patterns knows how to put them together.
8 It indicates clearly how newly invented patterns are to be related to patterns already known, in such a way as to maintain the organic unity of the whole.

The environmental pattern language will contain hundreds of subsystems and tens of thousands of individual patterns. Every conceivable kind of building, every part of every kind of building, and every piece of the larger environment will be specified by one or more subsystems of the environmental pattern language.

In summary: An environmental pattern language is a coordinated body of design solutions capable of generating the complete physical structure of a city. The language is designed to grow and improve continuously as a result of criticism and feedback from the field.

The Center

The Center for Environmental Structure is an independent corporation set up to create an environmental pattern language. The Center will undertake architectural and planning projects within the framework of this language. It was incorporated in late March, 1967, and received tax exempt status as a non-profit corporation from the State of California and the Federal Government. It is based in Berkeley, California.

The Trustees of the Center are:

Christopher Alexander, Associate Professor of Architecture, University of California, Berkeley.
William K. Coblentz, Attorney, Regent of the University of California.
Martin Meyerson, President, State University of New York, Buffalo.
Jesse Reichek, Professor of Design, University of California, Berkeley.
William L. C. Wheaton, Dean of the College of Environmental Design, University of California, Berkeley.

The Center has received starting funds from the Kaufmann foundation and from the Bureau of Standards.

Activities

The Center has three main activities. First, the Center will publish, and distribute, the coordinated pattern language, as it evolves. Second, the Center will undertake contracts to develop specific patterns and systems of patterns, within the pattern language, and to design buildings and parts of cities according to the language. Third, the Center will undertake basic research concerning the pattern language.

I. Publication, distribution and criticism of patterns

A. The pattern language will only succeed if its patterns are created by a wide cross-section of designers from many different fields, and if these patterns are open to continual criticism and improvement.

In order to achieve this aim, the stock of patterns in the pattern language will be organised in a way which closely resembles the organisation of a conventional academic journal. Thus:

1 Any member of the public is free to submit original patterns for inclusion in the language.
2 Any member of the public is free to submit critical papers, reports of empirical tests, and modified patterns, for inclusion in the language.
3 The editorial staff of the Center selects those patterns and critical papers which meet the Center's standards, and includes them in the language, under the author's name.
4 A catalog containing summaries of all available patterns and papers will be distributed regularly to subscribers.
5 Subscribers may then order just those patterns which they want to see in full.

This system has several advantages over the conventional academic journal.

1 A subscriber pays only for those patterns which specifically interest him.
2 Out-of-date patterns always remain available.
3 There is no publication delay whatever.

... opportunity to test the patterns which are used, to modify these patterns, and to invent new patterns. It also gives us an opportunity to check the coordination of the systems used, and to coordinate previously unused combinations of patterns.

I. Basic research

The Center will also undertake research not paid for by contracts. This research will deal with any topics important to the development of the pattern language, including both functional questions about cities, and theoretical questions about the language. There will be occasional seminars on these subjects, open to staff members, university students, and other interested persons.

Immediate and future plans

The development of the environmental pattern language is seen as a continuous, ever growing operation, and the life of the Center is expected to reflect this process.

It will probably take some two years for the Center to become fully organized and self-sufficient. Though we are dependent on foundation funds to begin with, in the long run we hope to derive our income from the activities described above. In the very long run we hope to receive fees for designing cities and parts of cities according to the pattern language.

The Center's current staff and associates are:

Christopher Alexander
Tamas I. Bartha
Alan M. Hershdorfer
Sara Ishikawa
Roslyn Lindheim
Marvin L. Manheim
Harris Savin
Murray Silverstein
Sim Van der Ryn

Pattern manual

This manual is intended to establish a single format for stating ideas about the physical structure of the environment. With such a format ideas will become comparable, and any individual will be able to criticise and modify ideas he has reason to disagree with. We call these ideas patterns.

The pattern format is designed to express ideas about the physical environment in a clear way. In doing so, it opens these ideas up to exacting criticism and improvement. By establishing such a format, this manual will also help individuals put their own special insights concerning the physical environment into communicable form.

The idea of a pattern format common to every idea concerning the physical structure of the environment raises an immediate problem. On the one hand, no one wants a straightjacket on his ideas; no one likes formats that are forced and boring. On the other hand, we want our ideas to improve under public scrutiny, and we want our good ideas to be potentially combined with other good ideas.

To overcome this problem we need a format that is both minimal and natural; we need a format that will clarify our ideas and tie them together without becoming a straightjacket.

A minimal format must bring out and emphasize only those parts of ideas that can grow and improve under public scrutiny. It must dramatize the fact that each idea is a formulation within a general language, a language that consistently talks about the structure of the environment. Once we are agreed upon such a format, everything else can be left to individual style.

To be natural, the format must be grounded in the way we tend to think about environmental problems. All ideas begin as intuitions; unless the format corresponds to the form these intuitions take, there is no hope that anyone will bother to use it, and the format will have no chance of becoming universal. To successfully avoid the straightjacket feeling, the format should read and sound very much like the way we talk about our design ideas in conversation. If this naturalness – elusive as it may seem – is not achieved, the ideas put into the format will seem stilted and watered down.

Clearly the current ways of expressing pattern-like ideas about the physical environment do not meet these criteria. Sketch plans, architectural programs, working drawings . . . they all fail in two ways: First, they lack the power to standardize the expression of a wide range of ideas about the environment; second, they do not isolate and open up individual patterns to criticism and refinement.

The format described in this manual is intended to solve this problem. We begin with the following hypothesis: Every time a designer creates a pattern (or, for that matter, entertains any idea about the physical environment), he essentially goes through a three-step process. He considers a PROBLEM, invents a PATTERN to solve the problem, and makes a mental note of the range of CONTEXTS where the pattern will solve the problem. For example, a designer considering the problem of traffic congestion and pedestrian access around central shopping districts might come up with the pattern, "Linear pedestrian malls bounded on both sides by rows of shops; parking lots strung along, behind the shops." He would then make a mental note of the kinds of places where this pattern is useful: "Commercial districts serving 300,000 people, where existing streets can be closed and paved, with car access evenly distributed behind the stores." This three-step process may be characterized most simply as WHAT (mall between shops, parking behind), WHERE (commercial area serving 300,000), and WHY (ease traffic congestion, create pedestrian access). Of course the sequence of these three steps is not always the same. Sometimes a pattern is invented before the problem is well understood; sometimes the context comes first, and Inspires the creation of a pattern. There is no need to formalize the sequence; it can always be left to quirks of the moment and individual style.

The format proposed here reflects this three-step process.

It contains three sections: PATTERN, CONTEXT and PROBLEM.

The format says that whenever a certain CONTEXT exists, a certain PROBLEM will arise; the stated PATTERN will solve the PROBLEM and therefore should be provided in the CONTEXT. While it is not claimed that the PATTERN specified is the only solution to the PROBLEM, it is implied that unless the PATTERN or an equivalent is provided, the PROBLEM will go unsolved.

Every single physical pattern – from the smallest detail in a building, to the distribution of central business districts in an urban region – exhibits this logic; every pattern can be conceived according to this triad: CONTEXT . . . PATTERN . . . PROBLEM.

> [We shall also use the word PATTERN to refer to the entire triad; as well as to the central section of the triad. It will be clear whenever we use the word whether we are talking about the entire triad, or simply the PATTERN section.]

For clarity, the three sections should be preceded by a SUMMARY which abstracts the essential idea contained in the body of the pattern.

Here [is an example of a pattern] using this format.

Example one

In some residential zones it is difficult to locate house numbers from a moving car. This difficulty is eliminated if house signs are at about 45 degrees to the street, and sign numbers are at least 6–12" high.

Free standing house on a street where cars move at speeds between 5 miles per hour and 30 miles per hour. The house may or may not be one of a regular sequence of houses all using this pattern.

Two house signs, each at about 45 degrees to the street, facing up and down the street respectively.

If the house is one of a regular sequence of houses all using this pattern, then the sign letters are at least 6" high. If the house is isolated, or is one of a sequence of houses not using this pattern, then the sign letters are at least 12" high. House signs must be 5 to 10 feet from the ground, and as far forward on the lot as possible, towards the line which divides the lot from the street.

House numbers are very hard to see from moving cars, especially for the driver. Numbers are too small to see from a distance. Many signs are parallel to the road (on the house face, or garden gate), so that they can't be seen from up the street.

Many signs are low enough to be obscured by parked cars in front of them. Some signs are high enough to make the driver crane his neck forward – for a normal car, close to a sign, anything higher than 10 degrees off the driver's path makes it impossible for the driver to keep his eyes on the road ahead.

> [It has been established that a driver can maintain his course safely while looking at signs, provided that the signs are within 10 degrees of his path. T. L. Moore and A. W. Christie, "Research on Traffic Signs, Engineering for Traffic Conference, Road Research Laboratory", July, 1963, pp. 113–114.]

With the present arrangement of house signs, the following facts conflict:

1 The driver is trying to maintain a reasonable speed on the road, say 25–30 miles per hour, both to save time, and not to inconvenience other drivers.
2 He is trying to identify the house without getting out of his car.
3 He is trying to see the number far enough ahead so that he can slow down without overshooting, and if necessary, turn into the driveway.
4 He is trying to keep his eyes on the road.

The proposed pattern resolves the conflicts among these facts, and is derived as follows: At 30 miles per hour, under average road conditions the safe stopping distance is 245 feet.

> [R. L. Moore and A. W. Christie op cit., pp. 113–122, see the formula on p. 117.]

Furthermore, it will take about 2 seconds to read the number, or 88 feet at 30 miles per hour.

> [Ibid, p. 113.]

The sign must therefore be legible 333 feet from the house. For 99% of all drivers to be able to read it, the numbers must be 12" high to be legible at 333 feet.

> [Davey, J. B., "The Vision of a Group of Drivers", Brit. J. Physiol. Optics, April, 1958.]

Further, so that these numbers are legible from either direction, and from the front, they must be placed at an angle to the street, (say between 45 and 70 degrees), one facing each direction.

At present, houses containing this pattern are very rare. However as soon as these patterns become widely accepted, a new factor will come into play: drivers will read the sequence of house numbers, and slow down as they approach the one they want: under these conditions it will not be necessary to see the number quite so far ahead, and the numbers may be reduced in size: say to 6 inches.

Even if the sign is large, the driver may not see the sign until he is close to it. The sign must therefore be as close to the street as possible, so as not to violate the 10 degree limit.

If there is any private land between the sign, and those parts of the street from which the sign is supposed to be visible, trees or fences may get put up in the course of the years, and obscure the sign. The sign must therefore be on the property line which divides the street from private property.

Each part is a defined piece of space, identified by any number of characteristics; examples of parts are: all kitchens; dormitory kitchens; efficiency apartment kitchens; public cafeteria kitchens; nursing units; emergency ward nursing units; light industrial plants; all industrial sites larger than two acres; a 2" x 4"; a 2" x 4" diagonal brace; all dwellings; residential areas with 40% of their population under 25 and median incomes between $6–8,000; garden paths; cobblestone paths; a doorknob; any freeway; freeway exit ramps; bookshelves.

The relation states the way these parts are to be arranged in space. Relation terms may include the size and shape of individual parts, as well as relationships between parts; examples of relations are: two miles across; spherical; at 45 degrees to; contained within; parallel; beneath; at least 20 feet between.

Every pattern contains at least one part, and at least one relation.

To make the distinction between parts and relations perfectly clear, the parts have been capitalized and the relations underlined for the pattern statements from our two examples:

1 Two HOUSE SIGNS, each <u>at about 45 degrees to</u> THE STREET, <u>facing up and down</u> THE STREET, respectively.

If THE HOUSE <u>is one of</u> A REGULAR SEQUENCE OF HOUSES all using this pattern, then THE SIGN LETTERS are <u>at least 6" high</u>.

If THE HOUSE <u>is isolated, or is one of</u> A REGULAR SEQUENCE OF HOUSES not using this pattern, then THE SIGN LETTERS are <u>at least 12" high</u>.

HOUSE SIGNS must be <u>5 to 10 feet from</u> THE GROUND, and as <u>far forward</u> on THE LOT as possible, <u>towards</u> THE LINE which <u>divides</u> THE LOT <u>from</u> THE STREET.

2 For each STUDENT ROOM, two ENTRANCES: ONE ENTRANCE <u>immediately into</u> a PUBLIC PASSAGEWAY, and ONE ENTRANCE immediately into COMMON LIVING SPACE, shared by several STUDENT ROOMS.

Each pattern defines a basic relationship between parts. In applying the pattern any variation is possible so long as the basic relationship holds. This means that the arrangement of parts in a specific building can vary a good deal, and still conform to a given pattern. In this sense, each pattern defines a whole family of possible variants. To define a pattern exactly, it must be clear just which features are essential, and

just what variations are permissible. It will usually be helpful to show a single archetypal diagram which summarises the Invariant features, and to make verbal statements describing the allowable variations. Drawings or photographs of a variety of different buildings, all of which conform to the pattern, also help to convey this idea.

Patterns do not have to be stated in a numerically exact manner to make their invariance clear. Some ideas lend themselves to precise numerical statements, and some do not. The minimum size for house numbers can be stated precisely because the functional problems can be stated in precise, quantifiable language. On the other hand the student room pattern calls for two entrances to each room, one into a public passageway and one into a common living room: This pattern does not give exact numerical distances or precise geometric positions, but the relationships it states are unambiguous in their own terms.

Context

The context is the spatial setting within which the pattern is valid.

A context is very much like a pattern statement. It consists of one or more spatial parts and certain relationships among these parts. Each part may have any number of aspatial characteristics associated with it.

Let us examine the context statements in our two examples; again, for clarity, we have capitalized parts and underlined the key relations:

1 FREE STANDING HOUSE on STREET WHERE CARS MOVE AT SPEEDS BETWEEN 5 MILES PER HOUR AND 30 MILES PER HOUR.
The HOUSE may or may not be one of a REGULAR SEQUENCE OF HOUSES all using this pattern.
2 STUDENT DORMITORIES at UNIVERSITIES. Specifically THOSE DORMITORIES BUILT BY THE UNIVERSITY OR ENTREPRENEURS, aimed at creating spatially contiguous STUDENT COMMUNITIES.

Each statement describes a spatial setting within which a certain pattern is appropriate. Other examples of context statements are: housing for people over 65; kitchens off executive conference rooms; bathrooms in primary schools; outdoor cafes next to busy pedestrian paths; communities with median income less than $4000 and with densities greater than 15 dwellings per acre; any building that must on occasion be approached and identified from a moving car; the threshold between indoors and outdoors in single family detached dwellings; any public commercial facilities open for business between the hours of 7 p.m. and 6 a.m.; urban regions with annual rain and snowfall greater than 10 inches; the check-out desk in main libraries in cities with population greater than 500,000; benches in parks smaller than 3000 square feet.

Clearly, the context may vary from short, common-sense statements to complex, analytically derived statements, many pages long. The essential point is this: The context must be a perfectly clear statement of exactly where the pattern is valid.

Note that a pattern valid in one context may be quite wrong in a context only slightly different. For example, a pattern that calls for a roofed porch around front door steps may only be useful in houses for elderly people in cities with rain and snowfall greater than 15 inches per year. In cities with no snowfall and very little rain – that is, in a different context – the very same houses would not require this porch cover pattern.

Remember that every part in the context may have any number of aspatial characteristics associated with it. Furthermore, these aspatial modifiers may have any number of values associated with them. Take, for example, a pattern dealing with the size of dishwashers and where they are located. The spatial context for the pattern is "kitchen". An aspatial modifier associated with this context might be "meal flow per day". This modifier might have any value associated with it – from very small values for domestic kitchens to very large values for restaurants. The size and location of dishwashers will obviously vary with different values of meal flow per day.

Every time a context contains an aspatial modifier with an associated range of values, corresponding pattern variants should be given in the pattern statement.

Problem

The problem statement contains all the reasoning which lies behind the assertion, "the stated pattern is valid in the stated context". It functions as a kind of string, tying together the context and the pattern. Although this seems to relegate the problem to a subsidiary position, in fact the problem is, from a human standpoint, the most important of the three components, and may be many pages long.

Let us examine the organization of the problem statement in our house sign example. The statement begins with a common-sense description of the problem, as it exists today:

> House numbers are very hard to see from moving cars, especially for the driver. Numbers are too small to see from a distance. Many signs are parallel to the road (on the house face, or garden gate), so that they can't be seen from up the street.
>
> Many signs are low enough to be obscured by parked cars in front of them. Some signs are high enough to make the driver crane his neck forward – for a normal car, close to a sign, anything higher than 10 feet may have this effect. Any sign more than 10 degrees off the driver's path makes it impossible for the driver to keep his eyes on the road ahead.

In short, the problem exists because certain functional demands are not being met by the pattern currently governing the arrangement of house signs. The problem statement continues by isolating these functional demands:

1 The driver is trying to maintain a reasonable speed on the road, say 25–30 miles per hour, both to save time, and not to inconvenience other drivers.
2 He is trying to identify the house without getting out of his car.
3 He is trying to see the number far enough ahead so that he can slow down without overshooting, and if necessary, turn into the driveway.
4 He is trying to keep his eyes on the road.

Finally, the problem statement shows how the new pattern for house signs is derived from, and thus meets, all the functional demands:

> At 30 miles per hour, under average road conditions the safe stopping distance is 245 feet. Furthermore, it will take about 2 seconds to read the number, or 88 feet at 30 miles per hour.

The sign must therefore be legible 333 feet from the house. For 99% of all drivers to be able to read it, the numbers must be 12" high to be legible at 333 feet.

Further, so that these numbers are legible from either direction, and from the front, they must be placed at an angle to the street, (say between 45 and 70 degrees), one facing each direction.

At present houses containing this pattern are very rare. However, as soon as these patterns become widely accepted, a new factor will come into play: drivers will read the sequence of house numbers, and slow down as they approach the one they want: under these conditions it will not be necessary to see the number quite so far ahead, and the numbers may be reduced in size: say to 6 inches.

Even if the sign is large, the driver may not see the sign until he is close to it. The sign must therefore be as close to the street as possible, so as not to violate the 10 degree limit.

If there is any private land between the sign, and those parts of the street from which the sign is supposed to be visible, trees or outhouses may get put up there in the course of the years, and obscure the sign. The sign must therefore be on the property line which divides the street from private property.

In a nutshell, this problem statement says, the existing house sign pattern creates a problem; this problem may be seen as a conflict between certain human demands which occur under present conditions. The new pattern is derived from these demands and solves the problem. Every problem statement, no matter how it is internally organised, should exhibit this logic.

There is always the chance that the problem stated is wrong. In fact, when we argue against a design idea it is almost always because we think the problem on which it is based is dubious, or we think important parts of the problem have been left out. In either case, it is clear that the rightness of a pattern hinges largely on whether the problem stated is correct.

Like the house sign example, problem statements will generally contain at their core a number of functional demands. In the student room pattern an example of such a demand is the statement, "On occasion students want to leave and enter their rooms without feeling obligated to those living immediately around them". These demands have at one time or another been called requirements, needs, performance standards, facts, tendencies, objectives, constraints, activities, technical data, and so forth. Whatever they are called, these elements form the crux of the problem, and, like hypotheses in science, they may be right or wrong. They may concern human behavior, economics, the state of technology, the political climate, whatever; no limits can be placed on the kinds of elements necessary to describe a problem properly. It is only essential that the hypothetical nature of each element be made perfectly clear: No matter how intuitive or how "scientific", every element in every problem is a hypothesis potentially wrong.

These elements will usually be spread throughout the problem section in a piecemeal way. Since they play such a powerful role in the pattern as a whole, they should be identified and isolated. It is not essential how this is done: They might be collected and listed at the end of the problem section; they might be collected and listed in "subsets" along the way, as the argument unfolds; they might be underlined as they appear in the text; and so on. In both the house sign and the student room example, the key functional assertions are isolated and listed midway through the problem statement.

Whatever data that can be gathered to substantiate the problem should also be part of this section; like the functional assertions, the data may also be presented in any

number of ways: woven through the text, as footnotes, in separate appendices, and so on. Remember this does not mean that arguments based solely on intuition are inadmissible. It does mean that intuitions must be clearly set forth, subject to empirical test. Wherever possible the problem statement should include descriptions of experiments that can be used to test the validity of key functional assertions.

Between the problem stated and the pattern lies an intermediate step. We call this step the derivation. In both the house sign and the student room examples, the derivation takes up the last paragraphs of the problem section and forms a bridge between the stated problem and the proposed pattern.

Let us take a close look at the derivation of the house sign pattern. The key functional demands are drivers trying to see numbers without leaving their cars or slowing down, and trying to see the sign in advance so as not to overshoot. With the present day arrangement of house signs these demands are in conflict: Signs are small and often parallel to the street; they cannot be seen in advance and drivers have to go very slow or else miss their marks. The essential step of the derivation centers on the observation that – at normal speeds and with normal vision – house signs must be visible to drivers 333 feet from the house. It is then possible to show that this requirement can be met by signs at 45 degrees to the roads with numbers at least 12" high.

In summary, remember that this format is not intended to be a straightjacket. It is meant to be a natural way of expressing thoughts about the physical environment. We have suggested that the three components common to every design idea are PATTERN, CONTEXT, and PROBLEM. The format makes each component explicit and thus opens every pattern to cumulative refinement and coordination.

7 Early ideas for the pattern language format, 1967–68

An early format for the pattern language was as individual items that could be separately updated and added to a loose-leaf binder. This allowed for the modification or addition of individual patterns, helping support the idea that patterns could be improved with new evidence over time. Subscribers would receive new or changed patterns on a regular basis. Indeed, the Wikipedia (which used the CES work on patterns as a precedent for how entries would be linked to each other) has this feature of continuous changeability. Although the publication of A Pattern Language *in book form eliminated this dynamic possibility, it did help give the pattern language importance and permanence. Many of the patterns here were developed for either the Peru housing competition or the Multi – Service Center project, both of which were important opportunities to develop the content and format of patterns.*

This early format would have helped support several ideas that were behind the pattern language idea. First, was the idea that knowledge of the built environment could have, at least partly, a scientific basis, in that evidence for the validity (or lack of validity) of a pattern could be updated as it became available. Second, was the fact that the linkage between patterns in a "wiki" – format could change over time and be different from situation to situation. And third, was the availability of this new form of an architectural knowledge system to anyone: the separate pages could easily be published and read independently. But the published version did not eliminate the popular intention of the work. The final book was designed so that it could be easily handled and so that a double-page spread was smaller than an 8-1/2" x 11"/A4 page and therefore easily placed on a copy machine.

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Barbershop Politics



It is easier to strike up a political talk in a place like a laundromat or a barbershop, than it is, coming as a stranger, to a person's home.



When a community center takes on the task of organizing around some issue, there is the problem of reaching everyone in the neighborhood. It is impossible to reach many people with a door-to-door residential campaign. Often people don't want to be bothered in their home: either they are busy doing something else, or they are just relaxing, and don't really want to talk politics.

Where can organizers engage people, outside of the home, where they will be relatively open and receptive?

We suggest that the places where discussion can most naturally arise are the following:

1. Barbershops.

2. Laundromats and lunch counters.

3. Small, street-oriented businesses, like news racks, cigar stores, record shops, small grocery stores.

4. Hangouts around pool halls and bars.

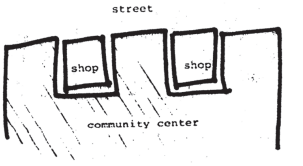
5. Places where people wait to get unemployment checks, food stamps, and so on.

(See for example, *M. Kaplan, Leisure in America, J. Wiley & Sons, Inc., New York, 1960, p. 101.*)

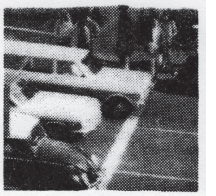
Certainly community organizers will need to spend a lot of time in places like these. But also it will help if the center, itself, is near these places. The closer the connection between talking and the potential for action, the better. Talking politics in a barbershop suddenly becomes real when next door there is a facility for turning your two cents into some action. (Imagine open mimeo machines, a community wall, hot lines to the mayor and governor, all around a grocery store and a bar.)

(continued over)

Therefore: Weave at least one, preferably several, of the kinds of activities named into the public face of the community center.



Paths Interrupt Roads



Pedestrian crossings are obstacles to pedestrians and throughways to automobiles—the car rules over people.

In many places, it is recognized by law that pedestrians have the right-of-way over automobiles. Yet at the crucial points where roads and walkways cross, designers invariably give priority to automobiles. They make the smooth, fast road continuous, interrupting the pedestrian walkway at the junctions. This continuous road surface actually implies that the car has the right of way.

What should crossings be like to accommodate the needs of the pedestrians?

The way a path crosses a road, depends on traffic density. If the traffic density is very low, it is safe to let people cross where they want to. If the traffic density is high, the crossing has to be specially defined.

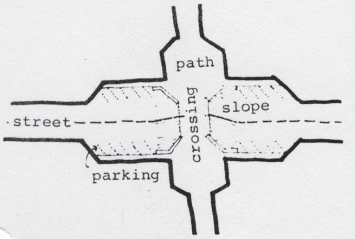
The main problem for pedestrians trying to cross a heavily travelled road, is the width of the roadway. Buchanan has shown that the average waiting time, and the percentage of pedestrians who are forced to wait, for various levels of traffic flow, is greatly affected by the width of the road. *(Colin Buchanan, et al, Traffic in Towns, HMSO, London, 1963, pp. 203-213.)* The road and the lanes themselves, should therefore narrow to the width of the through lanes. Any crossing more than three lanes wide, should be split in two. This not only keeps the crossing distance at a minimum, but it enables the pedestrian to get beyond the visual barrier of parked cars for a clear view down the length of the roadway.

The fact that pedestrians feel less vulnerable to cars when they are about 50 centimeters above them, has been discussed in the pattern, *Pedestrian 50 cm Above Car.* The same principle applies, even more powerfully, where pedestrians have to cross a road. The pedestrians who cross, must be extremely visible from the road. Cars should also be forced to slow down when they approach such a crossing. If the pedestrian way crosses 6-12 inches above the roadway, and the roadway slopes up to it, this satisfies both requirements. The slope may not be too steep, since this would be dangerous to traffic, and make the pedestrians invisible as the car nose rides up. A slope of 1 in 6, or less, is safe from both points of view. This kind of crossing is somewhat elaborate. It is probably only appropriate where pedestrian traffic is unusually heavy—for example at a corner where a great deal of pedestrian traffic is generated by the entrance to a school, or a transit station.

To make the crossing even easier to see from a distance, and to give weight to the pedestrian's "right to be there", the pedestrian path could be marked by a canopy at the edge of the road.

Finally, bus stops, vendors, shops, grow naturally around a place where a pedestrian path crosses a road. There must be enough room for these activities on both sides of the crossing, and for the parking, standing, loading and unloading that go with them.

(continued over)





Therefore:

1. Narrow the road to the length of the through lanes at the crossing.

2. If the road is more than 3 lanes, split it, and provide an island in the middle.

3. Keep the pedestrian path at a constant level through the crossing, 6-12 inches above the road surface, and slope the road up to it—with a slope not greater than 1 in 6.

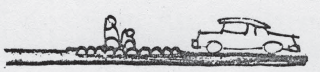
4. Swell out the pedestrian path on both sides of the crossing to make space for kiosks, benches, vendors, etc.

Paths Interrupt Roads

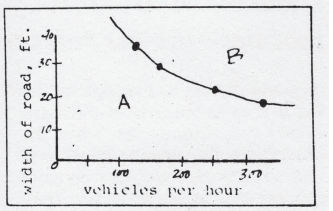
Problem (continued)
A less extreme solution, to be used perhaps at less important intersections would be to modify the roadway's texture along the approach to the crossing. Rougher texture gives the driver three kinds of warning: a) it alters the dynamics of the car giving a different "feel" to the roadway; b) the sound of the car passing over the road is noticeably different; c) it gives the roadway a different visual appearance. All of these cues combined will be incentive for the driver to slow down and become more alert. The length of this textured section will depend on the speed limit of the road. For 25 mph, it will be 62 feet on either side of the crossing; for 35 mph—105 feet and so on according to the following table from the *California Drivers Handbook, California Office of State Printing, April 1970, p. 15:*

25 mph	62 feet
35 mph	105 feet
45 mph	160 feet
55 mph	225 feet
65 mph	302 feet

The use of bumps or textured roadways for slowing people down is demonstrated in railroad crossings. Highways are now using rough and noise generating textured surfaces to slow drivers down for off-ramps and for sections of the highway where lanes merge. They are apparently effective alarms; some of them generate noises and vibrating sensations inside the car.



Context
This pattern applies to road crossings where pedestrian density is apt to be fairly high and where traffic is also fairly heavy. It does not apply to local residential roads where both are low. It does not apply to crossings where pedestrian density is high and traffic low, since under these conditions the pedestrians have no trouble competing with cars. The pattern only applies to situations where the pedestrian is "threatened". Buchanan defines a situation where a pedestrian is threatened, in terms of the delay he experiences while waiting for a gap in the traffic: "when 50% of pedestrians are liable to experience delay the average delay to *all* is about two seconds. The corresponding average delay to those who are actually delayed would in this case amount to 4 seconds. It is generally considered that, at about this point, the pedestrian's freedom to cross the road anywhere he pleases in accordance with his own judgement needs to be curtailed, and that canalisation of pedestrians onto some kind of controlled crossing is required. We think that an average delay to all crossing pedestrians of two seconds may be taken as a very rough guide to the border-line between acceptable and unacceptable conditions. Any greater delay would imply that most people (more than 50%) would have to adapt their movements, to give way to motor vehicles—a situation clearly not compatible with the idea of an environmental area." *(p. 204) Buchanan, op.cit.* His data for this borderline condition is presented below. If a particular roadway of width, W, carrying a volume of traffic, VPH, lies in region B, then a special pedestrian crossing is required.



Region A — Pedestrians free to cross anywhere.
Region B — Some form of controlled crossing desirable.

By: Christopher Alexander, Sanford Hirshen, Sara Ishikawa, Christie Coffin and Shlomo Angel.
Contribution By: Ronald Nicolino.
August 1969, revised September 1970
This pattern is tentative. If you have any evidence to support or refute its current formulation, please send it to the Center for Environmental Structure, P.O. Box 5156, Berkeley, California 94705; we will add your comments to the next edition.

All services off Arena

If services are located all over the building, one or two will inevitably dominate, clients will not realize that the others exist, and the referral process will break down.

There are five points to note.

1. For the community the services are the most important part of the building; they don't want them to fade into the background, behind a "culture" center, or the like. (This sentiment was clearly expressed by members of the Hunts Point Community in meetings during 1967-68.)

2. The services must operate in parallel; no one should be allowed to dominate the others. If, for example, one service takes over the ground floor and pushes the others upstairs, people will tend to associate the entire building with this dominant service, and forget that the others exist.

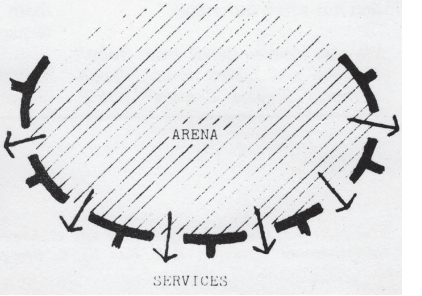
3. Bringing a wide range of services together, heightens the possibility for effective referral. When services are spread out, referral does not work (55.6% don't follow through; *Gene Bernardi, "Preliminary Evaluation of Neighborhood Organization Programs – Individual contact and Referral Activity", Department of Human Resources, Oakland, California, 1967, Table V.*) Referral becomes real when the service in question is right there, across the room, and can be pointed to.

4. From his experience with a center, the client should come to know that the concept "multi - service" has some significance. There is some evidence to indicate this rarely happens today. Four out of five people interviewed in an East Oakland MSC did not realize that the Center offered anything more than that for which they were waiting. Also: ". . .Most of the clients know about the centers in a very limited fashion. . .their acquaintance. . .is likely to be for the purpose of securing a certain kind of service. Accordingly they associate the center with that function and nothing else." *Kirschner Associates, "A Description and Evaluation of Neighborhood Centers, Albuquerque, New Mexico, December 1966, p. 25.*

(continued over)

Therefore: Let every service have space on the main floor. For each service, place at least the entire interview space in this main area. Open all the services to a common space, an arena for public loitering – each service with roughly equal frontage on this arena. If there is a reception station, make it directly visible and accessible from the arena. If a service needs more than its main floor space, put the extra space directly above it, on another floor, with direct vertical circulation.





All Services off Arena

Problem (continued)

5. Inter-service communication between staff interviewers must be fluid. Clients get better help with their problems when staff members from various agencies are able to coordinate their efforts, and deal with the problem on a "case" basis. In theory this is obvious, but in practice it has been a very difficult relationship to achieve. Kirschner reports (*op.cit., p. 34.*):

"At present, with rare exceptions the most that can be said about the coordinating function of neighborhood centers is that they represent a single accessible point for the dissemination of information about services. This is a convenience for clients seeking information and represents a service whose values should not be underestimated. At the same time, however, it is a far cry from the idea that centers should function to coordinate services on 'a case' basis. This is a much more difficult task requiring a high order of professional and technical skills. Where efforts have been made to set up integrated programs the impetus seems to have come from planning at the CAA level."

And on page 44:

"The integrated efforts that appear to have been most successful have focused on 'case' coordination and have involved a very considerable devotion of time and effort to provide across-the-board but intensive help for families. Integrated efforts of large organizations dealing with particular neighborhoods, types of clientele or problems have been rare and not often successful."

We also have evidence from *Robert Perlman and David Jones "Neighborhood Service Centers", HEW, Washington, D.C., 1967, p. 34:*

"Despite the strains, more interservice activity occurred than would be indicated by the fact that 70% of the cases in the sample received service from only one unit in the center. Actually, in connection with the 23 multi-service cases in the sample, there were four Review Conferences and 21 inter-service consultations. Informal contacts among workers go on all the time but do not show up in the forms and statistics. The lawyer pointed out, for example, that the usefulness of the other services for her clients is enhanced by the possibilities for communication within the staff and that this contrasted with the more typical legal aid office which must refer to other agencies all non-legal problems."

This last remark makes it clear that inter-service coordination does exist; but also makes it clear how important it is to enhance it wherever possible.

Good integration of services thus seems to depend to some extent on open and informal lines of communication among staff interviewers throughout the center. Intuition tells us that a staff member is most likely to be in touch with other staff members who work near him, and on the same floor.

Thus all interviewers should be located on one floor off a common space. If any service needs more space, than it can have on the main floor, the clerical staff should move onto another floor, with some convenient vertical connection between them and their ground floor counterpart.

This pattern enchances inter-service communication among interviewers, at the expense of intra-service communication between interviewers and clerical staff. It is true that this is an unusual step, and that the individual services may try to resist it. In defense, we must point out that the communication *between* services is, *from the point of view of multi-service,* more important functionally than the communication between interviewers and clerical staff within a given service.

Context

A multi-service center, or any public building which contains a number of services, working in parallel.

By: Christopher Alexander, Sara Ishikawa, Murray Silverstein.

July 1968 revised June 1970

This pattern is tentative. If you have any evidence to support or refute its current formulation, please send it to the Center for Environmental Structure, P.O. Box 5156, Berkeley, California 94705; we will add your comments to the next edition.

Eight Beds Per Nurse

If the nurse has too many patients to look after, she cannot give them the feeling that they are being cared for.

Most nursing units in large general hospitals do not provide the setting necessary for the fastest possible recovery of the patients; they are mechanized and impersonal. The usual arrangement is a long corridor with rooms lined upon both sides and a nursing station with some four or five nurses located in the middle. There is no sense of relatedness to anything or anybody for the patients to take hold of; there is no sense of identity among the rooms.

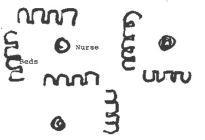
Patients feel anxious that they are forgotten and that there are too many different people taking care of them. They feel that they are not getting enough personalized care and attention.

On the other hand nurses complain that the present method of practicing nursing is not what they thought it was or what led them into the profession. They have too little personal contact with their patients. There are too many nurses caring for the same patient so that a nurse never gets the gratification for being solely responsible for a patient, or cultivating a one-to-one relationship with the patient. In addition, she never is quite sure of what the last nurse has done for the patient.

Further, in most hospitals nurses find that rather than actually caring for the sick, they have become administrators, devoting most of their time to supervising nurses aides and orderlies and doing paper work. There is little time for personal contact with the patients.

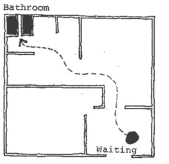
(continued over)

Therefore: Arrange the beds in clusters of eight, with one nurse's station central to each cluster.
Arrange the clusters in groups so that one nurse (on night duty) can supervise several clusters at the same time.



Accessible Bathrooms

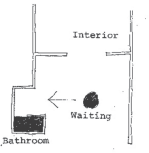
While people are waiting for an appointment they will want to use the bathroom; they shouldn't have to traipse over half the building to find it.



Bathrooms will, of course, be scattered through the building to serve the staff. If the public is forced to search around for these facilities there are two effects: First, it is simply a nuisance to the public; it puts them off. Second, in many cases they will have to wander through office pools to get to the bathroom, and this makes the staff nervous. If there is ever a theft of any kind, staff-community relations are threatened. Yet a community building cannot deny the use of bathrooms to the general public.

(continued over)

Therefore: Locate the public bathrooms immediately beside the waiting areas, so people do not have to walk through the interior of the building to get to them.



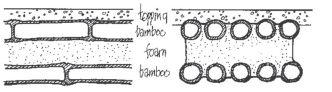
Where bamboo is plentiful, how can it be used as a structural material?

Composite Bamboo/Foam Plank

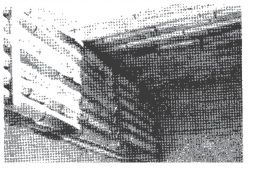
Conventional reinforced concrete beam and plank is expensive and heavy. A number of recent experiments have shown that sandwich planks with plywood, gypsum or cement asbestos skins and polyurethene foam cores have enough strength to span 2 – 3 meters with normal live loads; they have been widely built and tested in many parts of the United States. In a country where bamboo is readily available, and wood expensive, it seems natural to use bamboo as the outer skin of the sandwich instead of plywood.

(Continued over)

Therefore:
Make floor and roof planks from bamboo-polyurethene foam sandwiches.



Maximum span for this system is approximately 2.50 meters unless panels have additional thickness and reinforcing. Allowable loads are shown in the problem statement.





Corridors Which Live

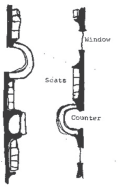
Corridors in modern public buildings are unfriendly and sterile places. They are designed for scuttling people through, not for people to stay in.

If a building is organized so that you feel as though you have to have an excuse to be in every part of it, it makes it impossible for anyone to get a sense of what the building is all about, and it gives a general feeling of being unfriendly.

While the rooms in a building are purposeful, the corridors and lobby do not have to be. It is true that they are mainly for circulation, but it is important that they be something more than just for moving through. It is from the circulation system of any environment that one gets a total sense of that environment. If the circulation system invites you to stop and be there for a while and see what is going on around you, the whole environment seems friendly. For instance streets with people sitting on stoops, and stopping to look in shop windows or to buy something from a street vendor, are alive and wonderful places to be, while a street with only blank walls, where people pass through intent only on their destinations, are frightening and alienating.

So it is with corridors in public buildings. Like the street, these corridors should have many places to stop, to sit, to look at things, to buy things and should give you a sense of what is going on around you.

(continued over)



Therefore: Line the corridors with windows looking into the services; make places by concentrating seats and activities along the way; project counters and entrances of services into the corridors. Make the main part of the corridor about 12 feet wide, and between 12 and 16 feet high, and where activities and counters are placed – make edges about 7 feet high, going to a total width of 21 feet. Give the corridor as many windows as possible, and make other corridors lead into it wherever possible.



Barbershop Politics



It is easier to strike up a political talk in a place like a laundromat or a barbershop, than it is, coming as a stranger, to a person's home.



When a community center takes on the task of organizing around some issue, there is the problem of reaching everyone in the neighborhood. It is impossible to reach many people with a door-to-door residential campaign. Often people don't want to be bothered in their home: either they are busy doing something else, or they are just relaxing, and don't really want to talk politics.

Where can organizers engage people, outside of the home, where they will be relatively open and receptive?

We suggest that the places where discussion can most naturally arise are the following:

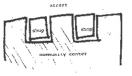
1. Barbershops.
2. Laundromats and lunch counters.
3. Small, street-oriented businesses, like news racks, cigar stores, record shops, small grocery stores.
4. Hangouts around pool halls and bars.
5. Places where people wait to get unemployment checks, food stamps, and so on.

(See for example, *M. Kaplan, Leisure in America, J. Wiley & Sons, Inc., New York, 1960, p. 101.*)

Certainly community organizers will need to spend a lot of time in places like these. But also it will help if the center, itself, is near these places. The closer the connection between talking and the potential for action, the better. Talking politics in a barbershop suddenly becomes real when next door there is a facility for turning your two cents into some action. (Imagine open mimeo machines, a community wall, hot lines to the mayor and governor, all around a grocery store and a bar.)

(continued over)

Therefore: Weave at least one, preferably several, of the kinds of activities named into the public face of the community center.

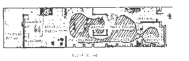


Fiesta

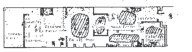
Parties are the lifeblood of Peruvian social life.

In Peru, fiestas (parties) happen many times a year in every household—every time there is a birthday, name-day, or any kind of special occasion. Our observations suggest that typical households may have as many as one a month, and that there may be as many as forty or fifty people at these fiestas, even in a small house.

This many people can't drink and dance together, unless the various available living areas (sala, patios, family room, verandas) form a continuous and sizeable space. It is also necessary that this space be reasonably continuous; the flow of persons from group to group strongly affects the life of a party; distinct rooms will hinder this fluidity.



On the other hand, for reasons presented in *Intimacy Gradient* the sala and family room must be strictly separated during everyday use of the house. These rooms must therefore be distinct, yet capable of forming a continuous whole on special occasions.



Context: This pattern is especially important in Peru since fiestas are so much a regular social activity. It is clear though, that it has a much wider context and applies to any household (in any culture) where there are large parties and celebrations.

Therefore:

Arrange the sala, the family room and the spaces which connect them so that they are distinct spaces, yet also form a continuous single space for parties.



Buildings Surround Open Spaces

What arrangement of buildings and open space gives the most daylight and the best use of land.

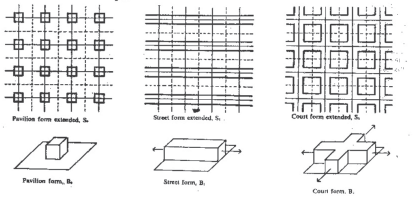
Lionel March and Leslie Martin have shown that two main factors influence the relative layout of built and open space.

1. The intensity of land use.
2. The amount of the building in-tensity which has daylight.

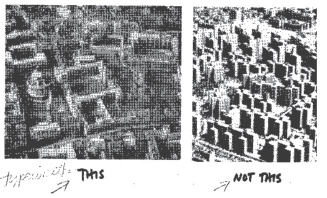
Intensity of land use, is conveniently measured by P, the ratio of built floor area to total site area. Access to daylight is conveniently measured by d, the semi-depth of the building.

March and Martin have compared these factors for three different arrangements of building and open space, which they call S_2 S_1 and S_3.

(continued over)



Therefore: When density and daylight are important considerations, make buildings surround open spaces, do not make open spaces surround buildings.



Free Waiting

Large institutions with busy professionals subject their clients to endless waiting; this waiting has a deadening effect on people.



This problem arises in the following way:

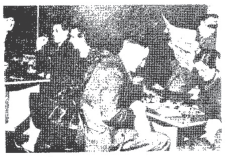
Interviewers squeeze as many interviews as possible into a tight schedule. But the exact length of any one interview is unpredictable. This means clients will inevitably be kept waiting.

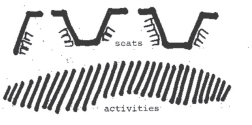
Further, since people never know exactly when their turn will come, they cannot even take a stroll or sit outside. They must stay in the narrow confine of the waiting room, waiting their turn. But this, of course, is an extremely demoralizing situation: Nobody wants to wait at somebody else's beck and call. (Kafka's greatest works, *The Castle* and *The Trial*, both deal almost entirely with the way this kind of atmosphere destroys a man.)

Evidence for the deadening effect of waiting comes from Briar's study (*Scott Briar, "Welfare From Below: Recipients' Views of the Public Welfare System", in Jacobus Tenbroek, Ed., The Law and the Poor, Chandler Publishing Company, San Francisco, 1966, p. 52.*) We all know that time seems to pass more slowly when we are bored or anxious or restless. Briar found that people waiting in welfare agencies always thought they had been waiting for longer than they really had. Some overestimated their waiting time as much as four times.

For most people the best antidote for the waiting feeling is to get involved with something interesting that has nothing whatever to do with waiting.

(continued over)





Therefore:

Place a number of seats within sight of the interview office (use the average number of people waiting at any one time plus a safety factor). Place exhibits and reading material near the seats. Connect the exhibit and seating area to a larger open area, with activities for waiters and non-waiters alike (e.g. public arena, pool tables, coffee counter). Equip this larger area with a public address system, for calling people to their appointment.

Light Is Information

If the places where the light falls are not the places you are meant to go towards, you will inevitably be confused.

People are phototropic—they tend to move towards light, especially natural light.

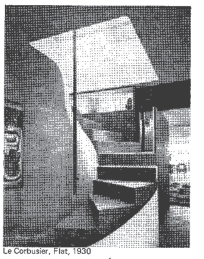
When the light is uniform, or the arrangement of light and dark is different from this pattern, the environment is giving information which contradicts its own meaning. The environment can only function in a single-hearted manner, as information, when the lighter spots coincide with the points of maximum importance, or maximum information, or goals, in the circulation system.

This has the effect of enormously increasing the legibility of the environment—the light and dark function as sources. The arrangement of light and dark provides a prime source of information about the way the environment is to be used.

Context Any circulation system.



John Galen Howard and William C. Hays, Old Architecture Hall, U.C. Berkeley



Le Corbusier, Flat, 1930

Therefore:
In the circulation system give all the nodes which function as targets for people to walk towards (receptionists, entrances, access points, coffee, information) higher light intensity than the surrounding areas and than the passages between them.



Horizontal Office Buildings

When an organization occupies many different floors of a multi-storey building, communication between staff on different floors is shot.

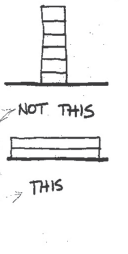
Every organization depends on informal communication between its various departments. The formal messages that pass between departments are only a small part of the "glue" which actually holds an organization together. A much larger part of the work that gets done hinges on human relationships. When people are getting along well, and when they understand each other, the organization functions smoothly. When people stop understanding each other, and try to do business on a purely "business" basis, the smooth functioning of the organization falls apart.

The creation of proper human relationships depends most on chance, informal, casual contact between people. A smile, a good morning, a chance to discuss a misunderstanding while in the corridor, a shared idea during a coffee break, these are the moments that make a healthy organization work. In short—a healthy organization requires a great deal of casual, informal contact among people from different departments. (See, for instance, *Bernard M. Bass, Organizational Psychology, Allyn and Bacon, Inc., Boston, Mass., 1965.*)

The amount of contact between staff members in different departments, depends greatly, on the floors they occupy. This is a part of everyones common experience. You get to know the people working on your floor much better than the people working on other floors.

(continued over)

Therefore: Make all office buildings horizontal. If possible keep them down to two storeys in height. Where land values force the creation of high office buildings, still keep the emphasis of building horizontal, and make sure that the floors are as large as possible, so as to minimize the number of organizations that have to spread themselves over more than two floors.



ENGLISH TYPE

Look-See Familiarity

Patients get turned off if they can't see what is going on around them.

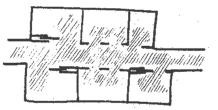
In existing mental health facilities, a patient who comes in often gets a sense that he is going to lose control over what happens to him. He may be afraid he will lose all the power of decision over his treatment, be exposed to unwelcome forms of treatment and personal contact, or be subjected to frightening, inappropriate security provisions.

This has a strong bearing on the design of circulation spaces in the mental health center. Such spaces should be designed to be sources of information to support the patient's sense of reality. They should make the treatment facility familiar to him as a non-threatening, non-secretive place to be.

These spaces should therefore be open in plan in all areas designated for daily living and frequent use by patients. Closed-off spaces can scare patients; from outside, they may cause him to be barred or feel threatened by secrecy from activities which are taking place in the closed area—from inside, they prevent him from getting out, taking part, or being able to make "checks" on what is happening.

Context
Circulation in a mental health facility.

Therefore:
1. Eliminate doors where possible.
2. Use sliding doors, which stay open except when room is actually in use.
3. Place many interior windows looking from corridors into adjacent spaces where possible.



Necklace of Community Projects

The facade of a community center must not be offensive to the community it is meant to serve.

Assuming that the internal operations of a community center are personal, indigenous, respectful of the community, non-bureaucratic and non-oppressive, then how can the center be organized so that these qualities are visible from the outside? One clue may be this: red tape is the opposite of small, informal organization, private ownership, simple, direct relationships. Buildings that have these qualities are more like dwellings than offices. (Benny Parish, community organizer: "Our office was like a house—the thing I liked—it was like a living room.")

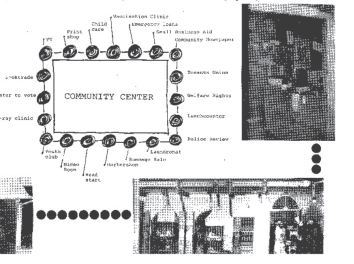
In order to make it clear to people that the center is not subject to office-like red tape nonsense, the outside of the building, at ground floor, should be entirely made of community-owned projects, which are small in scale, privately built, individually accessed, not under the aegis of formal receptionists.

It is especially important that they be privately built. If they are not, they will seem standardized, and impersonal. But this is clearly difficult. The individuals and groups in the community who try to build community projects will inevitably be short of money, in order to make it as easy as possible for the to build space, the most expensive elements should be provided for them in advance. These are foundation, floor, roof and services. It therefore makes sense to create an overhang, with roof and floor complete, and with electric conduit boxes in the wall.

(continued over)

Therefore:
Ring the building with a series of small, shop-like spaces, for community projects; Invite groups in the community to build and use these spaces individually; Design the facade of the community center as a superstructure, providing roof, floor slab, and conduit boxes for these individually built community projects.



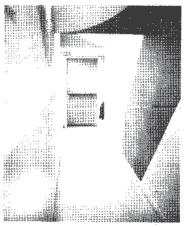




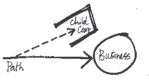
Child-Care Position

Children get anxious when they are suddenly left in child-care rooms that they've never seen before.

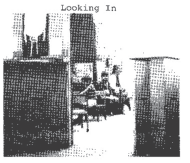
They feel deserted, and the ensuing scene causes tension between mother and child. (See *Lynn, Shapiro and Silverstein, "Kiddie Korral Observations", unpub. ms. Department of Architecture, December 1966.*) The only certain way to solve this problem, is to create circumstances under which the child decides, of his own accord, that he wants to play in the child care room. Of course the physical design cannot guarantee this circumstance — since it depends on many personal and idiosyncratic factors. However, the physical environment can help to increase the likelihood of the circumstance, by exposing the inside of the child care room *to the child*, for as long as possible, *during the time that the mother and child approach it*. The longer the child has a chance to see what is going on in the care center, the greater the probability that he will, of his own accord, decide that he wants to be there. The child's experience during the 20 or 30 seconds it takes to approach the space plays a crucial role in establishing this possibility. (continued over)



Therefore: Place the child-care space on the path from the building's entrance to the actual place of business, and make it visible from this path; lay out the path so that it looks into the depths of the child care station for at least 20' along its length. Make sure the visibility is established from a child's eye view.







Window near Front Door

Who is at your front door when the bell rings?

The following tendencies conflict:

1. The person answering the door often tries to see who is at the door before they open it.

(For instance, Banhams Patent Locks, Kensington High Street, London, report a 50% increase in the sales of domestic door viewers between 1963 and 1965.)

The anonymous nature of the metropolis, and the possibility of unwelcome callers, makes the need acute. Many people, if they have a convenient window, also make a slight detour when they hear the doorbell ring, to see who is outside.

2. People do not want to go out of their way to peer at people on the doorstep, partly because it is too much trouble, and partly because they don't want to make it obvious that they are appraising the visitor.

3. If the people meeting are old friends, they seek a chance to shout out, wave, in anticipation.

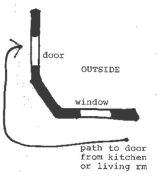
4. If the visitor seems unwelcome or dangerous, a woman alone especially wants to be able to talk to him without opening the door.

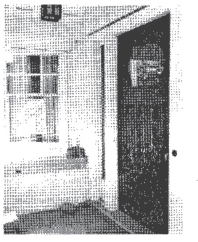
5. Since it takes a few seconds to adjust mentally and posturally to an encounter, people answering the door may want a second or two, unseen, after they know who is at the door, before they open it, and before they can be seen.

The conflicts among these tendencies are *not* resolved by any of the following arrangements.

An entrance in which there are no clear glass windows at all; an entrance in which the first view of the visitor which the insider has, is through the door itself, so that he has no time to prepare; an entrance such that the nearest window is off the natural path to the door; a window which looks straight at the visitor on the doorstep from the front; windows which are unopenable, so that the lone woman is forced to open the door in order to talk to the visitor; an all glass entrance; a window so placed that because of privacy it gets a curtain hung in front of it, and the curtain has to be pulled back to see through.

Therefore: Put an openable window on the path from the kitchen or living room to the main door, so that it faces the area immediately outside the front door. Make a short stretch (at least 5') of non-transparent wall between this window and the door.





Public services don't work if they are too large. When they are large, their human qualities vanish; they become bureaucratic; red tape takes over



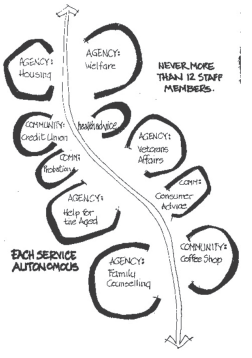
Small Services without Red Tape

Red tape can be overcome in two ways. First, it can be overcome by making each service program small and autonomous. A great deal of evidence shows that red tape occurs largely as a result of impersonal relationships in large institutions. When people can no longer communicate on a face to face basis, they need formal regulations—and in the lower echelons of the organization, these formal regulations are followed blindly, and narrowly.

Second, red tape can be overcome by changing the passive nature of the clients' relation to the service programs. There is considerable evidence to show that when clients have an active relationship with a social institution, this institution then looses its power to intimidate them. (continued over)

Therefore:

Give the services in any public service organization the following characteristics:
1. No one service more than 12 staff members, total.
2. Each service autonomous as far as possible; and housed in an identifiable, physically autonomous unit, with direct access to a public thoroughfare.
3. The services arranged in a loose informal way; so that there is no hard and fast distinction between services provided by agencies, and services which are initiated and run by members of the community.



Ground floor windows facing directly onto the street are a nuisance: they violate the privacy of the house.

No Ground Floor Windows on the Street

When passers-by can look through ground floor windows into a house, the people who live in the house will inevitably curtain or shutter the windows. If the front rooms rely on these windows for light and air, this makes them dark and stuffy, and less usable.

The phenomenon is widespread, and applies to many cultures. We found it to be particularly acute in Peru, where many houses are immediately adjacent to the street, and where peoples need for privacy and fear of thieves is very strong. Windows facing onto the street, at ground level, are *almost always* boarded up, painted with whitewash, heavily curtained and screened.



A survey of 60 first floor windows in San Martin de Porras (a part of Lima) showed only 2 out of the 60 which were not completely obscured by curtains, shutters, blinds, paint or other opaque materials. One of the two opened onto a home workshop; the other into a shop.

A less extreme version of the same behavior occurs in all cultures.

Therefore: If a house is right on a public street, place all windows which face the street above eye level.



It is important to take this into account from the very outset in the way that front rooms are lit and ventilated. If the front room relies on a street window for light and air, the inevitable boarding up will make the room dark and stuffy and less usable.

Overview of Services

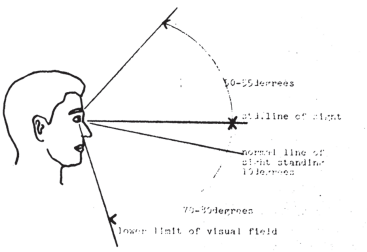
To get oriented in a public building, you've got to establish an overview of the building's parts, the split-second you walk in.

There are two parts to this argument. First we shall suggest that a person orients himself to things most naturally when he is slightly above them; second we shall describe a characteristic of those spatial layouts that can be "picked up in a glance".

1. It is well known, informally, that we see an array of buildings better if we approach them slightly from above. People get a better view of something when looking down at it, than when they are looking at it on the level or looking up at it. There are two reasons.

a. The normal line of sight for a person standing on a horizontal plane, is 10 degrees below the horizontal. (*Henry Dreyfuss, The Measure of Man, Whitney Library of Design, New York, 1959, Chart F.*) It is also known that looking *up* at things is tiring. This has been measured only in the extreme case (Kinzey and Sharp state that looking up at an angle greater than 20 degrees above the horizontal is tiring, *Environmental Technologies in Architecture, Prentice Hall, New York, 1963, p. 354*), but it seems likely that any deviation from the line 10 degrees below the horizontal is relatively uncomfortable according to its magnitude.

b. When a person looks straight ahead, fixating on the horizontal, his field of vision extends about twice as far *below* the horizontal as it does *above* the horizontal. This supplements the first effect. It is shown on the diagram below. (The source again is Dreyfuss, Chart F.)



Both these effects make it clear that a person entering a building, will be able to see its services and their signs most easily, *if they are at least 10 degrees below his horizon.* (continued over)

Therefore:
Place all the services off a common space; and let each entrance to this common space have sight lines to every service, or to marked paths leading to the services. Give each service a legible sign. Locate the services or paths below the level of the building's entrances (or raise the entrances), so that the sight lines from the eye of a person entering to the signs carrying the names of the services, are 10° below the horizontal.





Shop Front Possibility

10% of low and medium income families in Peru want to open a small shop of some sort.

Many families with low incomes, start a small shop to supplement their income. Figures for low to moderate income sections of Lima, for example, indicate that 10% of the houses contain some type of shop or workshop. (*Jose Matos Mar, "Migration and Urbanization", in Urbanization in Latin America, edited by Phillip Hauser, International Documents Service, Columbia University Press and UNESCO, 1961, page 181.*) Our own count gave the same figure. We suspect that government policy may not allow the construction of small shops in public housing. However, a small survey of white collar workers showed that many of them desire this option, and would in many cases prefer it to the provision of other kinds of space. *We strongly urge that they be allowed to build stores if they want to.*

If the family had to build a little shop onto their house, the cost of doing so would probably cancel out any additional income he may hope to derive from the shop for months and perhaps for years. Most of the shops we observed, seemed to make very little profit, but what ever little profit made was very significant to the family. Thus, the only way it would be economically feasible for a family to open up a shop, is if they can easily turn an existing room or space into a shop.

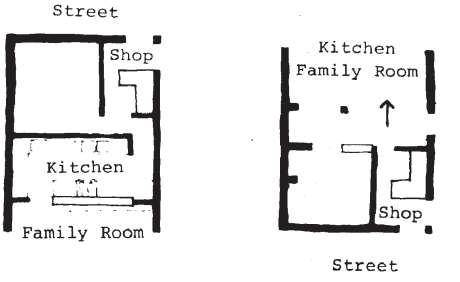
From a physical point of view, the problem is rather simple. The house should contain space, at least 2 x 3 meters, on an exterior face of the building, preferably on the corner where the most people are going past. This space must be placed so that the inside of the house will still be private and secure, if there is a shop built there; and if possible, it should be visible from family room or kitchen, so that members of the family can keep an eye on it from the family part of the house.

Context

This pattern is valid (most likely to a lesser degree) in low or middle income urban areas almost anywhere. The picture below shows such a store in West Berkeley, a middle-low income area.



Therefore: Put a space in the house where the owners can start a small shop if they want to. The space need be no larger than 2 x 3 meters, and should be in sight of the family room or kitchen.



Light Is Information

If the places where the light falls are not the places you are meant to go towards, you will inevitably be confused.

People are phototropic—they tend to move towards light, especially natural light.

When the light is uniform, or the arrangement of light and dark is different from this pattern, the environment is giving information which contradicts its own meaning. The environment can only function in a single-hearted manner, as information, when the lighter spots coincide with the points of maximum importance, or maximum information, or goals, in the circulation system.

This has the effect of enormously increasing the legibility of the environment—the light and dark function as sources. The arrangement of light and dark provides a prime source of information about the way the environment is to be used.

Context Any circulation system.

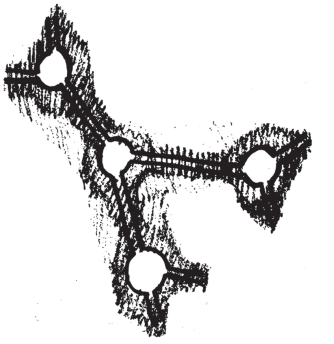


John Galen Howard and William C. Hays, Old Architecture Hall, U.C. Berkeley



Le Corbusier, Flat, 1930

Therefore:
In the circulation system give all the nodes which function as targets for people to walk towards (receptionists, entrances, access points, coffee, information) higher light intensity than the surrounding areas and than the passages between them.



Necklace of Community Projects

The facade of a community center must not be offensive to the community it is meant to serve.

Assuming that the internal operations of a community center are personal, indigenous, respectful of the community, non-bureaucratic and non-oppressive, then how can the center be organized so that these qualities are visible from the outside? One clue may be this: red tape is the opposite of small, informal organization, private ownership, simple, direct relationships. Buildings that have these qualities are more like dwellings than offices. (Benny Parish, community organizer: "Our office was like a house—the thing I liked—it was like a living room.")

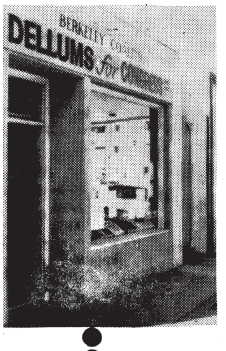
In order to make it clear to people that the center is not subject to office-like red tape nonsense, the outside of the building, at ground floor, should be entirely made of community-owned projects, which are small in scale, privately built, individually accessed, not under the aegis of formal receptionists.

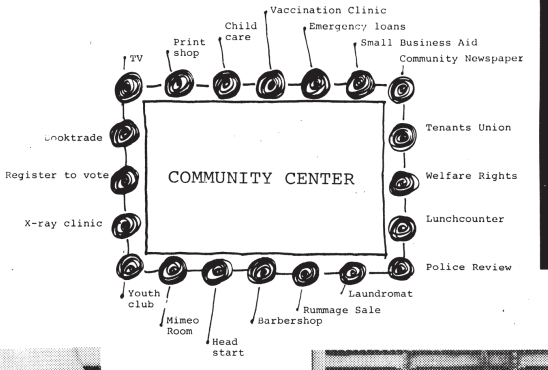
It is especially important that they be privately built. If they are not, they will seem standardized, and impersonal. But this is clearly difficult. The individuals and groups in the community who try to build community projects will inevitably be short of money. In order to make it as easy as possible for the to build space, the most expensive elements should be provided for them in advance. These are foundation, floor, roof and services. It therefore makes sense to create an overhang, with roof and floor complete, and with electric conduit boxes in the wall.

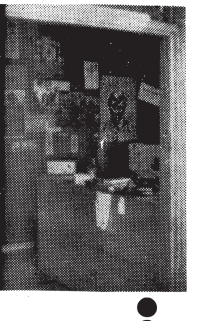
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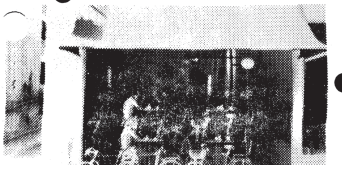
Therefore:

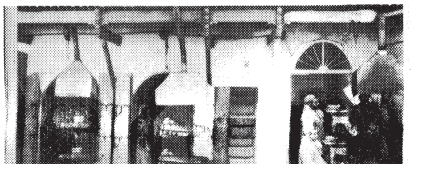
Ring the building with a series of small, shop-like spaces, for community projects; Invite groups in the community to build and use these spaces individually; Design the facade of the community center as a superstructure, providing roof, floor slab, and conduit boxes for these individually built community projects.











8 Major changes in environmental form required by social and psychological demands, 1969

This article, in Constantinos Doxiadis's journal Ekistics, *helped establish the importance of social and psychological factors in design, and how it is possible to be explicit about them in the development of patterns. The idea of relating mental health to the physical environment was beginning to gain traction at the time. Roger Barker, who invented the idea of the "behavior setting", published his groundbreaking book* Ecological Psychology *in 1968;*[1] *the Environmental Design Research Association (EDRA) was founded in the same year. And the development of the pattern language itself was partly supported by a major grant to the CES from the National Institute of Mental Health (NIMH).*

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There is a strange dichotomy between the present architecture and planning professions. On the one hand, the architects are in the habit of creating completely mad idealistic utopias. These utopias often have little meaning, they are unlikely to be implemented; often no one in his right mind would want to implement them. They are personal dreams, not anchored in reality. Archigram's city on legs is an extreme example.

On the other hand, the current generation of city and regional planners – and the regional scientists are included – have established a tradition of boring attention to detailed facts, and extrapolation from these facts. The future, as seen by planners, is merely a tidier version of the present. While architects dream of utterly unimaginable futures, the planners talk about piecemeal incremental planning. The visionary architecture is imaginative, daring, but completely mad. The planners' plans are utterly and boringly sane; though based on facts, they offer no comprehensive vision of a better future.

We may strengthen these statements. It is no exaggeration to say that many of the most imaginative utopian architects actually dislike facts, and have a kind of

1 Roger Barker, *Ecological Psychology*. Stanford: Stanford University Press, 1968.

DOI: 10.4324/9781003187516-9

supercilious disregard for them. And it is no exaggeration either to say that the kind of data gathering which planners most often do, since it is based on data about the status quo, tends to reinforce the status quo; and that planners – perhaps because of their concern with this kind of data – tend to have a rather conservative attitude.

This split is more serious than it seems. It is more than a mere difference of philosophy between the two professions. What it amounts to is this. We have not found a way of making a coherent, criticisable and empirically founded statement about the kind of future we want for the living of life in cities. So long as the split between Utopians and data gatherers persists, it will not be possible to make such a statement. The reason is obvious. A statement of this kind will require vital imagination about man's future, based on empirical insights about the really deep forces in a man's life.

The possibility of constructing serious Utopias in this sense is being set back, at present, by two beliefs – widely held by planners in the United States.

1 The first of these beliefs says that the physical form of the environment has very little effect on behavior – hence, that the physical form of the environment is not very important socially. According to this view we can tolerate architecture as a kind of amusement which has do to with beauty – the sugar on the cake – but we are supposed to recognise that it really has very little to do with the problem of making cities better to live in. Since most of the "comprehensive" urban Utopias have been physical ones, designed by architects, this belief functions as a kind of backhand attack on utopian thinking.
2 The second belief – not so explicitly stated as the first – says that psychological insights, while no doubt interesting, are as yet too vaguely formulated to have any serious bearing on urban form. According to this view concern with the nature of life cannot have any serious bearing on the day to day work of the urban and regional planner.

As we shall see, both of these beliefs, though clothed in scientific reasonableness, are in fact merely offshoots of the more general refusal of city planners today to make a concrete statement of what life is all about. Let me say a few more words about each of these beliefs.

What about the first belief, that the physical environment has little effect on behavior. This belief has only come into play during the last few years when planners and architects have been claiming that they can influence people's well-being by manipulating the physical environment. A typical statement was Neutra's: "Let me design a house for a happily married couple, and I can have them divorced within six months." This sort of arrogance naturally invited suspicion. People have begun to quote the famous Hawthorne experiment – where it was shown that the crucial variable, responsible for increased production and worker well-being in an electric plant, was the attitude of management, not the pleasantness of the physical environment. Another famous study of workers in northern California, examined their life style while living in a high density slum in Richmond, and then three years later, their life style living in a low density suburban area of single family houses; their life styles had not changed in any significant respect.

The recent statements by Webber and others, which show that social groupings are not based on spatial proximity, but rather on communality of interest, have been

widely received. The planners who take this idea to its most extreme form, say: let the urban sprawl go on any way it wants to – what really matters are the economic and social organizations, not the spatial. This general attitude has gone so far now in the United States that many intelligent students and young professionals have become convinced that the spatial organization of cities does not really matter much – and have gone into other, more obviously social, fields.

What about the second belief; that psychological problems are too subtle to be taken seriously. I have never actually seen this belief expressed in print. But it is reasonable to infer it, from the subjects which planners most often deal with. In urban planning and regional science, two closely associated disciplines predominate: Economics of location, and transportation theory. It is not unfair to say that 90% of the literature on regional science deals with one of these two topics. Even in the architectural literature, where there are occasional references to psychological questions, they are almost never seriously studied.

It is perhaps helpful to ask *why* the regional science literature is so heavily weighted towards the problems of economics and transportation. The answer is very simple. Since these are two disciplines where reasonable models can be made with the help of arithmetic and elementary mathematics, and since the people who started out to develop regional science were enthusiastic "model builders", wanted to be scientific and precise, and loved playing with numbers, the field of urban planning got slanted in this direction. If you press a regional scientist, and ask him why he does not take social and psychological problems more seriously, he will say that he would like to, but unfortunately these subjects are not yet sufficiently precise, and nothing sensible can be done with them.

I shall now give a series of examples, to show that these two beliefs are mistaken; and to show that, in a modest way, careful consideration of psychological problems will lead to major revisions of environmental form.

To begin with, we must face squarely, just what the task of city planning is: it is, in short, the design of culture. A culture is a system of standard situations. Each of these situations specifies certain roles, certain allowed limits of behavior for the persons in these roles, and the requisite spatial setting for this behavior. Each situation thus specifies a certain physical pattern – and each pattern recurs many thousands of times in a given city. The form of the city is generated by the combination of these patterns. In this sense, the city, viewed as a purely physical system, is a direct concrete manifestation of the culture. Any attempt to change the physical organization is an indirect attempt to change the culture. That is why I say that city planning is the design of culture.

Now, each person in a culture lives his life by moving from situation to situation – he builds his life up as a kind of necklace – by stringing together those situations which are available to him in his culture. In a successful culture, the set of situations which is available to him is sufficient to allow all the inner forces which develop in him free play. In order to criticise a culture, we must find in the lives of its members recurrent situations which expose the members to conflicts which they cannot resolve within the framework of the cultural institutions and situations that the culture normally makes available to them. We may then try to invent new institutions, or institutionalized situations, compatible with the rest of the culture, but capable of letting people resolve this conflict for themselves.

In order to make such a criticism, we need to know something rather concrete about the inner forces which a person is typically exposed to during the course of his life: otherwise, we cannot say what kinds of conflict he will experience. Recent work in psychology and

social psychology has done much to help us here. It will perhaps help to make this clear, if I first mention a very early view of human needs, presented by Bronislaw Malinowski. Malinowski said that a culture is a system of institutions designed to satisfy seven basic needs: metabolism, reproduction, bodily comfort, safety, growth and health.

This view does not help us to criticise the culture of a metropolitan United States at all. At this level of analysis, we have every right to be satisfied with our culture. We do have food supply, housing, transportation, schools, parks and hospitals. All we need is more of them, perhaps. But these seven basic needs give an extremely mechanistic view of man's nature. More recent study of needs has shown us a rather more complex picture. Consider, for example, the work of Alexander Leighton, Abraham Maslow, and Erik Erikson.

Leighton identifies 10 basic strivings in man: physical security; sexual satisfaction; the expression of hostility; the securing of love; the securing of recognition; the expression of spontaneity; orientation in terms of one's place in society; the securing and maintenance of membership in a definite human group; and the sense of belonging to a moral order and being right in what one does.

If we assume that these 10 strivings are at work in adults, then it already becomes rather clearer that our present culture does not always provide an adequate system of institutions for the expression of these strivings. And, as Leighton says, frustration of these strivings leads not to physical death, but to psychiatric disorder and to spiritual death.

Maslow has described a hierarchical system of evolutionary needs. According to his view, once the basic system of food and drink needs has been met, the system of security and safety needs comes into play. Once these safety needs are being met, a system of need for affection comes into play; and once this system of affection needs is being met, the individual experiences a need for self actualisation – development of the self. In advanced economies the earlier systems are usually met, and the later systems are the most important. The last of all, the effort towards self actualisation is a system which is very inadequately met by people in modern western culture, and the culture does little to support it.

Erikson takes a developmental view. According to this view, each person goes through eight major stages during the course of his life. At each stage the person is fighting a particular spiritual battle: Erikson calls them crises. A healthy person must win each of these battles in order to be able to go on to the next; if any one of the crises is met unsuccessfully, development cannot go on to the next stage: the person gets stuck. The eight stages are:

Basic trust – mistrust	Infant
Autonomy – shame/doubt	Infant
Initiative – guilt	Child
Industry – inferiority	Child
Identity role confusion	Teenager
Intimacy – isolation	Young adult
Generativity – stagnation	Adult
Ego integrity – despair	Old age.

Again, there is abundant clinical evidence to show that the system of institutions which our culture provides does not give each person a reasonable chance of meeting each of these crises successfully.

With the help of these notions, I shall now state a number of typical recurrent problems, which cannot be solved within the framework of our existing culture. In each case I shall propose a pattern which may help to solve the problem. (Many of these patterns were developed at the Center for Environmental Structure, Berkeley.) I define a pattern as a new cultural institution together with the physical and spatial changes needed to provide a setting for this new institution. These patterns are intended for the present culture of the metropolitan United States.

In each case, I have tried to put each of these proposals on an empirical basis. I do not claim that any one of these patterns is correct as stated, I am merely trying to show the order of magnitude of the changes which careful consideration of psychological issues will lead to. However, to make this point, it is important to show that these patterns are not merely products of idle dreaming, and are not merely "utopian" in the bad old architectural sense. I shall therefore propose one or more experiments which could be carried out in connection with each of these patterns, to test its validity.

Each pattern is stated in three parts:

a A brief summary of the pattern itself.
b A brief summary of the problem which the pattern solves (with notes showing the relevant concepts in Leighton, Erikson and Maslow).
c A collection of short refutable hypotheses which, when made more precise, could be used to test the validity of the pattern.

The statements are very sketchy – no more than shorthand. After the statements of the individual patterns, I describe a city where all 20 patterns are present together.

1 Cells. Many small residential areas (diameter 200–2000), each one a different subculture the total variety of subcultures far greater than today, and also the variety of subcultures per square mile greater than today. (Hendricks, Alexander)

People seek their own kind. Character formation. Self-actualization. Require support of "same kind of people." This requires great variety of people. Also requires exposure to many types of people. Requires safety affection all OK. (Maslow, self actualization. Leighton, Orientation).

Hypotheses

a Physical barrier helps formation of more distinct subculture. Homogeneous continuous development prevents formation of subcultures.
b Support of differentiated subculture helps character formation.
c Exposure to variety of different subcultures allows fuller choice, and therefore leads to self actualization.
d Subcultures latent in modern city are very numerous.
e Provision of appropriate facilities will induce formation of subculture.

2 Roads. Cellular network of one-way high-speed arteries (parallel, cellular, hexagonal doesn't matter). (Walkey, Hershdorfer, Alexander). People seek greater average speeds, and will stick to private vehicles as far as possible. Contact. Spontaneity. (Leighton, Expression of love, Securing of love, Spontaneity.)

Hypotheses.

a For a given arrangement of origin destinations a network of largely one-way arteries optimizes flow (i.e. average speed). (Hershdorfer)
b Capacity of such arterial loops is very large – can clear as many as 8,000 cars per hour (Walkey)
c Friendship satisfaction varies with the number of acquaintances who can be reached in five minutes.
d Average number of planned versus unplanned encounters correlates with disorders of spontaneity. (Clinical)

3 Small group work. Scattered semi-autonomous employment – each large organization consisting of many smaller units – loosely connected by phone, etc. Each one largely autonomous.

Efficiency of work. Understanding of the purpose of work. Autonomy, self determination. Self respect. Split work/play. (Erikson, Generativity. Maslow, Self actualization. Leighton, Membership in definite human group.)

Hypotheses.

a Work efficiency improves under small work conditions.
b Small work groups report better satisfaction on the part of workers.
c Work quality, quantity, and worker satisfaction decrease as number of levels of administrative hierarchy increases.
d Number of cases of mental illness in individual or his family correlated with number of levels of hierarchy above him.
e Spatial centralization of work effort not correlated with overall efficiency of output.
f Split in work/play has an effect on mental picture of the world. Test by Osgoods method.
g Test resentment of wives, children, on not knowing the purpose or details of husbands' work.
h Under present circumstances few real friends at work. Depth of friendships at work correlated with size of autonomous group.
i Work efficiency and involvement go up when work/play cycle is freed to each individual's own rhythm. (Schnelle)

4 Windows. Every workplace has windows overlooking areas of life. This has huge implications either for building shape (exterior windows) or for mixed land use (interior windows). (Alexander, Ishikawa, Silverstein)

People need refreshment – the opportunity to break out of the immediate social world. Can't keep getting up and going somewhere.

Hypotheses.

a In windowless rooms, projective tests show bad state of mind.
b Rooms with windows, if only of sky or other buildings, would show similar results, less acute.
c Window significant to worker as a source of "change" not daylight (Markus).

5 Old age islands. Each one holds about 75 people (50–100). Scattered as widely as possible, so that they occur in every type of neighbourhood – *i.e.* every type of cell. (Falor)

On the one hand, economies of scale – shared facilities, etc. On the other hand, need for interaction with rest of for old and for young. At present old people forced into large relatively isolated aggregations by cost, and by old age cities. (Erikson, Ego integrity-despair. Leighton, Human group.)

Hypotheses.

a Disease incidence higher among adults who are separated from the young. (Liverpool)
b Fear of death higher among young people with little contact with old people.
c Old age trauma (retirement) worse for people who have not had contact with the old.
d Old people want to live where other old people are: how large must colony be before this want dies out.
e Retirement trauma improved if people can go on living in the same general type of neighbourhood. (Falor)

6 Cruising strip. (Context: rich, low density) Every metropolitan area has cruising strips – a strip, many lanes, no through traffic, hotdogs, etc., sidewalks, between lanes, lights, special parking, many stops possible. Strips spaced at about 20 mile intervals. (Goldberg)

Teenagers need a place to meet. Houses not suitable. Schools closed. Large crowds come together by car. Police a problem today. Boys' clubs etc., won't work. (Erikson, Identity-role confusion.)

Hypotheses.

a Increase in the number of persons taking part in this activity.
b Where such strips exist, thousands of persons take part.
c Teenagers will mention express need to meet in public, unhindered by adults, in interview, etc.
d Negative correlation between teenage crime and attendance at such gatherings.

7 Public discussion places. Frequently spaced: on the sidewalk circular rooms about 10 feet in diameter – discussion only. Sidewalk adapted to hold it. (MeCoy)

Loneliness. No avenues for meeting. Open talk. (Leighton, Moral order – right in what one does, Maslow, Self actualization.)

Hypotheses.

a If a place clearly designated as talking place, people will go there.
b People have a need to talk to people – but don't know how to enter into serious talk with them.
c High attendance at T-group type meetings. (Synanon, etc.)

8 Schools open to the city, connected with other functions, not closed. Integrated with work-study in commercial institutions. (Hoare and Silverstein)

Adolescent feels disconnected from society. Compare with village culture. Hence no possibility of identity formation; and disenchantment. (Leighton, Recognition. Erikson, Identity.)

Hypotheses.

a Feeling of teenage alienation inversely correlated with degree of work-study.
b Gradual mastery of real tasks correlated with strong identity formation (cf. East African example). (Clinical)
c Correlation of learning speed with relevance of material. (Bruner)
d Negative correlation between teenage alienation and effective participation in social institutions during childhood.

9 University. Loose aggregation of small centers. Mainly small group work. Use of all members of society in this process. Especially women, old people. No closed campus.

All people involved in the process of education. Adult education. Learning-teaching. Handing on insights to next generation (anthropology). Women's university in Los Angeles. Chinese commune. Life a process, going in and out of university continuously. Budget will not permit seminar type s/f ratio under present circumstances. Giving courses as common as taking them. (Leighton, Orientation. Erikson, Generativity.)

Hypotheses.

a Research shifting more and more to small centers and institutes.
b Increase in adult education.
c More learned by teacher than by student.
d Greatest influence on education had in small group study. (Midwest)
e Satisfaction of adults (note especially women and old) related to the extent to which they see themselves as handing on information, culture, etc., to next generation.

10 Group houses. Dwellings where group of people, married and/or single, live in commune.

Family too small. Tensions. Huxley Island. Need for more mixed, less intense, contact – balancing out tensions; close contact with more people. (Erikson, Intimacy. Leighton, Hostility.)

Hypotheses.

a Increasing tendency for people to seek such arrangements today: (music groups, spread of Kibbutzim, *Telluride*, summer houses).
b Correlation of mental health with average size of household. (Indirect evidence of this in high mental health of Italian and Hong Kong areas).

11 See through living room; porch; direct contact between every dwelling and public thorough fare. More private pavilions. (Alexander)

Need to be in touch with the community. Contact. Possibility of dropping in. Privacy a matter of choice. (Erikson, Intimacy – isolation. Leighton, Spontaneity.)

Hypotheses.

a Distance from street correlates with incidence of nervous disorders and upper respiratory disorders. (Medical Journal)
b Reports of loneliness correlated with distance from street. (Confirmed by British studies).
c Correlation of isolation and indices of mental trouble. (Faris, etc.)

12 Thick walls. Every lived in room has walls of materials which are easy to mould and adapt and form, permanently to individual and habits. Hence owned dwellings: condominium. (Alexander)

People seek feeling of relation to environment; they need the possibility of local adaptation. Present building types make it hard.

Hypotheses.

a People modify their dwellings as much as they are able to.
b The personal character of a room, as perceived by inhabitants, resides mainly in the walls.
c Depressed results of impersonal room character. Rate of turnover in personnel. Projective tests. (Maslow-Mintz)
d Self esteem greater in a place which one has influenced. (Correlation of self-esteem with other indices of well being). Ego-strength.

13 The teenage room/cottage/studio. Teenage a period of exploration and identity seeking – new in industrial society, since choice of adult life not automatic. Requires possibility of exploration while at home. (Silverstein)

Hypotheses.

a Relation between parents and teenage children better if children have place of their own, private access. (Clinical subjective reports)
b Where room close to parents children report constrained feeling.
c Incidence of run-aways higher in homes where this relation does not exist; lower in homes where it does.

14 Child care. In areas where families with small children live, each house opens off a common area which is entirely enclosed – connected to nursery supervision.

Small children need each other in play.

Danger to them on streets.

Parents want to go out.

Hypotheses.

a Greater incidence of mental illness among children who have no playmates in first five years.
b Correlation between mental trouble for child, and non-activity of mother. (When mother is educated.) (Mead)
c Even where there are efficient nurseries, away from home, amount of use is considerably reduced. (Denmark)
d Incidence of child trouble caused by conflict by keeping child in, against wishes, cf. reports of how wonderfully manageable children are, when they can play together, in unlimited amounts.

15 Density of residences at different distances from local community facilities and centers: as nearly as possible: 50% within two blocks, 25% within six blocks, 25% more than six blocks. (Loetterle)

Expressed preferences. Close ones still want gardens, etc. Deeper significance not clear. Guess introvert dimension.

Hypotheses.

a Distribution statistics of vacancies and houses for sale conforms to pattern.
b More disorders among people whose introvert – extrovert rating is mismatched with their dwelling location.

16 City hall small (max. population, 40,000), and highly accessible place for discussion, complaint, political action. cf. Multi-service centers. (Alexander, Ishikawa, Silverstein)

Political effectiveness. Small units. Culture of poverty. (Erikson, Generativity. Leighton, Mosel order, Spontaneity, Orientation.)

Hypotheses.

a Seed for political action exists; compare well being of those with involvement with those without it. (Check across cultures.)
b Hopelessness is correlated with non-effectiveness.
c Effectiveness of citizens a function of the size of community.
d Involvement correlated with case of access to city hall, and possibility of starting programs there.
e Maximum size of institution still capable retaining informal atmosphere, freedom from red-tape, is about 20 persons.

17 Religious center extended displays where picture of desired urban life can evolve, and be discussed and criticised freely.

All cultures have religion. One function is to provide a communal world view, with community participation which connects each man's picture of his own life to that of the community.

Hypothesis.

Correlation between mental health and ability of person to state a connection between his own life and the structure of the larger world.

18 Trees. Special fixed inviolable locations very frequently spaced throughout the city.

The need for a relationship with trees. Contemplation. Especially old trees. Length of time for trees to grow versus rate of demolition and construction in urban areas. Contemplating existence and permanence as opposed to action.

Hypotheses.

a House price correlated with presence of trees in neighbourhood.
b Reverence for trees correlated with age of the trees.
c Ill effects of long term isolation from nature.
d Part played by trees in convalescent process. (Medical evidence)
e Person able to lose himself more completely in the presence of a tree, than without tree (may also apply to rivers, ocean, etc. but these are rare and far apart).

19 Peckham Health Center. Place which makes much of birth process. Pre-postnatal clinic, swimming, etc.

Birth. Surround it with importance. Effect on the mother, hence on the child, if this is not done. (Erikson, Basic trust-mistrust)

Hypotheses.

a Correlation between attitude of mother to birth, before birth, and mental well-being of child afterwards.
b Correlation between importance given to birth as an event, pre and post, and the well-being of the child.

20 Death. Funerals, cemeteries, etc. More respect for dead.
Longer and more complicated process of burial.
Need to absorb the death of those you love. Death rites. Virtual absence of death rites in our own culture.
Hypotheses.

a If death not "lived through" psychologically, trouble likely. (Clinical evidence). (Lindemann)
b Negative correlation between clinical problems traceable to death of loved ones; and relative importance of death rites in different cultures.

These patterns are only a few of hundreds of similar large scale patterns which must be combined to create the full form of an urban environment. Nor have I mentioned the literally thousands of patterns at smaller scales, which will combine to give the detailed form of buildings. And I have not described the combinatory rules which allow us to put these few patterns together. However, few as they are, they already begin to define a radically different city from the cities we live in today.

There is no CBD. The city consists of hundreds of small residential islands, each with a different subculture. Density is high at the edge of these islands, and falls off towards the center of each one. The islands are widely separated, and surrounded, by a sea of employment and communal facilities. Also winding around the islands there are nets of high speed one way arteries. All employment is radically decentralized – even when a corporation is large, it consists of many small autonomous group-run workshops. The university and schools are woven in and out of the entire fabric of the city. They do not exist as distinct entities. The process of education is going on all the time, and involves all members of the culture. Houses and households have a much greater variety of size and type than they do today. Some are group houses, in which many individuals live together. At the other extreme there are individual cottages for teenagers and old people. Some houses, for families with small children, surround inaccessible shared gardens which touch all the houses but cannot be reached directly from outside. In some cases, as for teenagers, the one room cottages are attached to larger houses. Thus we shall find many dwelling units grouped hierarchically around slightly larger ones, and these larger ones in turn again grouped hierarchically in larger groups. None of these dwellings will be high-rise in the modern sense – all houses will have at least some part where they come into open, visible contact with the outside. All dwellings are owned. The city is dotted with many tiny knots of trees, undisturbed by demolition or construction. Many of the cells contain colonies of old people – these colonies smaller than the basic cells themselves – where life runs a little more slowly. There are many kinds of highly specialised places devoted to public meeting – the teenage cruising strip, the covered discussion seats, and the new kind of highly accessible city hall which I described are merely examples. The detailed structure of all these buildings, especially the dwellings, is such that the final details are personal. The walls and materials are capable of remembering the touch of the inhabitants who live there – they are rich with detailed individual adaptations. The sterile thin panels of today will be unknown.

Even without making drawings, or models, or filling in the details, I think it is clear that this is a kind of city utterly different from the one in which we live today.

I do not expect you to agree with the particular patterns which I have presented – on the basis of the scant evidence I have given. That was not my purpose in this paper. What is clear is that physical conceptions as radical as the one which I have sketched out can be reached on the basis of common sense discussion of the issues concerning human nature, as they are known to anthropologists and psychologists today. Every one of the patterns which I have described can be discussed, tested, and improved, on the basis of simple, feasible experiments. Yet the overall picture thus presented is as radical, as utopian as the visions of classical artist-architects.

Let us review the two detailed questions which I began with: Are psychological matters too subtle to handle; does the physical form of the environment have any effect on behavior.

First of all, these examples will hardly allow us to accept the view of regional scientists and planners who claim that economic location and transportation – because they can be quantified – are the only problems which can be competently handled. Even the material which I have presented is enough, I think, to discredit the idea that social psychology is too vague to play a useful part in city planning, or too subtle to take seriously. The issues which I have mentioned are, indeed, so unsubtle, so massive, that we tend to pass them by in our everyday lives, as being hopelessly unamenable to change. They are not subtle. We are all aware of them. In order to take these issues seriously, we need only have the courage to take them seriously. Although the scientific evidence which shows that these demands are critical is admittedly weak, this is only, I believe, because we have not so far tried to find evidence of this kind. The idea that we should consciously try to design our own culture, seems crazy at the first sight – and so much so that people simply haven't been trying to gather the right kind of evidence.

Secondly, we come to the question: "Does the environment influence behavior?" This is a curiously mechanistic and behavioristic question. Of course the physical environment, *alone*, has little effect on human behavior or welfare. Can we seriously expect that the position of a wall is going to make us happy, rather than unhappy. We are not rats in a conditioning experiment. But the conclusion which planners have been drawing from this obvious point – namely, that therefore the organization of the physical environment does not matter much – is false. I have given a number of examples of psychological demands which occur in metropolitan United States. The examples show that if we take these demands seriously, and try to invent cultural institutions which deal with these demands, we shall then have to make major physical changes in the environment. In every case, the argument which connects the psychological demands with the change in spatial pattern is simple and common sense. What does this prove? It does not prove that the environment has an effect upon behavior. I have not claimed, in any one of the examples, that the form of buildings *alone* . . . influence on people's lives, on their be . . . their needs. In every case, the pattern of . . . or doors or buildings that I have specified, . . . specified along with some kind of social change. The environmental change, without the social, would accomplish nothing. But the reverse is also true. These social changes cannot be made unless the physical changes are made with them. There is no more point in trying to make the social change without the physical, than vice versa.

Let me finally stress, once again, the extremely tentative nature of the patterns which I have proposed, and the empirical results which I have based them on. Experiments

in social psychology are notoriously difficult, and always subject to interpretation. However, even the scant evidence which I have presented has clear implications. And, I believe, once it is made clear that new patterns may be derived from these empirical insights, this will greatly sharpen our ability to find evidence. The evidence which I have cited so far has accumulated more or less randomly. If patterns of the type I have described are defined first, and empirical studies made second, with the process of empirical observation specifically designed to refute, or support, hypotheses connected with individual patterns, the whole process will be greatly sharpened.

But I do not apologize for the tentative nature of the patterns. Indeed, in a way it expresses rather clearly their most important feature: the fact that they are set up to be criticized. They are deliberately open to criticism. They invite it.

Each one is stated in such a way that it can be criticized by experiment and observation. This gives each person the chance to disagree with the patterns on the basis of public, empirical findings – there is therefore every prospect that we shall one day be able to define patterns which we agree on. These patterns therefore have an enormous advantage over the private visions of an architect. However vulnerable they may seem today, they raise the prospect of finding form for the environment that is so firmly based on the demands of human nature, that planners and architects will all be able to agree on it. This is a prospect which current methods of architecture and planning cannot look forward to.

9 The atoms of environmental structure, 1970

This article, written with Barry Poyner, connects physical design needs with human tendency, and argues that "Everything desirable in life can be described in terms of freedom of people's underlying tendencies. Anything undesirable in life – whether social, economic, or psychological – can always be described as an unresolved conflict between underlying tendencies," and finally that "Life can fulfill itself only when people's tendencies are running free." This is one of the underlying ideas in patterns – that they represent ways in which potential conflicts in the physical environment, that prevent people's natural tendencies to be expressed, can be resolved.

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This paper is about design programming. The atoms of environmental structure are relations, the simplest geometry which can be functionally right or wrong in the design of any man-made object or environment. They are statements about the physical organization which is required if the design is to function well. A list of required relations replaces the design program or brief and the first stages of sketch design. The argument of the paper has four parts. First, the idea of need should be replaced with its operational counterpart, tendency. Second, a single need, when operationally defined, makes no demands on the physical environment, and the environment requires a specific geometry only to resolve conflicts between tendencies. Third, once a conflict between tendencies is clearly stated, it is possible to define the geometrical relation required to prevent the conflict and to insist that this relation be present in any context where the conflict might occur. Finally, the environment needs no geometrical organization beyond that which it gets from combinations or relations so defined. Two appendices follow, the first illustrating specific tendencies, conflicts, and relations for the entrance to an office and the second illustrating tendencies, conflicts, and patterns for the entrance to a suburban house.

At present, there are two things wrong with design programs. First of all, even if you state clearly what a building has to do, there is still no way of finding out what the building must be like to do it. The geometry of the building is still a matter for the designer's intuition; the program does not help. Second, even if you state clearly what the building has to do, there is no way of finding if this is what the building ought to

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do. It is possible to make up an arbitrary program for a building. There is, at present, no way of being sure that programs are not arbitrary; there is no way of testing what the program says.

As far as this second point goes, most designers would maintain that no program can ever be made nonarbitrary. They would say that the rightness or wrongness of a program is not a factual matter but a moral one; it is not a question of fact but a question of value. These people argue in the same way about the physical environment itself. They say that the environment cannot be right or wrong in any objective sense but that it can only be judged according to criteria, or goals, or policies, or values, which have themselves been arbitrarily chosen.

We believe this point of view is mistaken. We believe that it is possible to define design in such a way that the rightness or wrongness of a building is clearly a question of fact, not a question of value. We also believe that if design is defined in this way, a statement of what a building ought to do can yield physical conclusions about the geometry of the building directly. We believe, in other words, that it is possible to write a program which is both objectively correct and which yields the actual physical geometry of a building.

What is a need?

Let us begin with the kind of programs which people write today. It is widely recognized that any serious attempt to make the environment work must begin with a statement of user needs. Christopher Jones calls them performance specifications; Bruce Archer calls them design goals; in engineering they are often called design criteria: at the Building Research Station they are called user requirements: at the Ministry of Public Building and Works they have been called activities: they are often simply called requirements or needs. Whatever word is used, the main idea is always this: Before starting to design a building, the designer must define its purpose in detail. This detailed definition of purpose, goals, requirements, or needs can then be used as a checklist. A proposed design can be evaluated by checking it against the checklist.

But how do we decide that something really is a need? The simplest answer, obviously, is "Ask the client." But people are notoriously unable to assess their own needs. Suppose then, that we try to assess people's needs by watching them. We still cannot be sure we know what people really need. We cannot decide what is "really" needed, either by asking questions, or by outside observation, because the concept of need is not well defined. The word need has a variety of meanings. When it is said that people need air to breathe, it means that they will die within a few minutes if they do not get it. When someone says, "I need a drink," it means he thinks he will feel better after he has had one. When it is said that people "need" an art museum the meaning is almost wholly obscure. The statement that a person needs something has no well-defined meaning. We cannot decide whether such a statement is true or false.

We shall, therefore, replace the idea of need by the idea of what people are trying to do. We shall, in effect, accept something as a need if we can show that the people concerned, when given the opportunity, actively try to satisfy the need. This implies that every need, if valid, is an active force. We call this active force which underlies the need a *tendency*. A tendency, therefore, is an operational version of a need. If someone says that a certain need exists, we cannot test the statement because we do not know

what it really claims. If someone says that a certain tendency exists, we can begin to test the statement.

Here is an example. Suppose we say, "People working in an office need a view." This is a statement of need. It can be interpreted in many ways. Does it mean "It would be nice if people in offices had views"? Does it mean "People say they want a view from their offices"? Does it mean "People will pay money to get a view from their offices"? There are so many ways of interpreting it that the statement is almost useless. We do not know what it really says.

But if we replace it by the statement, "People working in offices try to get a view from their offices," this is a statement of fact. It may be false, it may be true, but it can be tested. It is a statement of a tendency. If observation shows that people in an office actively try to get those desks which command a view, it is clearly reasonable to say that they need the view. If, on the other hand, people make no effort to get a view even when they get the chance, we shall naturally begin to doubt the need.

Every statement of a tendency is a hypothesis, an attempt to condense a large number of observations by means of a general statement. In this sense, a statement of a tendency is like any scientific theory. Since a statement of a tendency is a way of interpreting observations, we must try as hard as possible to rule out alternative hypotheses. Suppose we have observed that people in offices try to get desks near the window when they get the chance. It is possible to infer from this that they are trying to get a view. But we might equally well infer the existence of other tendencies. They could be trying to get more light, or better ventilation, or direct sunlight. Or they may be trying to get something far more complicated; they may want to be in a position from which they see the light on the faces of their companions instead of seeing them in silhouette against the window.

In order to be confident that people really seek a view, we must make observations which allow us to rule out such alternative interpretations one by one. For example, suppose we construct an office in which light levels are uniform throughout, because windows are supplemented by artificial light. Do people still try to work near the window in such an office? If they do, we can rule out the possibility that they are merely trying to get more light. Ruling out all the alternative interpretations we can think of is a laborious and expensive task. Furthermore, in order to make the hypothesis more accurate, we must try to specify what kind of people seek a view from their offices, during what parts of their work they seek it most, what aspects of "view" they are really looking for, and so on. Again, this is a laborious and expensive task. It is like the task of forming any scientific hypothesis or theory. A good theory cannot be invented overnight; it can be created only by refinement over many years and by many independent, different observers.

It is, therefore, vitally important that we do not exaggerate the pseudoscientific aspect of the concept of tendency. Since a tendency is a hypothesis, no tendency can be stated in any absolute or final form. The ideal of perfect objectivity is an illusion, and therefore there is no justification for accepting only those tendencies whose existence has been "objectively demonstrated." Other tendencies, though they may be speculative, are often more significant from the human point of view. It would be extremely dangerous to ignore such tendencies just because we have no data to "support" them. Provided they are stated clearly, so that they can be shown wrong by someone willing to undertake the necessary experiments, it is as important to include these tendencies in the program as it is to include those tendencies that we are sure about.

Conflicts

Now we face the central problem of design: Given a statement of what people need, how can we find a physical environment which meets those needs?

In order to answer this question we must first define clearly just what we mean by meeting needs. This is not as easy as it seems. So long as we are using the word needs, the idea of meeting them seems fairly obvious. However, once we replace the idea of need by the idea of tendency and try to translate the idea of meeting needs into the new language, we shall see that its meaning is not really clear at all.

The idea of needs is passive. But the idea of tendencies is highly active. It emphasizes the fact that, given the opportunity, people will try to satisfy needs for themselves. When we try to interpret the idea of meeting needs in the light of this new emphasis, we see that it is highly ambiguous. To what extent are people expected to meet needs for themselves, and to what extent is the environment expected to do it for them?

Take for example a simple situation, a man sitting in a chair. He has various needs. He needs to shift his position every now and then, to maintain the circulation in his buttocks and thighs. If he is trying to read, he needs enough light to read by. If he sits in his chair long enough, he will need food or refreshment. He needs ventilation. Under normal circumstances he is perfectly able to meet these needs for himself. But if we define a good environment as one which meets needs, we should logically be forced to design an environment which meets these needs for him. This conjures up an image of a man lying in an armchair, food being fed him mechanically, a window opening automatically when the room becomes too hot, a light being switched on automatically as evening comes, and pads in the chair massaging his buttocks to keep the pressure from building up too much in any one place.

The image is absurd. It is absurd because the man is perfectly capable of meeting these needs for himself. Indeed, not only is he capable of meeting them for himself, but for his own well-being it is almost certain that he should meet them for himself. Man is an adapting organism. A man who is no longer meeting his needs is no longer adapting. The daily, hourly, process of adapting is the process of life itself; an organism which is no longer adapting is no longer alive.

It is, therefore, clear that a good environment is not so much one that meets needs as one that allows men to meet needs for themselves. If we define a need as a tendency, as something which people are trying to do, then we must assume that they will do it whenever they get the chance. The only job which the environment has is to make sure they get this chance.

Now at first sight it may seem that the argument leads to a dead end. Go back to the example of the man sitting in a chair. Under normal conditions each one of the tendencies which arises in this situation can take care of itself. The man can do everything for himself. There is no problem in the situation. The environment does not require redesign. If needs are defined as tendencies, and if tendencies are capable of taking care of themselves, then why does the environment *ever* require design by designers? Why cannot people be left to adapt to the environment and to shape their own environment as they wish, with the help of bricklayers, carpenters, electricians, and others? If tendencies are active forces, then people will presumably take action whenever the environment is not satisfactory and will meet their own needs for themselves. Why does the environment need design? Why should designers ever take a hand at all?

The answer is this. Under certain conditions, tendencies conflict. In a *conflict* situation, the tendencies cannot take care of themselves, because one is pulling in one

direction, and the other is pulling in the opposite direction. Under these circumstances, the environment does need design; it must be rearranged in such a way that the tendencies no longer conflict.

Let us go back once more to the man sitting in a chair. There are certain chairs, made of canvas slung between wire supports, in which you cannot move about at will, because your body always sinks to the lowest position and is held there by the canvas. After sitting in one of these chairs for a few minutes you begin to feel uncomfortable; the pressure on certain parts of the body builds up, but you cannot move slightly to reduce this pressure. You try to shift positions but you cannot. At first sight it might seem that this is not so. Indeed, the tendency to try to reduce the pressure on your body has a simple outlet. You can simply get up and walk about. The trouble is, of course, that in many cases there will be another tendency operating which makes you want to stay sitting where you are. It is the conflict between your tendency to stay where you are and your tendency to shift position which makes a problem. In a properly designed chair this conflict does not occur.

We may, therefore, replace the simple-minded definition of a good environment as one that meets needs, by the following definition: a good environment is one in which no two tendencies conflict.

Of course, the conflicts that occur in buildings and cities can be much more complicated than the one we have just described. There can be conflicts between tendencies within a single person, between one person and a tendency of a group, or between a tendency in a person and some larger tendency that is part of a mass phenomenon. But the principle is always the same. Provided that all the tendencies can operate freely and are not brought into conflict with other tendencies, the environment in which they are occurring is a good one. It follows then that the environment only requires design in order to prevent conflicts occurring. If we wish to specify the pattern an environment ought to have, we must begin by identifying all conflicts between tendencies which might possibly occur in the environment.

In summary: Until we have managed to see design problems in terms of conflict between tendencies, there is nothing for the designer to do. So long as we see nothing but isolated tendencies we must assume that they will take care of themselves. We have only succeeded in stating a design problem in a constructive way at that moment when we have stated it as a conflict of tendencies. Since the tendencies in conflict may often be hidden, to state the problem is a difficult process which requires a deliberate and inventive search for conflicts.

Relations

We design the environment, then, to prevent conflict. We must now start talking about the features of buildings which can help us do this. The features that cause and prevent individual conflicts are not bricks, or doors, or roofs: they are geometrical relationships between such concrete pieces. We shall call them *relations*.

Before describing how we invent a new one, let us look at some examples of well-known relations. Here are five typical relations from a supermarket:

1 Check-out counters are near the exit doors.
2 The stack of baskets and trolleys is *inside* the entrance and directly *in front* of it.
3 Meat and dairy refrigerators are *at the back* of the store, and all other goods on display are *between* these refrigerators and the check-out counters.

4 Display shelving has a *tapering* cross section, narrow at the top and wider at the bottom.
5 The store is glass-fronted, with aisles running from *front to back at right angles* to the street.

These relations have become widely copied and typical of supermarkets because each of them prevents some specific conflict. Here are the five relations followed in each case by the conflicts.

Check-out near exit doors. This relation prevents a conflict between the following tendencies:

1 Management has to keep all goods on the sales side of the check-outs.
2 Management is trying to use every square foot of selling space.

Baskets or trolleys inside the entrance and directly in front of it.

1 Management tries to encourage shoppers to use baskets, so that they are not reluctant to pick up extra goods.
2 Shoppers tend to move as fast as possible for the goods and are therefore likely to miss the baskets.

Meat and dairy products at the back of the store and all other goods between these counters and the check-outs.

1 Management tries to get every shopper to walk past as many goods as possible.
2 Shoppers visit meat and dairy sections almost every time they go to the supermarket.

Display shelving with tapering cross section so goods near the ground are clearly visible to shoppers.

1 People tend to walk around a supermarket without bending down constantly to look for goods.
2 People want to be able to find the goods they are looking for without having to ask.

Glass fronts, aisles running back from the street and at right angles to it.

1 Management is trying to give passersby a view of the entire inside of the supermarket, to draw them in.
2 If the supermarket is on a street most of the passersby are walking past the front.

A *relation*, then, is a geometrical arrangement that prevents a conflict. No relation can be regarded as necessary to a building unless it prevents a conflict that will otherwise occur in that building. A well-designed building is one which contains enough relations to eliminate conflicts within.

So far we have discussed only known relations, those which exist already. How do we invent a new relation? Obviously, we start by stating a conflict. But how do we

invent a relation that prevents the conflict? The key is this: tendencies are never inherently in conflict: they are brought into conflict only by the conditions under which they occur. In order to solve the conflict we must invent an arrangement where these conditions do not exist. For example, where a public path turns the corner of a building, people often collide. The following tendencies conflict: (1) People are trying to see anyone approaching them some distance ahead so that they can avoid bumping into them without slowing down, and (2) going round a corner, people try to take the shortest path. At the blind corner the first tendency makes people walk well clear of the corner, the second makes them hug the corner. At a blind corner the tendencies conflict.

Before we can invent an arrangement that prevents this conflict, we must find out exactly what makes these tendencies conflict. In our example there are several aspects of blind corners to blame: the fact that the corner is solid, the corner is square and the ground is unobstructed around the corner. To eliminate the conflict we must get rid of one or more of these features. If we make the corner transparent, people will be able to see far enough ahead through it. If we round the corner with a gradual curve people will be able to see round the corner. If we place a low obstruction at the corner, like a flower tub, people will have to walk around it and will see each other over it.

It is plain from the example that there are certain arrangements causing the conflict and certain "opposite" arrangements preventing the conflict. These two classes of arrangement are mutually exclusive. Our task, given any conflict, is to define the mass of arrangements that prevents the conflict. This is always difficult. In theory the class is infinite: even in practice it is very large. We must, therefore define an abstract geometric property shared by all arrangements in the class and by no others. This is what we mean by a relation. A relation is a precise geometric definition of the class of arrangements preventing a given conflict. It must be so worded as to *include* all the arrangements that prevent the conflict and *exclude* all those which cause it.

Let us continue our example. We have described certain arrangements that cause a conflict at corners and others that prevent it. Those preventing it include: a corner made of transparent materials, a rounded corner, a tub of flowers so placed that people have to walk clear of the corner. What is the property common to all these good arrangements, which the bad arrangements lack? Roughly speaking it is this: If we define a path around the corner at a distance of one foot out from all walls and objects which project from the ground, and if we examine all chords on this path which are less than fifteen feet long, we shall find that none of these chords is, at eye level, obstructed by anything opaque.

The conflict in this example happens to be a simple one. However, even when the conflicting tendencies are much larger in scale, or more subtle, the logic is the same. We state the conflict, give examples of arrangements causing and preventing it, and then try to abstract the relation that defines the latter class.

Two minor points remain. First, conflicting tendencies occur under specific conditions. The relation required to prevent the conflict is required only under these specific conditions. The conditions under which the conflicting tendencies occur must be stated as part of the relation. Thus, the final form of a relation will always be: "If such and such conditions hold, then the following relation is required." Second, the actual process of inventing a relation will not follow the process of finding conflicts and defining relations in strict sequence, as it has been presented here. In practice, the statement of tendencies, the statement of conflict, and the statement of relation all develop together.

Let us summarize what we have done. We have described a process which has two steps: (1) identifying a conflict, and (2) deriving a relation from it. This process for

obtaining a relation is objective in the sense that each of its steps is based on a hypothesis that can be tested. The two hypotheses are: (1) under certain specific conditions such and such conflicting tendencies occur, and (2) under these conditions the relation is both necessary and sufficient to prevent the conflict. If we cannot show that either of these hypotheses is false, we must then assume that any building where the conflict can occur must contain the relation specified.

In order to create a building in which no tendencies conflict, the designer must try to predict all the conflicts that could possibly occur in it, define the geometric relations that prevent these conflicts, and combine these relations to form a cohesive whole.

The scientific attitude to relations

The point of view we have presented is impartial. This is its beauty. Because it is impartial, it makes possible a sane, constructive, and evolutionary attitude to design. It creates the opportunity for cumulative improvement of design ideas. Everything hinges on one simple question: What does a designer do when faced with a relation which someone else has written?

The traditional point of view about design says that the rightness and wrongness of a relation is a question of value. A designer with this point of view will claim that a relation can be judged only by subjectively chosen criteria or values. Since people value things differently we can never be certain that one designer will accept another designer's opinion and there is, therefore, no basis for universal agreement.

Our point of view is different. We believe that all values can be replaced by one basic value: Everything desirable in life can be described in terms of freedom of people's underlying tendencies. Anything undesirable in life – whether social, economic, or psychological – can always be described as an unresolved conflict between underlying tendencies. Life can fulfill itself only when people's tendencies are running free. The environment should give free rein to all tendencies; conflicts between people's tendencies must be eliminated. In terms of this view, the rightness or wrongness of a relation is a question of fact.

As we have said, each relation is based on two hypotheses: (1) the conflicting tendencies do occur as stated, under the condition specified, and (2) the relation proposed is both necessary and sufficient to prevent conflict between these tendencies. Faced with a relation stated in this form, the designer must either accept it or show that there is a flaw in one of the hypotheses. Whatever he does, he cannot merely reject the relation because he does not like it. The body of known relations must, therefore, grow and improve. Design, if understood as the invention and development of relations, is no longer merely a collection of isolated and disconnected efforts. It becomes a cumulative scientific effort.[1]

1 Since the first version of this paper was written, the theoretical framework has been developing. For example, the term "relation" has been supplanted by the term "pattern" as the latter gives a more accurate picture of the fact that the entities are spatial and are conditional on context. Several workers in Berkeley have been developing the idea of a pattern language as a system that gives the grammar of the combinatory process. See Francis Duffy and John Torrey, "A Progress Report on the Pattern Language," in this volume.

Appendix A: Relations for an office entrance

The relations presented in the original study[1] prescribed the organization of an office entrance situated on a busy city street. It was assumed that the building was built right up to the sidewalk, so that the entrance opened directly onto the street. It was also assumed that there was a receptionist in the entrance. The relations dealt with the arrangement of pavement, entrance doors, elevators, reception desk, and seats for visitors. In each case the statement of the relation was accompanied by a written explanation and a diagram to show how the relation was incorporated into the whole entrance structure shown in Figure 5.

For the purpose of this extract, four examples from the original twenty-two relations have been chosen. Relations 1, 2 and 3 have been chosen because they illustrate the way in which relations can be combined. Relations 2 and 3 interlock neatly with the general structure defined by Relation 1. The overlapping and interweaving of relations is characteristic of relational design, and it makes possible the creation of compact and economic forms. Relation 4 is included because it illustrates particularly clearly the idea of conflict.

The parts of the building on the ground floor, adjacent to the entrance, must be set back to allow the entrance to project.

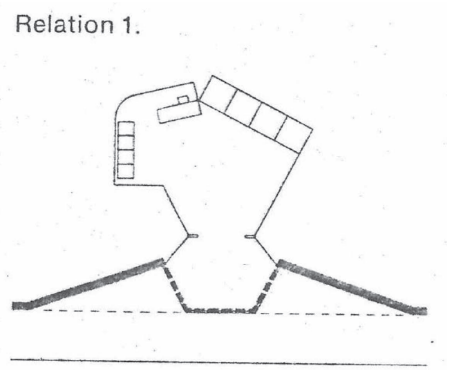
The following tendencies conflict:

1 Some people coming to the building will be unfamiliar with its location. They will know roughly where it is and on which side of the street, but because the street is busy, they will tend to cross to the correct side at an intersection well before reaching the building. But the building is built right up to the sidewalk, so they will approach it at an acute angle and may have difficulty seeing the entrance.
2 On a busy sidewalk people try to work out their route some distance ahead, to preposition themselves to take the shortest path.[2]

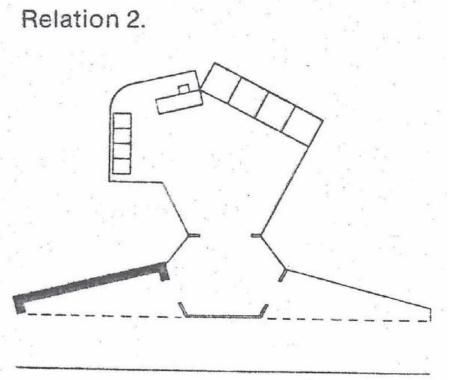
Relation 1

Some arrangements which cause this conflict are as follows: If the entrance doors are recessed and there is no projection at the entrance, people will tend to move to the

1 This study was conducted by Barry Poyner in 1966. The complete study is available from the Ministry of Public Buildings and Works. London.
2 See Tyrus Porter, "A Study of Path-Choosing Behavior," in particular the study of the Kaiser Center lobby.



1. Diagram of the relation for projection of entrance



2. Diagram of recessed space relation

Figure 9.1 Diagrams showing relationship between parts of a building entrance.

outside edge of the sidewalk to see along the building more clearly. If they do this, they cannot preposition themselves to take the shortest path into the entrance because they will have to bob and weave their way across the path of other pedestrians. A projecting canopy will not necessarily be associated with the entrance. If there is a low projection, like a step, people will not see it because it will be obscured by other pedestrians.

Arrangements which may prevent the conflict are these: Some projections, for example, a classical portico with columns, a projecting lobby, or a revolving door, can be seen by people approaching the entrance at an acute angle. Such projections are roughly single-story height. In the example in Figure 1, the

building is built right up to the sidewalk, so the entrance cannot project onto it. To gain a projection, the parts of the ground floor on either side of the entrance must be set back.

A covered linear recessed space, at the side of the entrance doors, about two feet deep and roughly parallel to the street.

Where the building entrance opens directly onto the sidewalk, the following tendencies conflict:

1 When it begins to rain heavily, people in the street take shelter in the entrance for a while. They try to stand out of the way of others going in and out.
2 While sheltering in an entrance, people tend to stand in a line facing the street. It is characteristic of human behavior that people in crowds avoid standing face to face.

Arrangements which cause this conflict are these: If the only cover is in front of the entrance doors or on a direct path in and out of the entrance, and if many people try to shelter, the entrance gets blocked. Even where there is a covered space at the side of the doors, if the doors are set back so that this space runs in at right angles to the pavement from a narrow opening, people will not use it; they will tend to form a line across the opening facing the street, again blocking the entrance.

Arrangements which may prevent the conflict will have some covered space at the side of the entrance doors, so that people can shelter without blocking the doorway. The space must also be recessed to avoid being on any direct path in or out of the entrance. But if it is deeply recessed or not parallel to the street, it is wasted, because people tend to stand in a line facing the street, watching for the rain to lessen. The space must therefore be a shallow linear recess, roughly parallel to the street. A depth of two feet should be sufficient to allow a single line of people to shelter. Note: the length of this space will depend on how busy the pavement is, whether there is a bus stop near by, and how much other shelter is available. A convenient relative length is shown in Figure 2.

Space immediately inside the entrance, close to the doors and clear of all entry and exit paths, with a direct view of the street.

When it is cold and windy, people who are waiting to be picked up by car will want more shelter than the covered entrance provides. The following tendencies conflict:

1 People tend to wait at a point overlooking the street: they will want to know the moment the car they are expecting arrives.
2 People who are waiting try to keep out of the way of those going in and out.

Arrangements which cause this conflict: If the only windows near the entrance doors are in the entrance doors themselves, those who are waiting will tend to crowd around the doors. Even if there is another window near the doors, if the space just inside is close to any path in or out of the entrance, then

again people will get in the way. In both these arrangements, people cannot stand by the window and at the same time keep out of the way.

Arrangements which may prevent the conflict: If the entrance lobby is large and surrounded by glass, the conflict will not occur. Indeed any entrance with a space overlooking the street and near the entrance doors will prevent the conflict, provided the space is clear of movement. Figure 3 shows one solution.

The shortest path from outside the entrance doors to the reception desk is not less than forty feet.

Visitors arrive at the building after finding their way along a busy street. The street is noisy, and they have been jostled along the pavement. The following tendencies conflict:

1 Visitors try to move directly, without hesitation, from the entrance doors to the reception desk.
2 Visitors need a minute or two in which to reorient their thoughts before arriving at the reception desk.

4 Diagram of distance relation

Arrangements which cause this conflict: An entrance which has the receptionist just inside the door, particularly if there is no entryway to protect from drafts.

Arrangements which may prevent the conflict: If the receptionist is placed well away from the entrance doors, or if there are one or more lobbies between the street and reception, the conflict does not occur. The essential property of these arrangements is that the visitor must cross a quiet space after leaving the street, before arriving at the reception point: forty feet seems to be about the minimum length of such a space. See Figure 4.

Porter made observations of an entrance to a department store in Berkeley.[3] A number of display cases separate the store front from the street forming an arcade between street and store. He found that most people entering the store chose a path through the arcade rather than the direct path between the pavement and door to the store. He suggests, also, that people will choose to use a transition space to reorient themselves, on entering a space which is radically different from the one they have just left.

3 *Ibid*., the study of Hink's Arcade Berkeley.

Appendix B Pattern for the entrance to a suburban house

This appendix[4] describes four of the twenty-six relations or patterns[5] that must be present in the entrance to a single-family house standing on its own private lot on a suburban street. Each pattern is a geometric relationship between specified physical elements. Each pattern is necessary, in the sense that a predictable conflict will occur and recur during the life of the house if it is missing.

The twenty-six patterns do not form a perfectly self-contained complex. The circumstances which surround any one particular kind of housing may require only some of these twenty-six or they may require extra ones. The twenty-six patterns must be thought of as a kit of parts to be put together differently in different conditions.

It is therefore important to specify the precise conditions or context under which each individual pattern is necessary. Given knowledge of the circumstances which surround a particular building, it is possible to decide exactly which of the twenty-six it must contain. This detailed specification of conditions will accompany the discussion of each pattern. In general, it can be said that the patterns all apply to the entrance of a single detached suburban house, containing a single family, with or without children; it is assumed that the family owns at least one car and that its way of life is some version of that commonly found in a middle-income suburb in the United States and, more recently, in England. It is assumed that the house stands on a street carrying fairly light traffic, that the house contains a kitchen and some kind of living room, and that these rooms contain windows. These elements are not being questioned. Whether the street should have sidewalks, whether the kitchen should be closed or open, whether there should be one living room or two, whether windows should have built-in curtains, or whether any of these elements should exist at all – none of these questions is being asked.

This does not mean that streets, kitchens, living rooms, windows are right as we now know them. Above all, it does not mean that one-family suburban houses are a good idea. They are very likely not. But discussion of these elements would be fruitless

4 This study was begun by Christopher Alexander in 1966 and revised and extended for this presentation. The original twenty-six patterns for a suburban house are available from the Center for Environmental Structure. Berkeley.

5 The theoretical framework developed in Berkeley from the concept of "relation" to that of "pattern." The distinctions are briefly made here and in Francis Duffy and John Torrey. "A Progress Report on the Pattern Language" in this volume. This appendix is an example of patterns. See also Alexander, Sara Ishikawa, and Murray Silverstein, *A Pattern Language Which Generates Multi-Service Centers*.

without deep analysis of the relationships which define them. The problem has been deliberately restricted to avoid the dangers of unlimited expansion.

This has an obvious consequence. The twenty-six patterns defined here apply only to certain houses whose other defining patterns are those normal for suburban houses in 1968. As soon as the patterns now defining suburban houses – relatively quiet streets, windows, kitchens, living rooms – are changed, the entrance patterns presented here will have to be reexamined. It is impossible to predict how many of them will be stable under the impact of such changes. However, many will still be required. To this extent the twenty-six patterns form an isolable; independent complex.

Four of the twenty-six patterns are presented. Each has the same format: first a verbal statement of the topic, the context, and the relations which the pattern specifies; second, a description of the problem and conflicting tendencies: third, a description of the kinds of arrangement which cause the conflict and the logic of the solution.

Finding house numbers from a moving car.

If: Free-standing house on a street where cars move at speeds between 5 miles per hour and 30 miles per hour.

Then. Two house signs, each at about 45 degrees to the street, facing up and down the street. Sign letters 12 inches high, or down to 6 inches if the house is one of a regular sequence of houses all visibly numbered with house signs following this rule. House signs must be 5 feet to 10 feet from the ground and as far forward on the lot as possible.

The problem is that house numbers are hard to see from a moving car especially for the driver. Many signs have too-small numbers, are parallel to the road (on the house face or garden gate: or they are low enough to be obscured by parked cars or high enough to make the driver crane his neck forward (anything higher than 10 feet may have this effect if the car is near).

The following tendencies conflict:

1 The driver is trying to maintain a reasonable speed on the road, say 25–30 mph.
2 He is trying to identify a house without getting out of his car.
3 He is trying to see the number far enough ahead so that he can slow down and if necessary turn into the driveway.
4 He is trying to keep his eye on the road.

Arrangements that cause this conflict, in addition to numbers that are too small and signs placed too high or too low include a sign placed at right angles to the street, since this cannot be read from the part of the street in front of the house; a sign more than 10 degrees off the driver's path when close enough to be read;[6] a sign facing only one way.

This conflict may be resolved as follows: At 30 miles per hour, under average road conditions, the safe stopping distance is 245 feet. Furthermore, it will take about 2 seconds to read the number, or 88 feet at 30 mph.[7] The sign

6 R. L. Moore and A. W. Christie "Research on Traffic Signs".
7 Ibid., especially p. 113 and the formula on d. 117.

must therefore be legible 333 feet from the house. For 99 percent of all drivers to be able to read them, the numbers must be 12 inches high to be legible at 333 feet.[8] Further, so that these numbers are legible from either direction and from the front, they must be placed at an angle to the street, say between 45 and 70 degrees, one facing each direction. The sign must also be as close to the street as possible, so as not to violate the 10 degrees limit.

If there is any private land between the sign, and those parts of the street from which the sign is supposed to be visible, trees or outhouses may be put up there in the course of the years and obscure the sign. The sign must therefore be on the property line which divides the street from private property.

At present houses containing this pattern are very rare. However, as soon as the pattern becomes widely accepted, a new factor will come into play: drivers will read house numbers in sequence and slow down as they approach the one they want. Under these conditions it will not be necessary to see the number quite so far ahead, and the numbers may be reduced by half.

Pattern 2

Letting people inside the house know who is coming to the door.

If: Entrance to any dwelling.

Then: The area outside the main door at least 200 square feet enclosed by walls on three sides and shielded from the street. Kitchen windows and living room windows open onto this area, but not visible from the street. Parking places within or immediately adjacent to this area, and all parts within this area surfaced in noisy material like gravel or wood.

The problem is that people like to know who is coming before they hear the doorbell. In the United States, where almost everybody has a phone, it has become a common courtesy to call ahead: people like to know who's coming in advance. Knocking on doors before you enter is a widely accepted habit throughout the Western world, it gives the person inside a chance to adjust himself, mentally, for the coming encounter. In many countries a visitor has to pass through a court before he reaches the house, and while he is in this court he can be seen and heard. However, if the living room or kitchen windows overlook the area in front of the house, they may be exposed directly to the street, which is also undesirable.

The following tendencies conflict:

1 People like to hear visitors coming before the doorbell rings.
2 Visitors tend to take the shortest path off the street, the path to the door is usually within range of street noise, and the noise of arrival is therefore often unnoticed.
3 People tend to "live" away from the street, or if they do live on the street side they tend to keep windows closed.
4 People do not want the inside of the house to be visible from the street.

8 J. B. Davey, "The Vision of a Group of Drivers."

Some arrangements that cause this conflict are windows that look out on the front but are visible from the street, thus forcing people to curtain them and to live away from them; or a path to the front door that does not pass windows of living areas.

The area in front of the door must be so laid out that the path to the door is visible from windows but the street itself is not. This means that there must be some kind of obstruction placed near the street end of the path. The area must be acoustically shielded from the street; otherwise arrival noises are indistinguishable from street noises. But arrival sounds, like a car engine and footsteps, must be heard, so the car must be brought into the area by the door, and the area must be paved in resonant materials.

Pattern 3

Transition between street and house in an urban area.

If: Any dwelling in an urban area.

Then: The surface of the paths between street and door and between parking places and door must have at least two changes of level and be made of more than two materials. If possible, there should be some change of view, like an opening into the back garden. The floor of kitchen and living room should be at least one step lower than the floor immediately inside the main door.

The problem is that if the house is too closely associated with the street, people who come into the house find it difficult to lose the "closedness" and tension that are appropriate to street behavior and public encounters, and are thereby prevented from relaxing, or from opening up sufficiently to interact with people in maximum contact.

The following tendencies conflict:

1 On the street people adopt a mask of "street behavior"; the momentum of this mask tends to persist until wiped clean.[9]
2 Arriving home, people search for an inner sanctum where they can relax completely.

Arrangements which cause the conflict are any kind of environmental continuity between street and house, for instance, where the sidewalk continues unbroken up to the front door, or where the inside of the house is at the same level as the street or has the same view as from the street.

Arrangements which may prevent the conflict are changes of view surface materials, and level. A step down into a living room helps destroy the street mask by creating a strong sense of stability and arrival.

9 Evidence for this tendency comes from the report by Serge Bouterline and Robert Weiss, *The Seattle World's Fair*. The authors noticed that many exhibits failed to hold people: they drifted in, then drifted out again within a short time. However, in one exhibit the viewers had to cross a huge, deep-pile, bright orange carpet on the way in. Although the exhibit was not better than other exhibits, they stayed. The authors concluded that people were, in general, under the influence of their own "street and crowd behavior" and that while under this influence they could not relax enough to make contact with the exhibits. But the bright carpet presented them with such a strong contrast that it broke the mood of their outside behavior, in effect "wiped them clean," with the result that they could then become absorbed in the exhibit.

If: The front door of any dwelling.

Then: Walls inside the main door so placed that a person standing on the doorstep, with the door open, cannot see into any room, especially the living room or kitchen, nor to any passage connecting rooms. The area immediately inside the door must be a dead end. (If there is a window near the front door, the pattern applies also to the areas visible through this window from the doorstep.)

The problem is that people want the inside of the house to be private when they open the front door.

The following tendencies conflict:

1 Politeness demands that when someone comes to the door, the door be opened wide. If the occupant goes back to get something, the door must be left open.
2 People seek privacy for the inside of their houses. In particular, they try to prevent callers from seeing an untidy house.
3 The family, sitting, talking, or at table, do not want to feel disturbed or intruded upon when someone comes to the door.
4 At various times of the day the members of the family may wander around inside the house incompletely dressed.
5 People in the house do not want their movements seen from outside.

Arrangements that cause this conflict are a door that opens directly into any living room, or a door that opens in such a way that a person standing on the step can see into any room whose door is open.

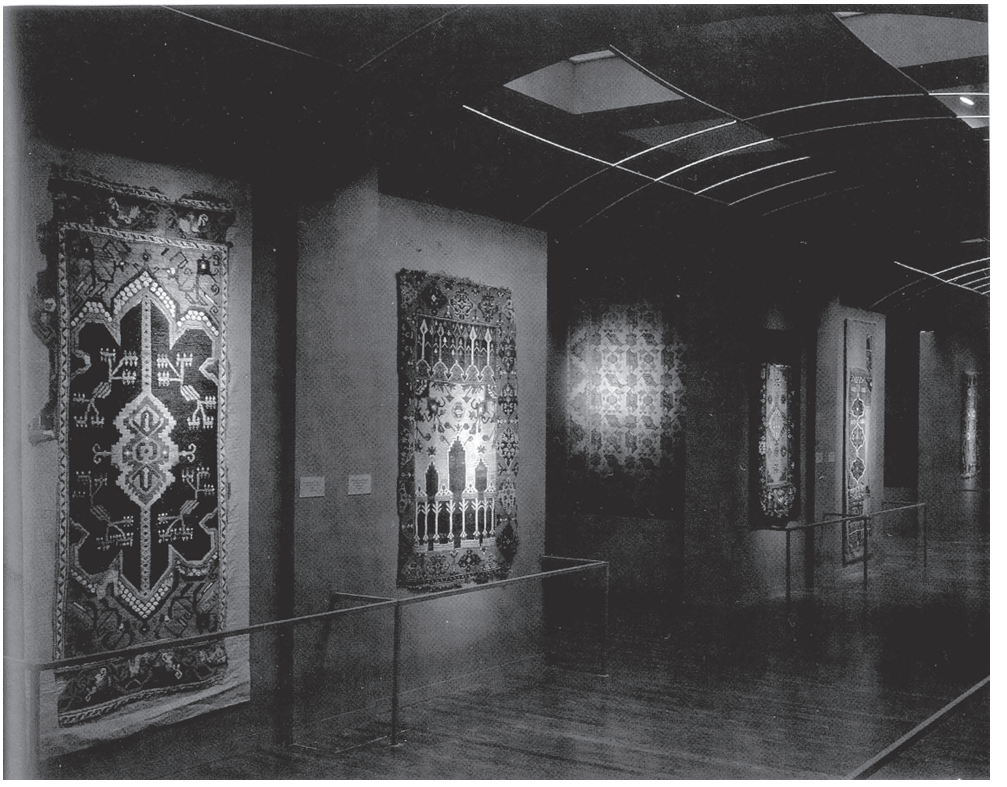
The first part of the pattern is immediate. The argument for the second part is that it may be desirable to have a window opening onto the front doorstep. However, if this window is badly placed it will be curtained and its function destroyed. The window must be placed in such a way that people feel comfortable to leave it uncovered.[10]

10 People are reluctant to use clear glass in doors. See Albert Haberer. *Doors and Gates*, pp. 8–12. When clear glass is provided, if the inside rooms or movement are visible, curtains are put over the glass. For a dramatic example consider a recent house by Edward Barnes. Although the living room seems to be screened from the entrance, in fact the glass at the entrance does give onto the sides of the living room and the path from the bedroom to the kitchen passes right past the glass. Inevitably the architect was forced to put curtains in as soon as the building went into use. See *Architectural Record,* January 1957, p. 208.


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PART TWO

From the center to the universe



Christopher Alexander's rug exhibition at the DeYoung Museum, San Francisco, 1989–1990.

DOI: 10.4324/9781003187516-11


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10 Value

A reply to Protzen, 1977

This article was written as a reply to Jean-Pierre Protzen's review of A Pattern Language, *which had been published by Oxford University Press the same year. At the beginning of his career, Protzen was identified with the "design methods" group on the Berkeley architecture faculty, and had been associated with Horst Rittel, one of the leading scholars in this area. CA had rejected the "design methods" approach several years earlier, most visibly perhaps in the preface to the paperback edition of* Notes on the Synthesis of Form, *in which he wrote that it was primarily the diagrams in that book that remained important. But Rittel and Protzen represented what may be seen as an opposing intellectual view on the faculty to that of CA, and this exchange was important in its establishment of clear positions on each side. (In subsequent years, Jean-Pierre Protzen went on to become a leading scholar on the ancient Inca stone buildings of Peru.)*

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The discussion which Jean-Pierre has begun, in his article "The Poverty of *A Pattern Language*," cannot be usefully continued at the level at which it has been begun: with the detailed examination of minutiae, until the fundamental issues in the debate, the difference in underlying assumptions, are made completely clear.

I believe that the criticisms which he has raised follow inevitably, from certain assumptions which he makes about the world. These assumptions concern the role of value, and its relationship to facts. Further, I believe his assumptions in this sphere to be wrong.

I shall therefore do my best, in this article, to lay out the most crucial difference between his point of view, as I understand it, and my own.

I believe that Jean-Pierre holds the view, that propositions, statements of fact, lie in one realm of discourse, commonly known as the discourse of science, and that values, lie in another different realm of discourse. Further, I believe that he holds the view that while values are of immense importance, they are nevertheless, personal, and that differences in different people's values can therefore not be reconciled by appeal to any one fundamental value, but only by conflict, and argument, and compromise.

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This point of view is entirely consistent with the overall mechanistic view of the world, which has been growing strength since the time of Descartes. It is true that it does not entirely exclude value from the realm of discussion, as positivism does. However, it does maintain that value is purely personal and cultural, and not connected, in any deep way with facts or discussions of fact.

I shall label this point of view neo-positivism. This view has been greatly influenced by Kant, and has been proposed, and discussed extensively . . . that it does, admittedly, help to foster respect for values (note the plural), and does in this sense, help to create respect for people different from oneself.

My own view is entirely different. I believe that differences in values, can be resolved by appealing to one central value (note the singular). I believe, indeed, that this central value, lies behind all things, which we may call the one, the void, the great Self: I believe that every person is connected to this value, and is capable of making contact with it, to a greater or lesser degree, by awakening his own consciousness: and that connection with this one value, provides us all, with the ultimate basis for our actions, and for our actions as creators, artists, architects.

This point of view is commonplace in many traditional societies: it was the normal point of view in western society up until the time of Descartes or slightly later. It was the normal point of view in Islamic society until the eighteenth century; it is today, still the point of view found in Zen Buddhism, in Sufism, and in many other less "sophisticated" cultures.

These two views, both centrally concerned with value or values, differ mainly then in the fact that Jean-Pierre believes that there are as many values as there are people: while I believe that there is one value, which we can choose to connect to, or not, as we wish.

The essence of Jean-Pierre's criticism of our book, *A Pattern Language*, is I believe simply this: He is offended, perhaps deeply offended, by the underlying theme present in the book, namely, that matters of value can become objective, and can, by implication then, be appealed to one great central value. All his criticisms, in one way or another, cry out for pluralism, argue that there are many values, that it is impossible to find one value, and that any body of knowledge which draws its strength from an appeal to one value must, ipso facto, be wrong, and "poverty-stricken."

I believe the very opposite. Namely, that if we hope to make progress in one thing, which has a value component, we will only be able to do so to the extent that we believe in this central value, however dim or distant it is: and that naïve pluralism, or neo-positivism, is incapable of making any useful progress in anything that concerns design, or creation, precisely because of the position it takes.

Before I try to make this clear, I should like first, to dispel some of the more obvious objections, which might be raised against the notion of one single, central value or ground.

The most obvious objection is that this is likely to lead to fascism, or that it is an oppressive attempt by some people to "lay" their values on others. And related to this, is the second, also obvious objection, namely that this point of view is disrespectful of cultural differences, and is potentially racist or imperialistic.

Of course, the view that there is one value, does not contain such an obvious ridiculous component. The view that there is one value, clearly recognizes that we all have different backgrounds, different natures, different histories, and different preferences. There is nothing in this one value, which will try to make each person

more like another. The only value, only requires that each person become more like himself, closer to his own self. This is of course deeply satisfying, and admits of vast differences between people, and vaster differences between different cultures. At the same time, there is a recognition though, that as we become more true to our selves, more like our selves, we do, without intending to, approach one another, because within all of us there is that element, that water, that void, in which we are very similar indeed, not with respect to our outward preferences (TV v. hamburgers, v. baseball), but with respect to our essence, with regard to the transparency we reach, the extent to which we manage to be united with the Divine void. Of course, this process is very difficult: it takes all one's life to do it; and one becomes more alive, more awake, to the extent one manages it. But certainly there is no superficial sense in which we become more similar by going on this path. And those people who, seeking this path, do become very similar in some obvious outward way (cultists, sectists) are usually very far from the path itself, because they are so concerned with appearance.

Having removed, I hope, the most obvious argument-provoking objection to the view that there is one central value, we may now go on in a fairly objective spirit to compare this view with the view that there are many values, as many as there are persons, and that there is no central value which we can reply upon, or appeal to.

Here in the College of Environmental Design, we are concerned with architecture, planning, and environment. I should like to compare these two views, then, in so far as they bear on the conduct of architecture, planning and environmental design.

The crux of my argument is simply this: although either of these two views, the many-value view, or the one value view, could be all right in theory, in practice it turns out that the one value view leads to results, and allows us to go deeper and deeper into what we are doing, while the many-value view, leads to a lot of words, and simply does not help us to reach better, deeper results: in building, planning or managing the environment.

I should like to make it clear, at this stage in the argument, that I believe the many-value view, the neo-positivistic view, is extremely widespread in the world today, especially in academic circles, and that it has arisen precisely as the scientific world view, has met, collided with, the need to design things, which is an activity not covered in any obvious way by science.

I believe that it is not only theorists in our college, like Jean-Pierre and Rittel, who are neo-positivists, but that very many members of our faculty, implicitly or explicitly, also hold this view. It is the view which is held by the super-technologists, when they try to graft high technology, and industrialization, onto the process of building design. It is the view held by pluralistic planners and planning theorists. It is the view held by "urban designers", or by big-time architects, who do things that they don't quite believe in, for money, or for fame, or because the client wants it.

It is, in short, the view that is held by anyone who does not base his actions totally, utterly, on the realm of feeling.

The reason for this situation is very complicated. At one time, in pre-Cartesian Western thought, it was considered natural that the view of the universe, however scientific and powerful it was, must at the same time also be a view which included the self of the perceiver, as an essential part. In these pre-scientific cosmologies there was no rift between fact and feeling, between fact and value, because people made pictures (theories) in which the two were united.

However, during the period from 1600–1800, roughly from Descartes to Leibniz, God was taken out of the world, and replaced by an endless, isotropic, homogeneous universe, represented by a geometric structure, in which value had no natural place: indeed, it was value-free, and value could not be related to it, in any sensible graspable way.

We have grown up with this scientific heritage. Trying to be good scientists – or at least believing in science – we have accepted the idea of a world picture, without value in it. And yet we face a paradox, as architects, planners, faced with human decisions, decisions about the structure of our world every day, we patently face the issue of value constantly. Trying to keep faith with "Science", and therefore accepting the idea that there is not one Value essentially connected to the structure of things, we replace it with the idea of many values (little "v"), and try to let those little v values take the place of a world in which fact and value are united.

But this cannot be done. If the conception of value which we have, is purely personal, treats each person's values as interesting, deeply important, but arbitrary things, not essentially connected to the structure of things, we still flounder about in the value free structure of science, trying artificially to graft on the little v values, which individuals have: and then we dignify this patchwork, and call it a theory.

Myself, as some of you know, originally a mathematician, I spent several years, in the early sixties, trying to define a view of design, allied with science, in which values also were let in by the back door. I too played with operations research, linear programming, all the fascinating toys, which mathematics and science have to offer us, and tried to see how these things can give us a view of design, what to design, and how to design.

Finally, however, I recognized that this view is essentially not productive, and that for mathematical and scientific reasons, if you like, it was essential to find a theory in which value and fact are one, in which we recognize that there is a central value, approachable through feeling, and approachable through loss of self, which is deeply connected to facts, and forms a single indivisible world picture, within which productive results can be obtained.

This is the crux. Many people recognize that architecture and planning are in bad shape, because our towns and buildings are unpleasant, inhuman, ugly and so on . . . Most of us are struggling with this, in one way or another – both those of us who practice as architects, and those of us who work on design methods, on the human processes of planning. But in every case, we must ask: how much progress does a particular theory make, in helping us to move; helping to get results about design; helping to design buildings which are indeed more human, which allow the human soul to rekindle a flame. If a theory does not do this, does not appeal to intuition or feeling, then it is a lousy theory. I have gradually come to espouse the view which I have explained here, not because I am a religious person, or because I have a predisposition to think religious thoughts, but because I find, speaking as a scientist, and as a mathematician, that this is the only kind of theory which actually gets us anywhere.

Let me now try to outline, point by point, the various ways in which the one-value theory is productive, and deep, and the many-value theory shallow, and unproductive.

1 Since the one-value theory gives each person a criterion for what is good and what bad (based on his own feeling), it is possible to make progress. Since we can tell the difference, intuitively, between good phenomena and bad phenomena

(at least roughly, and as a matter of degree), we can try to find out what characteristics are possessed, typically, by the better ones, distinguish the better ones from the worse ones, and we can therefore learn something about how to make the better ones. On the basis of the many-value theory, we cannot identify some things as better, and some as worse, and we cannot therefore make any progress towards making the things which are better. This difference applies equally to buildings, social structures, industry, political structures, ornaments: all the things which environmental design is concerned with.

2 Specifically, as witnessed in *A Pattern Language*, it is possible to identify large numbers of characteristics which can be reused. Neo-positivism cannot obtain fruitful results like this, because it will not permit these results to be obtained: it excludes them by philosophical fiat.

3 Of course, the fact that we can learn something, within the one value theory, and not within the many value theory, does not mean that all the things we posit in the one value theory, are immediately correct. Thus, for instance, many of the patterns defined in *A Pattern Language* are clearly incorrect, or only partially correct. But, once again, within the one value theory, we can appeal to our own intuition of the central value, and discover to what extent these patterns are correct or incorrect, in different circumstances, and try to do better. The one value theory therefore gives us a basis for discussion, and a basis for criticism.

The many value theory, although it seems to generate a lot of heat and talk, gives us no basis for useful discussion, because it does not allow that something might be more right, or more wrong. All that one can say, within the realm of the many value theory is "Personally I don't agree." This is as interesting as it might be for someone to say "I have a stomach ache this morning," or "I feel happy." It is very important as personal information, but it leads nowhere as a productive, oriented development of skill or mastery in design.

In line with this observation, you will find that Jean-Pierre's criticism of *A Pattern Language*, is always a meta-criticism: it is a criticism of method, philosophy, but never deals with the concrete patterns themselves, in a positive sense, only in a negative sense, because a person immersed in the many value theory cannot allow himself to make any general statement about what is good in the environment.

4 Within the many value theory, it is necessary to exorcise all words like "beautiful", "good", "better", "valuable", because according to this theory there are no legitimate concepts of this kind that make any sense in public discussion.

Notice, for example, how Jean-Pierre carefully calls the apartment in Genoa a "successful" space, protecting himself by this neutral and uncommitted word, against accusations of making value judgments, while sneaking the value judgment in, anyway, by the back door. Are we to accept the statement that this apartment is good or not, as an objective matter, or merely as a personal judgment? If it is a personal judgment, the whole argument which surrounds it makes no sense. If it is intended to be a tentative statement of fact, then we must admit the presence of some one value, which is being appealed to, that Jean-Pierre recognizes, and talks about in the belief that we will also recognize it.

5 The many value theory in its extreme, encourages, fosters, even insists on a highly nihilistic "you do your thing, I'll do mine" kind of argument, which can lead nowhere. For example, I had the following interchange with a student a couple of days ago.

She: I believe it is meaningless to design buildings as drawings, as we do in Wurster, because a drawing of a building is not a building.
Me: Does this mean that you think we should teach at least some classes where you learn design by actually building things?
She: No, not at all. I was merely commenting on the fact.
Me: Are you saying that some of the instruction here is irrelevant, and empty of content?
She: Yes, certainly. (laughs and nods from several listeners)
Me: Then you are implying that something should be done to change it?
She: Not at all. That's simply the way it is here. I accept all of life as one great learning experience, and I accept what Wurster has to offer as part of it.
Me: You criticize the teaching here, yet you do not wish to imply that it should be improved.
She: That's right.

In this astonishing conversation, there is an obvious confusion. If I read it right, the person concerned recognizes, intuitively, the difference between right and wrong, but has been so brainwashed by the many value theory, in which serious discussion about right and wrong is not permitted, that she prefers to accept "things as they are."

6 Of course, in the design studio, this kind of thing happens constantly. Students are confused, angered, by the fact that instructors are not willing to take a final stand on anything. Or rather, to be more accurate, each instructor takes his stand on his own thing, but there is a general refusal to admit these various "stands" might be scrutinized in relation to one another. Natural politeness makes this almost necessary, once things have reached the extreme stage which they have reached. So long as most people are connected in some rough way to the one central value, then no one of them is so way out, that it becomes embarrassing or offensive to question what he is doing. But after fifty years of neo-positivism and many value theory, people are in such entirely different corners of intellectual space, are so committed to their divergent and unconnected values, that it shakes a person's whole foundation, to confront him with the one central value.

Living under this cloud, all discourse becomes essentially impossible, because each of us has to tread so lightly that we cannot confront each other on almost any matter. That is why discussion about the architecture curriculum, and discussion about architecture itself, have almost disappeared from our college. After a few years of the many value theory, you cannot afford to have all these discussions, because they become socially unacceptable, too painful, and laden with danger.

In contrast to this situation, the one value theory, allows discourse, allows agreement to be forged, allows discussion because you are not threatening a person's whole cognitive existence every time you raise objections, but merely appealing to his own version of the one central value, which he has access to, just as much as you do.

7 Finally, the one value view, because it is centrally connected to feeling, allows us to express feeling in our work, makes the feeling something essential, and above all, permitted. Thus for example, within this point of view, because there is an ultimate identity between the one value and the feelings we experience deepest inside ourselves, we shall naturally be led to discuss questions like "What

kinds of tiles or ornaments are most profound?," "What kind of construction details allow a building to be made with deep feeling?," "What kinds of political process, in a neighborhood, will allow the people of the neighborhood to shape the neighborhood according to their own culture, with their own spirit?," "What kinds of production process are compatible with the well-being of the craftsmen who produce the materials?," "When does a building have the power to touch us deeply, and how can we make a building like that?," and so on.

The many value view does theoretically permit, and even encourage discussion of feeling. However, since it has to maintain the artificially aloof posture created by "scientific discourse," that small v values are personal, and not essentially related to facts, the feeling of the thing made is only rarely allowed to come to the fore. Of course, in the debate about small v values, people are allowed, even encouraged to express their various different feelings. But somehow, in spite of all this therapy style expression of feeling, actual works with powerful feeling, great works in which the human soul recognizes itself, are simply not being created in our age: because the many value viewpoint just is not deep enough to allow an artist to approach the depth of feeling which is required.

By contrast, in the great medieval period of Christian art, and in the great period of Islamic art, the artists were able to express such immense feeling because they worked, day after day, year after year, progressively modifying what they did, pursuing the kinds of actions, the states of mind, which were able to allow this feeling to come to light. This was a skill, a craft, a mastery of great order: it could only be reached be patient confrontation, every day, with the extent to which processes, procedures, ways of working, were able to come closer and closer to the One, allowing all other ineffective processes to drop away. It was clearly recognized, in those times, that it was only by constant, daily appeal to the One, that progress could be made in the artist's work, so that finally, after years and years, great results could be reached. In this sense, the central value played the same role for the artists and craftsmen of those times, as "empirical truth" has played in our era for science.

It is only by constant appeal, by hundreds and thousands of people, day after day, to this constant, sharable criterion, that progress is made. To make things which are deep, it is necessary to have a comparable shared value to appeal to, so that one can improve one's work.

11 Centering, 1977

This short document is one of CA's first efforts to write a description of the process that would be elaborated and interpreted in scores of ways in subsequent documents, culminating in Book Two of The Nature of Order, The Process of Creating Life[1]. *Making centers, elaborating them with smaller centers, and using them to help intensify larger centers is, according to CA, the fundamental process for the creation of wholes in buildings, landscapes and cities. This document is one of the clearest descriptions of that process, and was used by CA in teaching before the publication of* The Nature of Order.

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Process, second draft, March 3 1977
Part I: overview

1 The fundamental concept, is that of a center. A center is not a point: it is a whole, a shape, an area, which is well enough defined to possess or define a center, at its heart. In many cases the middle itself will be void, but the whole, by virtue of its overall organisation, creates a virtual center. A center must always have at least one axis of symmetry (maybe there are exceptions). In addition a center must have certain other features, which we shall define below.
2 The structure which we are trying to create is essentially a structure of centers. We shall see, later, how all the properties we have analysed, can be expressed in terms of centers.
3 The process by which we shall create this structure, consists of one operation, which will be performed over and over again. This operation consists of making, elaborating, strengthening, completing, some center which exists, or begins to exist.
4 Recognise that at any moment, the thing which is being created, has in it a large variety of centers, defined at many different levels.

1 Christopher Alexander, *The Nature of Order: The Process of Creating Life*. Berkeley: Center for Environmental Structure, 2002.

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These centers will have different degrees of definition. Some will be well developed. Some will be partially developed. Some will be only vaguely visible, like a whisper, barely discernible, but suggested by the structure which exists.

5 This applies, also, to the very first moment – the moment at which we begin our work. Whether we begin with a blank sheet of paper, a wall of a room, a column of a building, . . . even in its undecorated state, it is already a structure of centers, some strongly defined, others more weakly defined, others vaguely suggested or hinted at.

6 The fundamental operation, whether it is applied thus, to the blank, unformed paper, site building – or whether it is applied in mid-process, to the emerging ornament, or emerging structure, consists of taking one of its emerging centers, and developing it.

If the center is already well formed, this may mean elaborating it. If the center is half formed, it may mean strengthening it. If the center is only vaguely indicated, it may mean bringing it out into the open, creating it.

Part II: the operation

7 Although the operation of forming, developing, elaborating a center, will usually begin with attention to some one center, which is emerging, in order for the operation to function properly, is must have a very complex structure, which we may imagine, conceptually, in the form of a cross.

a As we develop, form, elaborate the emerging center, we must also develop, form, elaborate some larger center in which the first center is embedded.
b At the same time, we must consciously develop, create, elaborate some smaller center or centers, within the first center.
c At the same time, we must also develop, create, other centers, of the same size, which lie next to the given center.

Of these the most important is the larger center, a. The process works best when we actually pay attention to the larger center a, allow the development of the medium center, the other medium centers in parallel, and the smallest centers to follow, almost automatically.

8 This cross structure can be represented, diagrammatically, like this:

a. Larger centers
|
b. Same size centers – First center – Same sized centers
|
c. Smaller centers

9. It is in the nature of this process, that your attention will move. After working at this for a little while, this will happen for a variety of reasons. Partly, your attention will move, as the centers you are working on reach a different state. Partly, it will happen simply because the actual operation you are doing, gets completed, and your mind looks for something else.

Partly it will happen, because in the course of making this/elaborating the centers you are working on, you put, color, line, dark marks on the paper,

building, whatever – and the debris this activity, creates the possibility, or suggestion of new centers, which did not exist before, and your mind shift to them.

10 At this stage, complete the operation, and redirect your attention to a new center, and begin again. Sometimes it is valuable to direct your attention to a center which is already there, and needs strengthening. More often, though, it makes sense to apply your energy to look at the overall structure, search for some underlying new center which seems to be peeping through, or which seems incompletely, or incoherently present. You may then direct your activity to the strengthening, elaboration, of this incomplete, emerging center.

11 This is especially important, to apply this glance to those areas where there is no center at all hardly. You must work hard, to see some emerging center there, so that finally there are no areas left at all, which do not belong to at least one center.

12 There is one other rule which should govern your choice of the next center. In general, you need to keep moving up and down, sometimes focusing on larger centers, sometimes on small ones. In particular, at least every three or four times that you do this operation, pay attention to the very largest center of all.

There should be one center, at least, whose diameter is the whole thing you are working on.

13 In order to keep performing the operation over and over again, it is necessary to have a very precise, and full idea of what exactly a center is. In particular, your understanding of a center must be rich enough, so that the various properties that are necessary to the one, emerge naturally, from your piecemeal attempts to make each center more centered.

14 In general, a center needs to have more material towards its edge, than in the middle (VOID). The overall shape of a center, needs to have at least one axis of symmetry (SYMMETRY). The outside boundary of a center will often be imbricated, so that there is interlock with its exterior (INTERLOCK). In the same way, the center will often be most powerful when it is so formed, at its edge, that there is some ambiguity with the next door center, or with an overlapping center (AMBIGUITY). The boundary of the center needs to be drawn, in such a way that its shape creates additional, smaller, centers, and differentiates the center from its surroundings (GOOD SHAPE). The actual boundary of the center needs to be made up of smaller centers itself, which both unite, and distinguish the center from what lies next to it (BOUNDARY, LEVELS). Each center needs to have a color, which is complementary, or contrasting in value, with the next door color (CONTRAST).

Each center needs to be made by lines, and colors, which come from the same family as the other centers near it (ECHOES, FAMILY OF COLORS).

At the same time, the boundaries which form the smaller centers between any two given centers, must be of colors which both unite, and distinguish the neighbourhood colors (HAIRLINES).

15 Most important, each center must be drawn in such a way that it creates other centers next to it, contrasting in color, but equally strong in shape (NEGATIVE POSITIVE). This can only happen if you are always paying attention to the cross of centers, during the operation of elaborating centers.

16 FINALLY, whenever in create an alternating sequence of centers, to make some larger center (ALTERNATING REPETITION).

12 A shrine to color and light, 1990

In the early 1990s CA organized an exhibition of his collection of early Turkish rugs at the DeYoung Museum in San Francisco, and wrote the book, A Foreshadowing of 21st Century Art: The color and geometry of very early Turkish carpets.[1] *CA's study of these Turkish carpets played a large role in the development of principles of spatial wholeness that were explained in* The Nature of Order. *Although* Foreshadowing . . . *is not as well-known as many of the other books, it is remarkably clear in its explanation of centers and their relationship to fifteen principles of geometric wholeness. The proposal printed here is CA's idea for a permanent exhibition space for his carpets – a place whose "purpose is simply to take one of the most glorious works in the field of color, enshrine them together in a housing, which allow the visitor to be filled, inspired, refreshed, and enlightened, simply by their effect in the realm of color."*

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A shrine to color and light
The carpet museum

The purpose of the museum

I propose the creation of a single work of art: a museum, which contains some 80 Turkish carpets, chosen for unbelievable beauty of color and light. These carpets date from a range of periods from 12th century to 17th century.

The purpose of the museum is to create an experience of color and light, perhaps similar in depth of feeling, to the Sainte Chapelle in Paris.

The purpose is not academic, and it is not meant, primarily, for carpet specialists: It is meant to be, for everyone, a supreme experience in the realm of color: a shrine to color: a place where a person can go, again and again, to spend a few quiet hours, bathed in an extraordinary light.

1 The book was published in 1991. Christopher Alexander, *A Foreshadowing of 21st Century Art: The color and geometry of very early Turkish carpets*. New York: Oxford University Press, 1991.

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But to do this, I intend to use the 80 carpets of my collection, which are among the most extraordinary remaining Turkish carpets – and to use them, to weld them to a single whole, as they might have been once, perhaps, in a Konya mosque.

So the purpose is simply to take one of the most glorious works in the field of color, enshrine them together in a housing, which allow the visitor to be filled, inspired, refreshed, and enlightened, simply by their effect in the realm of color.

Location of the museum

I have taken twenty years to collect these carpets, and I want to make sure that they take their place in some part of the world, where the unique achievement of color that they represent is available to all, not buried. I want them to be in some cosmopolitan center, which plays a key role in the modern world. My preference would be for it to be in San Francisco itself, where I live, simply so that I could contribute in some concrete fashion, to the place that has meant so much to me during my years here. San Francisco embodies the passage of the 20th century, towards the 21st, and has been the birthplace of many new visions of reality, that have emerged in the 20th century. For that reason it would be highly appropriate.

Of course, many other places are possible, and might play a similar role, in encouraging a stream of international visitors, year after year. London, New York, Rome, Florence, Milan, Tokyo, Chicago, Brussels, Dallas, Rio de Janeiro, Los Angeles, Vienna, might all be possible.

Wherever it is, I hope it will be in a place which is visited often, by thousands, as a kind of pilgrimage, so that it is a place where peace and rest and quiet can be attained. If it were in San Francisco, I would hope it might be on the rocks of the Pacific, overlooking the ocean. If it were in Switzerland, in a quiet valley; if in London, perhaps on the edge of one of the great parks.

The location is important. It is not only a question of what happens when you go inside and are inside: but also the approach, the slow change of atmosphere as you approach, the vision of the outside of the museum, the arrival: and the possibility of staying there, for many hours, then leaving, and again the leaving may be important in itself.

Religious aspects of the museum

I do not believe that the quality of these carpets, or the feeling which is created by their color, can be separated from a religious feeling. The carpets were made in the crucible of sufism: the best ones are devotional objects, which come from the illumination of the spirit. My intent is that this religious spirit is clearly visible, and felt, in the museum: and my hope is that the building too, will embody this religious feeling too, as far as I can manage it.

In some respects, the building and the carpets, as a work, may play their role in the evolution of a new religion, which carries the spirituality of the early centuries into a new form, consistent with our ultra-modern view of the universe.

It is not a church, because it is not something which belongs to any one religion. But it is a shrine, which embodies and glorifies God, as far as my very slight ability can make it happen, in the inner experience of each person who visits it.

A museum of the 21st Century

I see the museum and its carpets together as one work. It is not to be thought of as a collection of carpets, housed in a building, but as a single work of art, which embodies the emerging spirit of the 21st century, forming its connection with the early spiritual centuries of the late middle ages and early 14th and 15th century.

The work of art, itself, that is the building, the formation of the building, is itself to be comparable in quality to the carpets: a vision of a new reality, arrived at again, as it was routinely arrived at in earlier ages. So what is under consideration, is this work of art, which is the building, and the color of the carpets, and the carpets and the walls. But it includes, too, the actual making of the museum, its stone, wood, glass, concrete, plaster, light. The colored plaster on the walls, the floors, the comfort of a real sort, spiritual in nature, but also ordinary comfort, to be found in this place, so that one might stay in it for hours and hours at a time.

This museum, then, is, as a work of architecture, a culmination of efforts and achievements which have been growing in my work over the last twenty years. It is a stepping stone, a possibility of something in the world of architecture, which has only very rarely – perhaps never – been accomplished in this century.

The San Francisco museum exhibition of 1989

The museum which I intend to build, would be based, in spirit, on the exhibition which I designed and built, inside the De Young Museum, San Francisco, November 1989 – February 1990. That exhibition was, in my mind, a dry run or testing ground for the form, organization and color of the permanent museum. The following passage describes the exhibition, as I wrote about it in HALI.[2]

I designed the De Young exhibition with one thing in mind – to create an atmosphere in which the real nature of the carpets would be visible. I imagined it originally as a rather informal, smoky, even dirty place, where carpets would be addressed not as museum objects but as friendly things which one has around in the ordinary course of daily life. That is the way I have lived with these carpets for many years.

The caption should not include the figure number.

As I started to construct the show, I realized that the formal position of the most important carpets mattered very much. I arranged the central aisle, with its transept-like spaces, so that the truly great carpets were either extremely close to the viewer's body, or clearly visible and distinguished from the lesser carpets by the layout.

As far as color was concerned, what developed truly surprised me. I started with the idea that the walls would be a warm off-white. However, I tried many experiments with color and light before I made the final decision as to how the galleries should look. I painted the walls, lit them, hung them with carpets and lit them again. Each time I modified the work until I felt the carpets' real nature to be shining out. The further I went, the darker the walls became, until I found myself making half the walls a deep somber red and the others grey. And I found myself using tiny spots of light on the carpets, not illuminating the whole carpet, but creating just enough light that the glowing presence of each carpet could be felt. And its life was there before me.

2 Christopher Alexander, "A New Way of Looking," *Hali*, Issue 56, April 1991, pp. 114–125.

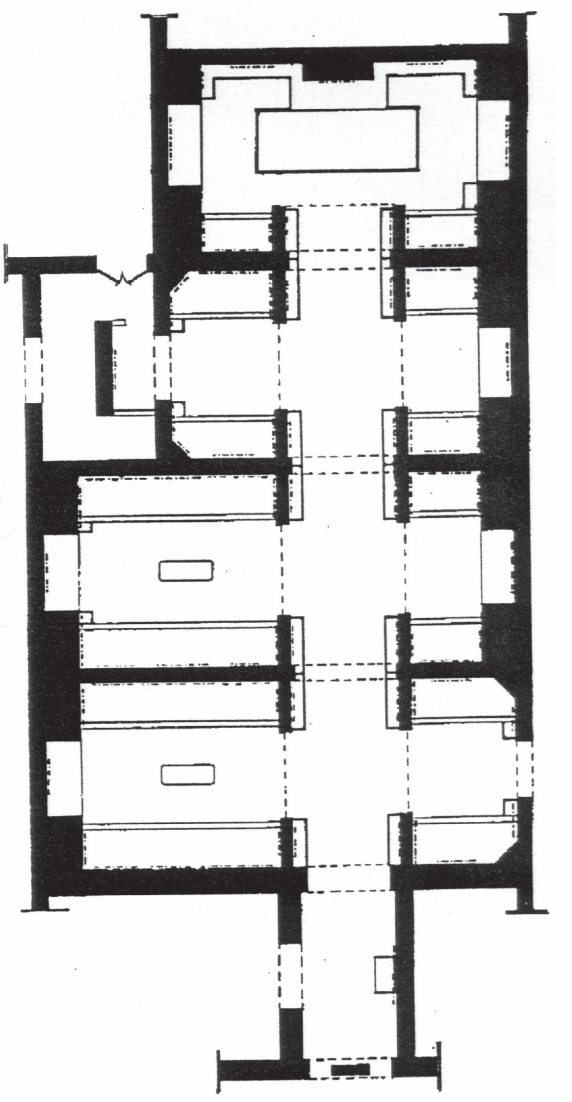


Figure 12.1 Plan of the exhibit in the DeYoung Museum.

Again this was very different from conventional museum curatorship. The labels were also controversial; when it came to choosing size, type and color, the museum staff, who helped so much, advised me to make the labels lighter and more legible. I refused, because experiment showed that instead of the objects themselves glowing mysteriously, with their spiritual content intact, the atmosphere became more like that of a museum, an academic place where labels, dates, places of origin – all the scientific paraphernalia – suddenly became important, with the inevitable result that the carpets themselves were diminished.

So the exhibition was essentially empirical. It was *that* arrangement of space, light and color, which I was able to find in a limited time, that placed the carpets most clearly in their proper spiritual and emotional attitude. In some ways, the result was, I suppose, like the interior of a mosque. This was not intentional, but in trying to bring the carpets, with their dark glowing spirit, into a direct relationship with all of us, I found it necessary to create this kind of place.

I do not think that it would make much sense if one had asked the architects of Gloucester Cathedral or the Sainte Chapelle to make their interiors lighter so that one could read the labels. The glowing presence of color is what matters most and that is what the architecture shows.

One day, I hope it will be possible to build a permanent museum – in San Francisco or somewhere else – where my carpets can be permanently housed, so that members of the public can visit and contemplate the awesome majesty of their color in a proper setting. I suppose that place, when it is built, will also be considered too dark; but there too, the colors will be softly glowing.

Design of the permanent museum

I imagine the permanent museum as similar to the San Francisco exhibition in its interior feeling and organization. It is a small building, intimate, solid, massive in its construction, intimate in the spaces, dark interiors, vaults and arches probably. As in the San Francisco layout, I imagine a main nave, two or three sets of transepts, perhaps the most important carpets in the main aisle and at the end, with the ends of the transepts too reserved for very wonderful pieces.

I imagine the building as more solid and more comfortable: during the San Francisco show I was impressed by the number of people who told me they had spent hours, two, four, even six hours in the exhibition. The place is very comfortable, made to allow comfort over a long period of time – and reverence.

From the outside, I imagine something solid, unobtrusive, a visible being of some kind, quiet, possibly even holy, with a garden leading to it if possible, and perhaps an interior court, very quiet, with a small stream and an apple tree.[3]

The carpets of the collection

So here, in the following pages, are some of my beloved carpets. Many of them are unique, not belonging to standard types, but belonging rather to unknown groups. Some of them are among the earliest carpets in the world. They represent something we might almost call the lost heritage of Turkish and Turkic art, preserved now, for the most part only in two Turkish museums, the Turk-ve-Islam and the Vakiflar museums, both in Istanbul, and in ones and twos among the great museum collections of the western world.

These 77 carpets from the 12th to the 17th centuries constitute a kind of "core" of the essential art of Central Anatolia. But this core of Anatolian art did not come into my possession because of any historical or geographical interest on my part. It

3 The reader may be interested in looking at another museum design of mine, also described in a book: Christopher Alexander. *The Mary Rose Museum*, Oxford: Oxford University Press, 1993.

came directly from my desire, as a builder, to learn from the carpets. I collected them because I wanted to learn from them, and for years I looked at them every day. Every day I learned something new from them. I still learn something every time I look at them. Many of the carpets in this collection, I must have looked at five hundred or a thousand times, and over the years I must have spent thousands of hours, simply looking, looking, looking.

I was never interested in the classification of carpets. I did not care if the carpets came from a certain area, or from a certain type, or from a certain period.

I was only interested in those pieces which had the most to teach me, in my own work as an artist. Gradually, as a result of this intention, I found myself looking for earlier and earlier carpets. This also did not happen because I had any kind of intellectual idea about early carpets. It happened simply because I discovered, slowly, through experience, that the earlier carpets had a deeper structure, were more beautiful, and had far more of that complex and important structure that was so moving that I wanted to learn from it. So, I tended more and more towards the very early carpets, in my search.

Among the very early carpets, I found myself with a marked tendency to choose Turkish ones. For some reason which I cannot entirely explain, it simply seemed that the Turkish carpets, more than any others, had most of that oneness, or spiritual depth which I was looking for. Even in those cases where I did buy carpets from other parts of the world, they were always those which had a pronounced "Turkic" character. For this reason, even though there are Spanish carpets, Persian carpets, Caucasian carpets, Central Asian and other European pieces in the collection, I have nevertheless always focused on the Turkish carpets, above all others, because it seemed that the oneness or wholeness I was after, simply occurred more often, and more deeply, in Turkish carpets than in any others.

Finally, among Turkish carpets, I found in myself a marked tendency to look for the great village pieces from the earliest centuries. These early village carpets, unlike the classical Ushaks – are the real core of authentic Turkish carpet production. Pieces of this kind, from the 14th, 15th, 16th and 17th centuries are almost unknown outside the Turk ve Islam and Vakiflar museums in Istanbul. Nevertheless, it is these pieces which, in my opinion, represent the true core of Turkish carpet weaving.

It is my belief, that the beauty, or oneness, which we find in these particular Turkish carpets – and in those other early carpets which I loosely think of as "Turkic" – has never been surpassed in the history of carpet weaving, and represents the pinnacle of what can be done.

What did their makers put into them? What aspects of form, organization, color, and geometry, is it that these carpets have, that lets them reach this pinnacle? What is it about their structure that places them, among all carpets, at the same level that Bach or Mozart occupy in the realm of music?

After years of looking, looking, and making things, I think I finally have a partial answer to this question. To a first approximation, I believe I can describe the structure which makes these carpets work. That is what I have attempted in my book on the carpets – to be clear enough about the structure which they have, so that we, as artists, in the 20th and 21st centuries, may have some hope of making things of equal beauty.

I know that this idea, this hope, may seem fantastic, even absurdly pretentious to some people. That, I fear, is only the mark of our age, where all people – and architects in particular – have almost given up the effort to make things of great beauty, because the knowledge of what it means, and the hope of being able to do it, seem so utterly remote.

But in any case, it is my hope that the opportunity to look at these carpets, enshrined in a single work, together with what can be said about them, and about the extraordinary structure they possess, may not only shed new light on the art of carpet weaving for scholars and collectors, but may inspire other builders and other artists to regain their confidence – so that they can make things of equal spirit and of equal beauty.

The museum catalog

The collection is permanently recorded in the book A FORESHADOWING OF TWENTY FIRST CENTURY ART: THE COLOR AND GEOMETRY OF VERY EARLY TURKISH CARPETS, published by Oxford University Press, 1993, in which the carpets are discussed from the point of view of a fundamental theory about carpet design and color, which breaks entirely new ground. The book is magnificently bound in Japanese silk, has 352 pages, 96 color plates, more than 200 hand drawn sketches by the author. This book will be available continuously, to museum visitors, who want to have it as a record of their visit.[4]

4 Christopher Alexander, *A Foreshadowing of 21st Century Art: Color and Geometry of Very Early Turkish Carpets*. Oxford: Oxford University Press, 1993.

13 OOPSLA lecture, 1996

CA is regarded as a pioneer in the computer programming world, whose work led to the introduction of the idea of "design patterns" in software development, an idea that greatly facilitated the development of long and complex programs. In this speech to the "OOPSLA" (Object-Oriented Programming, Systems, Languages and Applications) group, he urged software developers to use their talents to help bring his ideas about the built environment to have widespread influence in society. The introduction by James Coplien discusses CA's influence in the computer programming community.

The following presentation was recorded live in San Jose, California, USA, October 1996, at The 1996 ACM Conference on Object-Oriented Programs, Systems, Languages, and Applications (OOPSLA).

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The origins of pattern theory The future of the theory, and the generation of a living world

Introduction by James O. Coplien

Once in a great while, a great idea makes it across the boundary of one discipline to take root in another. The adoption of Christopher Alexander's patterns by the software community is one such event. . . . It is odd that his ideas should have found a home in software, a discipline that deals not with timbers and tiles but with pure thought stuff, and with ephemeral and weightless products called programs. The software community embraced the pattern vision for its relevance to problems that had long plagued software design in general and object-oriented design in particular.

Focusing on objects had caused us to lose the system perspective. Preoccupation with design method had caused us to lose the human perspective. The curious parallels between Alexander's world of buildings and our world of software construction helped the ideas to take root and thrive in grassroots programming communities worldwide. The pattern discipline has become one of the most widely applied and important ideas of the past decade in software architecture and design.

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But growth into the deeper and more fundamental aspects of patterns has been slow and difficult. And even as we struggle with the growth from patterns to pattern languages, there is a level of the yet scarcely touched: the moral imperative to build whole systems that contribute powerfully to the quality of life, as we recognize and rise to the responsibility that accompanies our position of influence in the world. And that leads us to the third inspiration for the direction of patterns in our discipline: Christopher Alexander himself, who directly engaged our community in this keynote speech at OOPSLA'96. The timing and audience of the venue afforded Alexander the chance to reflect on his own work and on how the object-oriented programming community had both hit and missed the mark in adopting and adapting his ideas to software. As such, the speech was a landmark event that raised the bar for patterns advocates, for object-oriented programmers, and for software practitioners everywhere. Beyond that, this speech has timeless relevance to any engineering, scientific, or professional endeavor.

Keynote address by Christopher Alexander

Thank you very much. This is a pretty strange situation I find myself in. I hope you sympathize with me. I'm addressing a room full of people, a whole football field full of people. I don't know hardly anything about what all of you do. So – please be nice to me.

My association with you – if I can call it that – began, oh it must have been two or three years ago. I began getting calls from computer people. Then somebody, a computer scientist, called me and said that there were a group of people here in Silicon Valley that would pay $3000 to have dinner with me. I thought – what is this? It took me some time to find out. I didn't really understand what had been going on, and that my work had somehow been useful to computer science. Only now I'm beginning to understand a little bit more of what you are doing in your field and the way in which it comes, in part, from some of the things that I've done.

When I faced the question of addressing you, I wondered what on earth I should talk about. And, earlier, a few months ago I faced a similar thing when I was asked to write an introduction to Richard Gabriel's book (*Patterns of Software*) and again the question for me was: What in the world should I write about? What is there that I could say that would be of interest? And, because I, in a way, myself started out in computers many years ago in the late '50s, this question became quite fascinating to me and quite absorbing. But still, I wasn't given much to go on. Take Jim for example. When he invited me, he was very friendly and I said to him, 'Look, what do you want me to talk about?' and so forth. He said 'Oh that doesn't matter. Just talk about anything. Because it's you, and because of the history of this pattern problem, people will find it interesting.' But still I thought, What should I really talk about? What is the connection between what I am doing in the field of architecture and what you are doing in computer science and trying to do in the new field of software design? That is the question I must talk about. What I'll do, in the time I've got here, is to tell you where my thoughts went as I stepped through the invention of the pattern concept, and where I have gone since then. In addition, I shall reach a conclusion which may surprise you. As I've been preparing for this speech during the last few months, I ended up with something that may startle you, and you may find quite strange. But, I'm not going to tell you what that is just yet.

In effect, I'm just going to do three things.

1 Pattern Theory. I'm going to talk first of all about patterns and pattern languages, what I did about that, a few little points about problems we encountered, why we did it, how we did it, and so forth. That is a historical survey referring back to the late '60s and early '70s.
2 *The Nature of Order*. Then, I'm going to summarize the theoretical framework which has evolved out of the pattern work: a framework which is about to be published in a series of four books collectively called *The Nature of Order*, four books that will be put out by Oxford University Press in the year 2000. That framework is a fairly radical departure from what the pattern language in the earlier theories contained, although it is consistent with them. That'll be the second thing. And, I'll just try and sketch that out in the hope that there might be some carryover or you might possibly find it interesting – even though of course I will have no way to apply this to your field directly when I tell you about it. However, there are undoubtedly abundant connections between the two fields that can be drawn.
3 What the Future Holds in Store: The Generativity Problem and the Generation of a Living World. At the time I wrote the introduction for Richard Gabriel's book, that was really as far as I had gotten in trying to trace the connection between my work and your work in the field of computer science: I tell you what I'm doing, and maybe some of you folks might find it interesting or be able to extrapolate. But I couldn't really find that sufficient to be satisfying. I felt that there is some more significant connection between your field and mine. Or at least that there perhaps is. And that finally brought me to the third point.

The third thing I'll talk about is how I now perceive that connection. I suppose that some of you know what I do for a living. You know I'm an architect. All of my life I've spent trying to learn how to produce living structure in the world. That means towns, streets, buildings, rooms, gardens, places which are themselves living or alive. My assumption here – a sad one – is that for the most part what we have been doing for ourselves, at least during the last 50 years or so, perhaps starting somewhere around World War II, has virtually no ability to produce that kind of living structure in the world. This living structure which is needed to sustain us and nurture us and which did exist to some degree in the traditional societies and in rural communities and in early urban settlements has disappeared. It is drastically gone. We don't know how to create it or generate it any more.

Of course, especially for architects, that is a debatable matter. Some professional architects might say, What are you talking about? What we are doing is absolutely fine, the buildings we are building today are excellent, very good, no problem!! I suppose the architect of this particular huge and nauseating conference hall we are in, here in San Jose, where we can hardly understand each other, would say that, too. But, actually, it isn't fine. It's a hell of a problem. It's a serious problem. It affects every man, woman, and child on Earth. We are so ignorant about how to do this, to make living structure on Earth, it is lamentable. And it is very, very serious, becomes more serious every day, because the population of the Earth is growing, and the Earth is being damaged more and more – and with the damage to our towns and buildings, we too are being damaged.

The fact that we don't know, really do not know what we're doing, and the fact that the built world is not nurturing is a very, very drastic matter for all of us. This is my concern. That is what I try to deal with every day.

Pattern theory

The idea that materialized in the published pattern language was first of all, of course, intended just to get a handle on some of the physical structures that make the environment nurturing for human beings. And, secondly, it was done in a way that would allow this to happen on a really large scale. And, what I mean by that is that we wanted to generate the environment indirectly, just as biological organisms are generated, indirectly, by a genetic code. Architects themselves build a very, very small part of the world. Most of the physical world is built by just all kinds of people. It is built by developers, it is built by do-it-yourselvers in Latin America. It is built by hotel chains, by railroad companies, etc., etc. How could one possibly get a hold of all the massive amount of construction that is taking place on Earth and, somehow, make it well, that means let it be generated in a good fashion and a living fashion? This decision to use a genetic approach was not only because of the scale problem. It was important from the beginning, because one of the characteristics of any good environment is that every part of it is extremely highly adapted to its particularities. That local adaptation can happen successfully only if people (who are locally knowledgeable) do it for themselves. In traditional society where lay people either built or laid out their own houses, their own streets, and so on, the adaptation was natural. It occurred successfully because it was in the hands of the people that were directly using the buildings and streets. So, with the help of the shared pattern languages which existed in traditional society, people were able to generate a complete living structure.

In our own time, the production of environment has gone out of the hands of people who use the environment. So, one of the efforts of the pattern language was not merely to try and identify structural features which would make the environment positive or nurturing, but also to do it in a fashion which could be in everybody's hands, so that the whole thing would effectively then generate itself.

What, now, of my evaluation of what you are doing with patterns in computer science? (Bear in mind, as you hear my comments, that they need to be taken with a grain of salt; I'm ignorant; I'm not in your field.) When I look at the object-oriented work on patterns that I've seen, I see the format of a pattern (context, problem, solution, and so forth). It is a nice and useful format. It allows you to write down good ideas about software design in a way that can be discussed, shared, modified, and so forth. So, it is a really useful vehicle of communication. And, I think that insofar as patterns have become useful tools in the design of software, it helps the task of programming in that way. It is a nice, neat format and that is fine.

However, that is not all that pattern languages are supposed to do. The pattern language that we began creating in the 1970s had other essential features. First, it has a moral component. Second, it has the aim of creating coherence, morphological coherence in the things which are made with it. And third, it is generative: it allows people to create coherence, morally sound objects, and encourages and enables this process because of its emphasis on the coherence of the created whole.

I don't know whether these features of pattern language have yet been translated into your discipline. Take the moral component, for example. In the architectural

pattern language there is, at root, behind the whole thing, a constant preoccupation with the question, Under what circumstances is the environment good? In architecture that means something. It means something important and vital that goes, ultimately, to the nature of human life. Of course, there are plenty of people who will debate whether the question is objective. Some architects are still going around saying that it is all a matter of opinion. But that is a dying breed. The moral preoccupation with the need for a good environment, and for the living structure of built environment, and the objective nature of that question, is largely accepted. I do not know whether that sort of moral component exists in computer science, or in software engineering, or in the way in which you do things.

I understand that the software patterns, insofar as they refer to objects and programs and so on, can make a program better. That isn't the same thing, because in that sentence 'better' could mean merely technically efficient, not actually 'good.' Again, if I'm translating from my experience, I would ask that the use of pattern language in software has the tendency to make the program or the thing that is being created morally profound – actually has the capacity to play a more significant role in human life. A deeper role in human life. Will it actually make human life better as a result of its injection into a software system? Now, I don't pretend that all the patterns that my colleagues and I wrote down in *A Pattern Language* are like that. Some of them are profound, and some of them are less so. But, at least it was the constant attempt behind our work. That is what we were after. I don't know whether you, ladies and gentlemen, the members of the software community, are also after that. I have no idea. I haven't heard a whole lot about that. So, I have no idea whether the search for something that helps human life is a formal part of what you are searching for. Or are you primarily searching for – what should I call it – good *technical* performance? This seems to me a very, very vital issue.

People have asked me what kind of a process was involved in *creating* the architectural pattern language. One of the things we looked for was a profound impact on human life. We were able to judge patterns, and tried to judge them, according to the extent that when present in the environment we were confident that they really do make people more whole in themselves. Of course you may ask, How in the hell did you test for that? But that is too long a story which I cannot cover in this speech. The important point is that such testing was going on continuously. A second, *almost more important* thing was going on. Whenever we had a language under development we always asked ourselves, To what extent does that language *generate* (hence produce) entities (buildings, rooms, groups of buildings, neighborhoods, etc.) that are whole and coherent? In other words, suppose I write a pattern language for a campus, and, I think I've got some sort of a language that looks as though it will actually do the job. To test it, I let it loose by giving it to people and asking them (in simulated form) to generate different campuses with this language. Let's see what the resulting campuses look like. And we test it ourselves in the same way, by using it to generate designs, rapidly, and only for the purpose of testing the results for their coherence. As it turns out, many of the languages that one creates do not generate coherent designs or objects. That is, they contain a bunch of good ideas. One can use these good ideas to (sort of) put something together from them, and a few fragmentary structural ideas will be present in the result. But that does not yet mean that the campuses created (in the above example) are coherent, well-formed, campuses. We were always looking for the capacity of a pattern language to generate coherence, and that was the most vital

test used, again and again, during the process of creating a language. The language was always seen as a whole. We were looking for the extent to which, as a whole, a pattern language would produce a coherent entity.

Have you done that in software pattern theory? Have you asked whether a particular system of patterns, *taken as a system*, will generate a coherent computer program? If so, I have not yet heard about that. But, the point is, that is what we were looking for all the time. Again, I have no idea to what extent that is true for you and whether you are looking for the same thing when you work on software patterns.

So far, as a lay person trying to read some of the works that have been published by you in this field, it looks to me more as though mainly the pattern concept, for you, is an inspiring format that is a good way of exchanging fragmentary, atomic ideas about programming. Indeed, as I understand it, that part is working very well. But these other two dimensions, (1) the moral capacity to produce a living structure and (2) the generativity of the thing, its capability of producing coherent wholes – I haven't seen very much evidence of those two things in software pattern theory. Are these your shortcomings? Or is it just because I don't know how to read the literature?

So much for my short historical survey of what we have been doing with pattern languages during the last three decades.

The nature of order

The pattern theory was followed by a deeper theory. I began to notice, by the late '70s, some weaknesses in our work with patterns and the pattern languages.

1 Under the circumstances that I was most interested in, when we and others were using these patterns to generate buildings, the buildings generated were okay but not profound. There was often a lot of nice stuff going on in them. People were improving certain features, perhaps the daylight was improved, or perhaps the entrance of a building was improved or the characteristics of a street might be improved or an alcove in a bedroom might make it more intimate or something like this. So, there were various isolated features of buildings that were improvements in building performance. The existence of the patterns also allowed people to have better control over their own environment. It succeeded in embodying that control in the real buildings that they made with the pattern material. That was good. But, nevertheless, were the buildings profound structures? To what extent did they really have coherent living structure as wholes? By the late '70s, I had begun to see many buildings that were being made in the world when the patterns were applied. I was not happy with what I saw. It seemed to me that we had fallen far short of the mark that I had intended. But, I also realized that whatever was going wrong wasn't going to be corrected by writing a few more patterns or making the patterns a little bit better. There seemed to be something more fundamental that was missing from the pattern language. So, I started looking for what that thing was.
2 At about the same time I began to notice a deeper level of structure and a small number (15) of geometric properties that appeared to exist recursively in space whenever buildings had life. These 15 properties seemed to define a more fundamental kind of stuff; similar to the patterns we had defined earlier, but more condensed, more essential – some kind of stuff that all good patterns were made of.

These were simple ideas. I can't take you through all 15 but they are properties like 'boundaries' which will not only delineate but connect the inside to the outside, or 'positive space,' as when you look at a Matisse cutout and see that the space between the colored paper is not amorphous but also has form. Anyway I began to notice that particular individual patterns seemed really to come always from the 15 deep properties that kept occurring again and again.

3. Another thing that was happening around this time (late '70s, early '80s), my colleagues and I began toughening up our ability to discriminate empirically between living structure and not living structure. During the years of doing the pattern language, we'd really been intuitive about that and not very rigorous. We were just trying to get patterns written and learning to apply them without asking rigorously if they made buildings with more life in them. But, at this point (about 1980), we felt it was pretty important to get a fix on the difference between a chair which has a more living structure and a chair that has a less living structure. And the same for a building or a room or for a main street in a town. If you want to say this one has life, this one has less life, how do you say that with any degree of empirical certainty? Can it, in fact, be made a relatively objective matter which people can agree about if they perform the same experiments?

Indeed, we did find such experimental techniques. The use of these techniques greatly sharpened our ability to distinguish what was really going on and what structures then correlated with the presence of life in a bit of the environment. The use of these techniques also helped us to refine the 15 deep geometric properties, as necessary correlates of all life in designed structures. These 15 properties turned out to be a substrate of all patterns, and began showing up more and more clearly in our work as the main correlates of living structure in places, buildings, things, space, and so forth.

A brief side remark: I need to say a word about the existence of objective criteria and experimental methods. In my discipline there are tremendous vested interests. Many architects claim, and want to claim, that in architecture there is no such thing as truth; that is because everyone wants to do their own stupid thing and get away with it. So, depending on who you talk to, they'd say, 'Well, this stuff Alexander's been discovering is a lot of nonsense. There is no such thing as objectivity about life or quality.' But, I am here today, and they are not here, so I'm telling you that there is objectivity. They are simply mistaken. Let's suppose that we've got a sidewalk somewhere on a bit of a street and we've got another sidewalk somewhere else on another bit of a street. We are trying to come to conclusions about which one has more life, which one is a more living structure.

My belief, by the way, when I began trying to find these experimental methods, always was that there really is such a thing, and that actually everybody knows it, but that it has been suppressed. That is because of the world view that we have and the way of looking at things and the nervousness about intellectual rigor . . . that people of our era have. Although they have these judgments within them, somehow they are separated from their ability to make these judgments correctly. This is just some sort of childish instinct that everybody has and knows. But, for some reason, we are so messed up that we can't see it. So these experiments were, in effect, designed to penetrate that end result through.

The essence of the experiments is that you take the two things you are trying to compare and ask, for each one, Is my wholeness increasing in the presence of this object?

How about in the presence of this one? Is it increasing more or less? You might say this is a strange question; What if the answer is 'Don't know' or 'They don't have any effect on me'? Perfectly reasonable! That can happen. But the resolution is easy. What turns out to happen is that if you say to a person 'Yes, it is a difficult question, it might even sound a bit nutty. But anyway, please humor me and just answer the question.' Then it turns out that there is quite a striking statistical agreement, 80–90%, very strong, as strong a level of agreement as one gets in any experiments in social science. All of these different experiments have to do with something like that. Do you feel more whole? Do you feel more alive in the presence of this thing? Do you feel that this one is more of a picture of your own true self than this thing you know whatever? It is always looking at two entities of some kind and comparing them as to which one has more life. It appears to be a rank bit of subjectivity. In other words, it sounds like: 'Well okay, fine; I mean maybe this is the truth about human beings in the sense about our coordination or about our perception or about our feelings.' But that is not necessarily the same as saying living structure as such is a real thing that resides in those objects. But anyway, to cut a long story short, it turns out that these kind of measurements do correlate with real structural features in the thing and with the presence of life in the thing measured by other methods, so that it isn't just some sort of subjective I-groove-to-this, and I-don't-groove-to-that, and so on. But it is a way of measuring a real deep condition in the particular things that are being compared or looked at.

What is odd about this, and in a way as our work went further and further, it kept bringing big functional and practical matters back to the human person. So, in other words, you take a parking lot. There are lots of technical problems in the parking lot. You have got to make it work. Cars have got to be able to move around. You know there are security problems. There are in-and-out problems. There are maintenance problems. As a whole, the way a parking lot works is essentially a technical thing. The question is, Is it working well or not well? And yet the functionality of the thing measured by these various ordinary bits of technical discussion *correlates with the condition* measured by the question, Do I feel myself to be more whole? It works well when you are getting a positive answer to this question. Thus there is a hint of a profound connection between the nature of matter and behavior of material systems, and the human person. Even in engineering design, as for instance where one considers the structural behavior of a bridge. Or the patterns of movement in something where a lot of cars are moving about, and there are complicated questions about how they move and so forth. In these examples very, very practical matters are nevertheless correlated with these apparently personal questions about whether the thing has life and whether it promotes life in me and you.

So there began developing, in my mind, a view of structure which, at the same time that it is objective and is about the behavior of material systems in the world, is somehow at the same time coming home more and more and more, all the time, into the person. The life that is actually in the thing is correlated in some peculiar fashion with the condition of wholeness in ourselves when we are in the presence of that thing. The comparable view, in software design, would tell you that a program which is objectively profound (elegant, efficient, effective, and good as a program) would be the one which generates the most profound feeling of wholeness in an observer who looks at the code.

The important thing is that – in architecture – this is not merely a hunch but a testable empirical result. It means that the objects that are most profound functionally

(when I say objects, I mean buildings, streets, door knobs, shelves, rooms, domes, bridges) are the ones which also promote the greatest feeling in us. This is a very peculiar thing. At first it sounds like rank sentimentality; and you just say, It can't be true. Why should it be true? And yet, it's a discovery which accords very well with the era that we live in. Because we are living in a period where perhaps the most noticeable and most problematic feature of our world is that feeling has been removed from it. When I make a joke in reference to this horrible meeting hall that we are in, maybe I am beating a dead horse, but I mean really, the problem is that whatever feeling there is in here is obviously not a profound positive feeling. And this is what we have come to expect in our modern world. The failure of that profound feeling to exist in the world around us at small scales, large scales, middle scales, here, there, and everywhere, is tragic. It's the thing that we miss. Of course, people have been writing about this for many decades. Writers have, of course, made this known. We all know it. The difficulty is that people don't seem to know what to do about it. If anything, at the moment, (I'm talking now again about my own discipline, of architecture) the problem is getting worse. It's not getting better. The world that is being built is more and more unfeeling. We are in a sense more lost, more fragmented, more sort of wandering about in this lonely desert than before.

If there really is a way of looking at structures which both deals with real functional structure in the ordinary technical and practical sense, and simultaneously has its roots in human feeling, this will be a very huge and positive step. In particular, the 15 properties that I have mentioned provide us the ability to be precise about the nature of living structure, in just precisely such a way that it is connected, not only to all mechanical function, but also to the depths of human feeling. That is why it is an important structure.

At the root of these 15 properties, there appears to be a recursive structure based on repeated appearances of a single type of entity – the primitive element of all wholeness. These entities are what I call 'centers.' All wholeness is built from centers, and centers are recursively defined in terms of other centers. Centers have life, or not, in different degree, according to the degree that the centers are built from other centers using the 15 geometric relationships which I have identified. This scheme, which is at the foundation of all the work in *The Nature of Order*, provides a complete and coherent picture of all living structure.

Stretching a bit, I think there may even be a little bit of a connection between the geometric centers which appear as the building blocks of all life in buildings, and the software entities that you call 'objects.' Centers are field-like structures that appear in some region of space. They don't have sharp boundaries, but they are the focal organizing entities that one perceives at the core of all pattern, all structure, and all wholeness.

Everything is made of these kinds of centers. The centers are more living or less living. And, that's essentially the only important property that they have. And the question of whether a center is more living or less living depends recursively on the amount of livingness in the other centers that it is made of, because each living center is always (and can only be defined as) a structure of other centers. This sort of recursion is familiar in computer science. But whether the structure I have discovered and reported in *The Nature of Order* will translate in any interesting ways to things that you do, I don't know. (It is true, I suppose that all software is made of objects, and nothing but objects. Could it be said that some objects have more life, and others less? If so,

there would be a profound correspondence). What is true, I can tell you from my own experiences in these last years, is that when one has this view of things in architecture, it becomes enormously easier to produce living structure in buildings. It has immediate practical usefulness. If you start understanding everything in terms of these living centers, and you recognize the recursion that makes a center, living as it is, dependent on the other centers that it is made of and the other larger centers in which it is embedded, suddenly you begin to get a view of things which almost by itself starts leading you towards the production of more successful and more living buildings.

This insight goes far beyond the power of the pattern language. Although the patterns define relations which might be regarded as specific instances of the recursive interaction of centers, the overall view of centers gives more comprehensive and more powerful results. It directly affects your ability to make good architecture, in a way that pattern language was not yet able to do by itself. This is a much more powerful and beautiful view than what's embedded in the pattern languages, because when one has constructed this view . . . you say, well, what is a pattern really? Then it turns out that patterns are merely a few of the structural invariants that appear within these centers under very, very particular conditions. So they're certainly interesting and important, but they don't have the same depth or the same universal character as these other structures that I'm speaking about now.

Now we come to the crunch. Once we have the view of wholeness and centers, linked by the 15 deep properties, *we have a general view of the type of whole which must occur as the end product of any successful design process*. And because we have a view of it as a whole, we are now able to understand what kinds of overall process can generate good structure, and which cannot. This is the most significant aspect of *The Nature of Order*, and of the new results I am presenting to you in this Part 2.

It means that we can characterize not merely the structure of things which are well-designed, but we can characterize the path that is capable of leading to a good structure. In effect, we can specify the difference between a good path and a bad path, or between a good process and a bad process.

In terms of software, what this means is that it is possible, in principle, to say what kind of step-by-step process can produce good code, and which ones cannot. Or, more dramatically stated, we can, in principle, specify a type of process which will always generate good code.

Of course we have not actually done this for the production of code. We have done it for design and construction of buildings. But it is possible. This is, if you like, the holy grail of software design – specification of the kinds of process which will (always) generate good, efficient, economical, beautiful, and profound, code.

What are the details? I can tell you in the case of buildings. If one has identified living structure with a reasonable level of objectivity, and if one has identified this recursive center-based structure as being the key to the whole thing, that's all very well. But then of course the practical question arises, How the hell do you produce this living structure? What do you have to do to actually produce it? You can clumsily try to find your way towards it in a particular case. But, in general, what are the rules of its production? The answer is fascinating. It turns out that these living structures can only be produced by an unfolding wholeness. That it, there is a condition in which you have space in a certain state. You operate on it through things that I have come to call 'structure preserving transformations,' maintaining the whole at each step, but gradually introducing differentiations one after the other. And if these transformations are

truly structure-preserving and structure-enhancing, then you will come out at the end with living structure. Just think of an acorn becoming an oak. The end result is very different from the start point but happens in a smooth unfolding way in which each step clearly emanates from the previous one.

Very abstract, I know, but the punchline is the following. That is what happens in all the living structures we think of as nature. When you analyze carefully just what's going on and how things are happening in the natural world, this sort of structure preserving transformation tends to be what's going on most of the time. That is why, when nature is left alone, most of the time living structure is produced. However, in the approaches that we currently have to the creation of the built world and the environment (planning, design, construction, and so forth), that is simply not what is happening. The process of design that we currently recognize as normal is one where the architect or somebody else is sort of moving stuff around, trying to get into some kind of good configuration. Effectively this means searching in an almost random way in configuration space, and never homing in on the good structure. That is why the present-day structure of cities, buildings, conventional halls, and houses are so often lifeless. The processes by which they are generated are – in principle – not life creating or life seeking.

If a process doesn't go in the structure-preserving way that I'm talking about, the result is never living structure.

In effect you can write theorems which say, Under the kind of conditions which occur in the construction industry today, you cannot produce living structure. So, the poor folks who designed and built this convention center were stuck with something lifeless, because they were embedded in the wrong kind of process. There was nothing they could do about it. It was part of the process by which this kind of entity is produced in today's society. As things stand, it cannot come out with a living structure at the end. That is a shattering discovery.

A very large part of my work and that of my colleagues in the last years has been one of trying to define social processes, economic processes, administrative and management processes which are of such a nature that they permit true structure preserving unfolding to occur in society, thus to allow the generation and production of living structure. This is what I do most of the time: I'm trying to do real projects of one sort or another where I'm introducing this unfolding process and trying to make it work under the conditions available to us in 1996. The social and technical shifts involved are large. The shifts in thought, in practice, in administration of money, in contracts, all sorts of real nitty-gritty things that one would much rather not mess with because they are so hard, you must mess with because it is those processes which are undermining the ability for our whole contemporary social process to be structure-preserving unfolding. If life is to be created, these processes must change.

That is the end of my Part 2.

What the future holds in store: the generativity problem and the generation of a living world

Let us now consider a problem of magnitude. There are some two billion buildings in the world, about 2×10^9 buildings. Differently stated, the total amount of built stuff is something on the order of about 10^{12}, 10^{13} square feet of construction. The total amount of built stuff in Manhattan is somewhere on the order of 10^9 square feet. If you

include all the exterior space in the world as well, the part of the outdoors that is somehow having to do with human beings and is part of our immediate world – gardens and streets and agriculture and all of that, in the world – we're somewhere up around 10^{14} square feet of constructed, designed space.

How are we going to deal with all that? How do we create, or generate, living order in 10^{14} square feet of construction? What process could possibly accomplish this within, say, one generation – the next 25 years? The effort of architects, no matter how hard we try and no matter how much good will we put in, does not begin to scratch the surface of that task. All the architects in the world, together, working as they do today, cannot design more than say 10^{10} square feet per year – a tiny, tiny percentage of what is needed – far too small to be effective.

I have, for many years, thought that this could only be solved by a genetic approach – an approach where deep structure, spread through society, creates and generates the right sort of structure, very much as genetic code creates and generates organisms and ecological systems – indirectly, by letting loose life-creating process.

That is what I still believe. But, today, I am convinced that the equivalent of the genes that act in organisms will have to be – or at least can be – software packages, acting in society. If these software packages are life creating, and accepted, and widely enough spread throughout the world, there is a chance we might get a grip on this problem: provided that the software is freeing, liberating, allows each person individual control and decision making power to do the right thing, and to create living structure, locally, wherever they are. This task must fall, inevitably, at least in part, on your shoulders.

The people who were kind enough to invite me to give this speech originally assured me that if I just explained the intellectual history (as I have done so far), there will be those among you who may find it interesting, that somehow they might latch on to it or know how to translate it into something that's more directly relevant to your own concerns. That is, after all just what you have done in the last five years with pattern languages. There clearly is a useful parallelism between our two disciplines.

However, after receiving this invitation, and contemplating the questions I could raise, I started dwelling on a conviction that was growing in me. This conviction led me to feel that there was a deeper coincidence in what you are doing in software design and what I am doing in architectural design. I began to feel that there is a deeper connection, which suggests that the two disciplines might merge in a way that would benefit us both – you in your discipline and me in my discipline. In the next few minutes I will try to sketch the nature of this connection.

As an architect, of course like anybody concerned with these things, I have a passion to try and make these things happen. It's not enough just to say, well, living structure isn't being produced. There is a question I must ask myself, a question I do ask myself, which all the time is: Okay, well, what are we going to do about it? Here we've got this poor Earth sinking under the weight of all this dross. And, what are we actually going to do? I do a $10 million project here and I do a $10 million project there. But that accomplishes virtually nothing. Life is short. A few of those projects . . . and what is it? It is an atom in the proverbial bucket. It's nothing. All of the efforts of the architectural brethren, even if I can persuade them of the truth of these things, is still a drop in the bucket. That by itself, will not affect more than a thousandth part, perhaps no more than a millionth part, of the structure covering the built part of the Earth.

When I started out 25, 30 years ago, I really thought that I would be able to influence the world very fast. Especially when I got to the pattern language. I thought, boy, I've

really done it. This is going to work. No problem. The patterns are self-evident and true. They will spread. And, as a result, the world of buildings will get better. Hey presto.

But it hasn't yet worked out like that. In practical terms, so far, I've done almost nothing. The pattern language, how much has it influenced the environment of the world? A few thousand buildings have been influenced. There are a few people that have lived a few things and been influenced. But, meanwhile, we've still got this gigantic amount of construction out there which is defining the world that all of us live in that is still going on in exactly the same fashion. I believe that the cultural process of influence is simply too slow to be able to take care of this problem. In other words, the process by which one discusses these kinds of things, shares ideas about them, gradually influences the way people are thinking so that gradually larger and larger percentages of bits of the environment might turn into living structure. That is a very slow process, and I don't think it is fast enough to do the job. And yet, as an architect, I view myself as responsible for that. Not of course, alone, but as a professional, my job is to try to understand how we can get hold of that – the entire structure of built environment, all over Earth – and do something about it to make it better.

For several years I have been asking myself how this effort can be expanded, and strengthened. It must be our aim to make the world's environment a living structure, within one or two generations. How, realistically, can that be done?

So, today, I am standing before you, thinking to myself: Right, I'm now talking to people who are in a way the core of the computer revolution. You probably realize, I know you must realize the extent to which the world is gradually now being shaped more and more and more, indirectly, by the efforts of all of you who are sitting in this room – because it is you who control the function of computers and their programs. It is the programs that control the shape of manufacturing, the shape of the transportation industries, construction management, diagnosis in medicine, printing and publishing. You almost can't name a facet of the world which is not already, to some very strong degree, under the influence of the programs that are being written to manage and control those entities or those operations. And this is still in its infancy. How long has this been really going on? Not long. About 10 or 15 years, though of course, the preparation for it goes a lot further back than that. But really this is quite new. It is going to look a whole lot different, even more powerful in its degree of influence.

And yet, as a professional body, I don't think that you are yet fully aware of it. I'm probably speaking out of turn here but, you know, I've thumbed through the proceedings of this conference, for instance. Jim was kind enough to show it to me yesterday. I don't really see discussion about what, collectively, computer scientists are supposed to be doing with all these programs. How are they supposed to help the Earth? And, yet, the capacity to do that is sitting right here in this room. That is an amazing situation. You have so much power . . . . but that means that you also have an enormous responsibility.

Is there a chance you might take on the responsibility for influencing, shaping, and changing the environment? Interestingly, I think many of you do also have the *inclination*. When I had the pleasure of beginning to meet some of the various folks who introduced themselves to me over the last year and a half from the software community, I began to be fascinated by the number of them that were closet architects. Greg Bryant, who worked on the 486 chip, is really interested in ecology and is an editor of *Rain*, an ecological magazine. Bill Joy is writing about workstations in the concrete physical sense that is familiar as an architect. John Gage, chief scientific officer of

Sun, is interested in neighborhood schools, and in the process by which people can repair their own physical neighborhoods by working together. Jim Coplien is dealing with social structures in human organizations. Mark Sewell from IBM wants to build houses. Dick Gabriel has, as his deepest passion, the writing of poetry: another kind of art. I don't have a long enough list. But my hunch is that an amazing number of you who got into this pattern game in the pursuit of your normal professional endeavors are also very profoundly interested in the real physical world, and its shape and its design, its deep feeling, its impact on human life. That is, the world in which we inhabit. It is therefore conceivable that you, collectively, could change the very drastic situation of a destroyed environment that I described earlier.

Let me just go back to the structure-preserving unfolding process that I described in Part 2 of this talk. I talked about this structure-preserving unfolding process.

When I first constructed the pattern language, it was based on certain generative schemes that exist in traditional cultures. These generative schemes are sets of instructions which, carried out sequentially, will allow a person or a group of people to create a coherent artifact, beautifully and simply. The number of steps vary: there may be as few as half a dozen steps, or as many as 20 or 50. When the generative scheme is carried out, the results are always different, because the generative scheme always generates structure that starts with the existing context, and creates things which relate directly and specifically to that context. Thus the beautiful organic variety which was commonplace in traditional society could exist because these generative schemes were used by thousands of different people, and allowed people to create houses, or rooms, or windows, unique to their circumstances.

When I first hit on the idea of creating, and using, pattern languages, I was inspired by these traditional generative schemes, and thought that I was essentially copying them. However, in the huge effort of creating a believable, new pattern language, in the 1960's the effort went entirely onto the individual patterns (their formulation, verification, etc.), and the idea that they were to be used sequentially, one after the other, dropped into the background. In fact, both *A Pattern Language* and *The Timeless Way of Building* say that the pattern language is to be used sequentially. In practice, however, this feature dropped out of sight, and was not emphasized in use. As a result, the beautiful efficacy of traditional languages and their simple and beautiful sequential nature disappeared from view.

In our most recent work, that has changed. We are now focusing on pattern languages which are truly *generative*. That means, they are sequences of instructions which allow a person to make a complete, coherent building, by following the steps of the generative scheme. We have done this for houses, for public buildings, for office furniture layout, and so forth. It works. And it is powerful.

Compared to the pattern language that you've seen in *A Pattern Language*, these generative schemes are much more like what you call code. They are generative processes which are defined by sets of instructions that produce or generate designs. They are, in fact, systems of instructions which allow unfolding to occur in space in just the way that I was talking about a minute ago (Part 2), and are therefore more capable of producing living structure. The published pattern language by comparison is static. The new generative languages are dynamic and, like software, interact with context, to allow people to generate an infinite variety of possible results – but, in this case, with a built-in guarantee of well-formed results. The design that is created or generated is guaranteed, ahead of time, to be coherent, useful, and to have living structure.

You know the pattern language (the one for architecture) consists of these objects which are interesting and which you somehow try to put together. But it's possible to have processes or procedures which will go much further, actually generate living structure. Because of the complexity of the situation in the world, and because of the way software is going, software that is designed to do this could very rapidly take the world by storm.

Why would computer scientists and software engineers suddenly become responsible for the form and structure of the built environment? Is that not the province of architects, planners, agricultural experts, forestry people, and civil engineers? It ought to be. But the members of these professions are not taking responsibility for the generative approach to living structure – and so cannot produce it. And, as far as I can see, they do not see it coming, and are not preparing themselves to take it on, mentally or professionally. Therefore it will fall to someone else to do it instead.

In history, this kind of unexpected switch is a common thing. When a paradigm change occurs, in a discipline, it is not always the members of the old profession who take it to the next stage. In the history of the development in technical change, very often the people responsible for a certain specialty are then followed by a technical innovation. And then the people who become responsible for the field after the technical innovation are a completely different group of people. When the automobile came along, the people who built the buggies for the horse and buggy did not then turn into Henry Ford. Henry Ford knew nothing about horse buggies. The people who were building automobiles came from left field, and then took over – and the horse and buggy died off.

It is conceivable to imagine a future in which this problem of generating the living structure in the world is something that you – computer scientists – might explicitly recognize as part of your responsibility. Such a change, representing a kind of a level of marriage between you and me, is of an entirely different sort from the one that I was invited by Jim Coplien to contemplate. I was brought here to answer the question 'Okay Chris, what new things have you been doing that might spin off and be useful to us in our neck of the woods?' Parts 1 and 2 of this talk were about that. But this Part 3 is about something quite different. I want you to help me. I want you to realize that that problem of generating living structure is not being handled well by architectural planners or developers or construction people now, and the Earth is suffering because of it. I believe there may be no way that they are ever going to actually be able to do it, because the methods they use are not capable of it. For you it is different. The idea of generative process is natural to you. It forms the core of the computer science field. The methods that you have at your fingertips and deal with every day in the normal course of software design are perfectly designed to do this. So, if only you have the interest, you do have the capacity and you do have the means.

I heard a rumor at breakfast that some of the people in this room have begun to worry about their jobs. I have no idea if that is true. But I was told there is an undercurrent of unease as to where all this – software design – is going. There is a huge expanding phenomenon of programming as an art, and yet an uneasiness about where it is all headed. What is it going to do?

My comment on this? Please forgive me, I'm going to be very direct and blunt for a horrible second. It could be thought that the technical way in which you currently look at programming is almost as if you were willing to be 'guns for hire.' In other words,

you are the technicians. You know how to make the programs work. 'Tell us what to do, Daddy, and we'll do it.' That is the worm in the apple.

What I am proposing here is something a little bit different from that. It is a view of programming as the natural, genetic infrastructure of a living world which *you/we* are capable of creating, managing, making available, and which could then have the result that a living structure in our towns, houses, work places, cities, becomes an attainable thing. That would be remarkable. It would turn the world around, and make living structure the norm once again, throughout society, and make the world worth living in again.

This is an extraordinary vision of the future, in which computers play a fundamental role in making the world – and above all the built structure of the world – alive, humane, ecologically profound, and with a deep living structure. I realize that you may be surprised by my conclusion. This is not what I am, technically, supposed to have been talking about to you. Or you may say, 'Well, great idea, but we're not interested.' I hope that is not your reaction. I hope that all of you, as members of a great profession of the future, will decide to help me, and to help yourselves, by taking part in this enormous worldwide effort. I do think you are capable of it. And I do not think any other professional body has quite the ability, or the natural opportunity for influence, to do this job as it must be done.

I've enjoyed talking to you very much. Thank you for listening to me, and I would be most keen to listen to your ideas on these topics.

14 Reply to William Saunders, 2002

This is a reply to William Saunders' review of The Nature of Order *in* Architectural Record[1]. *CA used his reply to make the case that his work represents a scientific approach to the question of value in architecture: "This is real science, in which empirical questions are being investigated, and, in spite of their inherent difficulty, the investigations are beginning to show sharable, empirical, results, which might, within a decade or two, begin to have profound effect on our society."*

http//www.natureoforder.com/library/reply-to-Saunders.htm, 2016. Republished by permission of Architectural Record.

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The Nature of Order: Some sober reflections on the nature of architecture in our time

Foreword

I have written the following article in reply to a Commentary, written by William Saunders, and published by *Architectural Record* in the May issue 2002.[1] The commentary took the form of a two-part book review, the first part dealing with a Pattern Language (a condensed version of a long review that appeared in the Harvard Design Magazine, Spring 2002) and the second part presented as if it were a review of THE PHENOMENON OF LIFE, Book 1 of THE NATURE OF ORDER.[2] However, the actual form of this second part was that of a personal attack. It was plainly intended to bring the book down not by argument, but by damage to my personal and professional reputation. The commentary gives little factual indication that Mr. Saunders has read THE PHENOMENON OF LIFE. Certainly he did not explain or summarize the arguments the book contains, nor did he offer any rebuttals to these arguments.

It is unusual for a book-reviewer to avoid talking about the contents of the book which he reviews. It suggests, to my mind, that the author either did his work very rapidly, and did not have time to examine the book carefully, or that he felt that *The Phenomenon of Life* contains material so damaging to the present way of thinking

1 William Saunders, review of *The Nature of Order, Book One*. *Architectural Record* 190 no. 5 (2002), p. 95.

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about architecture, that it had to be destroyed, rather than reasoned through, so as to prevent architects from reading the book at all.

If indeed that is the case, then this attempt to hide the faults of the present profession of architecture through bluster, is of interest, because it suggests how isolated the profession is from recent developments in the sciences. The book reviewed presents a proposal, ideas, and scientific evidence which, if taken together, could have enormous implications for the practice of architecture, and will, once taken seriously, inevitably change the nature of architecture in society.

An objective criterion of architectural value

The Phenomenon of Life describes an entirely new, scientific, criterion of architectural value. It is based on twenty-seven years of carefully recorded observation.

The basic proposal made in the book is that degree of life is an objective and observable characteristic of buildings and other artifacts, that it depends on the presence or absence of an identifiable structure which may be called living structure: and *that it is the presence or absence of this structure which distinguishes valuable buildings from less valuable, good architecture from bad*.

And this is real science, not phony social science, not work that only apes the forms of scientific investigation with manner, wording, and presentation. This is real science, in which empirical questions are being investigated, and, in spite of their inherent difficulty, the investigations are beginning to show sharable, empirical results, which might, within a decade or two, begin to have profound effect on our society. And it is work which has massive implications for all the most basic questions of architectural design and planning.

I have written this book because of my wish to help set architecture on a firm foundation: and because of my conviction that these questions lie, inescapably, at the core of the work all of us architects do every day.

It is presented with arguments regarding the scientific difficulty of dealing with this topic. It is presented with hundreds of examples. It is presented with a background mathematical theory, which has been applied to architectural examples from buildings through history.

It is written in simple language, with careful evolution of ideas, from foundations and first principles, to concrete results, experimental technique, comparison with other comparable methods used in architecture.

None of this is described, analyzed, mentioned, or even vaguely hinted at in Mr. Saunders's review.

There are no facts put forward to refute the theory presented, in spite of the fact that the book contains hundreds of pages of examples, facts, observations appear in the book, and in spite of the fact that the topic is germane to the interests of every architect.

After all, if there is indeed a scientific criterion, which might be used to distinguish living structure from non-living structure, and well enough formulated so it could be applied to architecture, this would be momentous for the architectural profession – and for society in general – since it would potentially show the beginnings of a way forward from our present widely recognized difficulty of building good environments. So why did this writer not describe what the book really contains.

Did Mr. Saunders avoid frank discussion of what the book contains, perhaps, simply because an awful [truth] is visible in *The Phenomenon of Life*, namely: that the criteria for living structure, if applied to current stylish architectural productions of our era, will in very many cases arrive at negative evaluations. Such a view, for the first time throwing objective doubt on the high priesthood of architecture, would be consistent with opinions held by many ordinary people who do not like the image-fed high architecture presently supported. The possibility exists, therefore, that if this book were to be taken seriously, either by architects, or by society at large, then the bubble of late 20th-century architecture, and its effort to scam the public, might, suddenly, be on the verge of being pricked.

There is an additional reason for wondering what Mr. Saunders was really attempting in his review. It is extremely odd that Mr. Saunders hides the central concept of living structure, central to the book and to the thesis of the book, and never once mentions it in his review. I say it is odd because in an article on architectural value, written in 1999, Mr. Saunders explicitly mentions the theory of living structure (he calls it the theory of maximum aliveness) which he ascribes to "John Dewey, D. H. Lawrence, Christopher Alexander and F. R. Leavis) (page 4), in these words: . . . and then goes on to say . . . "an architecture of maximum aliveness . . . is likely to satisfy several (if not most) evaluative criteria at once, or to satisfy one or two criteria to an extraordinary degree . . .. "[3]

Since he plainly understands the idea and has previously expressed the view, in print, that this is one of the more important criteria for architectural value, it becomes unclear why he would write a review ignoring the 350 pages devoted to sober discussion of this topic, and to the scientific problems inherent in it. It is also not clear why he would write in such a way as to obfuscate the central empirical questions.

The lack of a shared canon of value

Possibly the most dangerous weakness in the architectural profession today, is the failure of the profession to have a legitimate, shared, canon of value, one which resides in the deep feelings of ordinary people, and which resonates with their experience . . . or to grasp publicly experienced judgments of value as issues of fact, or to respect the values which "ordinary" members of the public have. Instead, the profession has erred, in the past, by looking down on the public, by holding up a highly idiosyncratic and specialized view of value, carried by "the few", viewing the common man as ignorant, and treating architects as people who believe they have the right and authority and political power, to keep on ignoring public opinion about architectural values, and pushing their own special brand of postmodern image architecture, that is largely out of touch with every man and every woman.

It must be said fairly, that Mr. Saunders does speak for that postmodern, disemboweled majority of the architectural profession, who have given up knowledge that there is truth about anything in architecture, in favor of the notion that there are merely attitudes, opinions and disguises, and that each person's disguise or point of view is equally valuable. This unhealthy position, inevitable under the impetus of Cartesian thought, is what dug the grave for architecture during the last fifty years. Yet those who espouse it, are wrapped in the necessity of this belief, because it is a necessary belief to bolster and rescue the absurdity of their positions. So any line of thought which actually suggests that feeling, quality, are objective, must be anathema – because to admit

the objectivity of these matters, would lay bare the poverty of their conceptions, and expose the whole profession and its activities, in the 20th century, as a hollow sham.

What, then, is the actual content of Book 1, THE PHENOMENON OF LIFE, which Saunders has failed to describe, or to address, preferring to dismiss it, facetiously, with vague waffle? The thesis is straightforward. It says that the positivistic separation of fact from value, and the notion that only facts can be objective while judgments of value can only be personal matters of opinion, is flawed, *and that there is a scheme of things, in which judgments of value may be examined empirically*: and that when so examined, the feelings of ordinary people, about value, when made in a certain special way, provide a plenum of judgment which is stable, and reliable, from person to person, and – by the way – conspicuously different in content from the notions of value which are prevalent among leading architects today.

There is a second part of this thesis: namely, that the value which is identified by these empirical methods, is generated by an identifiable, repeated structure that may be identified mathematically, and seen, repeatedly, in all naturally occurring structure, and especially in those structures which are commonly held to have life. By comparison with this class of structures, the structures put forward by architects of recent decades, are often lacking in life, and rather belong to a class of structures which must be considered dead.

The key issue, of course, is that both the original thesis itself, and the secondary observation, just mentioned, are supported by a wealth of empirical evidence, according to experiments which can be reported, and checked easily. The experimental procedures involved are unusual, but there are, nevertheless, sharable, and repeatable experiments. It should be said at once that the experiments are not opinion surveys, but rather experiments which use subjective judgments of a very special controlled sort, to obtain measures of life in things, events, and situations.

Thus the whole scheme of things, in which value takes on a new form, and in which judgments of value about buildings, can be checked and discussed in reasonable language, has experimental standing, and would have – if found reliable – enormous impact on the present and future conduct of architecture.

This thesis, momentous if true, and especially momentous for architecture, is clearly stated, and clearly argued in this first book of THE NATURE OF ORDER. It is not summarized, or discussed, in any form, by Mr. Saunders.

The concept of wholeness

Scientifically speaking, what is the origin of living structure? Where does it come from? And how may it be defined, to be accessible to discussion, experiment, debate.

The core of it resides in the idea of wholeness. In the last two decades, physicists and other scientists and philosophers of science have begun to discover that a wholeness-based view of the world is essential to proper understanding of the purely physical universe. A view of wholeness as an existing, guiding structure is essential in quantum physics; essential in biology; essential in ecology; in one form or another, essential in almost every branch of modern science. Yet even in these rather precise fields, it has been difficult to forge a scientifically precise concept of wholeness. The idea places demands on science which stretch the very notions of scientific inquiry, since they require a view in which value, and the notion of the whole, and the inclusion of the observer in the description of what is observed, seem to be at odds with scientific method; yet must be included in order to reach results.

For scientists, it has therefore become necessary to find new methods of inquiry and observation, in which the whole, the self, feeling, and value, play a role within the very act of observation – yet – if it is to be part of science – these inclusions must leave science objective, unbroken, and reliable.

The conception, experimental techniques, and even the way to modify our essentially Cartesian view, so that it can admit self, "I", and feeling – are extraordinarily difficult. Yet they are necessary for the progress of science.

They are necessary, too, for the progress of architecture. This subject is of the greatest importance to architects and to architecture as a discipline – since every time we build a building, it is the degree of participation in the greater wholeness of the world around it, which will determine its success, harmony, and degree of life.

Why is this so important for architecture? The harmony of a given road or building with its landscape can only be understood, and made profound, if we have a picture of the wholeness that is being harmoniously adapted. The adaptation of the light and movement in a building lobby can only be understood if, once again, we have a picture of the structure of the whole which is supporting the adaptation. A window in a wall – it's well placed, well sized, well designed, according to its harmony within the whole – and to do it well, we need to understand the whole. I remember Peter Eisenman telling me that he was not interested in harmony! Because the world is so tormented, he wants to express the torment. Well, bully for Mr. Eisenman. Not so bully for the unfortunates who have to inhabit his buildings.

Yet, important as it is, for some odd reason architects have been among the last to wake up to the world-wide intellectual and cultural movement in the sciences which seeks understanding of the concept of wholeness and the whole – and have been, and still are, extraordinarily hostile to this conception.

I well remember how my faculty colleagues at Berkeley reacted with intense hostility, when twenty-five years ago I first began speaking about wholeness as a necessary basis for architecture at faculty meetings. The very word "wholeness" incensed some of them and made them furious, maddened, as though it was a personal attack on them. And, sadly, it did not stop at that. In 1989 our chair, Howard Friedman, dared to propose that wholeness should, as a subject of study, be included in the Berkeley architectural curriculum. At the next faculty meeting, he was subjected to a vitriolic personal assault made against him by one of our faculty. As a result of the intensity of this verbal assault, the faculty meeting broke up. But before the faculty had even left the room, within the next few minutes Howard Friedman had a fatal heart attack. He was taken to hospital and died shortly afterwards.

Such a tragic event will not make the subject of wholeness and value go away. It merely indicates how much antagonism the concept can generate, possibly because it threatens to go deep into the fabric of present day practice and assumptions. It is painful to face the fact that Mr. Saunders's attack on my book which deals with the same subject, has a similarly irrational attack-dog quality.

The reviewer was asked to review a serious book which makes a start, trying to express, in scientific language, the foundations of a new view of wholeness which might, if successful, bring help and new perspective to architecture. But instead of giving sober reflection to the intensely difficult scientific and architectural problems (many of which are described in the book), he chose merely to try and destroy the *author* instead of the *arguments* (which he did not present). Perhaps he hopes that this strategy will make the topic disappear altogether.

But the topic remains momentous.

A vision of architecture as a discipline which heals the world

The essence of the situation is an entirely different way of looking at architecture, in which every action, small or middle-sized or large, is governed by one all-embracing rule: "*Whatever is done must always be done in such a way as to provide maximum possible healing of the whole: the land, the people, the existing structure of the city.*"

This rule is then to be applied when a window is placed in a wall; it is applied when a building is placed on a street; it is applied when a neighborhood is constructed or reconstructed in a city. In every case, what is paramount is the healing of the whole, the living wholeness of the earth, in that quarter, and the love and dedication which sustains it and preserves it and extends it.

This is entirely – totally – different from the present conception in which each thing done lives largely for itself: in which development, stylishness, and profit, are the guiding motives.

It is a new conception in which a new triad (Wholeness – Healing – Structure-preserving transformations) governs and replaces the old triad (Style – Profit – Advertising and Marketing advantages obtained through design), which governs all classical postmodern architecture of the mainstream today.

These are two different worlds: and no matter how much talk there may be, today, about ecology it is the second of these triads which ruled the architecture of the second half of the 20th century, in the 2% of the world where architect-designed buildings play a role.

The Earth, the city, the metropolis, may be shaped instead by a process focused on life, and on the healing of the Earth's surface, in metropolitan areas, and in nature, to work towards a living structure. In that case, the geometry, the design, the construction processes, will all be different – and what we now think of as architecture, will be given up in favor of a new vision, which is aimed primarily at the good of the Earth, and at its people, and the places, and animals, and stones of earth.[4] Great changes coming in the discipline of architecture: the idea of healing

Mechanistic philosophy and the present arbitrary views of value that hold sway in architecture today are intimately connected.

First, the developer's ideal of profit, and the profit oriented approach to architecture, building, and planning, inevitably work against wholeness, and against the healing of the earth. That is because the goals of value that can be stated within concepts of mechanism, are inherently unable to increase wholeness, or to heal systems.

Second, the very idea of healing, presupposes that we know what it <u>means</u> to heal, what health is, what, therefore, wholeness is. Still more vital, when thinking and speaking in the framework of a mental world governed by mechanism, any thought of value becomes an arbitrary, value impressed on the logic of the machine, external to it, and arbitrary therefore, in every respect that can be entertained or thought within the mechanistic world.

So, our values in architecture during the last fifty years, have been arbitrary, because they have been invented arbitrarily. They are protected by professionals only because they serve the goal of capital-induced development – the postmodern architect's bread and butter. So the values which have been created – the postmodern images – like all other passing styles and images – work for capital, for profit, for development, but against wholeness, against health, against the well-being of the earth.

That is the literary and artistic heritage now being taught in schools of architecture, and now propagated through architects buildings that serve the process of capital induced development.

This heritage does not serve wholeness. It does not serve the whole. It does not help to heal the world, or to rebuild Earth as a place where bees, people, breezes, stones, and lizards can run free . . . nor the starlings, spiders, urban foxes, water, businesses, restaurants, and taxicabs that populate the city.

I have spent my life, trying to find a sharable, rational, scientific model which brings this topic of life, wholeness, and harmony, into the open – especially as it touches the geometry of buildings, so that it allows us to share discussion and observation of its effects.

It is in our power to take an alternative path, one in which every single act of building, design, ornament, economic improvement – is always done in such a way as to be part of the healing of the Earth. This is possible even in the high-density metropolis, since there, too, we are capable of making nature.

But we cannot achieve this, or even move in this direction, without a respect for wholeness, made clear as a concept, and formulated so that it transcends all our current pretensions, concepts, and short term ideals.

The future lies with profound understanding of wholeness as a concept, and as a basis for practice. Turning away from it is more than just short-sighted. It would be a tragedy for architects to inflict further damage on the troubled Earth.

Going the other way, in search of a viable, scientific view of life, which can become a basis for our architectural practice, is more moral than what we do now, more just, more beautiful. It goes more to the service of life. And all those who practice such a revised form of architecture, will probably feel more wholesome in themselves.

When the life of the environment plays such a fundamental role in the well-being of the Earth, and when science itself is struggling to understand the nature of wholeness in the majority of new scientific fields, it would be a great pity if a philistine attack on necessarily preliminary efforts to make progress in this direction, were to keep architecture as the last of the philosophical dinosaurs from the mechanistic age.

What, then, are the implications of wholeness based architecture on our prevailing architectural values

The theory is so rich in detail, that we may draw extraordinary consequences from it. These are presented in volumes 2, 3 and 4 – not yet reviewed by Mr. Saunders or by the AIA. These consequences from theory have implications for the processes which a successful architecture must use, to reach buildings which have life.[5]

They have implications which dictate some, and eliminate other, relationships between design and construction, as a necessary part of architecture.[6]

It has implications for the involvement of people, in the design of buildings, and for the detailed ways in which this involvement is likely to be successful, or unsuccessful.

It has implications for the flow of money. It has implications for the handling of architectural detail, and for the successful integration of structural engineering, into the framework of design.

It has enormous implications, too, for the unholy alliance between architects and developers: an unholy alliance, possibly the darkest secret in the history of modern architecture, and one which has made architects little more than salesmen, writing advertisements several hundred feet high, claiming to be art, yet actually designed mainly as sign language to stimulate the flow of money into the developer's pocket.

It affects virtually every part of the profession we now know as architecture, and it indicates necessity for change, in almost all of them.

There is no question, that under the impact of this theory, architecture will be deeply changed: and it will be changed, for the better.

A note on science

It may be worth concluding with a short statement about what science is, and what it is not.

You are doing science, when you figure out how something works. Especially, if you figure out how something works, that people have not figured out before. You don't need to dress it up, you just need to work it out.

All the rest is dressing. Pompous language, format of summary and text and findings, footnotes, erudite references, carefully marshaled precedents . . . all those are the trappings of science, the appearance of science, not science itself. Too often the trappings and appearance are presented making something seem like science: but it is rare that someone actually figures out how something works.

The material in *The Phenomenon of Life*, and the material in *A Pattern Language* 25 years earlier, are both science. In both cases, partial workable answers have been given to questions about the way the structure of the environment affects people. In both cases we did, to a first approximation, genuinely figure how this works. It would have been possible, in both cases, to dress up the actual discoveries in fancy dress: but it would not have changed the actual discoveries very much.

For example, it would have been possible to dress the 253 patterns in a pattern language, as anthropology – thus giving them the dressing of science, references, language and so on. It might have helped create an illusion of science. But it would not have changed the fact that we did genuinely work out, in part, how the environment supports human life in society. Of course not all 253 patterns are equally profound: but in nearly all of them something has been figured out about how the world works, and we knew more about it after the work was done than we did before. And because it is published in an available form, we know it for always – or until someone else goes further, and finds out more exactly, or more deeply, how those things work.

In *The Phenomenon of Life* other, deeper, discoveries are presented. They would not be made more significant by anthropological dressing, or psychological dressing. They stand by themselves, and the reader can see that, easily, by studying the text. There will be time for scientific fancy dress later, when the hard work of going into more detail, and doing more careful experiments, really begins. But the really hard work has been done. It is a pity that Mr. Saunders couldn't see it.

The slighting references to "bad science" which appear in Mr. Saunders's article, only betray a rather undergraduate notion of what science is, and how it is done.

The Phenomenon of Life defines criteria for life in buildings, and replicable tests for deciding how much living structure exists in different buildings. Of course the appearance of a real test of value in architecture may give the sweats to the profession; but if the profession is worth its salt, and they fear the concept, they can disprove the argument rather than failing to see the point. This is an invitation for adult debate.

Notes

1 Christopher Alexander, *The Nature of Order*, Book 1: The Phenomenon of life, CES Publications, 2003.
2 William S. Saunders, "From Taste to Judgment" *Harvard Design Magazine*, Winter–Spring, 1999, number 7.
3 William S. Saunders, "A Pattern Language: Reviewed" *Harvard Design Magazine*, Winter–Spring, 2002, number 16.
4 Christopher Alexander, *The Nature of Order*, Book 2: The Process of Creating Life, CES Publications, 2003.
5 Christopher Alexander, *The Nature of Order*, Book 3: A Vision of a Living World, CES Publications, 2003.
6 Christopher Alexander, *The Nature of Order*, Book 4: The Luminous Ground, CES Publications, 2003.

15 Our new architecture and the many world cultures, 2002

This letter to subscribers of the TradArch blog, argues that the classical buildings of Greece and Rome represent only a part of the valuable artistic and building traditions of the world, that also include "the paintings of aborigines in Australia, and the starry friezes of Islamic buildings, and the beasts of Persepolis, and the long houses of Borneo, and the mud houses of the Cameroon." Like some other works here, this has particular resonance today, not only for broadening our understandings of architecture, but also in our efforts to create a more just and diverse society.

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An open letter to classicist and traditional architects

My dear colleagues,

In the last few weeks I have been reading many contributions to the TradArch listserv. I have not said anything, up until now, because I have simply been enjoying the community, the joy expressed in ancient things, and ancient wisdom, the renewal of the right to be careful with buildings and to take pains with details of buildings. Above all, I have enjoyed seeing the way many of you talk to each other, respect each other, and try, genuinely, to talk.

However, I have been genuinely puzzled by one thing enough for me to want to speak about it or at least mention it. So here are my thoughts.

Some of you take seriously the idea of classicism (not merely classicism in the sense of something "classic" – a different use of the word – but in the sense that is anchored in the architecture of ancient Greece and Rome, the Florentine renaissance, and the English and European styles from the 17th to the 19th century, that specifically used these details: egg and dart, Doric columns, Palladian windows, and so on) as a model for our building activities in the 21st century.

This became clear in recent TradArch discussions about classicism versus gothic, whether gothic could be admitted to "the canon," and the idea that Byzantine, anyway, could not.

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The point of paying serious attention to traditional architecture is something very much larger, is it not? All traditional architecture – that is, almost all the architecture built in Indonesia, Japan, Russia, Africa, Turkey, Iran, India, China – this dazzling wealth of forms, representing building, and art, and design for several millennia, is our heritage; and it is important because, regardless of its particular style, nearly all these buildings exemplify, in one way or another, a deeper thing: the presence of living structure. It is this living quality which inspires us, and which we, rightfully, must consider as our heritage and our great teacher. It is great, and it is a great teacher, because it shows us the existence of a fund of living architecture and asks us and inspires us to emulate that fund, in our own way, and to become part of it with our own buildings, in our own time.

The problem with the production of the last 80 years is that much of it has turned its back on this heritage, often deliberately, and has therefore been on a deliberate course to substitute empty imagery for living structure in a way that harms us all, and harms all humankind.

That it seems to me is our common point, what we hold in common.

If we hold too narrowly to the pure historical classicist forms, we run a very severe danger that this could be perceived as an elitist game, not relevant to seven eighths of the people on Earth, and possibly colonialist in its meaning if not its intent. Yes, we might say that the classical forms of building, from a tiny sliver of culture in space and time, were exported, for example to Peru and Colombia. That is just the same as the export of the Spanish language, or the English language, which had both good and bad effects. I know you do not mean to export the production of 18th century England and France as a new kind of elitism. But it can be perceived this way.

The same will be true if we try to export Doric columns to Nigeria, or Queen-Anne window shapes to Uttar Pradesh.

Certainly, contemporary architecture represents economic colonialism at its worst; it exports monstrous towers and glass façades that erase local traditional culture the world over, whereas classicists fundamentally respect human values in both the scale of buildings, and in the way they interact with people. It is also true that the third world or, at least its governments and the ruling power elite, love to replace their timeless architecture by the latest avant-garde absurdities. Sensitive classicism has offered an alternative to this madness.

The issue is, it seems to me, that we must renew our attention to forms that have life, and like nature, originate from life and joyfully celebrate life. This must be focused, above all, on the forms that we ourselves make from our contemporary technology. But it does have a great deal to do with what we view as proper models. We must eschew forms that fly in the face of the search for life (90% of the current modern canon); and we must try to learn how the shapes of living structure can come to our work, and to our hands, of their own accord. It is that deeper structure we must understand, celebrate, and search for in our projects so that ultimately we may learn how to construct a living world again, as people did centuries ago without even trying because it was so obvious to them.

But that is a very different activity from copying the shapes of classicism, in a literal sense. I understand that classicism has a well-defined set of rules, which can be learnt and applied, whereas the corpus of other traditional architectures has either been lost, or totally neglected in our times. In an emergency situation, the times of total architectural and social nihilism that we live in, it is possibly better to build classically than to follow the glossy architectural magazines and what is taught in architectural schools nowadays. It is now time to expand our scope, however.

I deeply love and understand the beauties of the classical tradition. I learnt Latin and Greek when I was eight years old, and was nurtured in the classic European tradition in England and Austria. My parents were both classical archeologists, and I grew up with respect for all these things. But I learnt anthropology, too, and have lived all over the world, and I have joy in the paintings of aborigines in Australia, and in the starry friezes of Islamic buildings, and in the beasts of Persepolis, and the long houses of Borneo, and the mud houses of the Cameroon.

We, as the architects of the new millennium, need to broaden our scope. Otherwise the fire that exists among the people who write to this listserv might be extinguished, because other people (at least 5 billion of the six billion on Earth) in the larger parts of the world will pay no attention, and might resent what is implied.

That would be a tragic misunderstanding. Of course, what classicists believe in is not meant to be slighting. It is meant to celebrate the reality of living structure as it has been observed, and loved, by many of us. It is that living structure, and the deep nature of what it is, and how it must be produced, that is what ought to guide us and lead us on.

It would perhaps be helpful for us to spend a little more time discussing the rules of deep structure which create life in buildings in general.

This is positive in intent, and will hugely broaden our base.

16 Harmony-seeking computations, 2005

This draft paper is notable for the specificity of analysis of emerging wholes in various complex systems found in nature as well as in human artifice, and for the relationships explained between those non-architectural examples and buildings, including some designed by CA and colleagues. Although some illustrations could not be included, the text has been only lightly edited and shortened for this book. (In the text, footnotes are used to provide captions for illustrations that appear in the original but were omitted in this book, and numbers in brackets refer to references that are cited at the end of the chapter in both the original and this reprint.)

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Harmony-seeking computations: a science of non-classical dynamics based on the progressive evolution of the larger whole

In this paper, I am laying out a proposal for a new form of computation, which focuses on the harmony reached in a system. This kind of computation resembles certain recent results in chaos theory and complexity theory. However, the orientation of harmony-seeking computation is towards finding harmonious configurations. It helps to create things, above all, in real world situations: buildings, towns, agriculture, and ecology.

This way of thinking about computation, though mathematical at base, is closer to intuition and artistic feeling than the processes we typically describe as "computations". It is also useful, potentially, in a great variety of tasks we face in building and taking care of the surface of the Earth, and quite different in character since it is value-oriented, not value-free. It has everything to do with beauty. The harmony that is sought in these computations is indeed what we otherwise call "beauty". But the result of harmony-seeking computations are not merely pretty or artistic. In most cases, they are also functionally and technically better than their inharmonious counterparts.

Harmony-seeking examples are taken from farming, art, architecture, embryology, physics, astrophysics, drawing, crystallography, meteorology, dynamics of living systems, and ecology.

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1. Background

1.1. Overview

The scientific importance of harmony-seeking computations arises in three ways.

First, there are a number of natural phenomena, especially those occurring in complex systems, that are approximated by present-day explanations, but which have annoying mismatches with reality. In a few cases that I describe in this paper, for example *Acetabularia* (§ 5.3), cosmology of large-scale structure in the universe (§ 5.7), group formations in bird flight (§ 7.2), cloud formations (§ 7.3), simulation of tree growth (§ 7.4), and snow crystal formation (§ 8.3), there is a possibility that the discipline of harmony-seeking computation can contribute something to solving puzzles and unanswered questions.

Second, there are cases where the conscious use of harmony-seeking computations strongly improves on current practice of design, planning, and ecology, in fields where it is our business to make beautiful and harmonious structures, but where, too often, contemporary architects and planners using current techniques fail to do this, for example, wind turbines (negative, § 5.2), Tokyo apartment building (positive and negative, § 5.4), Boston housing (positive, § 10.1), drawing by Nakano (positive, § 5.5), tree bole seat (positive, § 3.4).

Third, there are other cases where study of traditional building processes, and the structures they generate, give insight into the nature of the harmony-seeking computations themselves, for example, St Mark's Square (§ 5.6), hayricks (§ 5.1), the Parthenon (§ 8.2).

This paper extends results first presented in the four-volume work *The Nature of Order* (*NOO*) [1–4]. The results that underpin this paper are the following. There is a structure, visible in any given part of the world, which we may call *the wholeness*. The wholeness is an abstract mathematical structure, existing in space. It captures what we may loosely consider as the global structural character of a given configuration, in itself and in relation to the world around it. The wholeness is a structure that exists at many levels of scale, and covers the interrelationships of the configurations at different scales. The primary entities of which the wholeness structure is built are *centers*, which become activated in the space as a result of the configuration as a whole. Centers have different levels of *strength* or coherence. The coherence of a configuration is caused by relationships among centers. There are 15 kinds of relationships among centers that increase or intensify the strength of any given center.

The 15 properties, summarized in § 1.3, define the way that configurations within a configuration help each other. Within this scheme, unfolding of new configurations is a natural process, and can be understood and followed (see especially § 10.1). We thus have a basis for making computations about unfolding. These are somewhat similar to the bifurcations that have been observed and analyzed in complex non-linear systems [5], but they are much richer and more complex than the theory of bifurcations can at present contemplate. Unfolding occurs as a result of *wholeness-extending* transformations.[1] These are combinations and sequences of 15 possible spatial transformations (based on the 15 properties) that determine how coherent centers may be built from one another. A computational theory of wholeness-extending transformations does not

yet exist, but my aim here is to show how unfolding is built from these transformations, and how the outline of a new (computational) theory of unfolding can be established.

1.2. Wholeness: an illustrative example

To make more explicit what the term "wholeness" means, I describe the phenomenon of wholeness as it appeared in a series of psychological experiments. In studies performed at the Harvard Center for Cognitive Studies in the early 1960s [6], my co-workers and I discovered a curious phenomenon. When confronted with simple black and white strips, and asked to arrange them according to their relative similarities, different perceivers chose one of two different strategies, illustrated in figure 1.

In figure 1a we see five columns, organized and defined by a left-right reading of the patterns, somewhat akin to the Dewey decimal system of organizing books in a library or a system of ordering binary numbers according to their left-right reading.[1] The right hand ends of the patterns play virtually no part in placing it on the board: they are random with respect to black and white. The left hand end in each group starts with the same figure, two black squares in the first column, one black square in the second column, and so on. The *gestalt*, or overall pattern of each strip as a whole, plays no part in the arrangement of the strips on the board.

In figure 1b, we see various groups, and what ties together the patterns in each group, is the *overall* kind of pattern they have. One group has steady alteration of black and white squares. Another has a single chunk of black, with chunks of white on either side. Here the basis of classification is just the opposite from what is going on in figure 1a. The patterns are grouped according to their individual overall configurations, *as wholes*.

Of the two, the figural arrangements are more interesting. To a scientist, it is likely that this more morphological way of looking at the configurations is more pertinent in the study of physical systems such as the pattern of emerging galaxies, or the morphological development of embryos. As such we may consider the figurally-based classification as deeper and more interesting. The sequential basis for classifying patterns might interest a computer scientist concerned with binary codes, but is scientifically less interesting, and is functionally less likely to be important in the behavior of real systems.

However, our experiments revealed a remarkable fact. Our experimental subjects were women students at Radcliffe college, and therefore considered intelligent, analytical, and selected for good performance in academia.

About 80% of the students chose the first, sequential arrangement. Only about 20% used the second, figural arrangement.

The form of classification used by each student was spontaneous, and not "led" in any way by the experimenters. The experimental instructions asked only that they arrange the strips on the gray board supplied, and place those that look similar near each other. Each student made a unique arrangement; no two were exactly the same. But they fell into these two sharply different *kinds* of arrangements.

1 In the original, Figure 1a and 1b are in this place. Captions: "Figure 1a. Sequential-digital. Reading the individual strips left to right (from [6]); Figure 1b. Figural-holistic: Seeing the individual strips as wholes or as *gestalten* (from [6])."

We were startled to find that these students should spontaneously create arrangements based not on the inherent figural configurations in the material they were looking at, but instead on an arbitrary classification scheme that was external to the nature of the material. This was especially startling in light of the fact that either scientific training or artistic training would typically look towards the figural aspect of the strips as their more salient feature.

A further interesting fact emerged. Through our experiments we had invented, in effect, a way of calibrating a perceiver's way of looking at the strips, by objectifying their mode of perception in the arrangement that perceiver created, and using that arrangement as a definition of how that person was seeing the world. We began a second series of experiments in which we gave people various pre-experiment tasks, selected, we thought, in such a way that they would tend to induce "figural" perception in the subject. We used more than a dozen different tasks, including "creative play" in which subjects were encouraged to make enjoyable or beautiful arrangements with the strips, various memory tasks, perception under difficult conditions, ability to describe the strips verbally, and so on. After training the subject, we asked them to arrange all 35 strips on the gray board that grouped patterns which "looked alike to them". We used subjects who had never seen the material before, so there was no residual effect from earlier experience.

To our surprise only one training technique had a marked effect on the way the subjects perceived the strips. In this technique we showed each subject a single strip, flashed on a screen, and allowed them to study it and absorb its character. We then put on the screen, for half a second, an overall array in which all 35 strips were tightly but randomly packed in a rectangle. We offered the subject 5¢ if, in the half second available, they could find the single strip that they had studied previously. It is fiendishly difficult to do. Half a second is long enough to study only a few strips before the whole array disappears. After repeated failures, the subjects changed their strategy.

The only way to find the targeted strip was to relax: instead of an earnest, focused type of perception, one had to lean back mentally, and try to take in the whole board in a single glance. Although this required great concentration, in order to make it work the subject had to approach the task in a fashion that was inherently unfocussed and relaxed. When people learned this technique (which they discovered spontaneously: we never explained it to anyone) they were then able to locate the targeted strip in the array each time, and so earned their 5¢ for each display. And then, after *this* training, without any prompting, they tended to arrange the strips more in the style of figure 1b.

The experiment suggests that there is such a thing as "seeing the whole". Indeed, we began to recognize that the "whole" or "wholeness" that is seen is, apparently, an objectively present structure. It is not always easy to have the ability to see it, and students trained in analytical thinking are less likely than others to be able to see it at all: we found in other experiments [unpublished] that a group of 6 year old children, and a group of adults with learning difficulties, had much *greater* facility for seeing wholeness than the college students. To teach someone to see the wholeness, one had to break down the analytical habits of a lifetime of education [6].

The ability to see the wholeness is a prerequisite for the material contained in this paper. It is also, I believe, a prerequisite for seeing many of the key phenomena that are now an essential part of physics and biology, just as it is a prerequisite for seeing art with understanding.

1.3. Fifteen properties of wholeness

In *NOO* [1–4], I once again took up the study of wholeness that had first occupied me in those Harvard experiments 40 years earlier. Among other fundamental aspects of wholeness I focus on certain structural features which appear to be underpinning the wholeness structure, as it appears in the geometry of physical things. In *NOO* I identify 15 structural features that appear again and again in coherent systems, and appear to play a major role in establishing the wholeness of these systems. The 15 are summarized briefly here.

1 STRONG CENTERS. Wholeness is composed of centers, and centers arise from wholeness. A given wholeness is coherent to the degree that the centers within it are coherent. Centers are recursive in structure. Each center that exists acts to strengthen other centers, larger and smaller.
2 LEVELS OF SCALE. When a configuration contains centers, these centers are associated with centers at a range of sizes that occur at well-marked levels of scale. The scale jumps between levels are small: in coherent systems the centers of different sizes are often in size-ratios of 2 to 1, 3 to 1 and 4 to 1. If the jumps are larger – for example 10 to 1 or 100 to 1 – without intermediate levels, the coherence tends to fall apart. This means that in coherent structures, the ladder or hierarchy of levels has evenly spaced rungs, and is continuous and smooth.
3 THICK BOUNDARIES. Strong centers typically, though not always, have thick boundaries. The thick boundary may exist in 1-, 2- or 3-D, and is made up of smaller centers that have the LEVELS OF SCALE relation to the larger center being surrounded. Thick boundaries typically form a transition zone of interaction, allowing physical, chemical, or biological processes to occur without contaminating their centers. The boundary is often only one LEVEL OF SCALE smaller than the thing it surrounds, thus may be equal to the radius of the thing surrounded. Boundaries help to form the "field of force" that creates and intensifies a center; they surround, enclose, separate and connect.
4 ALTERNATING REPETITION. When repetition of similar centers occurs in a coherent system, the centers typically alternate with a second system of centers, thus forming a double system of centers with a beat or rhythmic alternation, from the positive space between the repetitions. Centers intensify other centers by their repeating rhythm; when a second system of centers repeats, in parallel, it intensifies the first system by providing a kind of counterpoint, or opposing beat.
5 POSITIVE SPACE. In coherent systems, there is no "background", or figure and ground. Instead, every bit of space is coherent, well shaped; and the space between coherent bits of space are also coherent and well-shaped. Thus every bit of space swells outward, is substantial in itself, and is never the leftover from an adjacent shape – like ripening corn, each kernel swelling until it meets the others, each one having its own positive shape caused by its growth as a cell from the inside. The positiveness of space is difficult to pin down exactly, but it is like a weak kind of convexity, or quasi-convexity. In systems where the space is positive, the principal elements of space are nearly all quasi-convex, and the pieces of space between these elements are also quasi-convex.
6 GOOD SHAPE. This describes a particular, coherent quality of the shapes that occur in or around a coherent center. This kind of "good" shape is somewhat

unusual, and is marked by the fact that the shape itself is made up from multiple coherent centers which together form the shape, and of other coherent centers which together form the shape of the space around the shape.

7 LOCAL SYMMETRIES. A local symmetry is a symmetry of a localised region of space that is not possessed by the space beyond. Strong centers often have strong local symmetries within them, and local parts of space with strong symmetries are typically strong centers. This feature binds together smaller centers within the whole, further creating coherence.

8 DEEP INTERLOCK AND AMBIGUITY. This occurs where coherent centers are "hooked" into their surroundings, making it difficult to disentangle the center from its surroundings. Often there are ambiguous zones which belong both to the center and to its surroundings, again making it difficult to disentangle the two. (See, for example [7]).

9 CONTRAST. Every center relies to some degree on the contrast of discernible opposites, and on its differentiation from the ground where it occurs. It is intensified when the ground, against which it is contrasted, is clarified and is itself made of centers and POSITIVE SPACE. The essence of this feature is that this differentiation arises from the degree or sharpness of contrast that is attained between adjacent centers. Note, though, that too much contrast is likely to be harmful, and must then be offset by NOT-SEPARATENESS, below.

10 GRADIENTS. Centers are generated and strengthened by gradients of size, shape, or quality. Thus any quality among a system of centers that varies systematically produces a gradient, and this gradient, by pointing to a particular center, helps to build that center and to intensify its coherence.

11 ROUGHNESS. In coherent structures we usually find a rough arrangement and repetition of centers rather than exact repetition in shape, spacing and/or size. Thus apparently similar centers are different according to context, allowing each part to be adapted to the geometric constraints around it, modifying details of the repeating structure as it needs to be. Texture and imperfections are generated, and in part create the possibility of uniqueness and life.

12 ECHOES. Within coherent configurations there are often deep underlying similarities or family resemblances among the elements. These similarities are often characterized by typical angles, and typical curves, so that they generate what appear to be deeply related structures, sometimes so deep that everything seems to be related.

13 THE VOID. In the most profound centers that have perfect wholeness, there is often at the heart of the structure a void that is large, undifferentiated, like water, infinite in depth, surrounded by and contrasted with the clutter of the structure and fabric all around it.

14 SIMPLICITY AND INNER CALM. Essential to the completion of a coherent whole is a quality of simplicity. Every structural feature that is unnecessary has been removed, so that the remaining structure has slowness, majesty, quietness.

15 NON-SEPARATENESS. This describes the connectedness of each center to the world beyond it. When a whole is a living center, we experience it as being at one with the world around it. When not-separateness exists, visible strands of continuity of line, angle, shape, and form, connect the inside of a living center

with the parts of the world beyond that center; it is impossible to draw a line separating the two.

These 15 properties are thoroughly explained in [1]. In [2], these structural features are also shown to form a basis for the wholeness-extending transformations that create life and coherence as configurations unfold.

2. The subtle process of adaptation

The core topic of this paper is geometric adaptation. In many real world systems, both in purely natural systems, and in those places where people form communities with animals, plants, and other people, the central observable is a close-knit adaptation of the system elements, usually arising over time, and expressed in the intricate geometry of the system.

This close-knit geometric adaptation has not been a major focus of scientific study, because it eludes simple algorithmic formulations. Studies of co-evolution and ecological evolution have moved in this direction, but they rarely concentrate on the geometry of the evolving system. That is not because this adaptation is too complex to be modeled, but rather because the elements of such are so simple, and so rooted in common sense, that they nearly elude the algorithmic and algebraic formulations that we view, wrongly, as more sophisticated.

For example, if a farmer places a row of fence posts, then runs a top rail, braces it here and there where it seems needed, allows it to relate in natural ways to declivities in the ground, or to nearby trees, this is supremely ordinary; it is characterized entirely by common sense, and by the farmer's ability to pay attention to the situation of each post, each rock, each bit of soil, each slope – and do it right. This oh-so-simple process eludes algorithmic formulation, because algorithmic formulation is not well tailored to this task, and at best only partially helpful in allowing us to grasp what is really going on.

That is not to say that a sensitive fence-building process is trivial or unimportant. On the contrary, the character of this minute, step-by-step adaptation is vitally important in the world, and we have been ignoring it, in recent decades, at our peril. But we do not have a theoretical model that emulates this process. As a result, the ability to perform adaptations in the real world according to such a process has been worn away and destroyed by other processes that are largely bureaucratic – often too bureaucratic – and, in their essence, algorithmic. The planners, building officials, construction companies, and engineers who have redefined everyday processes during the last 100 years, working in a broad context of algorithmic thinking, have, without explicitly intending to, destroyed a far more subtle process.

Until that subtle process is acknowledged, and then redefined in modern terms, it will not have the status it requires to play an effective role. The deep adaptation that nourishes the physical world *requires* this kind of adaptation. We can think of this adaptation process as a highly sophisticated computation, performed on real sticks and stones, producing deep and subtle results.

The progress of an evolving (unfolding) natural landscape, or the development of an embryo, have similar qualities. As cell division progresses, new cells take shape within the context of the surrounding cells, and, at the same time, adapt, so that they are

shaped by these surroundings, and simultaneously play an active role in shaping their surroundings. Again this process has not been modeled geometrically. The prevailing assumption is that what is going on in the real world is a nearly random aggregation of simple mechanical processes, with no special coordination or behavior as a whole. Within that view, there is little to be learnt from studying the process; it is just number crunching, without new insight.

But this view is, I believe, mistaken. The cells' progressive adaptations, as each part rubs up to its neighbors, shapes them, and is shaped by them, coordinates the whole. Some profound coordination of the whole is occurring. There are strong reasons to think that this aggregation of apparently random events is, instead, a highly organized wholeness-extending process, in which the process in the large progressively pays attention to the whole, reflects the whole, and extends and makes more beautiful the whole.

That is what makes the wholeness-extending process worth studying. It is a kind of computation, unfamiliar to conventional mathematics, but a computation nonetheless, and one that reaches profound results. By observing this kind of computation going on, and then, hopefully understanding it well enough to simulate it, we may lead to a new era of our ability to think.

. . .

3. Harmony-seeking computations

3.1. Relation of a given computation to the larger whole beyond it

In the examples I give, an essential feature of the process described is that the new configuration that is created does something to participate in, strengthen, extend, and enlarge the force or "presence", of some larger configuration in the world around it. In many cases, this larger configuration is not itself changed by the "computation", but it nevertheless enters into the computation as a crucial input.

If a lane exists, connecting two villages, and the road between them is then asphalted, the new, wider, harder road will primarily affect the *whole* configuration of these two villages, a tract of land much larger than the lane itself. Indeed, the new road may (according to its position in the region) also affect and strengthen an even larger part of the region's economic network. We recognize this as a fundamentally useful act (or, if undertaken without consideration of the wholeness, a potentially destructive act).

A played musical note is effective according to how it develops a melodic line, a rhythm, or a harmony. If it does all three simultaneously, it is the most effective. Once again, we recognize the usefulness of this act.

These are simple cases. Other cases involve creation of highly organized and complex artistic wholes. These have so far eluded science. Even the theories of bifurcation, symmetry breaking, chaos, and generative algorithms have not yet deeply plumbed the meaning, or the origin, of true complexity.

All this is hardly more than common sense. Yet the fact remains that this kind of adaptive process (the farmer building his fence with respect for the land) does not currently have an acknowledged part in theories of algorithms, in developmental biology, in architecture, or even in system theory. It is not part of the mental models in our current toolkit.

3.2. The essence of harmony-seeking computation

In essence, harmony-seeking computation creates new configurations, unknown configurations, and *good* ones, by taking off from a known configuration, extending, and enhancing, and preserving its wholeness, but without (necessarily) requiring human creativity. The process *itself* is creative.

Consider a given configuration with certain features visible, which define whatever wholeness we see in the configuration. In addition, in every configuration there are traces, hints, of dim structures not yet fully developed, existing in a latent form, "between the lines" of the configuration. What happens in harmony-seeking computation is that some process "notices" these latent structures, and enhances them, develops them. Sometimes what develops is relatively modest with respect to the size of the entire configuration. At other times, large structures may also be latent in a configuration, and *these* are enhanced. If the whole-seeking computation identifies this latent larger whole, and strengthens it, so that what was before only barely visible now becomes strong and easily visible, the configuration seems, to an untrained eye, to have gone in a new direction all by itself. It is this process that is the essence of harmony-seeking computation.

Once we add knowledge and perception of this type of transformation to our toolkit, we will want to program our own wholeness-extending computations. Even were the task of discovering latent structures too difficult, one could imagine a computational system that examines possible moves forward from a given state of a system, tests them, and evaluates the extent to which each of these moves participates in and adds to the larger wholes in the world around it, then chooses the most harmony creating and the most successfully whole-creating. Such a process of computing, if it can be attained, would be enormously powerful, and powerful in its implications.

3.3. Example: a natural system: embryogenesis

Consider an example of embryogenesis, a growing mouse foot (figure 2). Each stage contains within it some structure that is defined, and some that is, for the time being, a chemical gradient, then a vague and fuzzy mass of jelly, both latent structures which anticipate the shape of the next step. Shortly afterwards, the embryo consolidates and solidifies what was merely latent only hours before.[2]

What are some of the transformations that constitute the wholeness-preserving character of these moves? The form starts with a barely visible axis from the point of attachment to the embryo's body to the tip of the structure (2a). In figure 2b we see the emergence of a STRONG CENTER at the tip itself, forming a thick BOUNDARY (in one dimension) at the end of the arm, together with a dark fork that has emerged within the jelly. This center is then accentuated by the appearance of a GRADIENT leading to the fingers, and this gradient is then embodied in figures 2c and 2d by LEVELS OF SCALE, CONTRAST, and LOCAL SYMMETRIES, finally finding expression in the GOOD SHAPE of the whole.

2 In the original, Figures 2a, 2b, 2c and 2d are in this place. Caption: "Step-by-step development of a mouse foot, showing its growth over four days: 11.5, 13, 14, and 15 days. (From [8], fig. 10.5)

3.4. Example: an engineered system: a bench around a tree[3]

Consider the example of a growing willow tree, and the act of the landowner who chooses to build a bench around the base of the trunk. The bench places a BOUNDARY around the tree. Compared to the length of the trunk, this is a relatively small step. But the bench starts from the cylinder of three trunks, putting a small ring-shaped structure around it (the seat). We may say that the possibility of this seat was inherent in the previous structure, that it was latent there, and that the bench builder simply made explicit and more solid the structure that was already present mathematically in a weak and latent form, at the base of the willow tree.

I mean this literally, not metaphorically. The ring-shaped structure that later finds embodiment and physical form in the seat, is already present before the seat is built, in the ring-shaped system of symmetries and sub-symmetries of the space around the tree, because they are induced by the presence of the trunk and its roughly cylindrical shape. The ALTERNATING REPETITION in the basket weave, then arises through a natural wholeness-extending transformation from the simple (but structurally weaker) homogeneous cylinder first contemplated. This statement contains the crux of my argument, and in this statement – when it is generalized – lies the mathematical kernel of what I have to say in this paper.

In each of the two examples – the mouse foot, and the bench around the willow tree – the steps build on the structure that was there before. They do not destroy it or interfere with it, but rather enhance it, elaborate it, deepen it. As a result, what arises has wholeness, coherence, and beauty. *That is the trick, in a nutshell*. By continuously preserving and enhancing and extending the wholeness of the existing structure, a beautiful thing arises, naturally. Yet, because each whole is unique, and the idiosyncrasies lying latent in it are also unique, the new whole that springs from this process is unpredictable, original, and creative.[2]

To perform this trick we must ask rather more precisely what it *means* to take steps that intensify the latent structure that is present in a configuration. Can we define this idea precisely enough, so that we can start doing it on purpose?

4. Structure of wholeness

The idea that every geometric configuration might have its own "wholeness" seems odd at first. However, there is a definable mathematical structure underlying any configuration that captures, or "is", the structure of the whole configuration, its *global* structure. I call this structure *the wholeness*. It is not uniquely defined (mainly because the structure is so difficult and complex to describe precisely), but it is definite, and various attempts to represent this structure approximately, if they are any good, all have something in common. There is a deeper, global "something" there (for example, see the discussion of four Matisse self portraits shown in Alexander [1] page 97).

I first began to recognize this possibility in the experiments described in § 1.2, to find out how different perceivers see configurations [6]. These experiments were inspired by the early 20th-century gestalt psychologists – Wertheimer [10], Koehler [11], Koffka

3 In the original, Figure 3 in this place. Caption: "Building a delightful seat around a tree. (a) staking out the boundary (b) weaving the basket (c) the top of the seat finished with turf as a cushion. (From [9])"

[12] and others – who wrote extensively about the perception and cognition of wholeness and of wholes in the world around us. As explained in § 1.2, it was clear that the figural perception was somehow more real, while the analytical perception was arbitrary, and made according to arbitrary invented schemes. The figural quality was inherent in the material. The ability to perceive figurally was therefore of enormous importance. In broad terms, we may say that the wholeness or global configuration is a structure of the main features of any configuration – in particular *when it is seen as a whole* [13]. During the same series of experiments, we made another significant discovery. The relative coherence of different configurations could be measured by counting the number of locally symmetric sub-configurations it contains [14]. This measure gives results in strong agreement with other experimental results from cognition, memory, perception and so on. Thus a configuration and its structure do depend, in some considerable degree, on the nesting of LOCAL SYMMETRIES and on the structure of the system of locally symmetric subsets that occur in it. The fact that a simple measure (the number of locally symmetric subsets) to some extent characterizes the different configurations, lends further weight to the idea that for a given configuration, *the* wholeness is something real.

5. Examples of harmony-seeking computations in different disciplines

5.1. Example: hayricks in a field

Figure 4 shows a photograph of two modest hayricks placed in a rolling meadow in Romania. The placement is done in such a way as to complement the land, to enrich the land. It is humble, self effacing, there is no ego visible, only concern that the land and its harmony should be enhanced.

Several readers of drafts of this paper have commented that they believe they could equally well explain the placement in terms of the pure practicality of drainage, wind protection, a flattish area on which to build the rick, a roughly equal spacing of the ricks in the meadow, so that each has a similar sized catch basin of the available growing hay, and to reduce the work of carrying while forming the rick. It is true that all these practical arguments are sound, and essential to the success of the rick-building venture. Attention to these functional issues is necessary. But is not sufficient.

In order to create a coherent object, the inner coherence of the physical thing and its geometry, must also play a foundational role. That means that the unfolding of the geometry from the wholeness of the place, must also have a paramount role. Without having this as an explicit focus of attention, a pure practical solution without consideration for this harmony, will fall flat, and most often create disharmony, not harmony.[4]

During my work with traditional builders and craftspeople all over the world I have found that these so-called "humble" artisans, are always conscious of the harmony of the whole, and are always making sure that they are guided by it. I know of no exceptions. That makes me quite certain that we would be mistaken in believing that this Romanian field and its harmony could be successfully explained by pure 20th-century

4 In the original, location of Figure 4. Caption: "Hay ricks in Romania (photograph by Radu B. Chindris)."



Figure 16.5 Impressionistic depiction of the wholeness structure in that field.

functionalism. It is the explicit search for harmony that underlies traditional practical techniques, and it is this element which makes the results so good.

How is one to characterize what is happening here? What is it, that we see, and recognize as so supremely successful? Of course, the placement is indeed primarily practical. The hay ricks are placed on almost-level spots, but ones which have a slight slope so that they can drain. But there are many subtle harmonies, also visible. The ricks are on the same scale as the trees on the ridge; the trees gently surround and enclose the place where the ricks are; the rolling quality of the land, with its dips and hollows, and the hedges and trees as they are placed, is respected. The two hayricks are placed with considerable care, on slight outcrops of land, so that each hayrick is not only kept dry and free from rot, but so that it actively enhances and emphasizes the slight bumps in the land. In addition, the actual structure of the hayricks themselves (each rick a tree of light timber, with hay piled up on it), mirrors and echoes the character of the grass land and of the surrounding vegetation.

Figure 5 is a sketch that, in broad-brush terms, approximates the wholeness present in that field. The wholeness includes the sinuous curves, the kinds of shapes which are present in the field, the dips and hollows, the surrounding trees, the trees along the ridge, and the fallen down enclosing fence below. I believe that the people who tended the land, placed the trees forming a hedge on the ridge, allowed the hollows in the land; those who built and placed these hayricks were consciously performing harmony-seeking computations every time they worked the land. There are ECHOES of shape and size between land and hayricks, ECHOES of a certain kind of curve, LOCAL SYMMETRIES in the ricks themselves, the placing of the ricks emphasizes naturally occurring STRONG CENTERS that are generated by shelves and flattened places, bounded so that the hayricks nestled in the land, are subdued and congruent, and inside the structure which exists. The hayricks are kindly to the land, and they are placed with enormous care. They follow the wholeness of the land itself. The ricks fit into the land because of the way they function and because of what they are made of. In order to function well, they have to sit on a locally flat surface that is uphill from where water collects, and downhill from the crest of the hills so that the effort it takes to stack the hay is minimized. They are made of hay, the material produced by the place, so their scale, color and form are the same as their surroundings. Nothing foreign is introduced into the place for the sake of function alone. Form and function

together are part of the wholeness of the place. The wholeness is a harmonious structural and geometric quality within the whole.

5.2. Example: giant wind turbines on the Danish coast

In order to accentuate the harmony that was consciously generated in the Romanian field, let us compare it with the much cruder results typical of 20th- and 21st-century thinking about engineering and design. The 20th-century thinking was, usually, more or less algorithmic. When the computations about subtle and delicate wholes are rationalized according to crude dollar-based ways of thinking, they usually go badly wrong, especially as far as respect for the background global structure of the landscape is concerned. The subtlety and depth of the existing global structure is not easily recognized by technological thinking.

For example, in figure 6[5], the land has a global wholeness that is made of layered, nested flat plates, a two dimensional system of plates. The ecologist who placed the two giant turbines was evidently unconcerned about creating harmony with this structure. Cover up the two towers on this photograph, so that you can see the global structure of the land as it was before the towers were placed there. It is hard to see it, because the towers are now so obtrusive, and so alien to the kind of structure that is there.

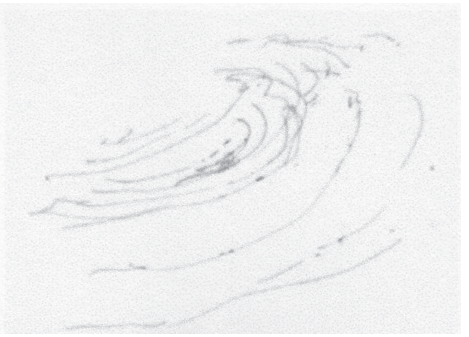
When an ecologist becomes too concerned with one aspect of sustainability (the importance of wind energy, as in this case), and plants 300 foot high windmills on an ocean front, it destroys the landscape. This is no longer a wholeness-extending transformation, but rather a well-meaning but ill-judged algorithmic computation of some inappropriate kind about cost benefit. In this case, the wholeness and the structure of the place have been severely damaged. Sometimes, the place, its landscape and its internal adaptations – often the result of centuries of patient work – are irredeemably destroyed.

In the coastal landscape where the Danish turbines have been placed, the structure that was there before (figure 7a) is flat like a disc, a great flat disc, the size of the bay, flatted at the edge where the waves meet the sand and the grassland just beyond it. This enormous gentle discus-shape, perhaps half a mile across, is suddenly violated by the two vertical structures, sprouting turbine blades dumped on it (figure 7b). The two massive vertical things have no relation to the structure of the subtle disc that lay in the land before. The slash of the new straight road is at odds with the curves of the land. And, in the foreground there are two teeny little sheds that look lost and forlorn, too. The building site is not even harmonious with itself. Altogether, the structure has been violated.

Compare what is happening in the hayrick example, and in the turbine example. In the case of the hayricks, the process of placing them has left the previously existing structure alone, indeed the process enhances it, strengthens it, increase its harmony. But in the case of the turbines, their shape and placement are at odds with the previously existing structure, they damage it, they destroy it.

What is the "it" that is being left alone in the first case and is being destroyed in the second case? It is the *wholeness*, that system of centers existing in the geometry of

5 In the original, Figure 6 here. Caption: Two wind turbines on the flat north coast of Denmark near Nibe. (From [15]).





Figures 7a and 7b The wholeness before construction of the turbines (a); and the wholeness after the construction of the turbines, which destroys virtually all the structure that was previously there (b)

each place that gives it its character, shape, organization, rhythm, feeling, and global configuration and relation to the land around it. One may describe the relation of the action to the wholeness like this. In the first case, the injection is friendly, helpful: what is there is enhanced, complemented, and continued. In the second case, the injection is violent, disrespectful, and structurally at war with the land that was there before.

My judgment about these two injections is not a romantic yearning for an idyllic past, but a structural judgment about something that is objectively present in one case, and missing in the other. It is also true that wholeness-enhancing processes allow growth and extension to continue while wholeness-destroying processes freeze things and inhibit improvement. One injection respects what is there, the other does not.

These structural judgments are about phenomena that are essentially mathematical in character. It is not just a question of feeling, but also a question of structural congruence, or the lack of it, that exists between an existing structure and an injected structure which has been brought into it. We need to understand more about this kind of structural respect.

In order to widen our understanding of the idea of harmony-seeking or wholeness-extending computations, we now examine a further series of examples of such computations, many of them occurring in the natural world.

5.3. Example: evolution of the whorled cap of *Acetabularia* – 6 steps

This example is taken from Brian Goodwin's work on the morphogenesis of *Acetabularia*, a single-celled alga which takes the form of a stem with a cupped whorl at the end (figure 8)[6]. Goodwin has studied the growth of this form, and the series of transformations that generate the form of the completed alga [17, 18].

6 In the original, Figure 8 here. Caption: "Whorls forming at the tips of developing Acetabularia (from [16]. The bumps in the caps develop as shown at the right-hand end of Fig. 11a.

The key morphogenetic sequence that Goodwin describes is illustrated in his five-diagram sequence (figure 9)[7], showing the stem bulging and then making the whorl. It goes as follows:

1 to 2. A hemisphere, formed by the bulging upward growth of the cell
turns into→ a hemisphere with a small centrally symmetric swelling on top (an ogee curve).
2 to 3. The hemisphere with a small centrally symmetric swelling on top
turns into→ an elongation of the swelling forming a neck.
3 to 4. The hemisphere with the elongated narrow neck
turns into→ a neck with a flattened top, upper end.
4 to 5. The flattened neck on top of the hemisphere, grows a ring of small projections (a whorl) that ultimately *turn into* the umbrella shape visible in the completed algae.
5 to 6. The whorl formed around the top of the cylinder grows outward
turns into→ a full umbrella-like ring of small projections that ultimately turn into the umbrella shaped cap visible in the completed algae.

As Goodwin says, this growth sequence is generated by natural physical phenomena. It has relatively little to do with DNA or genetic guidance. What is happening is a naturally occurring and inevitable progression of morphological transformations that arise directly from the geometry and dynamics of the form itself, to generate the next geometry [18].

It is significant that a prominent biologist has begun taking the emphasis of morphogenesis away from the influence of DNA, and has begun to see morphogenesis as an autonomous process in the geometry itself.

There is an interesting sequel to this story. When Brian first showed me the diagrammatic sequence illustrated above, I asked him if the progression from round-ended neck to flat-topped neck was correct. Why do you ask? he said. I said that, looking at this purely from the point of view of wholeness-extending transformations, I would have expected something different. It seemed to me very unlikely that a round topped structure could transform into a flat-topped structure. There is nothing like the flat top latent in the configuration. There is indeed a *ring* latent in a hemispherical configuration, but it is further down the curve. If you have a rounded hill, or hemispherical end of a neck-like structure, there is, inherent in that configuration, a latent structure something like a shoulder, which is incipient near the top of the hill and just below it (see figure 10b).

In figure 10a, we see such a structure on the prehistoric Wittenham Clumps near Oxford. It evidently was, for the builders who made these mounds, a natural way to continue the smooth structure of a rounded hill. This point of inflexion in the curve of the hill is a natural development from the smooth curve.

If you are in doubt that it is "natural", consider two possible transformations of a hemispherical hill, shown in figure 10. Figure 10b introduces a band below the top, with two points of inflection in the curve, as shown below. Figure 10c just flattens the top by squashing it down into a flat surface. Ask yourself which of these leaves the hill

7 In the original, Figure 9 here. Caption: "Brian Goodwin's five diagram sequence" (from [17] fig. 4.6).



Figure 10a One of the Wittenham clumps near Oxford.

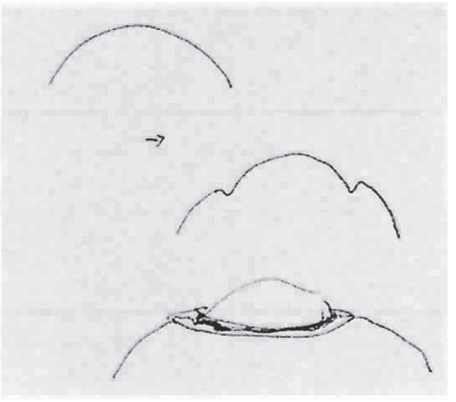


Figure 10b A diagram of the structure created on the mount by the prehistoric encampment. It is a wholeness-extending transformation. The smoothness of surface, the volume, possibly the area of the curved surface, are all preserved. It is generated by a continuous and smooth process. It preserves the feeling and morphological character of the whole.

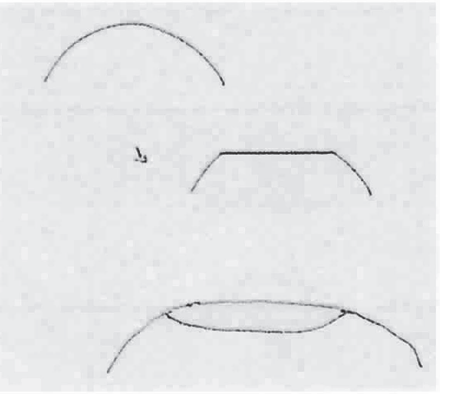


Figure 10c A cut. It is a transformation of a kind, but it does not extend or preserve the wholeness of the curved volume. Rather, it disrupts it, and alters its feeling and morphological character very substantially.

alone more, and preserves the global structure of the hill better. I think that you will agree that it is figure 10b. It is in this sense that the transformation in figure 10b is more natural than that in figure 10c.

So I asked Brian, referring to his *Acetabularia* diagrams: if such a configuration were latent, and did then transform to create such a ring-like shoulder, then it would be that *shoulder*, rather than the top, that would be the most likely place where whorls and

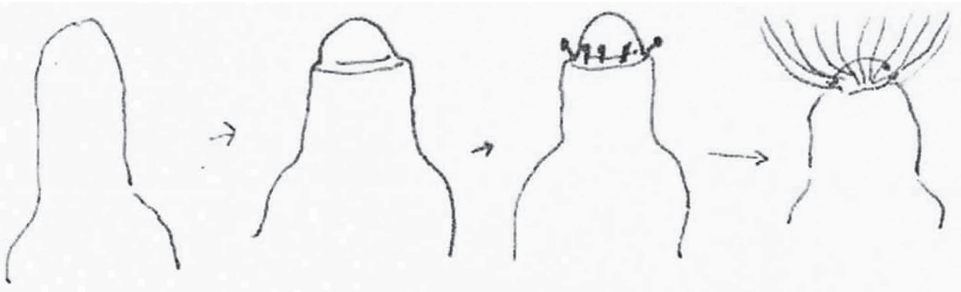


Figure 16.11 My analysis of the developmental sequence, based on W-E-transformations.

other irregularities might naturally form. So, are you sure that the real morphogenesis of *Acetabularia* doesn't go like that, rather than the way your diagram portrays it? As shown in figure 11, for instance, and the photograph in figure 8.

Brian laughed, and told me: you are absolutely right: that *is* what actually happens – I just got the diagram wrong.

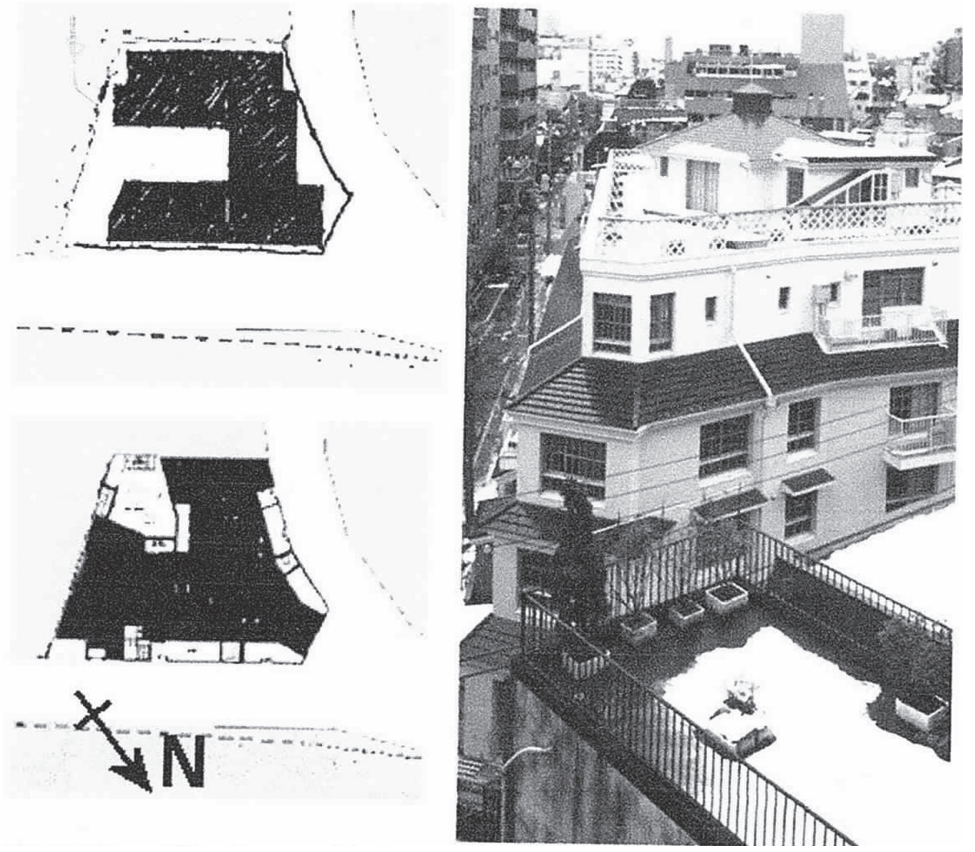
This story sheds light on the way harmony-seeking computations may be able to help observational biology, theoretical biology, and structural modelling and simulation. We come back to this later. The point for now is that it is possible to make accurate statements about what structures are latent at a given phase of morphogenesis; and it is therefore possible to say, objectively, how things are likely to unfold.

Look again at the photograph of the *Acetabularia* in figure 8, and look inside the caps: there is indeed a remaining *hillock*, just as my whole-seeking computation predicted. At the time I made the prediction, I had never seen enough detail of *Acetabularia* to know about this kind of cross-section. My guess arose solely from wholeness considerations, and from thought about what would be wholeness-extending.

5.4. Example: two possible plans for a five-story apartment building in Tokyo

Figure 12a shows a plan for this apartment building in Tokyo, done by a student. Figure 12b is the plan of the five-story apartment building that he and I subsequently built on the site (the Emoto Building, Komagome, Tokyo [3], figure 12c). Though typical of many architectural projects around 1987 (the era of the project), the student's plan lacks the wholeness-preserving quality of the final plan. The layout process for the final design has about fifty wholeness-extending steps (described in detail in [3]).

The plan as built complements and intensifies the wholeness of the site. This is clear from the ground plan alone. However, to emphasize what this really means, and to illustrate the deeper structures that are involved, I describe some specific features of the global structure that existed in that place, and that were solidified and complemented by the building placed there. Some of the structural features of the original site are: the center formed by the Y-configuration of the fork; the curving nature of the two branches; the space between the forks, and its specific V-shape; the southern spot hit by the sun.



Figures 16.12a and 12b. Two possible plans for the apartment building. The lower one is the one we built. (Upper drawing by Hajo Neis, when a student. Lower drawing by Christopher Alexander.)
Figure 12c. The completed Emoto apartment building in Tokyo. (Photograph by Hajo Neis)

The new building, when injected into this site, does the following things that help to accentuate and strengthen these structural features of the place:

1 The sharp end is given a snub nose, creating a place in front of it (it became the entry to a shop).
2 The front gardens of ground floor apartments are placed to form a boundary between the building and the street.
3 Since the boundary is of uniform width, the space of the street is maintained and continues its positive shape.
4 The building is wrapped round the sunny south-facing spot on the site, making sunny space for all the apartment owners.
5 On upper floors an inner layer of galleries and terraces form a boundary to this place.

As these various features are consolidated, they form a coherent structure, in which each feature supports and helps the others. Marked among this coherence is the presence of positive space *throughout*, even in a geometrically complex configuration; the fact that there are levels of scale within the structure; the focus of major centers to the structure, each with its own strength and beauty.

The entire process of building and injecting this structure into the configuration of the site – designing and planning and building the entire five-story complex – I view *altogether* as a complex computation. It takes the initial configuration (the site) as its starting point, then transforms the configuration, by about 50 steps, finally ending with the configuration illustrated. Although the work of an architect of this kind would conventionally be viewed as an artistic act, hence as an arbitrary and "private" process, I believe this to be seriously in error. In the process illustrated here, each step is based on the configuration that is there at the moment before, and the latent structures that exist, and then makes one step forward that specifically, and carefully, strengthens or supports, *and evolves naturally out of*, the structure that was there before.

5.5. Example: an ornament drawn by Hiro Nakano – 8 steps

Figure 13 shows a much simpler example, the evolution of a sketch, that follows the same process. This example is a result of a classroom exercise, where the students were given the initial row of dots.

- Start with a row of even spaced dots.
- Make a circle around alternate dots. (ALTERNATING REPETITION)
- Connect the alternating dots and circles with a line (NOT SEPARATENESS)
- Intensify these new centers with an additional circle, and also make a much smaller circle around every other dot. (STRONG CENTERS, ALTERNATING REPETITION)
- Take the bigger circles and subdivide each into eight sectors, four plain, and four that are fan-shaped alternating with the plain ones. Give each fan-shaped sector a special shape to emphasize it and give it more detail. (GOOD SHAPE, LEVELS OF SCALE, ALTERNATING REPETITION, THICK BOUNDARIES).
- Add a strong dark, shaded band, to connect the larger circles with the smaller ones they alternate with more strongly. (CONTRAST, NOT SEPARATENESS, LOCAL SYMMMETRIES).
- Add two additional lines, making borders to frame the dark band, and thus creating a still stronger sense of unity. (THICK BOUNDARIES, NOT SEPARATENESS).
- Darken the central band much more, and blacken the flower shaped quadrants of the inner large circles. (CONTRAST).

Through this sequence of seven transformations, we see the growth of a coherent and sophisticated structure, from simple moves. The names given at the end of each step are references to the 15 properties and wholeness-extending transformations, which play a fundamental role in the creation of this drawing.

The example is instructive because, although simple, it is complex enough to be interesting. We can see, for the first time among these examples, how recursive use of these transformations on the emerging centers, and on the centers that the transformations

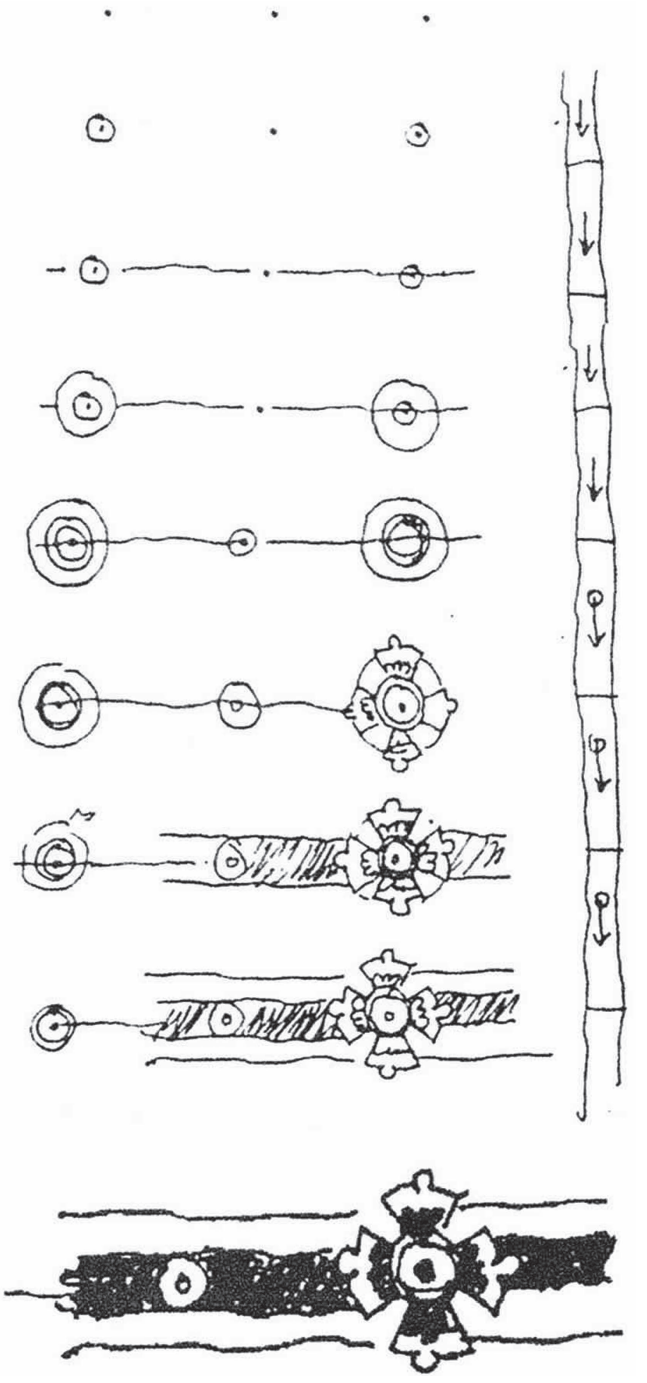


Figure 16.13 Eight wholeness-extending transformations creating an ornament [from an original drawing by Hiro Nakano, now lost, kindly recreated from a copy, by Hajo Neis. CES Archives.]

themselves generate, is potentially a powerful process, perhaps one capable of generating all complex configurations in their totality.

However, there is still much innovative work needed to take this informally described harmony-seeking computation process into an effective and operational form to cope with the broad range of problems we may wish to apply it to.

5.6. Example: historical evolution of St. Mark's Square – 10 cycles

Figure 14 shows the plan of St. Mark's Square, Venice, one of the most famous and beautiful public places in the world.[8] This highly complex structure grew steadily, over a period of about a thousand years. What happened there may be understood as a series of harmony-seeking computations, carried out at intervals, with intense and deliberate care. The series of growth cycles shown in figure 15 is historically accurate, although there is no historical evidence to suggest the nature of the activity undertaken at each stage.[9] However, I am fairly certain that it must have gone roughly as I suggest: the fact that it is possible to define a coherent and rather simple paradigm for each cycle of activity, and that in their essentials the cycles are all the same, suggests that what happened was indeed something along the lines of the underlying computation I propose. (Historical data and additional analysis of the evolution of St. Mark's Square are provided in [2, 3]).

In every cycle, there are three entities at work:

1 *The configuration in the large*, roughly the size of the whole of the frame. The focus of attention shifts from cycle to cycle, and is usually about half the area of the entire frame.
2 *The particular latent center* that most calls for elaboration and development. The focus of the latent center, shown in pink, is usually slightly smaller than the latent center itself.
3 *One or more smaller centers*, shown in blue. These blue centers are placed in such a way as to strengthen both the previously weak latent center, and the large configuration that is helped as a structure by the elaboration and articulation of the pink.

As a computation, the procedure goes like this. Find the latent center that is most salient: the center that seems most likely, if strengthened in the next step, to strengthen the wholeness of the larger configuration. Act locally, so that this latent center is strengthened, and globally, so that this strengthening also helps to strengthen the largest whole. Repeat this cycle ten times over a period of about 1000 years, (roughly once per century), and the result is St. Mark's Square as we know it today. This rule explains (or generates) the ten actual cycles of construction and improvement that occurred around St. Mark's from 600AD to 1600AD.

8 In the original, Figure 14 here. Caption: "Plan of St Mark's Square. (From [19], p. 104). This example, including the subsequent sequential drawings of the evolution of St. Mark's Square, is also illustrated in Book Two of *The Nature of Order*, *The Process of Creating Life*, pp. 251–255."

9 In the original, Figure 15 here. Caption: "Figure 15. Ten cycles (four frames per cycle) of wholeness-extending transformations in the history of the 1000-year development of St Mark's Square."

5.7. Example: formation of giant voids in the universe: a very large example of a generated wholeness

In recent years, attention of cosmologists has focused on the structures of galaxies and galactic clusters that are now called filaments. Attention focuses on the voids that seem to be encircled by these filaments. The filaments are typically hundreds of millions of light years long, and tens of millions of light years thick. The voids are often hundreds of millions of light years in diameter.

Figure 16[10] is one of the early pictures of the distribution of galaxies and galaxy clusters that for the first time clearly showed that these voids and filaments existed X[20]X. The voids appear to be convex, and quasi-spherical. To me, that implies the presence of some active principle pushing outwards. In terms of the language of wholeness, the existence of THE VOID (a general structure existing at all scales, and not specific to astrophysics and cosmology), and of THICK BOUNDARIES, and of the scale ratio given by LEVELS OF SCALE, is to be expected in all wholeness, since these are three of the 15 main ways in which coherent structure typically occurs. Further, the astrophysical voids seem to be close packed, rather like soap bubbles, and, like soap bubbles, where the bubbles meet, there is a film where the boundary material is concentrated. In just this way, the galaxies are spread out in linear filaments.[11]

Filaments are typically 200 to 500 million light-years in length. The so called Great Wall is roughly 1500 million light-years long, 600 million light-years across (band) and 15 million light-years thick. The voids are 30 to 500 million light-years in diameter. The actual physical size of one of these voids (typically about 100 million light-years in diameter), is almost unimaginably huge. A jet plane flying at 600 mph would take something like 80,000 times the age of our universe to cross this void. I say this to emphasize the huge size of the voids that we are talking about, and in particular to draw attention to the fact that if the void is that huge, then the ratio of ring thickness to ring diameter could (hypothetically) have an enormous range of possible values.

Yet that is not what we observe.[12] One of the structure's most unexpected features is that the ratio of filament thickness to void diameter is about 1 to 10, roughly one order of magnitude. (Figure 18 shows this structure more clearly.) This is interesting because the filaments could have been much thinner or much fatter, compared with the diameter of the voids. There is no *a priori* reason for the ratio to be in the range of 1:10 (one order of magnitude). It could just as easily be 2, or 3, or 6 orders of magnitude. Why is the ratio of filament thickness to void diameter on the order of one order of magnitude?

5.8. Harmony-seeking, but not teleology

Stated differently, what reason could there be that a circular filament lying on the surface of one of these giant voids should have roughly the same geometric proportion as a wedding ring or an elastic band? In the absence of any current theory to give us a

10 In the original, Figure 16 is here. Caption: "Intergalactic voids and filaments (from [20])."

11 In the original, Figure 17 is here. Caption: Simulation of 3D structure, showing roughly how the ring-like filaments lie in space, on the surface of roughly spherical voids (from [21]).

12 In the original, Figure 18 is here. Caption: Screen shot of a simulation by George Lake and Tom Quinn (from [22]).

predictive model of the relative size (unless one fits the parameters just to get the result we observe), there is one unusual but possible theory. It is worth speculating that the universe itself – its action – is (among other things) making harmony-seeking computations, and that the results of these computations lead to a system of voids and filaments and define the proportion of ring diameter to filament thickness. This could explain why the proportion of thickness to diameter so closely parallels our own cognitive and intuitive sense about the natural proportion of an intuitively sensible and natural ring.

What exactly do I mean by this? I mean to propose that there is a certain class of mathematical structures, in space itself, that has features that, for spatial and computational reasons alone, gradually appear in space, not because of something that is caused by forces, but *because of the geometry of space itself*. In short, certain kinds of ring thickness to ring diameter are more likely to occur simply because of their geometry. For some essentially geometric reason, the universe chooses to go in this direction.

If this hypothesis holds up, it would provide us with a process that looks *like* teleology, *without being teleology at all*. It would indicate that there is, inherent in space itself, a motion caused by the whole that can be understood in mathematical terms that are quite simple. Even very small local modifications of space cause a reshuffling, or reorganization, of the entire system of larger local symmetries, sometimes extending far beyond the point where the disturbance occurred. A new global configuration introduces new latent centers, sometimes far from the original disturbance. Harmony-seeking computations then strengthen the latent centers that were at first only dimly present, and we see how space itself, by virtue of its geometric organization, can move towards new configurations.

This process is *like* teleology, because it provides the system with a constantly moving goal that forms new structures all the time. It does not come merely from the dynamic trajectories of the past. At the same time, it is not the anthropomorphic teleology that scientists very properly reject. Rather the system's next move comes from the current state of system, *including its latent structures*, not from some future or external hand. It is an internally-fueled trajectory, caused by the phenomenon of the geometrical whole.

Try the following experiment when brushing your teeth: spit the frothy toothpaste into a bowl of gently swirling water. The toothpaste then moves in ring-like swirls on the surface of the water, and once again the roughly circular swirling ring-shapes that are formed have a diameter to thickness ratio in the range of about one order of magnitude. I do not believe the ring ratio merely fits a cognitive niche. Rather, once again, I suspect that there are, hidden in the geometry of space itself, reasons why ring-like structures with this kind of ratio occur. In current jargon, rings of this particular ratio might be viewed as attractors in some phase space. However, the discovery of geometric attractors in the solutions to systems of dynamic equations is, in my view, only one particular manifestation of the far more general harmony-seeking computations that occur naturally in three-dimensional space. The tendency for such structures to occur might be shared over a wide range of circumstances, and the voids and ring-filaments in the cosmos might form in thickness to diameter proportions similar to those found in chains of foam in the bathtub, not for dynamic reasons having to do with physics, but for mathematical reasons having to do with the structure of space itself.

If we accept that the harmony-seeking computation is based on transformations that are (for whatever reason) largely congruent with human cognition and mentality, then we can consider such a process as explanatory even in the most outlandish structures.

This supposes that there may be mathematical reasons for the generation of circles or ring-like filaments whose thickness is just about one order of magnitude smaller than their diameter. There is, at the moment, no physical theory that would predict this, but, from the point of view of harmony-seeking computation, the cognitive simplicity of this ratio for a ring- structure could suggest that it might have to be so, for mathematical or quasi-mathematical reasons.

Is this strange? Yes indeed, to our ears it is very strange. Yet it is not more strange than Pauli's exclusion principle.[3] It seemed strange when first put forward, but is now widely regarded as one of the cornerstones of quantum theory. A purely geometric harmony-seeking computation might explain at least one aspect of the structure better than any current physical theory. In the absence of better computations, some reason needs to be found why such processes, congruent with cognition, might occur in structures at the scale of the universe and at the scale of human beings, and why the ring-ratios – in both cases – tend to be roughly similar.

6. Wholeness-extending transformations

6.1. Viewing the previous examples as computations

The previous examples all suggest the possibility of some kind of harmony-seeking computations at work in a variety of systems. In all cases, there is some kind of wholeness-extending process at work, mainly geometric in nature, sometimes intellectually graspable, sometimes not so clear. Apparently, as a result of this wholeness-extending process, at each step the generated configuration moves a given configuration towards a more harmonious, more coherent, state than it was in before.

We may regard *all* these examples – physical processes, simulations, and paper and pencil exercises – as *computations*, each of which takes its system forward, step by step, from an existing state W_1 to W_2, W_3, . . . W_i, W_{i+1}, increasing structure and harmony and wholeness in the system as it goes. These steps are carefully calculated, commonplace in many spheres of human experience and in many natural systems. Some of them are done by animal instinct; some by human instinct; some by adherence to a certain tribal sensibility; some by concern for ecology. Many occur naturally (without human intervention) as part of the behavior of some complex physical system.

I use the word *computation* with a variety of related meanings:

- *Intuitive computations*, made by craftsmen: hayricks; the bench around the tree; the construction of St. Mark's Square.
- *Conscious computations*, made by a designer, according to a consciously used scheme that calls for certain actions to be performed in sequence: the Emoto apartment building in Tokyo; the ornamental drawing by Nakano.
- *Natural computations*, possessing explanatory power for straightforward scientific problems that have not yet been solved: the development of the whorl tips of *Acetabularia*; geese flocking to form a V-shape (later).
- *As yet half-formulated harmony-seeking computations*, which may be implicit in the behavior of complex systems, and would shed important light on the nature of the phenomena: the formation of giant voids in the unfolding of the cosmos; the formation of blue sky and clouds with their complementary positive space (later); the growth of tree limbs to create positive space between the limbs (later).

> In these cases we might also talk about the system behavior, and the rules according to which system behavior develops. It is perhaps odd to call them *computations*: but if we wish to simulate the system behavior that leads to harmonious results, we may need to use such a computation as the explanation of the physical system's behavior.

In a generic sense they are all computations. But in nearly all these cases they are not recognizable as computations in the way we conventionally understand calculations or algorithms. There are reasons to believe that a fundamental kind of process is at work in all these cases. We need to examine these computations, and understand or extract the underlying way they work – all of them together. If we succeed in getting the gist of this type of computation, we may find a powerful new way of computing that is guided by emerging harmony, and by a motion towards harmony.

I view these examples as computations because they all embody some kind of single process that has the capacity, starting with an arbitrary configuration, to reach a better and more harmonious configuration. Although the idea of a wholeness-extending transformation is, for the moment, still somewhat loosely defined, there is considerable similarity between the examples – in the way that they work and in what they accomplish.

To learn to see these examples as embodiments of a single type of computation, we must be specific about what this deep seated type of computation might be, how it might work, and how we can put it to work to give better organization, better harmony, better deep adaptation and better coherence for some real-world configuration.

6.2. Experimental confirmation

My own experiments in cognition show strong agreement among observers as to comparative judgments regarding which steps are wholeness-extending and which steps are not (see [2] pp 51–84, especially pp 59–61). A step is a harmony-seeking step if it extends and enhances the wholeness structure. When asked, under experimental conditions, to compare different possible steps, starting from a given configuration, in terms of the degree to which the steps are wholeness-extending or not, people largely agree, based on their intuitions, or on their own cognition. This strongly suggests that the quality of "being wholeness-extending" is to some degree objective, that the phenomenon reflects an objective underlying physical reality.

If we ask people taking part in such an experiment [2] to make (in their own chosen terms) any kind of structural diagram in which they try to capture the wholeness of the thing they are looking at, the agreement among observers improves. When people make such diagrams before judging which steps from it are wholeness-extending and which are not, the level of agreement between observers goes up strongly. Even though their diagrams are not alike, the people who have performed such a private diagram-making process then agree more strongly with one another on what steps from that structure are wholeness-extending. This occurs even though the making of a diagram that describes the structure is a private matter, and people are given no special instructions about how to do it, and the different diagrams people make are dissimilar. After simply *attempting* to represent the structure, they can judge more reliably what is wholeness-enhancing and what is not. This, once more, is evidence that the phenomenon of wholeness-extending is real and objective as a phenomenon, with objective structural content.

6.3. The wholeness-extending postulate: always helping a larger whole to form

How may we formulate, mathematically, the character of the wholeness-extending steps that occur in the examples?

In each case there is a whole *W*, and within the whole a latent center *L* that is being modified, transformed, or reshaped, by a certain step. This latent center is the focus of the transformation, and the latent center sets the boundary of the geometrical and physical transformations that are then undertaken.

The larger whole *W* is often an order of magnitude bigger than *L*. The wholeness-extending transformation improves the structure of *W*, and to do so modifies *L* relation to its whole context. Thus the output from this step is a modification geometrically within *L*, but it is a function of both *L* and *W*. In addition, there is a sense in which *L* is being *fitted* to *W*, it is being made more congruent with *W*, adapted to *W*, harmonious with *W*. Further, in modifying *L*, new centers N_i are created *within* and around *L*.

To undertake this transformation in such a way that it is indeed a wholeness-extending transformation, the various N_i are generated by 15 generic types of transformation acting on *L*. These are *the* 15 principal center-creating and wholeness-extending transformations. The N_i can then become the bases for further transformations.

6.4. The wholeness-extending transformations of St. Mark's Square

Now look again at figure 15. In each cycle, the pink area is a latent center *L*. The next building is built inside *L*. The larger context of the whole St. Mark's area is *W*. However, there is now a subtlety. In a particular step, we know what *L* is, because we are looking back in time and see what the step was. But the people who did the step did not have this perspective.

They could not know what *L* was, until examination of the context and the larger whole revealed it to them. (And there is not always a unique answer. Sometimes *L* is obvious, but sometimes there are several equally good choices. Other choices will generate other St. Mark's Squares. Nevertheless, the total number of harmonious results from this process, even taking into account the variety of possible choices, is a tiny fraction of all possible moves, most of which are *less* harmonious.) A further subtlety relates to the context *W*, which is not so general as the whole St. Mark's area. It is, rather, a particular area within St. Mark's square, where the latent center *L* has been identified as in need of improvement, or presenting itself for elaboration and strengthening. This latent center *L*, which plays a crucial role in the wholeness-extending transformations, *and* the detailed effects, are created by the 15 transformations acting together. It is the immediate local context of *L* that then gives rise to the step that transforms *L*.

Alternatively we might say that each latent center *L*, once identified, is the entity to be transformed, and the transformation is to be done in such a way as to strengthen *L* in its ability to help and make cohesive the larger context *W*. The N_i of the transformation are the various buildings and partial buildings generated by the action of the transformations.[13]

13 In the original, Figure 19 is here. Caption: "A second look at one of the wholeness-extending cycles in St. Mark's Square (repeated from fig 15)."

In figure 19, the pink ellipse is *L*, a latent center formed by the three buildings around it. To enhance and strengthen *L*, the blue building mass is built, thus forming a stronger rectangular space by enclosure, and by establishing continuity with the buildings on the right of the latent configuration. In the process two of the original buildings are absorbed into the new one, which continues and extends the wholeness.

7. Harmony-seeking rather than "emergence"

In recent years, complexity theory has begun to see emergence of complex structure as a result of coupled local atomic events generating larger wholes through interaction. Such bottom-up processes are said to demonstrate "emergence". It is used to explain how birds fly in flocks [24], how ants accomplish complex tasks together [25], or how slime mold (apparently an uncoordinated aggregate of cells) is able to move coherently as a whole [26]. In most cases, the explanation is, in some form or other, that the individual agents mimic the behavior or action of their nearest neighbors, or base their next state on the state of their neighbors. In many cases this ultra-simple rule of action, plus some refinements, explains considerably coherent movements of the larger body of cells [27]. In other more complicated cases, the atomic actions of individual cells are coupled, and the coupling helps more complex forms of behavior to occur in the group [28]. In all these cases, the resultant aggregate seems to be acting as a whole.

However, I do not think that this bottom-up emergence, caused only by local interactions, can adequately account for the world's ability to generate highly-ordered, complex phenomena. When wholeness, or harmony, exists in a part of the world, what is under discussion is always the relationship of a given system to the larger world beyond that system. So the issue is not merely whether a group of elements act together. What is important is that when the elements are grouped together to form a system, the resulting system then either does or does not act in such a way as to sustain, or improve, the coherence and health of its own component systems, and also of some still larger system around it: some part of the world *both inside and outside and beyond* the group.

The phenomenon of bottom-up emergence is a *two*-fold relationship between a set of elements and the group they form. The *harmony* phenomenon is a *three*-fold relationship between a set of elements, the group they form, and the helpfulness of the emerging group, through adaptation, to an even larger portion of the world beyond the group.

In figure 20a we have a group of small elements (white circles), and because of their interactive coupling they act as a whole, represented by the middle-sized grey circle. In figure 20b we also have a group of coupled elements that act as a whole because of the coupling, but in addition, *this middle-sized whole acts to support or help the coherence of a still larger system*, represented by the outermost black circle. The first system is interested only in itself: it does nothing to help the world beyond it, and does not contribute harmony to the world beyond it. The second system is not only embedded in the outermost ring: it *helps* that ring, and establishes harmony between the middle ring of rings and the largest ring, so that the middle ring is well adapted to the largest, and the largest benefits from the existence of the middle ring.

I now compare the doctrine of emergence from local, bottom-up interactions, with the richer notion that in many cases there is a *whole-based, harmony-seeking process that originates in wholeness*, works by continually strengthening latent centers that appear in that wholeness, and thereby operates on the larger wholeness that exists – all in such a way as to generate a new and deeper wholeness.

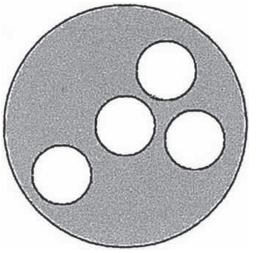


Figure 16.20a Emergence, a two-level relationship.

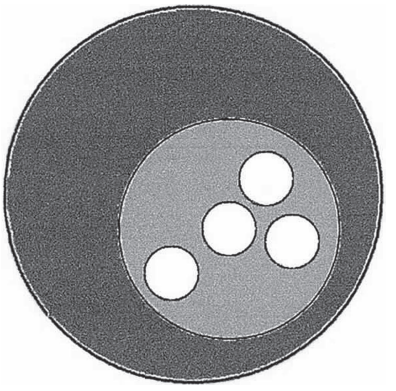


Figure 16. 20b Harmony, a three-level relationship.

7.1. What does it mean for a system to help a larger system?

In the example of St. Mark's Square, in each cycle the process (through human agency) identifies a latent center in the larger configuration. This latent center, if strengthened, would improve the coherence of the whole.

The larger area immediately around that latent center is then enhanced and made more coherent by the transformation of the latent center.

Abstractly we may express this concept by looking again at figure 20b. The middle, grey system is a latent center, a weak system that has the capacity to enhance the coherence of the black system beyond it: and it is able to do so by creation and modification of the small white systems – they are built and shaped to create more coherence in the grey system. However, the key point is that the enhancement will not take place, unless the grey system then *also* helps to enhance the larger system beyond it, the black one.

This three-level structure is a matter of common experience both in nature and in everyday affairs. In a family, for example, the individual members of the family do what they can to help the family be coherent, and one of the most effective ways this can be made to happen is through a situation where the family as a whole makes a positive contribution to the village. The individuals become stronger, and the family becomes stronger, as a result of the help they give to the village which contains them. We observe a similar phenomenon in the edge ecology of a river. It may be said that

if the two lower levels do not reach out to help the coherence of a larger system, their own coherence is likely to falter.

In general, the way that smaller systems are modified and arranged to help the coherence of larger systems, in the fashion described above, is too easily lost in too much focus on bottom-up "emergence". Emergence, in the form that is currently popular, is thought of as a two-level phenomenon: the emergent property and the level below. The appearance of "helping" in the world, depending as it does on transformations which increase coherence in the large, is crucial, and embraces a higher level: the wider environmental aspects of a larger system.

7.2. Example: flying geese and the V-formation

Bird simulations, due to Reynolds [29] and others, provide models in which the particles fly about, avoid each other, all go in the same direction, flock, play: altogether, simulate some of the behavior of birds in a fairly realistic fashion. When used to model bird flock behavior, there is a surprising realism in some of these models. However, simulations of this type do not do as well when it comes to generating more complex formations, such as the characteristic V-formations of migrating Canada geese (figure 21).[14]

When flying in V-formation, Canada geese can increase their flying range by up to 70%, because they use less energy, as a result of the vortex interactions [30–32]. When aircraft arrange themselves in similar V-formations, similar energy savings are experienced [33]. But that does not explain *how* the V-shape comes about in the case of migrating geese.

Let us consider what real geese may be doing to achieve the V-formation. Reynolds' three basic boids [sic] rules (as most frequently given) are these [34]:

1 Collision Avoidance: If you are about to crash into another bird, change direction or reverse direction.
2 Velocity Matching: Attempt to match velocity with nearby flockmates.
3 Flock Centering: Fly in a direction that moves you closer to the centroid of the nearby birds.

   This system of three rules generates *general* flocking configurations, to an extent that seems amazing the first time you see it. But these three rules, alone, certainly do not create a persistent, stable, *V-formation*. To do that we need to add two further rules.

4 Try to fly along the sweet spot, or line of maximum uplift, or the vortex cylinder of the bird in front (which the geese can do because they can sense the change in pressure and the easier ride in that position).[15]

14 In the original, Figure 21 here. Caption: "The V-formation of Canada geese. It is most interesting to look at the spaces between adjacent birds. In each case there is a rectangle of empty space formed by the left wing of one bird, the right wing of the other bird, and the two bodies. You may see these rectangles clearly in this photograph and in Figure 23b. They play a crucial role in generating the overall coherence of the V-formation.

15 In the original, figures 22a and 22b here. Caption to 22a: Figure 22a. In a bird, as in an airplane, there are two vortex cylinders behind the wingtips, each rolling towards the center. The zones of maximum uplift are visible along the outer edges of the drawing, along a line some distance outside the vortex axis. The same maxima of uplift are also shown in Figure 22c, as dotted lines. (From [35]). If you look at the

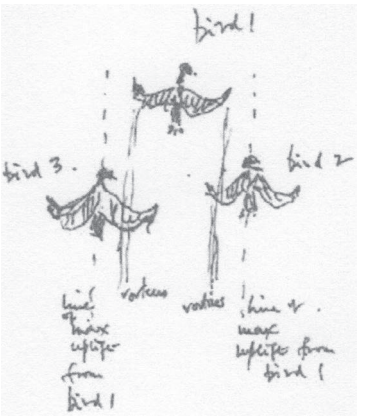


Figure 16.22c (CA drawings of birds in flight): Here each bird flies in the outer wake of the bird ahead of it, since this is the spot that takes the least energy – just like riding a bicycle behind a bus, to catch a ride from the uplift in the airflow.

The optimum uplift positions are in the outer wake of the bird ahead, off-center from the bird's axis [37]. A sophisticated algorithm would have to model the aerodynamics to identify the position of this sweet spot. A simpler (and more easily constructed) algorithm would merely need to identify the spot outside the wake (figure 22c), and give positioning in that area a high probability.

5 Finally, if you are the leader at the tip of the V, you have the smallest energy advantage in the flock. So, after a while, drop away, and let another bird take your place. This causes the V to regenerate continuously, and lets each bird carry an equal share of work.

When we use all five of these rules, I believe the dynamics will now generate a stable V that regenerates itself continuously.

We may easily see how this structure of events is a harmony-seeking computation, not merely an example of bottom-up emergence, since it has the three-level structure postulated earlier (figure 20b). The new rules of action require that the birds compute in a way that makes a local center (the bird's own body) work to create a second level element (the positive space shown in figure 23b). These second level elements are strung together to form the third level diagonal structures of which the V-formation is formed), thus demonstrating the action of the three-level structure.

The algorithm needs to be yet more subtle. Vortices form during flight, as shown in figure 23a. The shaded space between adjacent birds (figure 23b) is a positive shape, composed by one bird's left wing, the other bird's right wing, and the two bodies. Two birds can discover, through experience, that there is an optimum ride when they are in a position in which the left wingtip of one is approximately in line with the right wingtip of the one ahead of it, generating the rectangle in space. At that spacing the vortices cancel, minimising turbulence [38]. This relies on the positive and definite shape of the space between the birds, which strengthens the stability of the dynamic configurations.

Now we see how the three levels work together. Elements at level 1 (the birds) form chunks of positive space between adjacent birds. These rectangular chunks of positive space are the elements of level 2. The birds experience the best functioning when they

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cross section in Figure 22a, you see that the line of maximum uplift is parallel to the vortex cylinder, but outwards from it, and it is this line that gives the second bird its maximum uplift.

Caption to 22b (jet airplane in flight): Figure 22b: The cylinders of vortices seen as two outer parallel trails emanating from the wing tips. (The inner trails come from the engines.) (From [36]).



Figure 16.23a The vortices formed in a V formation (from [38]).



Figure 16.23b Position of the virtual rectangle of positive space between two birds.

are forming these chunks of positive space between them. The chunks of positive space then join up to form a coherent diagonal (elements of level 3), and these are the diagonals we see as the V-formation. This can only be generated by using a computation that looks at the whole, and the emerging structure of the V-configuration as a whole.

This situation cannot in principle be modelled properly without a harmony-seeking transformation based on the structure of the whole V as a guiding field, because the computation needed to generate the V is a computation that explicitly relates the individual to the whole. See figures 22 and 23.

The current enthusiasm for "emergence" as evidenced in bottom-up boid-like computer games and simulations does little to unravel the real and more subtle problems of the whole and its organization, which hinge (almost always) on the way that small

parts *work to help the coherence of a larger whole*, and the ways that the larger whole then also shapes and modifies the action of the smaller parts.

The real issue is that the emergence that is being attributed to the birds (when they are viewed as mechanisms) is not as dumb or mechanistic as some emergence enthusiasts like to think. To produce the V-formation, the birds themselves have to perform a harmony-seeking computation, in the way that they act to relate themselves to the larger whole, and to help that larger whole. This computation might be performed geometrically, by using the diagram illustrated above which offsets the bird behind by a certain ratio of the wake angle. Or, equally well, the computation might be performed physically by relating the bird's position to the sensed pressure. These two computations, though different, are nearly equivalent. In both cases, the fact that matters is that the birds themselves perform this harmony-seeking computation by relating themselves to the larger whole in a certain way.

7.3. Example: clouds and the positive space that arises between them

(...)

7.4. Example: the branching shapes of real trees and the positive space between the branches

The nature of POSITIVE SPACE as an active principle, which plays a major role in harmony-seeking computations, may be understood further by looking at the growth of trees. If we look at a tree we see volumes of positive space between the branches. It is visible, for example, in figure 28. So, apparently, the empty space between the branches must, like the blue sky, have a driving force, for it to be a definite "thing". How exactly might this be explained? The space between the branches has no obvious energy to push and create its positiveness.

Prusinkiewicz has made great progress by simulating tree growth through the use of L-systems, and has recently developed "environmentally-sensitive" simulations, which create more realistic structure that develops, in part, according to neighbour conditions [40] (figure 29)[16]. But the idea of empty space as positive does not yet have an accepted mathematical formulation in L-system theory, which focuses on the growth of branches, twigs and leaves. The L-system simulations that I have seen lack the positive character of the space between the branches in figure 28.

One can readily account for the positive space phenomenon as it occurs in trees.[17] The twigs and leaves in a growing tree are phototropic: they look for the light. (This *is* simulated in environmental L-systems.) The tree also needs air and breeze, and the leaves and twigs and branches modify their growth to allow the passage of air, and to avoid crowding of leaves that deny them light. Thus, the "empty" volumes of space that nestle among the leaves are highly sophisticated systems, as necessary to the tree as the complementary organization of limbs and branches that provides structural strength and the flow of sap. As in all systems of positive space, the one system complements

16 In the original, Figure 28 here. It is reprinted on the following page

17 In the original, Figure 29 here. Caption: "An environmental L-system simulation of tree growth in two adjacent, interacting trees (from [40]). The spaces between branches still lack the intensity as centers caused by the action of each volume of space as a system in its own right."



Figure 16.28 A sketch of mine showing a real tree as it typically is in winter, and strongly showing the positive space generated between the tree's branches.

the other. Both are necessary to the tree's living character. In this case, observation of the harmony-seeking calculations performed by the action of the tree teaches us more about the tree as a system, and could allow us, if we chose to do it, to write more convincing algorithms of a tree's morphogenesis.

Environmental L-Systems currently model the tree's environment in a manner very different from the way they model the growing tree itself, typically using a conventional simulation rather than a growth grammar. I wonder if an extended new type of

L-system might be constructed that allows two parallel and complementary growth grammars, (1) one for the branch and leaf system and (2) another for the system of space volumes between the branches, the two being coupled to evolve and unfold in parallel, and in a way that makes each the inverse or geometric complement of the other? I believe such a model is likely to provide a more accurate picture of the real structure that is generated in plants and trees.

8. Wholeness-extending transformations and symmetry-breaking

8.1. The possibility that wholeness-extending transformations are deep generalizations of symmetry-breaking

As part of an analysis of the evolution of natural phenomena and configurations, Stewart and Golubitsky were perhaps the first to lay emphasis on the phenomenon of symmetry-breaking [41]. The regular spacing of dewdrops on a spider's web is a case that they discuss in detail (figure 30). The water on a thread of the web starts out as a uniformly coated cylinder of water, made roughly uniform in thickness by surface tension. When the surface tension starts to break up the continuity of the coating, the configuration falls apart, but still repeats at least some of the symmetries present in the continuous cylinder, since there is no reason for all *those* symmetries to be removed as well.[18]

This idea is similar to that of a wholeness-extending transformation. We have a structure: in this case, the infinite translational symmetries of the cylinder along the thread, and the rotational symmetries of the cylinder around the thread. As this system moves to a fragmented version (caused by the action of the surface tension, or by jiggling of the thread), the simplest end product is a configuration that destroys the fewest possible number of symmetries. Golubitsky and Stewart's work on symmetries in the equation systems of bifurcation theory continue such ideas [5].

This one way of preserving structure is somewhat limited, if compared with all the possible ways of transforming a system while preserving and enhancing structure. Thus symmetry-breaking alone, as an interpretation of what is going on in the simple dewdrop example, is geometrically too limited. Each dewdrop also takes on local spherical symmetries and axial symmetries normal to the thread, and symmetries parallel to the thread but not aligned with it, that are not present in the symmetry scheme of the infinite cylinder.

In my view, the symmetry-breaking idea is not yet sufficiently developed to be useful as a general theory explaining complex configurations, or to account for the harmony-seeking phenomenon. "The" wholeness consists of the entire system of overlapping local symmetries at a wide variety of scales in a configuration [1, pp. 79–142 and 446–452]. We need to have a view where the underlying structure of all these symmetries, working together, is preserved. And further, the centers in a given wholeness are not all LOCAL SYMMETRIES. Other centers are formed by GRADIENTS, ECHOES, THICK BOUNDARIES, DEEP INTERLOCK, POSITIVE SPACE, NOT SEPARATENESS, and so on. These other properties, and the entire structure, too, have to be preserved when a harmony-seeking computation

18 In the original, Figure 30 is here. Caption: "Dewdrops on a spider's web [from Fotosearch.com]."

starts with a currently existing structure, and finds its way to a stronger structure that is latent in this overall configuration, and can be brought out by a few transformations.

In summary: a wholeness-extending transformation is a more complex and richer version of the phenomenon whose simplest cases have been called "symmetry breaking" or "symmetry reduction". This nomenclature is rather over-simplified, and does not do justice to the real potential complexity of the underlying phenomenon. A wholeness-extending transformation moves a complex configuration forward, retaining as much of its wholeness structure as possible, and drawing new structure from the latencies within the wholeness itself. In so doing the configuration becomes richer and more complex in unforeseeable ways that benefit the larger whole.

8.2. Local symmetry production

Even in the well-known cases of symmetry reduction, what we see, if we look closely, is symmetry *elaboration*. The infinite Euclidean 3D-space does indeed lose some global symmetries. But at the same time, LOCAL SYMMETRIES are strengthened, or generated where none existed before. This is a better picture of how harmony-seeking computations work. The failure to see it, comes, I think, from the fact that in recent years the symmetry structure of the plane and of the 3D-continuum, have been viewed too simply through the symmetries *of the whole*. It has not been sufficiently clear that there are, hidden in the plane, or in the continuum, an infinite number of *smaller local sets*, all over the place, some of which are themselves symmetrical, while others are not. There is an infinity of systems of smaller and smaller symmetries that occurs in these nested systems of sets. (Many physical examples of the presence, and density, of local symmetries in a structure are described in X[1]X). What happens when a whole evolves under harmony-seeking computations, is that many of these smaller symmetries are strengthened or generated where the latencies are strongest, thus gradually generating a hierarchical nesting of local symmetries at different levels of scale.

(....)

8.3. Example: snow crystals

Another illustration of the deficiencies of algorithmic computations in morphological matters lies in attempts to simulate snow crystal formation using Diffusion Limited Aggregation (DLA) and cellular automata (CA) methods. The results of these simulations do not accomplish the extraordinary variety and beauty seen in real snow crystals. Bentley photographed some 5,000 snow crystals [42], and his precise and exquisite photographs show us the kinds of structures that a successful computation must be able to create (see figures 33 and 34 for examples). In particular, we see LOCAL SYMMETRIES, DEEP INTERLOCK, POSITIVE SPACE, and GOOD SHAPE in these snow crystals, at levels that are common in works of art. Such features show up, only weakly, in the DLA or CA simulations.

The prevailing theory of snow crystal growth (described in [43], with simulations on the website [44]), is that the crystal grows outward starting from a small hexagonal plate. The six arms grow similarly, maintaining the six-fold symmetry, because the

conditions of temperature and spatial constraint, although changing, are roughly the same on each arm at any given moment in the crystal's growth.[19]

However, if you examine figure 33, you see that in addition to the six-fold symmetries, there are other symmetries. Most noticeable is an alternating pattern: three arms have one pattern, and the other three alternating with them have another. This may be seen in the moth-like figures that occur on the three arms that are 120 degrees apart.

Figure 34a, showing a simple plate crystal, has another aberration. Again, there is relatively uniform six-fold symmetry, centered on the six vertex axes as usual. However, if we look at the outer edges of the hexagon, along the three faces pointed to by the blue arrows, we see that these sides have a different symmetry: a shape that has two ogive S-curves (rather like a valance on the top of an 18th-century cupboard) just along the outer edge of the hexagon. This new symmetry is three-fold, and is based on three axes that are edge-centered, not vertex-centered.[20]

In figure 34b, there is a configuration where a figure like a pair of chromosomes appears within a conventional six sided plate, but shows up only twice, 180 degrees apart, thus introducing yet another symmetry.

Further information has been obtained by Ukichiro Nakaya, who observed and photographed thousands of snow crystals, and also experimented by growing them under controlled conditions [45].

The non-six-fold phenomena do not seem to be explained by the assumption [43]that the crystal's symmetrical growth is caused by uniform temperature variations on all six arms at the same time. Instead, there must be other mechanisms that generate a variety of alternating three-fold symmetry and two-fold symmetry. These various symmetries need to be the focus of our investigation, not only the overall growth. Some larger wholeness-extending transformation is entering into the computation. The three axes of symmetry now coming forward are not a subsystem of the original six growth axes, but new ones that are interlaced among them. I believe (but have not yet shown how) the phenomenon can be explained by strongly invoking the LOCAL SYMMETRIES transformation, but not as a part of the simple kind of growth mechanism described in [43]. It seems that only a model based on a nested, multi-level system of symmetries and axes of symmetry can ultimately provide an adequate explanation. Such a model may be a step towards a capability of modeling the general character of highly ordered structure at many levels simultaneously.

9. Wholeness-extending transformations and complexity theory

9.1. A small modification needed in the work of the modern masters and complexity theory

What I have said in the forgoing, can be simply summarized. Consider the modern masters: Benoit Mandelbrot, Brian Goodwin, Ian Stewart, Przemyslaw Prusinkiewicz,

19 In the original, Figure 33 is here. Caption: "A snowflake with two three-fold symmetries (axis- and face-oriented) appearing within the six-fold scheme (from [42])."

20 In the original, figures 34a and 34b are here. Caption to 34a: "Three-fold symmetries (axial and face-oriented) appearing within the six-fold scheme (from [42]). Caption to 34b: "A two-fold symmetry appearing within the six-fold scheme (from [42])."

Deborah Gordon, Craig Reynolds, *et al*. We must, and do, take off our hats to them. But if we examine the contributions made by complexity theory, we see that while making enormous strides, it has fallen slightly short in one all-important respect. It tries to explain complex emergence as a product of coupled interactions among local events. Yet, when one examines in detail what is actually going on, and what is emerging, it turns out that there is, in every case, some aspect of the emerging whole that cannot be properly explained by this approach. The aberrations are small, but not small enough to be overlooked. Although complexity theory seeks to explain the whole that emerges through analytical bottom-up means, it is the whole, the real whole in the world that makes us marvel in the first place, that is propelled by a second process, which is both whole-driven and whole-oriented.

I reiterate: this whole-seeking or harmony-seeking process is not teleological, not goal-seeking (see also §5.8). Instead, it comes about through a computation performed on the structure that exists, that brings to fruition a larger, unanticipated new structure of wholeness. The existence of such a computation, in virtually every creative process in nature and in art, perhaps embodies the real creativity of the universe at work.

I believe there is a realistic chance that this creative emergence, where the whole inspires the emergent structure and gives it direction, can, at least in part, be encompassed by a computational formula. This hinges on the construction of a new mathematical formalism in which nested systems of symmetries and centers are acted on by the transformations I have described, and where the future (the $(t+1)$-trajectory in phase space) is determined by action on the latent structures already present at time t, where these latent structures, too, are couched and described in terms of symmetries and centers.

(...)

10. Wholeness-extending transformations

There is a single theme present in all these studies: atomistic, bottom-up computations cannot adequately describe what is really happening in the world, and do not describe the especially important processes that *enhance the structure* of the world, that bring order into configurations in the land, in nature, in buildings deeply adapted to the land and deeply adapted in their internal structure.

It is not only large-scale configurations that benefit from this insight. Every configuration, at every level, is working to help the coherence of some larger configuration in which it is embedded. This runs up and down the ladder of scales, and must do so in any living world. A successful computation emulates this upwards- and downwards-reaching process. Purely bottom-up forms of calculation, not invoking this principle, will always remain too sterile to be real or profound.

10.1. What is the underlying process involved in these harmony-seeking computations?

I am proposing not only that we consider these many real world systems as computational processes. We need to find out how they work, and how, in particular, they work to allow the unfolding of structure, under the impact of wholeness. This requires a form of representation that is new. It has been sketched, in broad brushstrokes, in [1, 2]. We now need to find ways of describing this unfolding in more well-defined

mathematical and computational terms. That will be a long job. My colleagues and I have, in the last few years, gained insight into the nature of the harmony-seeking computations, but we are far from understanding them in detail. That task must now be undertaken, hopefully by many dedicated scientists together.

The phenomena I am talking about cannot simply be grouped under what is loosely called emergence. The emergence of wholes in the world does not come about by autonomous processes that happen to aggregate themselves to form wholes. Rather, the phenomena are the wholeness-extending processes I describe.

10.2. Wholeness-extending transformations

In all the real-world examples, the common phenomenon is that the computational steps are wholeness-extending transformations. Each wholeness-extending transformation operates on one wholeness to produce another in such a way as to preserve, or embellish, or enhance the global structure of the first.

$$W^{\mathrm{WE}}_{1\text{—}}\,1 \rightarrow W^{\mathrm{WE}}_{2\text{—}}\,2 \rightarrow W^{\mathrm{WE}}_{3\text{—}}\,3 \rightarrow W^{\mathrm{WE}}_{4\text{—}}\,4 \rightarrow$$

The mathematical description of a wholeness-extending transformation is the subject of future work. However, there is abundant evidence that the concept of being wholeness-extending is well-defined and objective, in the sense that different observers largely agree among different possible transformations of a given whole, which ones are more wholeness-extending and which are less so.

10.3. Models of the wholeness in a given configuration

To establish the character of wholeness-extending transformations, we begin with five postulates about the structure of wholeness:

Postulate A1. In any configuration we see certain salient wholes, or centers. Each of these wholes is an identified, spatially contiguous subset of the configuration that corresponds to something we see, or experience, as an entity.

Postulate A2. The sub-configurations may be spatially nested, or overlapping, or disjoint.

Postulate A3. Each sub-configuration has a measure associated with it, the degree of coherence or saliency within the larger whole.

Postulate A4. Latent centers may be low in saliency, almost invisible, but nevertheless coherent configurations in their own right, created by others in the configuration. It is these latent centers that play the biggest role in the evolution of the configuration, and in any wholeness-extending process.

Postulate A5. The wholeness is defined as the system of configurations, each one specifying its coherence, and each connected with other configurations which are part of it, or of which it is a part.

We also state four postulates about the definition of wholeness-extending transformations:

Postulate B1. A transformation is considered to be wholeness-extending if it elaborates existing centers or latent centers, and does not introduce new centers that violate or ‘cut across’ existing centers.

Postulate B2. The best latent center to work on is the latent center whose improvement or repair, would (probably) do the most to increase the coherence of the whole configuration.

Postulate B3. A successful transformation's transformation must always have positive morphological impact on the structure and coherence of some still larger whole.

Postulate B4. Once a transformation's transformation has been applied, new latent centers, not present or not visible before, make their appearance on the backs of the newly introduced structures. It is this process that continually generates newness in the evolution of the configuration.

10.4. A few examples of harmony-seeking computations

Each of the examples in this section (figures 40–45) is relatively simple: the same paradigmatic cycle is followed each time.

- Frame 1: a configuration
- Frame 2: identifies the locus and extent of some latent center in that configuration – one that, if consolidated, would help the whole to become more coherent.
- Frame 3: establishes smaller centers to embody and solidify that latent center.
- Frame 4 (when present): establishes yet further enhancement of new latent centers that have been generated.

The steps taken in going between each frame in each example are some conglomerate of the 15 wholeness-extending transformations.



Figure 16.40 STRONG CENTER → LEVELS OF SCALE → DEEP INTERLOCK → LOCAL SYMMETRIES

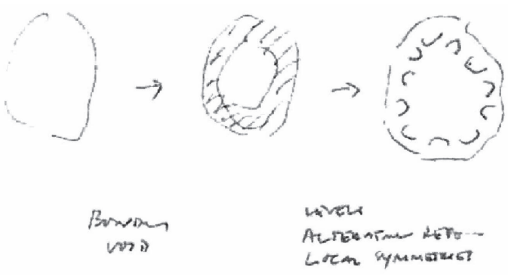


Figure 16.41 THICK BOUNDARIES, THE VOID → LEVELS OF SCALE, ALTERNATING REPETITION, LOCAL SYMMETRIES



Figure 16.42 → STRONG CENTERS, LEVELS OF SCALE → LOCAL SYMMETRIES

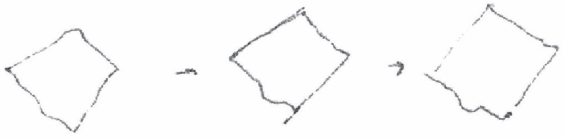


Figure 16.43 → THICK BOUNDARIES, THE VOID → GRADIENTS, LEVELS OF SCALE, ALTERNATING REPETITION, ECHOES



Figure 16.44 → POSITIVE SPACE → GRADIENTS, LEVELS OF SCALE → POSITIVE SPACE → MORE LEVELS OF SCALE

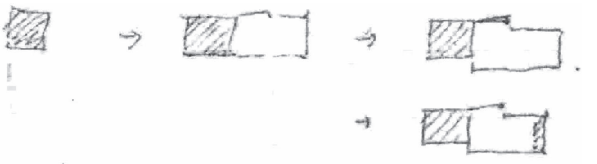


Figure 16.45 → GRADIENTS → SIMPLICITY → POSITIVE SPACE → LOCAL SYMMETRIES → CONTRAST

We can also see how symmetry elaboration is happening at each step. The space is differentiated, holistically, by an injection of LOCAL SYMMETRIES. The symmetries that appear, in most cases, appear because other symmetries are struck out, leaving the coherent form we see. Because of this symmetry-breaking aspect, the injecting of local symmetries is wholeness-extending, not wholeness-destroying. However, it obscures the core of what is going on to think of it in this way *exclusively*. It is more illuminating to focus on the fact that local symmetries of various kinds are being created. The kinds of local symmetry being created, when created well, enhance the underlying structure.

Such a procedure is creating structure in a new way. It may be done by an artist, with an intuitive grasp of the underlying latent structure, at each step in the unfolding of the whole. Or it may be done by an engineer, consciously. Socially speaking, this is a new kind of process, a new function for artists, and a new challenge to engineers, architects and planners. This new kind of work demands enormous concentration and attention.

The intuitive act is nevertheless a computation, and we may be able to pin down what *kind* of computation it is. Then, if we can succeed in making a harmony-seeking computation, perhaps helped by a computer working to achieve similar holistic results, it will be because the thing we recognize intuitively as coherent or whole, is, mathematically, a particular recursively generated structure of symmetries and centers that have the 15 properties in them. It is this underlying structure that allows the human mind, and natural processes, both, to follow this path and to seek wholeness in the way they do. Most important, we may become conscious about this process, and consciously use this kind of computation to improve the coherence and harmony of our world.

11. Conclusions

11.1. Fact and value

The architectural examples, and the example of the cosmological structure of voids and filaments, bring the potentially extraordinary nature of harmony-seeking computations into sharp focus. In the parlance of 20th century thought, designing a building is a matter of personal *taste*; it has essentially nothing to do with *fact*. On the other hand, the dynamics that lie behind the distribution of matter in the universe is undoubtedly a matter of fact, although the facts may be still poorly understood and much debated.

No matter how subtle our perception of a building design and its harmony might be, the idea that we treat its structure as a matter of fact may seem absurd to present day scientists, if they follow 20th century thought. It is, for the moment, still a contemporary article of faith that the goodness of a building is a matter of *taste*, not of fact. The harmony of the building cannot be (according to 20th century thought) a matter of fact in any sense. The mental protocols of 20th century thinking have forbidden it.

Here we come to a profound change lying in wait for 21st century science. It is a matter of historical record that scientists of earlier eras – indeed, many of the great scientists of earlier eras – had no difficulty in thinking of the great harmony that exists in the world. Pythagoras's phrase "the harmony of the spheres" was not an idle one. Newton considered the progress of the universe, in the large and in the small, to be entangled, inevitably, with a movement towards harmony, and with the greater harmony of the world as a necessary underpinning for the discoveries of science [46]. Leibniz, Kepler, and others thought the same.

When we consider the quality of a building merely as a matter of taste, this strongly limits our ability to understand its harmony. When we consider the evolution of the universe as a mechanical process that can best be modelled through value-neutral means, this also strongly limits our ability to understand the ensuing harmony, and creates a real possibility that we shall ultimately fail to understand the physics.

The possibility of harmony-seeking computations ventures into this forbidden domain. It is undoubtedly challenging to define and expand this concept so that it can become an effective part of the way we think about the world. But it may play a considerable part in reopening a door that has been closed for too long.

11.2. A new science of harmony-seeking computation: when and where?

A new science of harmony-seeking computation and wholeness-extending transformations can make amenable to computation phenomena that are beyond the reach of

conventional computational methods. It can help to open doors to the global qualities of harmony, figural goodness, ecological health and structural coherence – even value itself – as possibly computable features of configurations.

One first practical item on the agenda is to provide well-defined versions of the 15 transformations in *NoO*. This is a difficult task, for three reasons. Firstly, the 15 properties, though defined with some precision, remain somewhat elusive. Defining computational operations that can induce these properties in arbitrary configurations is challenging. Secondly, it is difficult to define them as transformations, since this presupposes a language of configurations that is amenable to transformation. Thirdly, some of the transformations are harder than others to define operationally in sufficiently concrete terms. For example, LOCAL SYMMETRIES, THICK BOUNDARIES and LEVELS OF SCALE are relatively easy to define. POSITIVE SPACE and ECHOES are harder. SIMPLICITY AND INNER CALM and NOT SEPARATENESS are among the most difficult.

Despite these difficulties, I am reasonably sure that the task of dealing with all 15 transformations can be accomplished, and open the door to a fully fledged, though first-draft, science of harmony-seeking computations. First steps have already been taken (for example, [47–50]). Harmony-seeking computation may then sit alongside other methods as a new tool in an armory of well-founded computational techniques. It is likely to be appropriate whenever a computational task is defined by adaptation and wholeness, with reference to the position some system has in some still larger whole, or by a desire for beauty, or life, or elegance. Complexity theory, architecture, biology, ecology, physics, cosmology – and computation – may then all be more firmly rooted.

12. Acknowledgments

I should like to record my very great thanks and my debt to Susan Stepney, for her patience and insight in editing and discussing this paper with me, while it was prepared for publication. I would also like to thank the anonymous referees who gave many constructive and helpful comments.

Notes

1 Throughout the four volumes of *NOO* [1–4], I call these transformations that move a system forward in time *structure-preserving*. This term is sometimes used in mathematics to refer to transformations that preserve some particular structural aspect of a given system, but by convention the particular aspect may be arbitrarily chosen. As a result of many discussions with colleagues, I have concluded that "structure-preserving" is not quite the right name here. The transformations are structure-confirming, structure-enhancing, structure-extending, structure- strengthening, structure-sensitive. Mere "preserving" sounds rather too static, too simplistic, and too arbitrary for the more active unfolding. The transformation preserves the whole, which is not arbitrary, but an objectively present feature of reality. Ability to see this feature of reality is dependent on training, on experience, on the observer's learned ability to see the whole. We might better call these transformations *wholeness-extending*.

2 Susan Stepney raised the question: What if the existing structure is ugly? Can it be made beautiful by this process (like sand in an oyster resulting in a pearl), or should one not start from there? The answer is, in varying degrees, both. In nature, structure generally grows from very small disruptions in a simple and almost pure homogeneity. The beauty is there from the beginning, and continues as the system evolves. Human created ugliness always arises from moves that are non-wholeness- extending. Among human-made urban landscapes, where

ugliness is common, it is tempting to tear down and start again. However as an architect, I myself usually resist this temptation, and leave much of the ugly part, pruning out only the worst. When wholeness-extending transformations are applied to this softened ugly place, it soon brings the system back to order, and leads to more wholesome results.

3 Pauli's exclusion principle (see, for example [23]) states that no two fermions of the same kind (for example, no two electrons, or two protons, or two neutrons) can be in the same quantum state at the same time. What this amounts to in atoms is that the electrons can form only certain mathematically symmetrical patterns, and results in the chemical properties of atoms. This is a quasi-geometric principle, consistent with the antisymmetric nature of a fermion's wavefunction, that has no known "force-based" explanation.

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17 Conversation with Rem Koolhaas, 2006

This conversation took place at Meadow Lodge in 2006. Rem Koolhaas was particularly interested in CA's diagrams in Notes on the Synthesis of Form, *but the conversation touched on many topics – and judging by the transcript, was lively and enjoyable. It included insights into CA's view of his own education, the diagrams in* Notes on the Synthesis of Form, *the relationship between politics and generative processes, the relationship between text and pictures in books, and many other things. The conversation, which also included the art critic and curator Hans Ulrich Obrist, was in English, and the version printed here is based on the original transcript, reviewed and corrected by CA.*[1]

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Rem Koolhaas: You were born in Austria and educated in England. When did you move to England? What kind of milieu do you came from?

Christopher Alexander: My family moved to England in 1938 because of the Nazis. My mother and father were both teachers, my father's still alive, he's 99. They both grew up in Vienna. I know relatively little about my mother's family. I know her father was a banker or something like that. It was a Jewish family but she was brought up as a Catholic. My father's side of the family had a variety of different things. His grandfather was a country doctor on the border of Czechoslovakia.

RK: Are there any Austrian elements in your make-up or character or thinking? Is it in any way important for your life?

CA: Mahler! Mozart! And perhaps a little touch of Kaiserschmarrn. [laughter]

RK: And also Freud and Schiele?

1 A German translation of the conversation was published: "Von fliessender systematic und generativen Prozessen: Christopher Alexander im Gespraech mit Rem Koolhaas und Hans Ulrich Obrist," *ARCH+ 189: Entwurfsmuster*, October 2008.

DOI: 10.4324/9781003187516-19

CA: Egon Schiele you mean? Yes indeed. But more especially Nolde and Heckel. The German painters.

RK: We've been looking at your lines, and we want to talk about your lines and your diagrams and trying to probe where you learn to do this. We've been looking at your books, and we want to talk about your diagrams, the lines of drawings and try to probe where you learn to do this. They are in a way expressive diagrams.

CA: I do feel quite strongly related to those painters, and to Klimt also, but it never occurred to me to get help from their work. I just worked, and then in what I did, later I found an affinity, perhaps, in my spirit and in the materials of these men.

Hans Ulrich Obrist: I have to specify. We would like to talk about three books: "The Synthesis of Form", "A Pattern Language" and "The Timeless Way of Building". When we looked at the lines in "The Synthesis of Form" we were wondering whether there is a link to Expressionism.

CA: Not a conscious one. It's not really an intellectual heritage, it's just that what I feel in here [points to chest] probably is certainly more Austrian than English. It's that inner feeling that you have . . . how can one put it into words? It's got to do with a state of mind, which is very dear to me. I remember once, I was traveling and for some reason I had to go to Vienna on the way back, and I hadn't been there for several years. I was so excited to be there, literally as I came down the steps of the airplane I got down and kissed the earth (actually the asphalt), which was very strange. What made me do that? It was quite a long time ago, probably in the late'70s.

HUO: [showing "entire village" illustration] We were wondering, in terms of Expressionism and those lines, how you made these drawings. They're not made with a computer. There is something of woodcuts?

CA: I made them with a magic marker. You need a firm hand to do that.
[Laughter]

RK: This is not quite a hand drawing.

CA: This was made before computers. I mean, around 1960 I used to use a computer as big as a building, which all of us used at MIT. But in those days you couldn't use computers for graphics the way it is possible now in Photoshop. I used to make photostats. If I made a drawing I'd make a photostat, and then I would blow the photostat up and then edit it to perfect the purity of a curve. And then you'd go back and forth between the negative and the positive of the photostats, correcting each one with black ink, so one could perfect the white, and perfect the black. That was a way I sometimes edited these things.

HUO: I'm very interested in the idea of books as a medium. In history there has always been architects, like Le Corbusier or now Rem, where the book is not just about their own work but it is a medium.

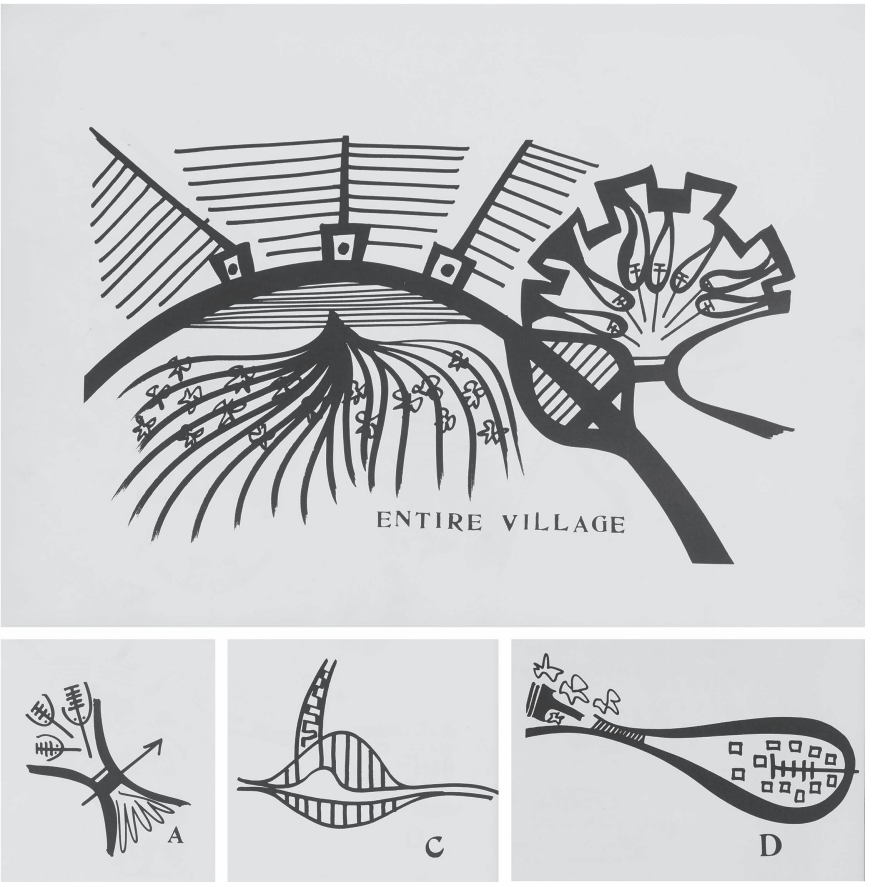


Figure 17.1 Diagrams of village in Gujarat, India, from *Notes on the Synthesis of Form*.

For me they are among the most extraordinary books I know. They are masterpieces, not only in terms of the content but also in terms of the form. This idea of how image and text is associated, that it's black and white, all of that. What gave you the idea? How did it happen? I want to know more about the format and the form of your books.

RK: Did you have a designer, for example?

CA: Oh, good Lord, no! I designed them all myself.

First of all, these books started out with many, many experiments. In other words, the only way I could find out how this book should be, was to make dummies of books, and keep going, until I felt that they were just right, in the hand. That was a very lengthy process in itself. The whole thing went through a whole series of experiments; the weight of the paper, the size of the print, typography, spacing . . . every detail I went through experiment after experiment

after experiment. Even for example, something as apparently unimportant as the flexibility. I knew that I wanted it to feel – it sounds a bit pretentious, but forgive it if it is – as if the book could become part of your heart. Very, very close to you emotionally.

HUO: The image text relationship is very interesting – the images are not explained they are kind of ambiguous.

CA: Yes, as far as the relationship between text and picture . . . I always felt that in writing, I was talking to somebody and showing them things at the same time, so I simply tried to make that fluidity actually happen on the page. It was quite conscious, that part.

HUO: I have one more question about the book. They have a lot to do with my world, the world of contemporary art, and they've been inspiring artists. I was very curious about the images, because you use all kinds of images. To some extent it reminds me of Gerhard Richter's Atlas and also of Hans-Peter Feldmann's encyclopedias. I was wondering to which extent you work on your own iconography. Do you have your own archive? Do you have a classifying system?

CA: No, I'm not a very systematic person. I keep it all in my head. My desk is pretty chaotic. I lose things all the time. Of course, we had to search for years for those pictures, for years. Normally, even when I'm writing something, as soon as I get serious, I start with the pictures. I have to think about what will convey the idea . . . When I give lectures the part that is the most draining is having to get the pictures in an approximately accessible form.

RK: In sequence?

CA: Well, I always give lectures which are completely spontaneous, I don't write them out or anything. And so I write myself a little bit of htm code so that as I'm going through and talking and thinking about things, and I suddenly realize I need that one, I can find it while I'm on my computer and giving the lecture, and then put it on the screen. And then I can actually make exactly the right picture to the right point . . .

RK: A fluidity . . .

CA: Yes, a fluidity which does not obstruct my thinking by some pre-set sequence like in PowerPoint. I never use PowerPoint, exactly because it has that problem.

RK: What is interesting is that the word you have used most frequently, is one that surprises me, the word "fluid" because you are a system-builder, and the preference for fluidity over rigidity is to some extent unexpected. Something I really like in the book – where you simply give instructions on how to read it in one hour, even though you've just explained that you've been working on it for years. I think that is a beautiful way of slaloming through something very complex. You have this tolerance for, not superficiality, but for a speedy way or an emotional way of getting through it.

[time elapses, CA pours water]

CA: Sorry, I'm a slow thinker.

RK: Is that true?

CA: Very, very slow.

RK: Is your life showing advantages of slow thinking?

CA: One of the reasons I'm successful is because I'm so careful, I'm very, very careful. Until I know something, I don't pretend that I know it, . . . that kind of thing.

Anyway, what I'm trying to get to is the physical because the physical organisation of buildings and the city is the main thing which really holds my attention, and I'm extremely much aware . . . I don't want to be aggressive about it, but the physical nature of the city has not yet been tapped at all, that is – what the geometry actually is and should become, is still a mystery. I'm struggling very much with this now. I mean, even the *language* for morphology doesn't really exist at the moment. You probably know I've written about morphogenesis. So the question is: how does the generating process actually create the form of a building, a neighbourhood, a window, a city . . . whatever. To me, that's the whole ball game. It seems ridiculous, I'm 70 now and I haven't hardly started. But that's the way things are.

[Laughter]

RK: I was asking about the advantages of slowness. There are of course also disadvantages: you said that the thinking has barely begun, but in the mean time while people like you or even us are thinking, developments are taking place beyond our control at such a speed that you wonder whether thinking even can be applied to something at this kind of acceleration.

CA: I agree, it's a very significant problem, whether it is velocity or sheer numbers crowded together or numbers of components, we have not yet found a way of addressing those numbers.

HUO: One of these things that I'm fascinated by which is related to numbers, is this idea of you before becoming an architect, being a mathematician. I've always wondered to what extent your use of diagrams and numbers has to do with that. You have done so many things, you're a builder, writer, designer, mathematician. You see yourself foremost as a scientist. So I was curious if you could talk in relation to those diagrams and numbers about your background as a mathematician.

CA: Actually, it was quite simple. In England one specialises much earlier than in America. So by the time I was 15 I was already in the track of science and mathematics. I had expected to become a physicist or a chemist. I was very fortunate, I got my entrance to university a year early. I then went to my chemistry teacher and said "look, I don't have anything more to do at school, but I have to stay here for another year, so I want to pretend to be a research chemist so I can find out what kind of life that is. So can you set me a problem so that I can experience it." He was a very nice fellow. So for a year, I worked on a rather abstruse problem of chemistry. I got completely fed up with it. It was completely boring,

drove me out of my mind. During that period, one day I came to an exhibition of architectural photographs in school, I went in there and had a look round and I thought "wow, this is amazing. The people who are making these things are doing the same thing I do when I paint, only they're making a living from it. So that's what I'm going to do." I was still only 16 or 17. My father was horrified when he heard this. He was always very helpful to me, so he said: "look, if you go straight into architecture now you'll waste your life. You won't know anything, and you won't be able to do anything." So I said "What do you expect me to do?" And he said "I tell you what – go to university and do mathematics or physics and *then*, when you have a degree in one of those, do as much architecture as you want." It was very kind of him, incredible. He changed my life with that one moment of advice. Without that advice, I'd be nowhere today.

RK: I would like to come back to the diagram. Are you aware that the diagram as an issue has been dominating the last 10 years of architectural discourse? The next question is, do you follow architectural discourse?

CA: I am not sure I understand. What do you mean? The path that has been taken, as opposed to the act of building buildings?

RK: The path that has been taken, you can explain it in many ways. But modernity or modernisation would be one way of putting it. Many younger architects in the past 10 years have thought also that the diagram would be a way out of the path taken in terms of making it less formalist.

We have been looking at pages like this [shows page] with complete fascination. We are completely seduced, still, by the language and also by the method. We were wondering, it's not unlike some literary movements emerging in the'60s. For instance in France, Georges Perec decided to write a novel that was missing the letter E.

HUO: The movement is called Oulipo. They also wrote books of lists, the movement was very much about the idea of constraint. Were any of these movements important for you? Oulipo, Fluxus, other artistic movements of the '60s which have to do with the dematerialisation of art. There were lots of lists and instructions. In one way it was no longer about the object, it was about giving instructions so that the user can make the art. If I think about the pattern language, it is almost like a "Do-It".

CA: During the late '50s and the early '60s, the main people I had dialogues with were anthropologists and psychologists, because I wanted to understand how form came about from society, because I felt it was very much contaminated at that moment. I thought "ok, if I can find out what's happening . . ." It's funny, because in those days it was quite common to look at primitive societies all over the place and nowadays they don't even exist any more. It is incredible how fast that happened . . . Anyway, so I went to

India for the material, it was in the appendix of this book. I lived there for seven months. When I came back – this is a strange story but it will tell you something about my character. I came back to Harvard. One day I got a letter from the Gujarati government: "We're familiar with your work that you did while you were living in Gujarat. Now we have to relocate a village because of a big dam project. Would you be interested in being the architect of this village?" So here I was, I was, in my mid-20s. It was you might say a fabulous commission. So I wrote back and said: "I'm honoured and definitely very interested, but I have to think about it a little bit and I'll let you know in a couple of weeks."

I thought about the whole thing, carefully, and realised that even though I had made these diagrams to define the key aspects of the village, it would mean nothing for me to design it, it would have to be the people themselves who used the diagram material, to create the forms of streets and houses.

RK: Program their actions, in a way.

CA: Yes, if I could give them the material in a way they understood it well. But even though I spoke a bit of Hindi, I didn't feel that I understood Indian people, their inner way of looking at the world, at all. I loved it there in India very much, but I noticed during my time there that there were amazing disconnects. Completely strange things would happen and I'd have no idea what they meant, but still they were happening. I thought about this, utterly different from my experiences in Japan where I always felt I knew what was going on even though some people consider it a very mysterious country. Since I did not understand the Indian people well enough, I thought it would be absurd for me to build for them, because that would only continue the tradition of modern architecture, where architects are constantly building buildings without truly understanding the people who are to live in them and work in them. So with great sadness, I wrote back and could not accept the commission.

I said in my letter, "I'm terribly sorry but the only way I can do this project is to have the people do it, and I don't think my communication with them will be profound enough, and what will happen is that something rigid will follow instead of something fluid. I am bitterly disappointed that I have to give this project up because it's the first really serious commission I've ever received. But on careful thought, this has to be my answer." I was stunned by this decision, and I was annoyed with myself. But I could not see how to do it.

In the months following this event, I realized that what I had done with the diagrams was not enough, and that I had to create a whole language which would liberate people, and give them both the freedom and the knowledge to make buildings for themselves, in their own way, just what they truly wanted.

RK: You said you need to think about it – how did you think about it? It sounds as if it was simply an intuition that had to mature.

CA: It was like that, I had an instinct almost immediately that it would not be possible to build the kind of thing that I believed ought to be built. I had to think about it very carefully.

RK: Was it the first time that you thought about a model of intervening in architecture where you were more somebody who would stimulate others than be yourself, whether others could be the agents of a critical way of thinking?

CA: I never viewed it like that. What happened, very simply, is that I thought and thought about it, and the only way that that could happen would be to give these diagrams to the people, and actually have such a wonderful rapport with them that they would understand and they would be able to carry them out. And it was out of that that I began dreaming about patterns, because patterns are a more explicit instrument for the use of a person. So that came directly from that.

RK: Would you say that the diagram therefore is also a way of communication beyond language, which was maybe in those early moments of globalization, a crucial device? An anthropological tool, also?

CA: For me it was something a little bit different. Although my origin was in anthropology, my physical desire was that of the painter or the builder. I was trying to find paths from the anthropological source to the actual thing, the building form, and the neighborhood form, and I'm still looking for those paths now, and still doing it in practice.

Think how important this is, and also how difficult it is. First of all, there are six, seven billion people now on Earth. It's quite impossible to create a humane environment in which all those people can live well, unless *they* (not we) are controlling their environment. Only then will people be comfortable, and at one with the land and towns around them. But to do that, one needs an extraordinary and sophisticated tool, some kind of wonderful generative process that can interact with exquisite sensitivity to people, and their desires. The current machinery of architectural production and the developers' production is far too crude and far too cumbersome to do it right. In most cases it does more harm than good.

This is where the use of generative processes comes in. By generative processes I mean new kinds of processes that include pattern languages, but that also include other vital elements – above all, an infrastructure of power-sharing among people, so that people get some measure of control over the processes that produce buildings and the public environment in cities. It also needs a revolution in the construction industry, so that construction itself is directly harnessed to the production of organic and highly-adapted organic structures which allow the variation needed for things to fit together in their unique circumstances, and allows builders to make all the needed adaptations without using or needing blueprints in their 20th-century form – all without increasing cost.

So, generative systems are capable of doing for the environment what DNA does for an embryo or a plant. I think the Pattern Language was an interesting first attempt to make such a thing, but I don't think it's good enough to do the job. First of all, there's the whole thing about the technics of this. What might a developed form of this look like, how might it be propagated, how would the construction arise. Those are all important questions. The last few decades have been dominated by the idea of DNA. Biologists are now beginning to realise that the shape of plants actually does not come from the DNA. This is really remarkable, the DNA guides the process but the actual shape comes from the literal unfolding of the geometrical object that is the growing plant. So, these morphogenetic ideas are much more powerful than what was in the Pattern Language. I'm trying to formalise them now.

RK: How and where? With a computer?

CA: Of course in a computer, in part.

Just to give you an idea of what I mean by generative system: You see, one of the most interesting building projects that I ever did, a very primitive one in Mexico . . .

RK: The Mexicali workers' housing?

CA: Yes! I achieved a unique building system which I have not yet ever been able to replicate again in other contexts. The system was unique because it enabled buildings to unfold step by step, thus allowing each individual house to be different according to its family, and yet cheap, simple, and ordered in its process, so that money was not wasted, and the steps could be simply and directly carried out, for all these different houses, without the use of drawings.

That system consisted of first of all, some special corner blocks. The procedure was really simple. You drive a steel stake to form corners of rooms and houses. You have freedom – you can put them where you like as long as they fit some very loose conditions. Then there's a special block that we manufactured, that was put down over that bar. That block establishes the corners of the rooms and the buildings in a more definite way. Then other blocks fit into a slot in each face of the corner blocks. The blocks are all cuttable, so you don't have to be restricted by the dimension of blocks. Then the walls go up. You lay in the windows as the walls are going up. Then you put a ring beam around the walls. The ring-beam form was very special, having two pieces of wood, which were kept apart. So then I had the families weave baskets, over each room, using lathing strips – long strips of wood with a cross section of about 30mm by 5mm so they are quite flexible and very easy to bend. These strips made a basket with a weave about 1 foot square, and the strips were trapped by the ring beam. Then, when the concrete was poured into the ring beam, it was firmly fixed. One could crawl around on these things. And finally a concrete shell was poured over the basket. Of course each one took

its own shape, because if the room had a funny angle here, then the vault that was formed by it took on a different shape. So in the end, the process alone actually was responsible for the form of the house.

HUO: So there was no script?

RK: There was a script.

CA: There were two kinds of scripts.

RK: I would even say that I hear a contradiction. The first one seems satisfaction at the purity of a process, regardless of human interference with it. The second one, an ambition to empower people to take a certain range of decisions themselves. Not that I want to exaggerate . . .

CA: No, you're not exaggerating, it's an interesting point, but it isn't quite like that. Look, my real aim is: I want the earth to be beautiful again.

RK: That's a very beautiful statement.

CA: To be beautiful, of course it has to have in it the nature and spirit of all the different people and all the different places. The purity of the unfolding process that can inspire them and that they can work with is very important in that it's elegant and simple, and that it actually works. The beauty that I'm talking about – when I say I want the earth to be beautiful – has to do with infinite differences. The nature of what is done is different in different situations and places. Also according to what hands were on it. But still, the power of it comes from the elegance of the generative code that makes it possible. I don't think it's a contradiction.

RK: To make the world beautiful again is a very forward looking ambition. Why and when did you introduce the word "timeless" and how does that relate to your earlier work? Is "timeless" a concept of your thirties or earlier or always something that was critical to you, can you explain what generated it? Because it's a very ambiguous word and means very different things in the hands of reactionary people who want to be in a timeless world, like Prince Charles for instance.

CA: Well, it wasn't ever widely used before I used it as the title of "The Timeless Way of Building".

You have to remember that I reached a lot of conclusions in those years, which were Zen-kind of considerations. I felt that the truth of these things was coming from the inner core of the person, and in that sense . . . I mean if you look at Zen as an example – there are others like it – the truths it deals with are not about the Victorian era, or the Ancient Greek era, or the 22nd century era, they are just basic things about what's flowing in here [points to chest] and I became aware, while I was writing. *The Timeless Way of Building* was written before *A Pattern Language* but *Pattern Language* was published before *Timeless*.

RK: So they are simultaneous.

CA: Yes. I was working on both those things from about the late '60s onwards.

Anyway, the point is . . . I think I have to deal with the smile on your face a moment ago.

[Laughter]

Because you are trying to drive me into a little bit of a corner.

RK: No, no, not at all.

CA: I need to say something about that. Some people, many people actually, perhaps of a conservative disposition have gone in the same direction where Prince Charles has gone. In that direction, or style, it is the image of something which is of concern. I am amazed, actually, that he is willing to put so much effort into such a trivial purpose as the image, for example building houses that look like old houses. He once wrote to me and said "I've just been in Bombay and the slums are so wonderful, they are completely spontaneous and people are doing what they want to do." And I said, "Yes this is what I've been telling you. So are you prepared to do a project like that?" He never had the courage to do it.

Timeless – if you wanted to ask me how I define it – would be somehow connected with an archetype, that it has to do with things which come from so deep down that they are cross-cultural. It doesn't refer to history, era or style. It refers to those things that are so deeply shared by human beings, that people of different cultures and different eras and so on will essentially recognize and respond to the same kinds of things.

I think architects of the last, well there's a very funny thing going on: there's a traditionalist movement – the Congress for the New Urbanism (CNU) is an example – which I find rather problematic.

RK: I would hope so.

[Laughter]

CA: It's embarrassing because they're very nice to me, but they don't understand why I don't like what they do. It's very peculiar, and it's the same with Prince Charles – he actually just doesn't get it. Even though he's a good man, a fine man, and well meaning.

I think that the architectural discussion of the last couple of decades has done something foolish. Which is, it doesn't know how to make a distinction between something which is deep and something which is superficial. In terms of, let's say these sort of "timeless" issues.

I'll give you the most absurd example: At one point, one of the original astronauts (Rusty Schweikert) came to see me. He was responsible for thinking about the space station. He came to see me, and he said, "I love your ideas, I want to use them in the space station." So I said, "Well that's great. Do you understand what they really are about? Perhaps you can give me an example of what kinds of things you think are important." He said, "I think the way you're using redwood all the time is really wonderful.

I want to take some redwood up to the space station." I was astounded, and had to say, "Well, this is really completely crackpot. You don't make something wonderful by sticking redwood on it. For instance, the people who make their own motorbikes, because they love them or the truck drivers who do the same thing with the cabs of their long-distance trucks, they're working with steel mainly. And they just use steel in a much more fluid and plastic way, they play with it, and shape it, and then they make it theirs. Don't you think if you're in the space station it would make sense to find some way to use titanium in that fashion, rather than lifting up a lot of very heavy redwood."

[Laughter]

Some people in architecture are afraid of these . . . what shall I call them, very deep-seated archetypes. And because architects are so panicked about whether or not something they make resembles something old, they feel forced to not do certain things that anybody in his right mind would want to do, because it's practical.

It is a very delicate subject, this one.

The other thing, going back to generative processes for a moment: In a truly morphogenetic process, you find incredible differentiation. If you look at a plant and see the amount of variety within that distance [shows inch with fingers], you may learn a lesson about architecture. This differentiation is also present in all well-adapted buildings and environments. In most contemporary buildings, we haven't learnt to do that yet, but it's going to come, for sure.

RK: Are you aware that there are a whole lot of architects who want to use the computer to not prefabricate things, but to use the ability of the computer to produce an endless number of varied and individual shapes.

CA: There's a huge problem with that. I am aware of this.

HUO: There is a whole generation of people like Greg Lynn or Hani Rashid.

RK: There's an almost biological correlation between differentiation . . .

CA: The question is whether it really is like biological differentiation or not. Because in a computer, of course you can set a number of parameters and churn out endless combinations and variations, but if they don't have meaning they are really just trivial games. For the people that live in a world that is created like that, it is actually frightening. It's not joyful, because it isn't coming from anything actual. You can read the insincerity of it. It's trying to fake the variation between one tulip and another, but it's the wrong kind of variation.

Morphogenesis has to do with drawing the real variation from the situation, and that's a much more difficult trick from a computer point of view. It's not playing games with computers, it's a question of having representations of the configurations which are profound enough so that when you draw on them you'll get authentic building

variation, room variation, roof variation etc., for really good reasons which make sense, and which are related to the world around them, and the whole to which they belong. And then human beings will feel more at ease and relaxed, because that's what we're all used to in the world. It is this kind of deep variation which is generated by the whole that gives us satisfaction, and meaning.

HUO: That leads to another question, the question of "egolessness". When you talk about the "timeless" way of building in your book *A Pattern Language*. In order to get there, one really must make a building "egoless", one must start with nothing in the mind, and on page 46 you talk about the idea that language might be a way to this "egolessness": "In this sense, the language is the instrument which brings about the state of mind which brings around the egoless." Why is egolessness necessary for timelessness? I think it's interesting in the current moment of the architecture world because Modern art and architecture right now are ego-driven.

CA: Well, I used to teach painting as well as architecture, at Berkeley. So, I remember I got a bit fed up with the students on one occasion, as I thought they were trying too hard and what they produced was too ego-bound. I had asked them to draw a certain kind of thing, and they had done it and I wasn't pleased with it. So I said "OK, I tell you what – I want you to get a very long roll of butcher's paper, I want you to make this drawing 150 times as you work your way along the paper, and then we'll talk. But just go as fast as possible. And you're going to get bored, so at that point just speed it up." And by the time they got even half way there, what they were doing had a different level of fluidity altogether. Because they stopped thinking about it, they stopped worrying about themselves, and they were obsessed with just getting it done. It's a very simple example of this kind of thing. Your body is acting, your mind is acting only in a certain way – but not in a way of controlling things. The pattern language has an ability to do something like that, because it provides you with things which are actually coming from your own person, because most of those things are like that in their nature.

RK: I wanted to add another question about language – when did the similarity of your operation with language become important to you? At some point there is some explicit correlation with what you do and your language. Was the thinking of Chomsky important for you at that point? About deep structure . . .

CA: Chomsky's work was a revelation to me. I was at Cambridge at the same time as he was. Although I don't think he was penetrating the deepest issues of language, only a small part of the issues, which had to do with grammar, and that was fine. His ability to bring that out was colossal, incredibly fascinating. That was my home turf.

RK: I would like to finish with something different. It's a series of interrelated issues. When I look at your work and try to reconstruct

or construct your relationship with the modern, I think that what fundamentally horrifies you is how everything that is modern is fundamentally stripped of all the familiar touch, familiar tactile and emotional paraphernalia that were there. If I look at your work, I think that what you're trying to do is to include the patina in newly constructed things.

CA: That's true. But only partly true. It is a deeper issue which we can, perhaps, take up in part two of our discussion.

RK: So I think that first of all there is a question: Can you actually include your own patina, or is patina something that accrues over time. The second question is, I want to suggest that there are two analogous efforts in history to what you have been doing. I've been trying to do a book about the Romans; the systematic nature of the Romans and the "pattern language" of the Romans, because it's very clear also a pattern language. Contrary to you, I'm not saying it's only you that shrinks away from doing a village, they didn't shrink away from doing anything . . .

[Laughter]

. . . and were happy to impose the same pattern language anywhere on the globe with remarkable success. I was just in Amman, and the most beautiful features of Amman are a temple on a hilltop and an amphitheatre for 6,000 people. Not only it is a very abstract and synthetic language without a lot of patina, but even in its smallest articulation it can be repeated and unindividual in a certain way, and still be successful.

The second analogy is more controversial, but if you look at modern architecture at its most idealistic and aesthetic success, we take Mies as an example, we see the same ability to create almost a universal language, to be also very sensitive within that language, to create objects of beauty etc. etc. And so, you could say that what the Romans did is similar to what you've been trying to do and what Mies has tried to do. If you then look at the differences, the only one is between the organic and the synthetic, with you ultimately finding the synthetic sterile or fundamentally lacking in something, and only the organic being able to provide that something. Would that be a fair . . . ?

CA: I don't usually use the word organic in relation to architecture. My most successful buildings are not organic in the sense of these kinds of shapes. [gestures flowing forms] I don't use those shapes.

RK: Maybe there's a better word for the opposition of synthetic . . .

Anyway, what would your response be in terms of the Romans. What I'm particularly interested in is also the issue of slowness and the current speed and your attempt, or your vision to make the world beautiful again. I can see that if at all, you can make the world beautiful again by becoming a Roman. But I don't think you can make the world beautiful again through the natural or the morphogenetic, in terms of the quantities that has to be done.

Theoretically I can see it, but not in practice. Theoretically it's a fantastic idea, but the very brutality of the Romans and the limitations and the lack of fluidity of the Romans is perhaps what could still do it. Do you also see that the Romans created a form of beauty in terms of planning?

CA: Quite remarkable I think in terms of planning, streets, houses, axis, aqueducts . . .

HUO: Rem mentioned the Roman model. You mentioned in your book "A Foreshadowing of 21st Century Art: The Colour and Geometry of Very Early Turkish Carpets" another model from the past as a tool for the 21st century, not Roman but Turkish art, early Turkish carpets. I was wondering if you could tell us a little bit about these Turkish carpets, and why they are a model for the 21st century.

CA: Well, they were masters of color, they knew how to do things with color. The old Turkish carpets came from the Sufic tradition. They came from the real origin of the Islamic mosques. Essentially in Islam you're not allowed to represent God as in Christianity. You can't have a picture of God. But the carpet is something like the picture of the soul. And they put into it all of the severity and the detail and the unfolding of particular parts and almost endless variation, and the most beautiful color transitions. All of these things are just there in the carpet. These carpets were made to sit on and help you see God, yourself. So I have always been fascinated by the most beautiful ones; I collected these carpets for years and years.

HUO: I thought it ties in beautifully with Rem's Rome question. For Rem, Rome is a model for the 21st century and for you it's this early Turkish art.

CA: I have an instinct that something like what you call the Roman way is actually what's needed. I agree with you about that. I'm very conscious of the fact that my attempt to create the sort of full-blown version of the morphogenetic processes that I've been speaking about, are flawed because I have not succeeded in giving them the thrust that is exactly the character of the Romans.

HUO: The thrust?

CA: The power and ability to get vast things done. I was hoping that I might first of all learn things from you about that, and that perhaps together we could find out how to do this.

RK: That would be exciting.

HUO: I have a last question: Rainer Maria Rilke's "Letters to a Young Poet" contains some of the most beautiful advices to a young colleague. What would be your advice in 2007 to a young architect?

[Laughter]

CA: Oh my. Well, it might sound a little bit simple, but I would say it's this: learn how to make the very small with your own hands, and learn how to make the very large with your mind. And above

all recognize the creative nature of new kinds of construction contracts that I have made, and that you may make to help the architecture of the future.

RK: And take your time.

[Laughter]

CA: Yes. And take your time.

To be continued . . .

PART THREE
Theory into building



Eishin School, Japan. Photograph by Howard Davis.

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18 The grassroots housing process, 1973

The idea of incremental growth, which appears in various forms in CA's work, provided the theoretical basis for this project that was intended to show how the house of a family might grow over time, based on money at hand rather than on a loan needing to be paid back with interest. (One estimate was that such a loan would ultimately triple the cost of the house). This new idea would allow the house to grow with the family and for investment to correspond to need. This is at once a clearly articulated idea and a radical program for eliminating the banking-based housing production system. (The appendices mentioned in the text were not found in the manuscript transcribed here.) Co-authors are Mike Cox, Halim Abdelhalim, Ed Hazzard, Ilhan Kural and Marty Shukert.

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Preface

A house is not just a shell for habitation; it is also an unfolding of our experience.

A house is not an act or a series of acts; it is not an object but an experience; it is not a commodity to be bought and sold but an activity essential to life.

Instead of being the unfolding of our existence and the expression of our freedom, our houses have become the imprisonment of our existence, the denial of our lives.

1. Introduction

In this proposal we are putting forward an entirely new concept in the field of housing, which covers financing, design, social structure, principles of ownership, and rate of growth. In place of houses that are completed before anyone knows who will live in them and are then sold as complete products, we propose a process in which the owner is intimately involved in the evolutionary design and construction of his own house. In place of high interest rates and ruinous mortgages, we propose a system that, with a very small initial investment, recycles the capital that it generates to begin more and more houses, without bank loans. We believe that this concept will help to solve the most fundamental problems in the housing shortage, in many countries.

The Center for Environmental Structure is a non – profit foundation based in California. We are writing this proposal in the hope that sponsors, in different parts of the world, will come forward and invest enough seed money to start a number of pilot

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projects. The Center, henceforward called the builder, will undertake responsibility for management, design and supervision of construction in these pilot projects – and can be paid entirely by fees generated by the process itself. If successful, the pilot projects can then be repeated, on a larger scale, by local builders.

Any local government, state government, public authority, non – profit foundation, or group of citizens can sponsor this process, by making a small cash investment, and by putting land in trust, for housing, with the understanding that it will be held by non – profit housing corporations, managed by the people who live in the houses, and cannot be bought or sold for speculation.

In return for these contributions, the sponsor will reap the following benefits:

1 On each side, a cluster of twelve houses will be designed and built by their owners. Each house will be ready for occupancy within a few months – and will then grow steadily for the next several years.
2 The process will allow people to own their own houses, without a down payment, merely in return for a monthly payment which is about the same as a typical medium – low income monthly rent or mortgage payment.
3 The project will generate enough money to seed new clusters within the community, as often as the sponsor is willing to supply one acre of land, on the delayed purchase arrangement. In these later clusters, the sponsor is not expected to contribute any further cash sums.
4 The new clusters will grow at an extraordinary rate: so great, that after thirty years, the initial cluster has seeded 70 new clusters; after fifty years, the initial cluster has seeded 1600 new clusters. In short, an initial investment of $30,000 will generate about 20,000 houses in fifty years.

Obviously, there is no form of public housing known today, which can generate such an astonishing supply of houses for such a trifling investment. But the houses are not only cheaper. They are also better, more beautiful and much more profoundly grounded in human needs.

Important note

Throughout this document, we are using United States 1973 dollars for the sake of concreteness. We wish to draw attention to the fact that in other economies, it is not appropriate to use these figures merely translated into local currency, but that the figures need to be scaled up or down, across the board, to reflect local wages, and local prices. We are confident that even though the detailed figures will change, the overall principles will stay the same.

Note also, that we have presented our results, and calculations, without including the rate of inflation. We have now begun to work on a more extensive document which outlines the connection between the flow of money, inflation, and the quality of buildings in a thorough and accurate way. From the point of view of our new work, we are now aware that this paper is full of imperfections, both in conception and in detail. However, we have received such widespread interest in this paper, as it stands – and we consider the subject which it deals with so important, and so urgent – not only as a way of improving buildings, but also as a way of fighting inflation – that we have decided to publish it, as it stands, in the hope that the reader will turn a blind eye to its imperfections.

2. The housing problem

The world – wide housing problem has three central features.

(i) The housing shortage

There is a drastic shortage of houses, all over the world. At the same time, the cost of houses is rising steadily. This rising cost makes it almost prohibitively expensive for people who have little money, to house themselves; and too expensive for public housing agencies – who must both build the houses, and then subsidize their rents – to provide houses for everyone; and thus well nigh impossible to build enough houses to overcome the housing shortage.

(ii) The sterility of mass – produced housing

The mass housing built to solve the housing shortage is totally inadequate from a human point of view. The houses required to satisfy human needs are not mass – produced, identical tract homes and concrete box apartments, but houses so various that each house is different and unique, according to the special nature of people who live in it, designed by the people who live in them, and based on psychological principles deep enough to satisfy the full range of human experience and need.

(iii) The high price of housing

At the same time, the average family gets a raw deal, in purely monetary terms. A house which costs $30,000, will typically need monthly payments of about $200/month to pay for it. The person making these payments, whether he is technically an owner or a renter, will typically end up paying about $80,000 over 30 years – almost three times the actual value of the house. This is why houses have become expensive. People are paying three times what their houses are worth. Our houses now consume three times as large a portion of our lifetime income as they rightfully should.

Faced with this three – sided housing problem, modern society has so far, invented essentially one answer to the problem: mass production: both on – site mass production of tract houses and factory mass products of package houses and apartments.

Industrialists, who control the machinery of mass production and their spokesmen, argue that more houses must be mass produced, in order to keep up with the demand created by the housing shortage. Designers and architects, in love with the idea of mass production, argue that designs of mass produced houses will be better, because more money can be invested in research and perfection of design – so that every family can have "the perfect bathroom". And the industrialists again, using the analogy of mass – produced cheap goods, explain that the economy of the assembly line will make the houses cheaper.

But industrialized mass housing does not and cannot solve the housing problem.

The high rate of production, does little or nothing to solve the housing shortage, since, it is in fact the shortage of capital, not the speed of production, which is actually responsible for the housing shortage.

The standardization of large – scale components like walls, bathroom and kitchens, far from improving design, in fact, reduces the choices which people have, and contributes enormously to the monotonous and alienating sameness which leaves people feeling dead and helpless.

And the mass production does not, in the end, even reduce cost. First of all, very few means of housing production can actually reach the volume of sales needed to bring about the economies of scale. But, much more important, the industrialized houses, even when they are sold in great numbers, are more expensive than the houses they replace because of the fact of mass production itself has brought with it spurious standards, which increase the costs. Does anyone really want, or need, wall – to – wall carpeting, or streamlined kitchen cabinets, or plate glass picture windows? These very expensive items have become necessities, under conditions of mass production, because they are the only ways that mass production can make up for the pitiful sterility of mass housing. In a simpler house, which you have made yourself, you just do not need these gimmicks – because it fits you, and you love its individual character. And because it does not need the gimmicks, it costs less per square foot.

But above all, mass – produced housing fails entirely to change the cost of houses, to any significant degree, because like all our other current forms of housing, it is based on the mortgage system.

In a simple society, people do not borrow money to make their houses: they build what they can afford. When they are young, they have a small hut; gradually, as they grow older, and have children, they are able to make their house larger to keep pace with their needs.

But mass production changes that. Since a house created by mass production is, inevitably, a commodity, an object – you have to buy it as a package – and to buy it as a package, you have to borrow money. But the borrowed money costs far more than any conceivable savings which the machinery of mass production can create.

The cost of a mortgage is higher, far higher, than any other cost. A mortgage, spread over twenty – five or thirty years, almost trebles the cost of the house. Two – thirds of the money which a buyer, or a renter, pays for housing, goes in the form of interest to the banks. No solution to the housing problem, which accepts the mortgage system, can possibly make any serious contribution to the price of housing, nor to the housing shortage, and that is why, at bottom, mass – produced housing fails utterly to solve the housing problem.

So long as we view houses as commodities, which can be bought and sold like cars, the processes which will then, inevitably, govern ownership, financing, building, and selling of houses, will make it quite impossible to solve the housing problem.

Let us begin by understanding the nature of housing as a commodity.

It hinges on the fact that people who live in houses do not really own them, in any significant sense; it hinges, in short, on the fact, that the idea of ownership, as it exists in modern society, is different from rental only in a rather trivial legal and financial sense. True ownership cannot exist so long as the house is seen as a commodity.

To begin with, there is a gross unfairness in the distinction between renters and owners. This distinction depends, in many cases, on the accident, that some people happen to be able to afford a down payment, and some don't. Beyond that, both renters and owners pay comparable monthly rents. But the owners have control over their land, and build up equity; the renters have no control, and after twenty years, they still have no equity, or money, built up.

But even those people who are lucky enough to call themselves "owners", are not owners in any very significant sense. The housing market that we know does not allow people to design and participate in the construction of their houses; they are built for them and, except in unusual cases, have no input at all. In addition to this, even the

ability of people to buy their own houses is being eroded. Costs of material and labor, increasing at rapid rate, are compounded by the cost of money which, in the long run, dwarfs the construction cost of the house. Under typical mortgage terms, a $30,000 house will cost as much as $80,000 by the time it is completely amortized.

In short, about two – thirds of the total money spent on housing in any one month, now goes the banks (either directly, in the form of mortgages; or indirectly in the form of rents, which help to pay off mortgages). This means that less than one – third of the money spent on housing, in any one month, actually goes towards the task of improving the housing, or improving the environment. And, of course, when the owner decides to sell his house, he finds that most of his investment is lost to him. He can only get back about one – third of what he has put into it, because the other two – thirds has gone to the bank.

Thus, the critical advantage of ownership, stemming from deep personal involvement with one's dwelling and living environment, are wasting away. A person finds himself buying a house that someone else designed and built. He has to have a lot of money to buy it in the first place. He gets rather little of his monthly payments back, when he decides to move. And, for all that, in any important psychological sense, the house is hardly his. It looks just like a hundred other houses, down the road. The space outside, the street, is not in his control – it is a public wasteland, looked after by some impersonal agency.

We see, then, that the heart of the "housing problem" lies in the mortgage system – or, if you will, in that interaction between houses and money, which treats a house as a commodity. People are persuaded that they must borrow money, huge sums of money, to get this house which someone else has built. Since they have to borrow so much money, most of their own money flows out of their pockets in the form of interest, instead of flowing towards the land and houses themselves – where it could actually help to make the houses better: so, by accepting the idea that he must have a house that someone else built, and must borrow money to get it, the house owner also condemns the house itself, to receive one – third of the resources – in labor, care and materials – which it ought to get – so obviously the houses themselves get worse and worse with time.

There is no way to cut this cycle of cause and effect, except at the root. It cannot be cut by making more houses which are commodities; nor by making better houses which are commodities; nor by making cheaper houses which are commodities. It can only be cut when we stop treating houses as commodities altogether, by our refusal, our total refusal, to treat houses as commodities – and by our consequent refusal to accept the monetary side conditions which come with the house, when it is seen as a commodity.

To solve the housing problem, we must learn to look at a house as an activity.

In this case, the life history of the house, and its relation to the people who live in it, and pass through it, is entirely different. The house is not produced at one time, and then used, unchanged, for years; it is created gradually, as a direct result of the living which is happening in it and around it. Building takes place in increments, day by day, year by year. The people who live in the house do not borrow money, ever; they spend only what they can afford. The people who live in the house are the ones who design it, as they go. They don't necessarily build it with their own hands; but they may build parts of it with their own hands, to help the builders. Each house is unique; it is the unique expression of a particular way of life, and of the particular history of all the

people who have ever lived in it. Ownership of the house, is not merely a way of making money, or a form of legal control; it is a vehicle for involvement, in the process of creating a suitable, beautiful environment. Above all, to repeat it, there are no banks involved, nor mortgages, because the houses are built at a pace which makes it possible to build them without borrowing money.

It turns out that this simple change of attitude, has the power to solve the housing problem totally, because it goes to the heart of the financial system, and changes the way that money flows.

1 It can solve the housing shortage.

It can create a vast number of houses, in a very short time, and therefore alleviate the world housing shortage.

2 It can solve the sterility of mass housing.

People can create housing which is adapted to their needs, under conditions where each family will have a unique house whose plan and functions are unique to them – though in construction and materials they are the same as all the neighbors' houses. The process overcomes the sterility of mass – produced housing, by increasing the labor content, human craftsmanship, and workmanship in each individual house, without requiring unfeasibly high labor costs. The land between the houses, is itself also controlled by the house owners, and is therefore as rich and beautiful as the houses themselves: there is no uncared – for public wasteland outside the houses.

3. It can solve the high price of housing.

It does not make heavy financial demands on its participants, and allows everyone to own his house, without any need for down payments. It allows everyone to build up equity, as he pays money into his house. Each person can get back 100% of the amount he has put into it, when he sells it, instead of the one – third which he gets back when his house is mortgaged to a bank. All the money which people spend on housing, every month, goes to improve the houses – instead of the one – third which now goes into houses, because the banks take two – thirds – so the environment has three times as much money flowing into its improvement as it does today.

It is, of course, true, that houses were built under these conditions, by people all over the world, for all the thousands of years which preceded the industrial revolution – in short, for most of human history. In fact, the very richest members of society now struggle to buy up the few remaining thatched cottages, redwood log cabins, Georgian town houses, Greek Island houses, Elizabethan farmhouses – because they recognize, intuitively, that these buildings, built by the very process under discussion, are the only ones which really satisfy the needs of the human soul – and they are therefore prepared to pay vast sums of money for them.

The grassroots housing process, which we now present in this proposal, will create houses as beautiful, as organic, as uniquely personal, as these traditional houses. And, as we shall show, it can produce them fast enough, and cheaply enough, to solve the housing problem. It is feasible in terms of money, and feasible in terms of labor. In short, it is immediately practical today.

3. The project proposal

Our solution to the housing problem, hinges on the creation of two new legal entities, both non – profit corporations, which we call the cluster and the builder, on the existence of a sponsor for their activities, and on a system called the pattern language, which provides the medium of communication between the cluster and the builder.

The sponsor may be any organization which has an interest in the provision of housing, and which has land that it can put in trust for the purpose of housing. It may be a group of private citizens, a local government, a private industry, an institution like a university, or a non – profit foundation. This report is addressed, principally, to potential sponsors, or to individuals or institutions who are considering the possibility that they might decide to become sponsors.

The cluster is a group of ten or twelve families, legally constituted as a non – profit corporation. The families will design their own houses, and help to build them if they want to; and together they will design and build the common areas between the houses. The houses will grow rather slowly – it will take at least five years for a house to reach its full size; but the houses will be made in such a way that people can live in them from the very beginning. In return for monthly payments, and without a down payment, the families will own their houses, and will be able to sell them, when they leave, for 90% of the payments which they have made.

The builder is a non – profit foundation, which helps the group of families design the public land between the houses, supervises all construction on the site, provides instruction for those families who wish to build for themselves, controls the monthly payments from the families, handles the seed money needed to start other similar clusters, and in later years, as the cluster reaches maturity, helps the families and the cluster diagnose those deficiencies in their surroundings which need to be repaired by new construction.

The pattern language is the instrument which makes it possible for members of the cluster to design their own houses, and for the builder to help them take their rudimentary sketches and make a building out of them. It is a system of instructions based on the most fundamental psychological necessities of buildings, which gives the individuals who use it unexpected creative power. We shall not describe it in this report, since it has been fully described in other publications, and its past applications are described in Appendix 7.

However, it is essential to understand that this pattern language is the instrument which gives the members of the cluster the power to design their houses for themselves, and the medium through which they can communicate their ideas to the builder. Without this instrument, the productive interaction of the cluster and the builder which we describe on the following pages, could not be accomplished.

Within the framework of the pattern language, and with the backing of a sponsor, the builder and the cluster, can as we shall now see, create conditions under which ordinary families can house themselves. We first go into detail about the activities of the cluster; then examine the overall flow of money, to see the feasibility of the project from year to year; then examine the growth rate of the clusters, as one cluster begins seeding others, in later years; then describe the activities of the builder in detail; and finally explain the sponsor's contribution.

A. The cluster

The cluster is, in essence, a group of a dozen families, legally constituted as a non – profit corporation. For the first fifteen years of the cluster's life, the members of the cluster, the builder, and the sponsor are financially and legally interdependent. During this period the title to the land is held in trust. At the end of fifteen years, the contracts are complete; the title of the land is transferred from the trust to the cluster itself: and the cluster becomes fully independent (for the life history of the cluster, see Appendix 1, for the legal structure, see Appendix 2).

Physically, a cluster will contain about twelve houses, on about an acre of land. Neither the density nor the size are absolutely critical. A similar cluster might be built at twice the density or half the density, for twice as many houses, or half as many, or even less. However, we consider a cluster of about a dozen houses as a basic unit, because it is an entity large enough to maintain itself as an identifiable social group, yet small enough to be able to maintain communication on a personal basis. A dozen families can sit around a table and discuss and resolve their own affairs and problems fairly easily. More cannot.

We shall now describe the principal features of a cluster:

Design

The member families of the cluster together decide the overall communal layout, each family will design their own house to suit their own needs. They will be able to do this with the help of pattern language: an instrument provided by the builder; and the builder will help them and guide them wherever necessary, as they make their designs. Although each house will have its own unique plan, all the houses will be built in similar materials – which are not modular panels, or factory components, but materials like wood and plaster, that allow each detail of each house to take its own shape, according to its position in the house.

Materials

Materials are free. As a member of the cluster, each family may use as much material as they need to build their house, to maintain it, to decorate it, or to build communal buildings, fences, seats, swimming pool, workshop between the houses.

And the system of materials, provided by the builder, is so designed to make construction very simple indeed: so simple that an average family can easily build their own house if they want to, or make additions, or build structures in the land between the houses.

Growth

The houses will be built gradually, over a period of several years. This makes sure that each part of every house is firmly rooted in people's experience and needs – since each piece that gets built is always a direct expression of some actual living need. A typical young family might build 350 square feet the first year; then live in that, and build 150 square feet per year, for four or five years, until the house has 1000 square feet; then build even slower, reaching a final house, ten or twelve years later, of 1500 or 1600 square feet. The slowness of construction is essential to the bootstrap housing

process: it is this one fact which makes it possible to keep clear of the mortgage process, and the high cost of money (see Appendix 3 for the explanation of the rate of construction, and Appendix 4 for the age of families which are able to live under these conditions, and Appendix 5 for the interim accommodation in the first few months).

Payments

Each family will be obliged to pay a monthly payment, or rent, to the cluster as a whole. The amount of this payment will be based on the area of the house which they have built, so that a family with a small house will pay less rent than a family with a large house. In addition, the rent per square foot is high in the first year, and then goes down slowly with time – so that a family which wants to build a very large house at the beginning, will pay very dearly for it; a family which is willing to build the same house more slowly will pay less. It is this mechanism which regulates the rate at which materials are consumed (see Appendices 10 and 11).

The monthly payment does not include the price of labor. It includes the price of materials, the price of the land, the services of the builder in the process of design, the builder's supervision of construction and lessons and instruction, where families decide to build for themselves. Ninety per cent of these monthly payments will be to the owner at the time a house is sold.

Construction

The families may either have their houses built for them, by labor under the supervision of the builder, or they may build their houses for themselves.

If they do not want to build for themselves, or want to contribute only part of the labor, they must pay for the extra labor themselves. But the simplicity of the materials makes it possible to hire very unskilled labor – high – school students during summer vacations – for example, at low wages.

If they do want to build for themselves, at least in part, the amount of labor involved is small enough so that a family can easily manage to do it at weekends, at the same time that they hold a full – time job on weekdays (Appendix 6). The builder will teach people how to build, and will help them when they get started. He will also be building a workshop for communal use within the cluster, so that people can watch him build for himself, alongside their own efforts. The materials are designed in such a way that any family can, if they want to, build the whole house for themselves.

Communal land and buildings

The street in an ordinary town is owned by the city, and is therefore not the property or the concern of the families who live on it. In the cluster, on the contrary, the land between the houses belongs to the people who live in the houses. It is their right and their obligation, to one another, to design this land to suit their needs, and to build whatever they want: paths, fences, trees and flowers, seats, workshops, playground . . .

Once again, the materials for all this work are free. And, once again, the actual labor needed to build these things must be contributed by the families themselves. Typically, they will probably start spending more time on the communal land, once they have the rudimentary shell of their own houses at least partly finished.

The physical appearance of the cluster

Although each cluster will be unique in its physical layout, it will typically consist of single family houses, grouped together, sharing some common land, about 25 percent of the site, the common land touching all the houses it serves.

Imagine the common land partly enclosed, but opening into a public outdoor room where informal gatherings happen; activity pockets around the public outdoor room; children's play area and areas reserved for sports, perhaps a pool; parts of the site where there exist trees or greenery, left intact in order to preserve the natural beauties of the site.

Imagine, low houses, at most three stories high, with half – hidden gardens or beautiful courtyards; open stairs leading to upper stories, houses which are flooded with sunlight; some houses with terraces overlooking the activity in the street, some with small gardens for growing vegetables, some with openings which make the outside part of the inside of the house, some with a low wall where people can sit and enjoy the life around.

(. . .)

Above all, as in this example, every cluster of houses will have a balance of order and disorder which is rather unfamiliar in today's housing. Most housing we are familiar with is either totally homogeneous – with standard plans, standard arrangements repeated identically along a street, or totally disparate with every house designed by a different person, a different architect, a different style, different materials.

The housing in a cluster, built by the process we are describing here, will be different in plan and shape and detail: yet all the houses will all be built in the same materials; and they will all have common features. Like the houses of a traditional town, they will be related and connected in a way which makes it clear that although each is individual and unique, they are together also pieces of a larger whole.

Diagnosis and repair

In ordinary housing developments, the architect and builder leave as soon as they have finished their work. They do not stay around to guarantee their work, nor to look after the environment as it evolves. In a cluster this is quite different. The builder undertakes a fifteen – year commitment to be there; he is also a member of the cluster himself, and has a personal interest in making it beautiful because he is going to be there.

A healthy environment requires not only that construction of the cluster be gradual, but also that the houses and public land between them always remain in a continual state of construction and repair. In this way, the environment can be constantly improved and modified according to people's experience of how it works for them.

This process requires a continual diagnosis of the existing space – indoor and outdoor – so that all new building, however modest, will repair the defects revealed by the diagnosis and ensure the gradual improvement of the environment.

The builder will spend about one month every year showing people how to make a diagnosis of all those things in the cluster which are not as beautifully organized as they could be; a seat in a wrong place, a corner where nothing grows, a window which needs to be enlarged to make a room sunnier, a good place to build an extra room; a way to mark an entrance clearly; a way to protect someone's garden from nearby

noise. In this way, most of the construction activity of later years will not only be making houses larger or more useful and beautiful; it will also be helping to repair the small mistakes of the past or those things that have stopped working well.

Ownership

The member families do not own their houses in the conventional sense (Appendix 2). What they own, instead, is a share in the cluster corporation, which entitles them to the sole use of that part of the land where their own house is; allows them to design their own house, modify it, alter it, in any way they want; and gives them control and use of all the public land between the houses. In all these respects, their ownership is very much the same as ordinary ownership, except that their control of public land is greater. But the conditions under which they are allowed to sell their houses are quite different.

Resale conditions

We consider it absolutely essential that the process of resale creates no conditions, whatsoever, which encourage people to build speculatively – that is, for other people's needs, instead of for their own. When people try to anticipate other people's need, or try to build a place they think other people will like – they build arbitrary fantasies, which have no roots in real life – and, the general situation created by this type of incentive – most vividly present in bank-controlled housing, which is all based on the "possibility of resale", is that the houses become impersonal, sterile, and artificial.

In order to remove this incentive, altogether, we have made the resale price independent of the house design entirely – in the hope that the more people see their homes as permanent life – long possessions, and not as cashable commodities, the more they will create environments which are genuinely adapted to their wants, and needs and comforts – and the greater the chance that the houses so produced will be human, and personal, and whole.

Specifically, the families may sell their share at any time. At the time of sale they will get back approximately 90% of the rent they have paid over the years. The rents are calculated so that if the house has been built with reasonable care, it will command this price on the market. (see Appendix 14, for details).

The family's own cash investment

Finally, it is important to recognize that, from a monetary point of view, the cluster gives each family a tremendous bargain.

The following table compares grassroots housing, mortgaged ownership and rent or public housing. In all three cases, families make roughly similar monthly payments. But the total spent in one lifetime, the percentage which the family can retrieve from re – sale, and the length of time for which they have to pay the monthly payments, are entirely different.

It is obvious from what has been said earlier that the grassroots housing process gives people a better way to live; and a chance to make a much better world for themselves, than ordinary housing does. What is remarkable is that it is also cheaper.

COMPARISON OF GRASSROOTS HOUSING, MORTGAGED OWNERSHIP, AND RENT FOR PUBLIC HOUSING

	GRASSROOTS	MORTGAGED OWNERSHIP	RENT FOR PUBLIC HOUSING
FAMILY PAYS FOR	15 YEARS	30 YEARS	LIFE
TOTAL MONEY SPENT	$30,000 PLUS LABOR WORTH ABOUT $10,000	$80,000	$80,000
CAN RETRIEVE	90%	30%	0%

It gives them far more, for far less money, than they can get with any current form of ownership or public housing.

B. The flow of money

The backbone of the grassroots housing process lies in the unconventional way that the money flows. We shall now show how the limited flow of money created by the families' monthly payments, can pay for the land, materials, the builder's labor, and the seed money needed to start other clusters in later years.

To do so, we shall lay out the accounts of a typical house within a cluster, to show the course of its financial position during its first fifteen years. See table. The accounts for a cluster are the same, multiplied across the board by twelve, if there are twelve houses.

The assumptions behind our figures are as follows:

1 The family builds 360 square feet the first year, 160 sq. ft. per year for the next four years, then 75 sq. ft./year for the next ten years. We have shown in Appendix 3 that these figures represent a feasible rate of growth for a young family. Of course, the figures are averages. In practice, each house will follow a different sequence of construction.
2 The rents fluctuate in two ways. First, the rent is calculated on the basis of the total area of the house at any given moment in its history. The larger the house, the more rent is paid. Second, the rent per square foot decreases with time. This reflects the fact that the cluster cannot afford unlimited materials at the beginning of its life, so the rate per square foot is high in the first year, and gradually goes down to a figure well below the current average later in the life of the cluster. The detailed explanation of acceptable rents, from existing payments is given in Appendix 10.
3 This fluctuating rent schedule, makes it possible for people to take part, regardless of their income level, and makes it possible for rich and poor to live together, in the same cluster. Middle income families will have rents like those shown in the table. Poor families can either reduce the rate at which they build their houses (as shown in Appendix 12), or they can be subsidized by public housing programs, as we have explained in chapter four.

4 Materials consumed cost about $10 per square foot of finished construction. This includes 10% for communal building and improvements.
5 The builder's fees are high in the first year, when he spends full time with the families, designing and building; and then decrease with time. The explanation of the builder's fees is given in Appendix 8.
6 There is a fixed annual cost for land purchase; and, after the tenth year, an additional fixed annual cost for maintenance. (The basis for land purchase is given in Appendix 13.)
7 In the first year of its life, the revenue is $2500 less than the expenses. To offset this initial deficit, the house consumes $2500 of seed money created, and donated to it, by some other cluster.
8 The house pays for this gift, by itself creating seed money and giving it to five other houses, in other, still newer clusters, during the first fifteen years. To this end, the balance of revenues minus expenses which remain at the end of each year, is set aside for seed money. When the seed money reaches $2500, a new cluster gets started and the balance goes back to zero. As we see, the cluster gets started and the balance goes back to zero. As we see, the cluster starts new clusters in the seventh, ninth, eleventh, thirteenth and fifteenth years.
9 The sale of houses does not figure in the accounts, since we have deliberately set up re – sale conditions so that they do not interact with the accounts: whenever a house is sold, the new owner takes over the payments, just where they are, and pays the seller – so that there is no net gain or loss to the cluster (Appendix 14).
10 In its fifteenth year, the cluster becomes independent.

FIFTEEN YEAR TABLE OF ACCOUNTS FOR ONE HOUSE

YEAR	NEW AREA (sf)	TOTAL AREA (sf)	RENT/SF (cents/sf/ month)	TOTAL MONTHLY RENT	TOTAL ANNUAL PAYMENT
YEAR 1	360	360	$.60	$216	$2520 + $2500 SEED MONEY
YEAR 2	160	520	$.40	$208	$2500
YEAR 3	160	680	$.30	$204	$2450
YEAR 4	160	840	$.25	$210	$2520
YEAR 5	160	1000	$.20	$200	$2400
YEAR 6	75	1075	$.19	$204	$2450
YEAR 7	75	1150	$.18	$204	$2450
YEAR 8	75	1225	$.17	$208	$2500
YEAR 9	75	1300	$.16	$208	$2500
YEAR 10	75	1375	$.15	$206	$2480
YEAR 11	75	1450	$.14	$203	$2440
YEAR 12	75	1525	$.13	$198	$2380
YEAR 13	75	1600	$.12	$192	$2300
YEAR 14	0	1600	$.11	$176	$2110
YEAR 15	0	1600	$.0	$0	$0

YEAR 22	5	22
YEAR 23	3	25
YEAR 24	4	29
YEAR 25	6	35
YEAR 26	3	38
YEAR 27	10	48
YEAR 28	3	51
YEAR 29	15	66
YEAR 30	5	71
YEAR 31	18	89
YEAR 32	10	99
YEAR 33	19	118
YEAR 34	20	138
YEAR 35	19	157
YEAR 36	35	192
YEAR 37	20	212
YEAR 38	52	264
YEAR 39	25	289
YEAR 40	68	357
YEAR 41	41	398
YEAR 42	81	479
YEAR 43	73	552
YEAR 44	91	643
YEAR 45	122	765
YEAR 46	101	866
YEAR 47	188	1054
YEAR 48	124	1178
YEAR 49	256	1434
YEAR 50	178	1612

C. The rate of growth

The project which we are proposing here, is important mainly because it provides an entirely new solution to the housing problem. As we shall now see, it is perfectly conceivable that a country which starts a number of projects of this kind, can hope to see as much as one – half of its entire supply of housing being built by these techniques, within thirty years – without any further input from the economy. In short, we believe that one of the most important features of the grassroots housing process is its very rapid growth rate.

The system, in short, has an enormous capacity to spread, purely on the basis of its rate of growth in detail. We know, from the cash flow for one cluster, that a cluster will generate seed money for new clusters in its seventh, ninth, eleventh, thirteenth and fifteenth years. Since each new cluster which is seeded, itself seeds the other new clusters which in turn seed yet other clusters, we may plot the growth of clusters as shown in the following table.

FIFTEEN YEAR TABLE OF CONSTRUCTION EXPENSES AND NEW SEED MONEY GENERATED BY ONE HOUSE
ALL AMOUNTS IN 1973 DOLLARS

YEAR	MATERIAL COSTS	BUILDERS FEES	LAND & MAINTENANCE	TOTAL ANNUAL EXPENSES	SET ASIDE FOR SEED MONEY	GROWING BALANCE	NEW STARTS EACH TIME SEED MONEY BALANCE GENERATES $2500
YEAR 1	3600	1330	160	5090	0	0	
YEAR 2	1600	500	130	2230	270	270	
YEAR 3	1600	500	130	2230	220	490	
YEAR 4	1600	500	130	2230	290	780,	
YEAR 5	1600	500	130	2230	170	950	
YEAR 6	750	300	130	1180	1270	2220	
YEAR 7	750	300	130	1180	1270	990	NEW START
YEAR 8	750	300	130	1180	1320	2310	
YEAR 9	750	300	130	1180	1320	1130	NEW START
YEAR 10	750	300	330	1380	1100	2230	
YEAR 11	750	300	330	1380	1060	790	NEW START
YEAR 12	750	300	330	1380	1000	1790	
YEAR 13	750	300	330	1380	920	210	NEW START
YEAR 14	0	300	330	630	1480	1690	
YEAR 15	0	200	910	1110	810	0	NEW START

The system has a growth rate about 16%. By the end of thirty years, one cluster will have generated a total of 70 clusters, and the process will steadily be generating about 13 new clusters per year. By the end of fifty years, the same one cluster will have generated a cumulative total of 1600 new clusters, and the process will steadily be generating 210 clusters per year. In short, $30,000 invested as seed money today, will, by the end of fifty years, have generated a total of 20,000 houses, and a steady flow of 250 houses per year.

Perhaps the most interesting way to understand the power of the growth rate, is to consider the housing problem in a typical city with a population of one million people. As a reasonable figure for growth and replacement, we may assume that a city of this size will need about 7000 new houses per year. We may ask how much this city would have to invest today, in the grass – roots housing process, in order to be able to generate half its annual housing need, or 3500 houses, or 300 clusters per year.

To start a process which will be generating 300 clusters per year in thirty years, it would be necessary to start 22 clusters now; in order to start a process which will be generating 300 clusters per year fifty years from now, it would be necessary to start 1–1/2 clusters now.

In short, a city of one million people can take care of half its annual housing needs within 50 years by investing $45,000 today.

If we ask the same question for whole countries, we shall see that the required investments are still remarkably low. For example:

INVESTMENT NEEDED IN MILLIONS OF DOLLARS TO SOLVE THE HOUSING PROBLEM IN DIFFERENT COUNTRIES

COUNTRY	POPULATION	INVESTMENT NEEDED FOR SOLUTION IN 50 YEARS	INVESTMENT NEEDED FOR SOLUTION IN 30 YEARS
USA	200 million	$9 million	$140 million
PERU	12 million	$0.1 million	$1.7 million
TURKEY	35 million	$0.8 million	$12 million
SWEDEN	8 million	$0.3 million	$5.6 million
EGYPT	30 million	$0.45 million	$7 million
INDIA	540 million	$5 million	$77 million

These figures are based on very rough estimates of annual housing need, and very rough estimates of local construction cost. But it is the order of magnitude which is important.

All these calculations have been made, without reference to inflation. If we are willing to inflate rents, at the same rate that materials and labor costs inflate, the figures remain essentially the same. However, for reasons explained in Appendix 15, it may not be possible to inflate rents as fast as costs – since it may put too great a burden on the house owners. If the rents are inflated at a lower rate, then it will be necessary to accept a growth rate of 12%.

This is, in the end, largely a matter of choice for the cluster projects. It is impossible to make accurate predictions about the rate of inflation – we have therefore given some possible alternative ways of handling inflation, in Appendix 15.

D. The builder

For the first pilot projects, in any particular area, we propose that the Center for Environmental Structure serve as a builder. However, in the long run, if the process grows at the rate we predict, it will obviously be necessary for local builders to take over the building process. For this reason, we now describe the builder's functions and responsibilities in very general terms (see Appendix 8 for more detail).

First, in order to guarantee that the builder's interest in maintaining the healthy environment is in no way influenced by the profit motive, we consider it essential that every builder, like the Center for Environmental Structure, be a non – profit foundation.

Within this non – profit framework, the builder's functions and responsibilities have six parts:

1 Design. The builder will teach the families and house-owners to use the pattern language. Since it is fundamental to the project proposal, that the families be able to design their own houses, and the public land between them, well and since – as far as we know – the pattern language is the only viable technique so far developed, which enables users to perform these functions adequately – it is essential, that the builder know this technique, and be able to instruct and help the users, in its practice. In some respects, this is the builder's central function (see Appendix 7 for past experience).
2 Construction. The builder takes responsibility for the purchase of materials, the permission to build, supervision of construction and organization of labor. He will also provide and supervise, the labor which the house owners need, at a price equal to, or lower than, the current market price of comparable labor. He is, in short, providing the services usually provided by the general contractor's foreman. In addition, he will train users to build their own houses, wherever they want to do so.
3 Management. Since the twelve families in a cluster will, together, make many decisions about their common land, they are acting like a local government in microcosm. This function is perfectly natural, and must in any case, come from energies and efforts of the people themselves. However, the group processes which are needed, both for reaching consensus and for encouraging distinctions, are unfamiliar ones at this particular moment in history. The builder will help the processes to become fruitful; and to this extent will function as a manager, whose task it is to ensure smooth and cooperative decision – making by the group of families.
4 Diagnosis. The process described here requires not only that construction of houses, public buildings and public land be gradual (i.e., spread out over at least five years to begin with), but also that the houses and public land between them remain in a continual state of construction, and repair, in later years, so that the environment can be improved constantly, and modified, according to people's experience of how it works for them. This process requires continual diagnosis of the existing space – indoor, and outdoor – so that all new construction, however modest, will always repair the defects revealed by the diagnosis, and will therefore ensure the gradual improvement of the environment.

This does not correspond to any existing service. It is perhaps analogous to medicine. It is as if the builder takes responsibility for the ongoing health of this small part of the environment, and takes, or recommends, the steps needed at every year, to maintain

this health. It is helpful to think of the builder as a kind of family doctor of the environment; or perhaps like a forester who tends his trees, and maintains their health – not wanting to influence them in any particular way – but always checking their health, and proposing those minimum actions which must be taken to maintain its health, and to cure its sicknesses.

5 Legal. The builder is responsible for creating the non – profit corporation which will become the cluster. From his position, on the Board of Directors of the cluster, he will then administer the charter and the by – laws of the cluster (see also Appendix 2).
6 Financing. The builder is responsible for the flow of money: he takes in monthly rents, buys materials, makes payments for the land, etc. The slower, more highly differentiated flow of money in the cluster housing process is a vital part of the processes needed to make the environment whole and healthy, and its care and supervision must, for this reason, be part of the builder's task.

In addition, he is responsible for channeling seed money from cluster to cluster. It is an essential part of his function, that he provide the guarantees that the excess profits generated by a cluster, will in fact be spent on seed money for other clusters. He is able to provide this guarantee, because his own corporations, and the corporation of the cluster, are both non – profit corporations, and are therefore constrained by law to spend their excess profits on grants to other non – profit foundations. Both the sponsor, and the house owners, can be certain, therefore, that the money which they generate will actually help other families, in other places, set up similar non – profit housing corporations for themselves.

Overview of these six services. The combination of these six services, in a single profession, is unknown today. But we have come to the conclusion that it is impossible to guarantee the health and wholeness of a housing project without providing all six services, within a single framework, in the way we have described.

In the mid – twentieth century, we have come to assume that the person in society who is most concerned with the well – being and health of housing projects is the architect. And it is true that the human ideals, which are represented in the grassroots housing process, are the ideals which architects stand for.

But, we have been forced by analysis of the circumstances surrounding the present practice of architecture, to the conclusion that there is no way whatsoever, that an architect, practicing within the confines of today's professional practice, can guarantee the health of the environment – since it depends too heavily on factors outside his control – i.e., the flow of money, the process of construction, the design by users, and the local control of public land by users.

In short, anyone who seeks the human ideals which architects have sought in the past will do well to recognize that the task of architecture can only be made practical and effective if it includes the six services which we have ascribed to the builder.

We have been able to demonstrate that a builder can perform these functions, at a normal salary rate, and can be paid for them, in the amounts that they are necessary, by the flow of money which we have described within the cluster (see Appendix 8).

It is clear, from the foregoing description, that the "builder" as we describe him here, is an entirely new kind of professional, not known at present. If the grassroots housing process grows at the rate described in the last section, it will be necessary to have

a very large number of builders in the world, within a fairly short space of time. We therefore finish this section with a brief mention of the process by which new builders can be trained.

It depends, simply, on a process of apprenticeship. We propose that every cluster will have at least two apprentice builders, helping the builder, and learning from their experience (see Appendix 9 for details). We estimate that three years of this apprenticeship will be enough to qualify a person as a builder. This will generate new builders at a rate faster than the growth rate of clusters, and therefore fast enough to staff new building projects. The apprentices also help to reduce the costs.

E. The sponsor

The symbiotic process in which builder and cluster together create housing, requires a sponsor. The sponsor may be a local government, a public housing authority; an institution like a university or a hospital; an industry; a foundation or other non – profit corporation; or an ad – hoc citizens group.

The sponsor has two functions; to provide the cash needed for initial seed money, for the very first cluster in any one sequence of clusters; and to provide land for new clusters. These two functions work quite differently.

1 Cash. Any one sponsor need only provide a cash lump sum of $30,000 once, to create seed money for one initial cluster. After that, that sponsor may benefit from the self-seeding nature of the housing process, to get as many housing clusters as the rate of growth will generate, as often as he is willing to provide land.
2 Land. The sponsor is not required to donate land. However, for the housing process to work, the sponsor must be willing to provide about one acre for every cluster, to put this land in trust for fifteen years, with the knowledge that after fifteen years, it will be paid for by the cluster, and then turned over to the cluster, with the guarantee provided by the cluster's charter, that the land cannot ever be bought or sold for speculation.

The price which is paid by the cluster, to the sponsor, may vary in different situations. Under some conditions sponsors may be willing to donate land free and clear, once the cluster has proved itself. In other situations, we hope the sponsor will be willing to accept a delayed payment of the original purchase price, without interest. In other situations, the cluster could pay for the land in full, with interest, over fifteen years (Appendix 13). Of course, the more the land costs, the slower the consequent growth rate of the clusters. A sponsor who hopes to see a very rapid growth rate, will probably try to keep the price of the land as low as possible.

Finally, we discuss the sponsor's exit from the housing process. Few sponsors will need to stay in this housing process indefinitely. Suppose, for example, that a university sponsors a cluster for student housing. Even if they have unlimited land resources, they will not need more than a few thousand houses, even in the long run. At that stage, it would be possible to stop generating seed money for other clusters. However, in the interests of world housing, we propose, instead, that the seed money may in this case, be used in other areas, outside the original sponsor's interest or jurisdiction.

In short, the builder will agree to go on using the seed money generated by the self – seeding growth of clusters, within the area of jurisdiction of the sponsor who started it in that area, so long as the sponsor is himself willing to go on providing land. When the sponsor is unwilling or unable to provide any more land, the builder will then have the right to use the left – over seed money to start clusters in other communities.

Grassroots housing as an alternative to public housing

Throughout our discussion, we have made it plain that the grassroots housing process can replace – and perhaps should replace – most of the conventional forms of housing: private ownership, rental, cooperative housing, institutional housing. We believe, in short, that any group of people in society will be better off if they get their houses by the grassroots housing process, than by any other process – because the process makes houses that are better adapted to people's needs, more beautiful and cheaper, than any other kinds of housing.

We have not, so far, said much about public housing. Yet obviously, every public housing program faces the same difficulties as any other kind of housing, as far as money and materials are concerned. A public housing authority has a certain annual budget – so many thousands, or millions, of dollars per year. Within this budget, they want to house as many families as they can; and to give them housing of as high a quality as they can. Since they have to build the housing, they are faced with just the same financial problems as all other house builders. The cost of money prevents them from building as many houses as they would like to – because their budget is eaten up by interest on the mortgages they take out from the banks. And the housing they provide, if built by normal building techniques, is usually even more sterile and monotonous than other kinds of housing.

We shall now show that the bootstrap housing process can help public housing authorities to provide better housing, and house three times as many families per dollar, as they can with present methods of financing and construction. We take the economics first: and then show the additional advantages which grassroots housing has, both for the public housing authorities, and for the families they serve.

Economic advantages. Let us begin by describing the economics of a typical housing program. Let us consider, for the sake of example, a housing program intended to help families with an annual income of $3800. These families are able to pay one – quarter of their income for housing – namely, $900 per year, or $75 per month.

A typical public housing program will provide such a family with an apartment of 1200 square feet. At prevailing mortgage rates this apartment will actually cost the housing authority $180 per month in mortgage payments, for thirty years. Since the family can contribute $75 per month, the actual cost to the housing authority of $105 per month, for thirty years (not including extra subsidies for taxes, insurance, and so on which are not included in our analysis).

In summary, then, under typical conditions today, a local government or public housing agency can house one family, by paying $105 per month, for thirty years. At the end of that time, the family still does not own their own house, and are therefore still a public liability.

For the sake of comparison, let us now imagine that the government decides to invest this same $105 per month, for thirty years, in the grassroots housing process.

We introduce a modified form of the grassroots process, in which the cluster grows for ten years only – not fifteen – at a slightly slower rate, and with rents which work

out at exactly $180 per month, throughout the ten year period. (Again, based on the assumption that the family pays $75 per month, and gets a subsidy of $105). These figures are presented, in sketch form, in the following table.

GROWTH IN THE CASE OF SUBSIDY

YEAR	AREA OF HOUSE	MONTHLY RENT/SF	FAMILY PAYMENT PER MONTH	SUBSIDY PER MONTH
YEAR 1	300	$.60	$180	$105
YEAR 2	450	$.40	$180	$105
YEAR 3	600	$.30	$180	$105
YEAR 4	720	$.25	$180	$105
YEAR 5	900	$.20	$180	$105
YEAR 6	950	$.19	$180	$105
YEAR 7	1000	$.18	$180	$105
YEAR 8	1060	$.17	$180	$105
YEAR 9	1125	$.16	$180	$105
YEAR 10	1200	$.15	$180	$105

Since the houses reach the full 1200 square feet by the end of ten years, and the cluster can be completely paid for by then (with the proviso that it seeds only two new clusters, instead of five), it is possible to use the same $105 per month to support three separate houses, in a thirty – year period instead of one; and, in addition, all three families will own their own houses when they get through and will therefore no longer be a liability to the public housing program.

We present the contrast in its most dramatic form in this table:

CONTRAST IN TWO DIFFERENT WAYS OF USING PUBLIC FUNDS OF $105/MONTH FOR THIRTY YEARS

	GRASSROOTS HOUSING PROCESS	CONVENTIONAL PUBLIC HOUSING
NUMBER OF FAMILIES SUPPORTED	THREE FAMILIES ARE SUPPORTED AND NO LONGER A PUBLIC LIABILITY AFTER TEN YEARS	ONLY ONE FAMILY IS SUPPORTED AND STILL REMAINS A PUBLIC LIABILITY AFTER THIRTY YEARS
STATE AFTER THIRTY YEARS	FAMILIES BECOME OWNERS, NO LONGER A PUBLIC LIABILITY	FAMILY ARE STILL RENTERS AND REMAIN A PUBLIC LIABILITY

3 Political Advantages. Housing is usually a political nightmare. The government is held responsible for one of man's most basic needs, spends large sums to satisfy that need, and not only fails to do so, but leaves behind expensive, permanent, highly visible monuments to its failure. A government neither desires nor is able to control the details of people's environments in the way that it must when it plans and builds a large housing project and fills it with people. In such a case,

people feel dehumanized and alienated, and they blame the government for treating them as mere numbers; yet it is obliged to do so by the nature of current architectural practices.

By adopting the process proposed here, each different scale of environmental decisions is controlled by the group whose personal interests are most related to that scale. The individual designs and builds his house, the cluster deals with its local environment, the builder guides arrangements between clusters, and the sponsor (or government) provides land and initial financing. People have good houses to live in which they own and control, but the government is still in a position to carry out long – range planning and protect the people from the excesses of private speculation and profit.

A stigma will no longer be attached to public housing; it will be better than "private" housing.

4 Social Advantages. In a self – built housing cluster, the physical environment and the financial structure will both reinforce a sense of neighborhood identity, pride and stability. People will be motivated to stay in one place longer and be more actively concerned with the quality of their surroundings. The result will be a coherent and responsible community that is not possible under the present open – market system of housing construction.

Since the same house – building method is equally suitable for a wide range of income groups, and the land is protected from speculation by government ownership, the cost of houses will no longer divide cities into separate quarters for different classes based on income. Everyone will be able to own his house.

Differences in rents will be the result not of an arbitrary formula, as in the present public housing, but on each individual's free choice of the size and rate of growth of his own house.

5 Advantages in the fight against poverty. Perhaps most striking of all, is the effect of grassroots housing on the problem of poverty. Let us first remark that public housing, although intended to help people who are poor, usually does nothing fundamental to change their poverty. They get a subsidy, which helps to house them. But after twenty or thirty years of this condition, they are still poor.

In a grassroots housing cluster, the situation is quite different. The government pays this subsidy for ten years, and by that time the house is paid for. The families no longer have to face the burden of a monthly rent at all, and thereby effectively increase their income. In short, this kind of subsidy is a temporary kind of help, given by the government to needy families, which actually helps these families escape from the poverty syndrome. It brings the family to a position of dignity, and reduces the tax payer's burden. The difference is startling.

If public housing agencies invest their money in the grassroots housing process, then for the first time, "public housing" will be substantially superior to "private housing"; it will be less expensive, more human, more beautiful and more fully adapted to people's needs than housing on the present market. Instead of spending millions on living quarters that nobody wants anyway, the government will be responsible for a housing program which is better in every way than what is presently available on the open market.

Afterword

In summary, the overall importance of the grassroots housing process lies in the fact that it can solve, or help to solve, "the housing problem", because it can change all three facets of the housing problem simultaneously.

First, it can help to solve the housing shortage. It has inherent self-sustaining growth, which will double the number of finished houses every 5–7 years, without any further drain on capital resources. Unlike most public housing projects, its scale is not crucial to its success; it will spread of its own accord, without additional capital inputs; and it can be adapted to all parts of the world, and to people of every economic class.

Second, it gets away entirely from the repressive ugliness of mass housing, and makes houses and neighborhoods which are beautiful, and well adapted to their inhabitants.

Third, it brings the cost of houses down to almost one – third of their present costs.

Since the grassroots housing process has these three features – since, in fact, if our claims were correct, it seems to create an almost impossibly wonderful solution to the world housing problem – it naturally makes us wonder: "How is it that no one is doing this right now? Why isn't it happening already?" We shall finish by explaining just what it is that has been preventing this from happening, and how it is that this process actually manages to solve the housing problem when we look beneath the surface of the arithmetic.

Recognize first of all, that the very astonishing growth, shown in this project, is in fact a phenomenon which is the normal backbone of economic development. The only reason it is so unfamiliar in the form outlined in this proposal is that it is usually creamed off by the banks. Every month Americans spend about six billion dollars ($6,000,000,000) on rent and mortgage payments for housing. Since even the rents are, for the landlord, most often mortgage payments, two-thirds of all this money goes to the banks in the form of interest. This means that of the six billion which people spend every month, only $2,000,000,000 goes into the land; $4,000,000,000 of it goes straight into the pocket of the banks, and is immediately reinvested to make money for the banks. If you stop and think about the incredible economic growth which has taken place in this country over the last hundred years, and the vast riches which have been developing here, you recognize, indeed already know, intuitively, that the paychecks of people coming home from work month after month, can create enormous wealth.

Imagine simply that the whole six billion dollars which people spend on housing every month goes into the land, and into the birthright of the people who made the money. That is essentially what this proposal does. It channels money into the land – not just a part of it. In short, the vast, well-nigh explosive economic growth which has created such untold riches in this country, is being re-channeled so that it benefits the land and the people who live on it, instead of simply lining the pockets of the banks.

19 The growth of order from small acts, 1974

This lecture, an early rationale for what is now sometimes called "bottom-up planning," which shifts power downward to local communities, was presented to the Department of Architecture at UC Berkeley on February 6, 1974. Using examples of biological growth to start, and followed by descriptions of several current projects, the lecture concluded as a "call to arms" against modernist urban planning. The lecture hall was full, and the positive reaction of many of the students, who cheered at the end of the lecture, was very different from the visible anger of some of the long-term faculty, two or three of whom were sitting in the row just in front of mine, and who left very quickly at the end. When he gave this lecture, CA was 37 years old.

The transcript of the lecture, done from a tape recording, was unfortunately not complete – major gaps are indicated in the text – and the slides referred to were not available. Because it has not been edited, it shows CA's conversational approach even in important lectures. But it has been included for three reasons. It is descriptive of a major issue – that of piecemeal growth and the necessary agency of ordinary people in the development of the built environment – that occupied CA throughout his career. It points up the ways in which CA thought about projects while carrying them out, to investigate fundamental ideas, and to justify strong reactions to conventional wisdom. And it shows his willingness to talk frankly in public about tentative ideas, that are in the first, rough stages of formation or realization.

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What I want to talk about is a re-casting of one's ideas of what it means to create something. I suppose most of the people in this audience are architects or architectural students. The essence of what I'm going to try and get to is the notion that has developed in the last fifty years of what it means to create something from an architectural standpoint is simply wrong. I take the desire to create something, the creative instinct, incredibly seriously. I believe that the feeling that a person has to want to shape something is one of the most wonderful feelings. I think that it has been made quite ugly and distorted and I hope to persuade you of that, actually by a rather simple appeal to certain facts.

I am really going to talk in three parts: the first part of what I have to say is rather theoretical and deals directly with the matter that the title of this lecture concerns – the

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growth of order in small acts. It has to do with the question of what is order and I shall try to persuade you that order can only come about from literally millions of almost infinitesimal acts, and if you accept that, that fact alone would change your conception of what it means to create something, either as an architect or as a planner. In the second part of what I'm going to say, I'll give a number of examples of the recent work of the Center for Environmental Structure. I'm giving these examples to show what you might call groping toward the matter that I'm talking about. It will be the longest part of what I have to say. And then at the end I'm going to try and say a few words about – what if one takes all this seriously, what it actually mean for the profession of architecture and the profession of planning. Because if you take me seriously, it will force you, I think, if you have not already come to these conclusions, to examine very, very hard what you are doing as an architect and what it means for you to create something now and in the future.

I would like to begin by showing one or two slides, first of some plants and then of some very simple traditional buildings.

I think it would be helpful if I start with a very personal statement. For ten or fifteen years, all of my concern with buildings and with planning and bits of towns, has had to do with the fact that the most beautiful things in the world are things like what you're looking at in this picture. When I ask myself "How am I going to make something, what am I really trying to make?, I take the bits of grass and the flowers and the trees around me always as the most fundamental models of anything. I have done this for many years, and all of the rather muddled and slow, painful theoretical progress that I've made in the last few years, has actually had to do simply with my own wish to be able to make things as beautiful as that. I realize, of course, that it is almost impossibly difficult. I will not succeed and you will not succeed in matching the beauty of these grasses, but still I do take it seriously as my ideal and I am saying it and dwelling on it, because these simple grasses have a property which none of the buildings of our era have in the slightest degree. Now this property, quite simply, has to do with the level and the degree of the internal adaptation of the parts to one another.

And that in turn has come about in these grasses or any others from the way in which this thing has grown – slowly, as a whole. And in growing slowly, as a whole, and in literally millions of minute acts, first at the molecular level, and then at the cellular level, and then at the level of the individual blades of grass growing and flowers blooming, this thing has gradually come into being. And every one of these small acts, every one of these minute interactions of a molecule with another molecule – the growth of a cell in a particular position, the growth of a blade of grass, each one of these things is happening in a position where it makes sense with respect to the whole that is immediately around it. As it is happening, it adapts itself to every particle of what is there already: it is swayed, shaped, modified, and particular by its exact position in that whole, and because the wind is different and the soil is different and the juxtaposition of the grass is different at every spot, you get a simply wonderful incredible variety within such essentially simple order. Now this comes absolutely from the simple fact of the growth process that I just described.

What I am saying is actually obvious, and even within what you might call the fields of architecture and planning, or at any rate, within the practice of building, something similar to what I've just described has been going on for thousands of years. It's as old as human history – except maybe for the last fifty or seventy-five years. And just to make that point obvious, again I'm sure you all know it, I'd like to show a short series

of slides of places in Southern Italy which were made in a way very, very similar to the way that these grasses were made, but by human hands.

As far as I'm concerned, these things were worth doing. This garbage that we're sitting in is not worth doing, very bluntly. And the problem is, what is the difference? Of course, there is a visible, obvious difference, all of us can feel the difference, we know the difference when we go to these two kinds of places, but can we make the difference clear enough so that we can actually choose to do that, and not this?

The first thing, which is quite clear and obvious, is that these buildings that I just showed you were like the grass, bit by bit, one building at a time, one roof at a time, one room at a time. A step was changed, somebody came out and planted a bush, somebody decided to put a bench right here against the wall, somebody came in and added a window – for years and years and all this thing was happening, it was a normal process of everyday life, and these wonderful buildings were made.

There is philosophical tradition in modern planning or American planning, which superficially sounds like what I just said, this is what is sometimes called piecemeal planning or ad hoc planning, sometimes even laissez faire – don't do anything, everything will take care of itself, just small things, the market place, it'll all work out. Now, the problem is that that kind of business has at least in some very slight degree, the character that it is made piece by piece over a long period of time, rather slowly, with a certain amount of attention. But of course, what is entirely missing from it, is the whole. Actions which just go forward, hundreds of them, thousands of them, day after day, uncoordinated in any deeper sense, will, very probably, create chaos of some sort. And so, in fright at this sort of chaos that's been developing, the world of planning and architecture of the last 50 years, and especially the last 20, has become more and more tyrannical, because people see what's going wrong, they see the cars are screwing up their neighborhoods, and they see that there is too much noise, they see that there is this and there is that, and they say, "We must have control, we must have order, we must have planning."

And that kind of planning, to some extent, leads to the same attitude in building – we must have urban design, in other words we must make a whole out of an area of say 10–15 blocks, we must have gigantic buildings such as this one or our own architecture building, so that there can be some sort of order, so the tyranny is getting worse and worse, people are getting more and more alienated. The reason for all this happening is that there is no clear insight about how to allow thousands, hundreds of thousands, millions of small acts gradually to create wonderful wholes. We don't know how to do that. As soon as we find out how to do it, we won't have to do all this tyranny, and we can tell the people who are doing it to stop, because we've got something better. So this is really the central, most urgent problem.

Actually, very little is known about it. I say "it" because this happens to be a problem which is very, very widespread. It is a fundamental problem in biology, but thoughts on this subject in biology, for example, are extremely primitive at this stage, even after several decades of thought about it. When I say "it", and talk about the same problem, what I mean is that a developing organism, an embryo for example, or in a plant that's growing, or in a person who is being healed over a period of time as the cells regenerate themselves, how is it that those cells continue to create order at the level of wholes, when the acts that are going on are millions of small acts? What is it that coordinates them? It certainly isn't tyrannical, there's nothing in the slightest degree tyrannical about that wonderful field of grass I just showed you, but somehow, there is a relatively large order emerging out of these millions of small acts.

I want to give you two or three tiny examples about this in the physical sciences to emphasize the fact that it is a general problem, not peculiar to architecture or planning, and also to underline the relatively primitive degree of understanding that exists about it.

This is a simple diagram of a crystal in the process of growth. Suppose that you have a crystal that is, in the way of molecules, let's say a piece of salt, are wanting to line themselves up in a roughly cubical array, take it for granted that the crystal ends up as a cube. But actually, why is that? This diagram makes the problem a little bit clearer. At any moment, as the molecules, or atoms, in this case, are placing themselves within the crystal ladders, the thing obviously is going to have a rough, irregular shape, like a lump. Here are these things coming along, plonk, plonk, plonk, and it has this amorphous form. How is it going to end up as a cube? The reason is that this is a statistical process, it's happening in a solution, and here are all these little particles arriving on this lump, and the point is that in this position, this lump that tries to land up here, has only got some binding energy on one face, whereas a lump that lands up in a corner is being bound on two faces and is therefore much more likely to stay there. So therefore what's happening is that these lumps start to grow and fill in the corners and meanwhile the flat faces don't get extra excrescences on them, or at least that's much less probable. And therefore the crystal as a whole becomes a cube, even though it wouldn't if it were not for this very, very small scale process. This is an example where there is certainly nothing unsolved about it, I mean it is quite obvious.

I'm mentioning it because unless one happens to have thought about it, it is not clear that that large scale thing we called a crystal actually comes to be just because of the peculiar nature of that very small process whereby one extra particle gets added to that crystal (. . . .) give another example of the relative naivete of the kinds of things that have been done in the last couple of decades, this is just a mathematical game, one of many such games. I think this work was done by (. . .), where he just defines two or three rules of growth, they're purely abstract rules, and he shows that when you allow these rules to interact, a very small number of rules is already capable of generating relatively complex and organic-looking structures. I say organic . . . because this is a trivial thing, it hasn't any meaning. It is just the result of a game. But it's interesting that the general line of work done by these mathematicians to show how very, very small number of rules interacting can produce a rather involved complexity. The biological case, the biological question, why do the cells grow in the right places so that the organs form themselves in a sensible way and so that the organism as a whole grows properly, there are many unknowns about it. The general central insight came from the work of a biologist named Spemann who discovered that there are essentially fields, chemical fields within the organism. In most cases these fields are created by certain centers, that is, specific actual physical points – throughout the organism, (. . .) but distributing out from these points, (. . .) chemical fields and the gradients of the amount of chemical that from different places controls the relative growth rates of the cells and thereby starts to create the large-scale order.

The reason I mention this case is that obviously what is most important about the biological examples is that the growth that's taking place is simultaneously creating these wholes but it is also adapted. That is, architects have, at various times, designed such things as the evolving house, or a system of components (. . .) where you can gradually build up a building over a period of years, in a certain specific manner, or at a slightly larger scale, traditional master plan is essentially doing the same thing.

It is a map of a certain imaginary future, with the idea that the slots on that map are gradually going to be filled in, one at a time. This is a completely brittle conception of growth, where actually there is no genuine growth taking place in the sense that I'm speaking about it. The only thing that is happening is that the construction of a finished, completely tyrannized object is being phased.

Now that is quite a different process from the case where the end product is unknown in detail, and the small acts that go to make it up are coming one at a time, and each one is adapting to some local condition, and therefore is beginning to make everything just right. In the course of that adaptation, it may bend the blade of grass, it may twist the tree, it may make a really funny thing at the corner of a house, if it's in a traditional case where the streets meet in a strange way – all of these funny things happen, but still, the order of the whole is preserved. In other words, it is not the case of piecemeal growth creating chaos, it's piecemeal growth which is sufficiently guided by something so that it is simultaneously adapting locally all the time, and creating these wholes.

(...)

I'm going to give five examples of different projects that we have done, or are in progress, and I want to make it quite clear that I don't consider that we've solved these problems. I'm giving these examples as essentially just bits of things that we've done that are part of our struggle to create this kind of situation that I've been talking about. There are actually two different ways of getting this property that I've been speaking about. One of them has to do with the people who are living and working in the environment, and the other one has to do with the actual speed, that is, the slowness of the growth. I just want to make it clear why there are those two different things, which are both essentially facets of the same problem. This adaptation that was taking place in the grasses, or that was taking place in the Italian houses, is going on day after day, hour by hour, minute by minute. It is incredibly intricate, incredibly detailed. It's worthless if it isn't, but in order for it to be possible for it to be that intricate, only the people themselves can do it. I mean in other words, if every window sill and every door, and the seat and the position of the wall, and the exact place where the path goes because of a favorite rose bush, and all of those things are really going to gradually get in the groove together, as the thing grows over time, obviously, the only people who can take care of that are the people who are right there all of the time. It is simply nonsense to imagine that somebody, one of us, can just draw up something in our office, some distance away, or even right there, for that matter, and then walk away from it and expect it to have these qualities.

It is a continual process, a life process, and for this reason, as some of you – at least those faces that I recognize – and I know some of you have spent a good deal of energy in the last few years trying to understand the processes by which people can do these things for themselves. Now in fact in that matter we have been rather successful. I'm not giving a lecture about that, so I'm not going to speak about it hardly at all. I think in terms of what I'm saying, it's enough to just briefly summarize the fact that it turns out that there are language-like systems in people's minds, that these language-like systems which we call pattern languages, are able to give anybody who knows very, very little about architecture as we professionally think about it, give anybody, the (. . .) to create buildings, part of buildings, for groups of people to create part of neighborhoods, (. . .) power is put right at their fingertips by the mere existence of such a language. Essentially, that language is playing a role like the role that the genetic material plays in the case of the grasses. In other words, the grasses, the reason

they are coherent for all of their minute adaptations, is that they have genetic material in the cells which essentially is giving the rules of growth, and the rules of order, and all of these wonderful things are happening within these rules created by the genetic system. The human version of this is not passive like that, it's creative. The people who use pattern languages are creators, they're able to make things themselves, the things which have these kinds of properties. They're able to do it in the large, and they're able to do it in the small.

We spent a great deal of energy, the better part of eight or nine years in working out how that can be done and actually getting it to the point where it does work. The part of our work that is really new, and that is at the heart of this question, which is actually an open question to me, has to do with this question of speed.

So suppose that you do succeed in getting the creation of the environment into the hands of the people to a certain extent (. . .) I'll show you some examples in a minute of cases where we've done that. It is also not really going to work unless the thing is happening through time in the way that I said. And specifically, let me remind you of the . . . principle – namely, that the small acts are happening all the time, are not controlled, that is they are not intended to put things in pre-existing slots, the end product is unpredictable, and the question is, these small gradual acts are somehow together helping to build up these wholes.

Now the thing of this, the actual necessity, for example, of a building (. . .) like the architecture building, over a period of twenty years, not knowing at the beginning how it is going to be at the end, that's what I'm talking about. That's the kind of thing I'm talking about. I honestly don't know how to do this. I know enough about it so I think I'll be able to talk coherently for another half an hour, but I really don't know how to do that, and you'll see why. It's not a theoretical reason exactly, it has to do with a professional reason. There are professional difficulties (. . . .)

Before coming to the implications for the profession, I'll just go straight-forwardly through five examples of current work and essentially just describe them as they go.

The first one is the University of Oregon. Just a brief introduction to it – the U of O invited us to do a master plan, we said no, we won't do a master plan, we don't want to make a drawing of your future, we will provide you with a process of the kind that I've been talking about tonight, in which people of the University, that is the students and faculty, can together design their own buildings for themselves and do it in such a way that the small acts by which they do it will gradually become coherent in the University as a whole. Let's just look at the pictures . . .

The first things that I'm going to show are actual sketches made by a group of people in the Department of Music, designing, together with us, an extension to the music school in Oregon. I'll show you first just a series of pencil sketches that were actually made during the course of a week while we did this on the site up there. Then I'll show you a series of simulations of what might happen at the University of Oregon over the next thirty years if this sort of process continues.

One of the crucial points that I will come back to – I think I'd better just talk about this for a second. What you're going to see here (. . .) About the fact that this building was made by some of the faculty and students in the Music Department, using the pattern language out there on the site (. . .) the important thing, from the point of view of the theoretical difficulty that I posed, is that we have succeeded in defining certain sorts of fields similar to the fields that I mentioned are operating in the organism, and that these fields are essentially governing the large-scale order, also in terms of pattern,

in such a way that the small buildings that are made actually not only contribute to themselves – that is are human, beautiful, appropriate, correct, whatever – they are also contributing to the large-scale order that seems to be needed in an emerging fashion in the University as whole.

Now in this particular slide (I was reminded of it because it says "University Street" up there) it happens that one of these field-like properties in the University as a whole had to do with the emergence of certain special kinds of streets which would be very, very connected to all those floors of the university buildings, with the idea of increasing the density of communication among the people in the university as much as possible. The diagnosis of the university in its present state shows fairly clearly where such phenomena exist already, where they're emerging, and where they don't exist at all. The existing building is roughly speaking that white, sort of L-shaped thing, and it happens that in this general area of the campus it was very obvious that there was no university street, nothing like it, and so therefore the emergence of such a street occupied the people who did this design while we were doing it, even though it was not of direct concern to the problem of the music school. What I'm saying is there was sort of a bargain being struck; there's a certain task, there's not enough space for the music school, and there's a whole series of patterns in a particular language for making that music school – which evolves in a way you'll see in a second – but the bargain that's struck is that in return for essentially having the privilege for doing this for themselves, the people of the music school agree that they will also take seriously the need for these larger structures to grow in the university.

So they will make an effort to have university streets appear or begin to appear in this particular part of the campus while they're going about their own business, putting in the wings of the buildings where they need them and making the building fit their own purposes. As this bargain, whereby small acts are made in such a way as to contribute to larger wholes, is very fundamental to the matters which I'm talking about, in fact it's absolutely essential to them; because it's exactly without that sort of bargain that you do not get large-scale order emerging. And then you really do get the kind of chaos produced by independent, unconnected, piecemeal acts.

I have so much material that I'm not going to try to explain exactly what was happening here. It's just that these are literally the sketches at day's end that were made on a series of days. This is the end of the second day. (next slide) By this time some fairly definite ideas had been formed about where to place practice studios and extra practice rooms and a new band room and so on. (next slide) At this stage the layout had fallen more or less completely into place and all the connecting links were clear. You see the shaded stuff is the new material, we (. . .) the old. And there is some modification going on in the old. (next slide) That was a detail about how one of the people there thought the practice rooms ought to be laid out. (next slide) That was more or less the conclusion, the end of a week's work. All day, for five days.

This building is waiting for funding, and what I want to show you now is a series of imaginary plans, which have to do with the campus as a whole, and the way in which it might grow over a series of thirty years under the impact of relatively small-scale actions of this kind. I say relatively small-scale, by the way, of course this is really pretty huge actually. It (. . .) as huge as current practice has it. The current practice at the University has buildings going up, typically they are in the $3–4 million range, not that much different from this building, but this is probably a more expensive building than that. But the same sort of thing has been happening on this campus, these huge

sort of bombs are getting dropped here and here and here and there. The very first thing we did when we started our work with them, was to say "Look the budgetary procedure has got to be changed." Because the sort of process that I am speaking about is fundamentally undermined so long as large acts of that sort are going on at all. Suppose that you have $7 million to spend, or $5 million, and most of it is blown on a $5 million building, of course, you can't really do anything of the kind that I am talking about, and the essence of our budget – any recommendation to them which they, I think have taken with a pinch of salt is this: for every million dollar building or project, you have got simultaneously to build ten $100,000 projects, a hundred $10,000 projects, and a thousand $1,000 projects. Think about that for a minute. That is what this process is really all about.

I would like to just dwell on that monetary aspect for a moment, because again, so far what I've said might be interpreted to mean that the money or the flow of capital into the environment is just going on rather slowly through time, instead of in relatively large pieces. But I'm actually saying more than that, and I think that those numbers that I just said make it clear – and that it is not enough to just do things gradually, the point is that you have to go back and do things again and again and again. Because you always make mistakes, so that if you spend $100,000 on a certain building, you need ten or twenty doses of $10,000 over a period of time, and fifty doses of $1,000 over the next 10–15–20 years, to get that building into shape. It's pure fantasy to imagine that that thing that was made "bang" by somebody drawing a drawing and building it, could conceivably be any good, and that's true even if it was built without drawings and all that sort of thing. The fact is that the environment needs to be taken care of all the time, and in order to take care of it all the time, there's got to be money flowing into it all the time, rather than in these huge packets, which essentially deprive the environment of all the energy that it needs all the time to keep healthy and to keep this wonderful, subtle adaptation.

Let's just look at these next few slides for a moment. This is a series of four slides of plans of the University of Oregon at 10-year intervals in our imagination. This is the way it is right now. This is the music school building that I just showed you. Gradually small things are beginning to happen. Now of course, this is not a plan of the University ought to be in 1990 (. . . .) they follow the procedure that we've laid out for them, and there is every indication that they will, with some minor reservations, there's a chance for a structure of this kind to emerge there. And given the fact that this thing started with a fairly regular grid and a few pretty large lumps sitting in it, you can see that even after a period of 30 years, this thing has begun to take on the kind of character that I'm speaking about. And of course this drawing does not show the actual things that would be going on locally, that would depend very much on matter that we have yet to come to.

So that is one example. The next example I'm going to give you actually doesn't have anything to do with growth at all. The reason I want to show it to you, though, is that in small degree an element of this same kind of process is at work in this next project. This is the clinic which is now under construction in Modesto. (next slide) I haven't got any photographs because it's not inhabited yet and there is no point in photographing it until it is. (series of 3 slides) The building is built in a conventional way. (next slide) That was the original sketch of it. The point is that as it's being built, it's being built all at once, $600, $800,000 building, it does not conform at all to the ideas that I am speaking about tonight. But the fact is that this was also (blank spot in tape) site, as

the music school was, and just the sheer fact that it was designed by the people who were going to use it means that the level of differentiation in the building, the amount of small, subtle adaptations, is very much higher than in a typical building that might have been built in this situation. In fact, the original building that was projected for this site was a concrete cube, and it was because of that that the psychiatrist in desperation started a process of investigations which finally led him to us, and ended with this.

But what I am saying is that if you'll try and imagine that at a particular moment, in the course of the evolution of this thing, here we all were walking around on the site and imagining to ourselves (. . .) comes in and you've checked in at the main entrance and reception point and you're then going through to the outpatient clinic, what happens as you walk around this corner, and here we are – you can imagine, five or six of us, walking around on the site, sort of structural marks on the ground, thinking that that building is already there, imagining what it's like to walk out of it, walk around the corner, sit down, and wait for somebody to come and do something . . . a simple process is simulated exactly the same as the adaptation which you'll make in the grasses or in the Italian buildings, except that there it's happening in time and here it was all happening in a very short period, as if it were for real. Very important difference, but still, there is a certain measure of value even in what we did, just because the adaptation is so much more subtle, relatively speaking, than in a building which you'd just dreamt up on a drawing board. This is no reflection on a person doing something on a drawing board. It just isn't possible for one man, without the reality of the situation, to get into all of these incredibly minute things – because you can't make them up out of nothing. Unless they're really happening to him, what's he to do, just push his pencil along these lines. The main thing to do, in a sense, the main point of everything I'm saying tonight, is to get yourself out of that situation. Don't allow yourself to be in that situation. Because as soon as you put yourself in a situation where real influences are capable of acting on the shape of the building together with you, that building will start to take on this very much more subtle and highly differentiated kind of adaptation.

(...)

The next thing I want to describe to you very briefly is the content of a class I'm giving at the moment. I didn't describe in any detail . . . (gap in tape) . . . of the following type in the City of Berkeley. Namely, that any neighborhood of between 300 and 1000 people of that number of users, either people living or working in the area – a neighborhood 300 to 1000 people, relatively small, in other words a maximum diameter of about 400 yards. Really tiny. There are about 200 of these sorts of things in Berkeley (. . .) each of these neighborhoods has the right according to this ordinance we are working on, if it can diagnose its own area in such a way that it becomes clear what sorts of small acts of repair would help to start building in the larger-scale patterns that are missing from the environment, that the neighborhood would then be entitled to a share of the Berkeley city budget, specifically the part concerning capital construction, and that it would have the power of the board of adjustments and of the zoning ordinance, control over these matters in the area of its own concern.

What we're trying to show is that an ordinance of that kind which might give one of these tiny neighborhoods as much as say $20,000 a year to play with, and the control over the private built investment, we're trying to show that in a fairly short time, maybe as little as ten years, under the impact of an ordinance like that, the whole city of Berkeley could essentially come to order in environmental terms. By people taking care, in millions of small ways, of matters which they're essentially not in a position to

take care of today. They're not allowed to, they're not in the sense that the tax money is not permitted to be used for these purposes, and they don't have sufficient control over the private construction that's often expected to have these effects. The next slide is a drawing by one of the people in the course, showing diagnosis in similar terms – it's a very small area, you see, Hearst/Grove up to Shattuck at the end, a block and a half in that direction. House by house, if you were to see the drawing itself you would see that all over it small things are written in where the small acts of growth are needed in order to start bringing this neighborhood into order in terms of its large-scale patterns.

Finally, my last example – I'm going to describe something that was done in another course, which took place during most of last year, and concerns a very extraordinary finding that is really central to this whole matter than I've been speaking about. We began this course asking essentially the question, how could a group of householders, let's say a dozen families, design a dozen houses for themselves and the land between them. This was a matter that in purely physical terms we had investigated earlier (. . .) the techniques of the pattern language we've been able to show that people can create a world which has very much more of the kind of richness that I have been speaking about – in a static sense, that is, as a design. In fact some of the people in the class where we first did that are sitting right here, I see several of them. I'll show you those drawings from that in a second.

We made a very extraordinary discovery about money (long gap in tape) to start, for a young couple to start with 350 sq. ft., and in the course of a number of years, in some cases seven years, ten years, to have a complete house, and essentially, at that point to stop paying. That means that instead of paying, let's say $200 a month for 30 years, these people are paying $200 a month for ten years – finish. And at that point, all of their income which is essentially what you might call housing income, or the amount of money that they are bringing to the environment, or are willing to bring to the environment, instead of having to pay off any interest, instead of having it be completely wasted in the form of bank payment could, if they wished, start to pay for the gradual repair and ongoing construction and reconstruction both of their immediate environment and the larger environment around them. I want to make clear that this is really quite a fundamental and central point. Because the whole construction industry at the moment is geared to the banking situation, in such a way that we have come to take it for granted that you build whole complete entire buildings, and we have come to take this for granted partly because the banks want it to be that way. This is not the only reason, because the fact is that we as architects and planners are also wanting it to be that way because of a whole lot of egocentric trips, which are very unfortunate, and I think can easily be set aside. But there are these two kinds of reasons which are at the moment creating these gigantic buildings which are taking the money that actually is needed to go on with this ongoing growth process, and wasting it.

I think at this point I want to wrap up anyway because I've been going on longer than I meant – it's fairly natural for me to kind of come back and summarize the question about – what is the implication of all of this for the profession? You can see that the examples that I've given are so far incredibly inadequate and partial. You can see roughly where they're headed, though. What does it mean to be an architect in the context of an attitude like that? What do you have to do, to be able to live like that, what do you have to do to your mind to be certain that you are still a creative powerful artist? What do you have to do in your profession to guarantee the client will actually be willing, to enter into contracts that are compatible with this kind of process?

I want to answer those two questions since I think the answers are quite simple. The first thing which I believe is vital – it sounds trivial, but I believe it is vital – is that the creative instinct of a person who nowadays calls himself an architect are actually being misled by the picture of architecture that we have. We have a picture in which it is necessary in order to fulfill yourself that you create these rather large things which are complete at the time of their conception. If you think back to the grass, think back to those flowers in the grass, think back to the Italian villages that I showed, and ask yourself, isn't it much more wonderful to be a person who is willing to set in motion processes that will create things like that? I mean if you can really anchor yourself in that fact, you will feel such creative power just at the mere possibility doing it, that the fact that it does not have the form of today's creative effort on large pieces of paper will simply not matter. Because you're really making something alive, you're capable of making something alive. But it does mean anchoring yourself in a process.

It means specifically that when you take on a building project, quite apart from working with the people who are to live and work there, quite apart from possibly moving more towards the construction of the building and not being a purely abstract architect – I haven't spoken about that tonight, I haven't had time – this is also very much part of the same matter, to move towards the construction of the building – quite apart from that there is the simple thing that you say, look, I want to build this building over ten years. Now it sounds crazy today, but it's not crazy. And it's possible that all of us could essentially get into the frame of mind where that is what we would do as a matter of course. Because we know that it's better for the environment. And, very important, it also happens to have this strange connection to the monetary aspect.

Let me just give a concrete example. A couple of years ago, two or three years ago, I was asked to make some rough, some schematic designs for an extension of the Berkeley City Hall, which – at that time, really, these thoughts that I've been describing tonight were completely unclear to me. So just went about this, did my best, using various techniques, and so forth . . . anyway, of course it has not materialized because it's not the right thing to do with the money anyway. But there they are in the position now of wanting in order to satisfy the city service a $2 million building. Now what I realize today is the following: in order to get a $2 million building they were willing to pay $200,000 a year for 30 years, because that was the rate of amortization. Because they essentially had access to $200,000 a year. What I would say to them today is build a $200,000 extension every year, once a year, for ten years, and at the end of ten years you will have that building, it will be infinitely better, because it will be far more grounded in the realities, and you will have saved $4 million.

And that's true, it's actually true. It sounds incredible because architects are not usually in the habit of thinking about these things, but that is actually true. (comment from audience) I think it's very important to discuss the subject of inflation. In fact, the present attitude for that money is precisely what is behind the phenomena of inflation, and it is of course very easy then to say, wait a minute, this isn't compatible with the inflation thing.

Let me just sum up. In the last few years, I have more or less discovered how to get a fairly serious kind of thing happening in which the users of buildings take part in their designs in such a way that the very highly differentiated character of more traditional environments actually comes into being. That part, at least, seems relatively clear. This other part, what I have been speaking about tonight, is not clear. I grant you that freely.

I don't know exactly what to do. What I have just been suggesting, for instance, that one try to persuade one's client to set up contracts of that sort, that one enter into altogether different agreements with the people with whom one is making buildings, in such a way that the buildings can be built gradually under the guarantee that the large-scale order will emerge because of the fields or other diagnoses which I again grant you are not completely clear at this point – but that is our real task at this moment in the evolution of our work. To persuade people who are paying for the buildings that this is what they should pay for, and on our own part, to refuse to enter into those kind of situations where we are making these absurd and gigantic cardboard blocks.

I will put this in very straightforward language: I think any one of you who is a student in this school is in a position where if a design project comes up, and somebody says to you, Hey, listen, the design project for this class is to do urban design on this and this scale, and you realize that some gigantic cardboard model is going to be the outcome of it, essentially a huge urban design or a gigantic building or set of drawings, you can refuse.

20 The architect-builder

Toward changing the conception of what an architect is, 1977

This short article was printed in a newsletter published by the Northern California chapter of the American Institute of Architects. By that time, CA had a contractor's license in addition to his architectural license, and was doing projects that combined the two roles into that of the "architect-builder." This professional re-definition went along with theoretical work that spoke to the importance of design decision-making being integrated with the emergence of the physical building in the construction process. CA argued for a complete redefinition of the architect's role, to include control over construction itself.

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The core issue, at the heart of architecture, and at the heart of the process of architectural education, is our conception of the architect. Although we often take this conception for granted, like the fish who is the last one to discover water, still, it is our unconscious, accepted, half-formed, certainty about the nature of the architect, which ultimately forms our attitude to making building, and our attitude to training architects.

In our time . . . in this crisis, which is now completely clear; in this period when the buildings that architects have built for the last fifty years, have ravaged the earth, have made it an almost horrible place; when lay people have finally given up the pretense that they "like" modern architecture; when instead, almost everyone knows that these awful crystalline, solid, lumplike boxes, these giant packing crates that cover our cities, are no good for us, are inhuman, sterile, ugly, and devastating for our social and emotional lives . . . most architects have still not fully understood the fact that it is ultimately our conception of the architect which is responsible for this.

It is true that many people are asking themselves what to do; that new methods, new theories, new kinds of building form, are being tried. Schools of architecture have almost all tried sociology, "urban design," communication theory, systems theory, system building, computer analysis, psychology, super graphics. Marxism, user participation . . . and all of these techniques are being taught, and tried at Berkeley. But, when you get right down to it, they just do not make much difference. The preamble to the building process changes. But the building process itself remains the same.

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Noticing that these many techniques have seemed to fail, another group have expressed their concern by going back to the most conservative form of professionalism. Assuming that these techniques which seek to modify the architects' work do not help, they argue that we must abandon them, and go back to the most solid form of professionalism which we can, revitalize the attitude to architecture which was current perhaps twenty or thirty years ago. So there is a second attitude at Berkeley which seeks to re-entrench the professional architect as the center of all things.

But this fails too. The failure of the first group of techniques does not lie in the fact that they are different from professional architecture. It lies in the fact that they do not change the fundamentals of the profession at all. All of these techniques have always been taught, and understood, as ones which can happily be grafted onto the work of the architect *as we have always known him;* and this is what makes them fail. Because – so long as we do not fundamentally, radically, alter the way an architect works, his place in society, his conception of himself – it is impossible to change the horror of the landscape, because this horror is a direct outgrowth of the conception of the architect.

What changes need to be made in the conception of the architect to correct these problems?

Since the art of making buildings, and cities, is an art, then, like any art, it must be understood as a process of making things. The most fundamental problem with our present conception of the architect is that he is trained to tell other people to make things. He gives instruction. But he himself does not make anything.

In short, an architect who merely makes a drawing from which another man is going to make a building cannot be an artist, because he cannot put his feeling into the thing he tells the other person how to make. Only a builder can put feeling into building. And therefore – to be an architect who makes a thing with feeling – it is necessary to be a builder, not an architect.

This requires a radical transformation in the architect, because instead of being the middle man between client and contractor (as he is today), he must become the contractor himself . . . who himself takes the burden and the delight of the decisions which involve the actual art of making the building.

The recent decision to allow architects to be their own developers, though it sounds similar, is not the same at all. The architect developer is merely another middle man between the client and the actual builder, except that he takes profit and not only professional fees.

For the architect to be an artist, builder, contractor, it means that his relation to the material of this art – to the brick, stone, concrete, wood, tile, and plaster, and paint – is the same as that of the cabinet maker to a piece of furniture, or of the painter to his paint. He makes it, he shapes, he is physically the maker of the building.

And this does indeed require a vast change in our conception of the architect.

It requires a change in the legal structure of the profession. It requires a complete change in our daily work. It requires that we get up at a different time of day. It requires that we are on site all the time, not in an office. It brings joy with it, because it is in the actual process of building that the art of architecture develops, not in the fiddling around on bits of paper with a pencil.

Of course, the profession we call architecture cannot be changed overnight to bring about this state. People's professional lives, work, salaries, legal positions, are too tightly defined to make that possible. But it is possible to change it, by changing what

we teach. Those who have been taught this new conception will change the profession, as they enter it.

This requires an immense change in what we teach people who are hoping to be architects. At present, our program at the University of California has almost no time devoted to the actual practice of construction. It is all theory and paper. In order to change this, we need to understand the making of a building as a craft. In a school where this craft was taught and practiced, we would see physical columns, capitals, arches, seats, windows, being built, instead of drawings pinned on walls.

I believe that the great changes which have been made in the techniques of the profession – the user design, the kinds of analysis which can be used to understand human needs, the use of pattern languages to design better buildings, the innovation in new materials and new processes of fabrication – all these are wonderful, and essential.

But they will become full-blooded, able to remake our towns and buildings, able to regenerate the life-blood of society – only when the most fundamental conception of the architect, as a glorified draftsman, as a legal mediator between client and builder, is finally renounced, as a mistaken experiment of the last hundred years. It must be replaced by a new version of the most ancient form of architect – the *master builder*. Our schools must accept this fundamental act of *making* as the most fundamental, central item, in our conception of the architect.

21 Rebirth of the inner city

The North Omaha Plan, excerpts, 1981

The Omaha project defined a participatory planning process for a largely Black neighborhood in Omaha, Nebraska – an area that had experienced several decades of disinvestment that was at least partly racially motivated. The project was spurred by the need to develop an effective process for the spending of block grant money that came from the Federal government, for the use of the North Omaha community. It laid out a way through which neighborhoods would have control over the money, and spend it on improvements linked to an emerging field of centers in the neighborhood. Howard Davis was co-author of this project.

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The essential idea of this plan is that the people of North Omaha, themselves, will take responsibility for their own future: that they will make the decisions which most closely affect their lives.

This is the basis of the plan, and was our most fundamental mandate, given to us at the time of our commission. It was made clear to us, both by the citizens of North Omaha, themselves, and by the officials of the City, that above all, this plan was to be a plan in which the people make the planning decisions themselves, and in which above all, the neighborhoods themselves govern their own futures.

Since this idea is so fundamental to the plan we shall discuss, first, the specific human structures – the human groups, and the structures of responsibility – which must exist, and be created, in order to make this process work.

Although "participation" is a term which has been widely used in the last few years, there have been few, if any, plans which really do place the decision-making power, for a part of a city, in the hands of the people who live and work there. For this reason, it is necessary, in this first chapter, that we explicitly define the various human structures which are needed to support the real participation of the people in their own affairs.

In the conventional city planning process, there are essentially just two levels of human structure:

1 The city.
2 The families and businesses.

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Of course, "the city" in this context, is a complex fabric of interconnecting departments and agencies, some of which are directly responsible to still higher levels of government – such as the state, and the federal authorities. And of course, the "families and businesses" again stands for a vast complex array of individuals, families, partnerships, and corporations.

However, in the conventional process, there are no intermediate institutions, with authority and legal responsibility, lying between the level of the city, and the level of the individuals. Since the city is comparatively large, and cannot have the amount of personal relationship with individuals that is required, this has the effect of making the relationship between individuals and the city quite distant – and above all makes it extremely difficult for the people of a community or neighborhood to influence local decisions in the area where they live, directly.

In order to make the local decision-making process real, and effective, we believe that it is necessary to introduce two new levels of government, or human institution, in between "the city" and "the individuals," thus:

1 The city

NEW * 2. The community
NEW * 3. The local neighborhoods

4 The individual families and businesses

In the case of North Omaha, these two new levels already exist, informally. The community in this case is a rather well-defined area which happens to be the target area of this plan. It is an area about 2.2 miles long and 1 mile wide, with well-defined boundaries, and a population, in 1980, of about 13,000 souls, with an existing community development organization, the North Omaha Community Development Corporation (NOCDC), that has existed since 1974, and is together with the city, our client in this plan. In this respect the city already recognizes the standing of this community, at least to the extent of entering into a partnership with it, in the preparation of this North Omaha plan. And the local neighborhoods exist informally as well. There are at present 13 neighborhood groups, each one with a fairly well-defined boundary, which are explicitly recognized by members of the community, and each one with a neighborhood association with its own legal status and its own bylaws.

(...)

The groups at these two levels – the North Omaha Community at one level, and the individual neighborhood associations within North Omaha at the lower level – have already entered into the process of planning, in various informal ways. They have advised and assisted the City of Omaha in the preparation of plans for the area; they have worked with us during the preparation of this plan; and they have frequently, even continuously, entered into discussions with the City, on various matters relevant to their own future.

However, this informal level of activity does not provide an adequate basis for a plan. Although the City of Omaha does already respect, and recognize the existence of these groups, there has never yet been any formal way in which these groups have been given explicit standing in the process of city government, nor in the process of city planning, in so far as it affects their areas.

. . .

Our first task, therefore, and the first task we have been called upon to perform by the city and by the community, is to define a formal human structure, which will establish the informal structure which now exists, and make it a proper, normal, and recognized part of the city planning process.

Before specifying the nature of the human organization which we wish to institute, we shall briefly review the vital reasons why this must be done, and why these two new levels of human organization, should become a formal part of the city planning process.

We have said already, that we are committed, in this plan, to a process in which the people of the community are able to remake the community themselves, to make it theirs, to make it develop economically, to shape it in their image, and to make it, for themselves, the kind of place they want to be. This requires that the process of control be truly local, truly small in scale.

As a person I can take an interest in my block, in the two or three blocks around my house, or around my business . . . because I know them, I know what happens there, I understand it, and it makes sense to me. But I cannot, honestly, become involved in large scale decisions about the city, or even, about the community which contains 13,000 souls, living in two and a quarter square miles. Of course, it is important to me what happens there . . . but I cannot pretend to have a direct relationship to it, most of it is too distant, it is unfamiliar, and abstract.

Any process which promises "participation," but in the same breath asks people to "participate" in these large scale decisions, will not work. If I am supposed to participate in my community, then let me become involved in what happens locally, what happens on my street, where I know the kids, where I know which corner is dangerous because of trucks, where I know who is broke, and who is making it, where I know the nice places to sit in the sun. If a city promises to let me "participate" in my community, then it must also make it possible – honestly and above all practically, possible, for me to play a part in helping to shape my immediate world, the few blocks right round about me, where I live, and where my business is.

This advice, this principle, may be homespun, but it is fundamental. And it is the backbone of this plan. It is based on two essential practical realities:

First, although we sometimes use the word "neighborhood" to refer to many different sized political entities, which may contain anywhere from 500 to 50,000 people, the fundamental psychological fact about people in the cities is this: People identify with an area which they see and think of as their immediate neighborhood, and this area is generally no more than two or three blocks in diameter. This fact needs to be acknowledged in the physical and human development of the city: so that the process of development, and the process of control, accentuate, and relies upon, this human reality of peoples' local neighborhoods, which gives them their feeling of identification in the city.

Second: The problems which people experience as most pressing, vary constantly, throughout a community. What is most urgent to do on one block is different from what is most urgent on the next. As we go through the city each local neighborhood is, in a certain sense, identified by an area in which people have obvious common problems.

Thus, for instance, in one neighborhood, peoples' most pressing concern is the problem of truck noise, because a major truck route disturbs peoples' sleep at night. Two blocks away the most urgent problem concerns a large piece of vacant land,

which has become a nuisance; two blocks away again people are relatively well off, and their main concern is the task of restoring their houses to their traditional state, and keeping the historic quality of the trees and lawns; again two blocks further over, there is a potential for business development, and the main concern that people have is to channel this potential development, and keep businesses in the hands of local owners . . . and so it goes on. The grain of the city is very small, the problems change block by block, and, above all, it is only the people who actually live and work on any given block, who have the accurate enough perceptions of their immediate reality, to be able to make sensible decisions about what to do there, and who know what is appropriate.

We therefore accept as fundamental, the idea that the types of decision enumerated at the beginning of this chapter, must be made as far as possible, by the people who are local to a given area: and that, for this reason, we have included in our physical and economic structure, the principle that identified neighborhoods are very small, both in population and in area.

On the basis of these arguments, we reach the fundamental premise of this plan: The process of city planning in the North Omaha community must formally be a four level process, which includes:

1 The city
2 The North Omaha community
3 The local neighborhoods
4 The individual families and businesses

All detailed decisions, made in the planning process, will be distributed in a specified manner, among these four levels of government, and on any given decision concerning the development of the area, these four levels of government will enter in, in a well-defined and exact manner. Thus, the rights and responsibilities of each of the four levels will be precisely defined, with regard to any given question or decision of city planning and development.

In particular, the following two principles are to be adopted, formally, by the City Council, as part of the adoption of this Plan.

1 The community of North Omaha is to be acknowledged as a legal entity in the planning and development process, by formation of a representative body to be known as the North Omaha Community Development Authority (NOCDA). This body will be constituted in a manner specified in chapter 10. A majority of the board members will be residents of the North Omaha community, elected by neighborhood associations, and the remainder of the board members will be appointed ex officio, or by the Mayor. The NOCDA will have broad powers to make planning and budgetary decisions within the area of North Omaha, and North Omaha will be declared a special district for zoning purposes. All this is spelled out in detail in 0.
2 The individual neighborhoods of North Omaha will be formally recognized as legal bodies which enter into the planning process. The associations will be directed by a board of neighborhood residents, and regulated by the NOCDA. The individual neighborhood associations will make budgetary decisions and will govern all planning permission and building permits, within their boundary areas, acting in an advisory capacity to the City Planning Board. These matters also, are fully spelled out in chapter 10.

Although the legal details of these principles are not fully defined until chapter 10, nevertheless, most of the following chapters – especially chapters 5–8 – rest on the assumption that these principles have been adopted. Thus, in chapter 5, we shall show how the city allocates budgets to community and neighborhoods; in chapter 6, we shall describe the process by which the community makes decisions to heal itself; in chapter 7, we shall describe the process by which the neighborhoods make decisions to heal themselves; and in chapter 8, we shall describe the process by which both community and neighborhoods are able to influence the construction undertaken by private investment, in such a way as to bring the maximum benefit to the community.

In short, throughout the plan which follows, the formal existence and legal powers of these two new levels of city government, are considered fundamental to the success and well-being of all development.

Chapter Two
Economic structure: basic assumptions

In this second chapter we are concerned with the economic health of the community. Of course, anyone who visits North Omaha today, is struck by the general level of deterioration which exists on a purely physical level. Houses are falling down, roofs are in bad repair, roads need mending, shops are closed or derelict, there is little fresh paint anywhere, children have few attractive places to play, there are few public places which can be visited with pride.

However, obvious as it is, this deterioration is merely the outward surface of a much more fundamental problem: a serious deterioration in the economic structure of the community. And of course, the physical structure cannot be repaired without also taking into account the much deeper problem of repairing the economic structure.

We therefore come to a fundamental question: What kind of economic structure is needed to support a healthy community? What is a healthy economic structure for North Omaha?

At present, the community is in a depressed state, because there is relatively little cash flow: there are few jobs: and the environment is deteriorated to the point where even it is no longer able to help generate income. There is a shortage of income: and a shortage of income-generating projects.

The stimulus provided by the federal government in the form of block grant funds, cannot be seen as anything more than that: a stimulus. At present levels of spending, block grant funds will produce some $20–25 million over the next few years.

But rough calculations indicate that the long range economic health of the community requires a much larger investment: on the order of 2–3 times as much, amounting to perhaps $72 million, over a ten year period. This figure comes from making a rough, overall estimate of what will be required. There are now about 4000 houses in the community. If we estimate that half of them have to be repaired, at an average cost of $10,000 each, that is 2000 x $10,000, or $20 million; 400 new dwellings, to accommodate an influx of population, at $55,000 each, will cost $22 million more; five new shops in each neighborhood at a cost of $25,000 each will cost $1,875,000 more; an investment of $10 million in streets and sidewalks, and an investment in parks and common land of $10 million will cost $20 million more; a public building in each neighborhood costing $200,000 will cost $3 million more; five new factories, each with an initial investment of $1 million, might cost $5 million more. The rough total is about $72 million – some $47 million more than what block grant funds can provide.

At present the income producing activities necessary to produce the additional $45 million do not exist in the community. Unless we make sure that they do exist, the funds spent by the federal government, of course, cannot possibly improve the fundamental economic situation.

We therefore seek a form of development which will be capable, over a ten year period, of producing jobs, and income generating activities within the community. This requires two steps.

First, we must bring new sources of income into the community. Second, we must keep the community's money circulating in the community.

There are four ways in which we can bring new sources of income into the community:

1 Through new jobs, commercial or industrial
2 Through public investment
3 Through private investment from outside money
4 Through influx of new families who bring new income with them

But, even if new families and new businesses can be successfully invited to come into the community, this alone cannot solve the economic problem. Ultimately, all the families and businesses, those already in the community, as well as those who come in as newcomers, must have a viable economic position, so that they can invest, or reinvest, a reasonable part of their income, in making improvements in their own houses and businesses.

This means we must create a structure, an economic structure, within the community, which effectively keeps circulating its money, within the community, so that a spiral of increasing jobs, income, retail, and reinvestment is created: the so-called multiplier effect.

Of course this requires income, and jobs. However, more generally expressed, it requires that as much of the money which comes into the community, should recirculate, several times over, as many times as possible. This is the so-called multiplier effect. If we can arrange matters in the community, so that the dollars which come in, through the stimulus of outside intervention and public programs, can then be made to bounce, from family to family, business to business, three or four times, then the total effect of these dollars will be greatly multiplied, three or four times, and the economic benefit to the community will also be multiplied three or four fold.

In order to understand this clearly, it is important to understand that, frequently, the block grant funds do not recirculate, or multiply in this fashion (. . ..) it is used to justify the hiring of contractors, materials suppliers, professionals, and other services, all from outside the community (. . .) always with the argument that the community itself cannot supply the necessary talent.

This is a totally self-defeating argument, which must be stopped, completely, in order to allow the community to develop economically, as a result of the programs initiated for that purpose, by the federal government.

Thus, it is possible to visualize a situation in which the $2.5 million in block grant funds, to be spent on capital improvement in the community, actually moves from person to person within the community, all the time stimulating the economy, and putting money in peoples' pockets, which they can then use for their own private efforts of improvement.

(...)

For this reason, we consider it absolutely essential, that all physical development, undertaken as a result of this plan, be placed in the hands of contractors, individuals,

and families, who live and work in the community, so that this money can then be spent, a second and third time, in local stores, reinvestment in do-it-yourself home improvements, and so on.

We consider this issue so important, that we have given it a special status in the plan. As we shall see in chapters 4 and 5, and the chapters which follow them, we have specified that a certain proportion of block grant funds, must be spent in the effort to help black contractors, and other contractors living in the community, to establish themselves. We have specified that some of this money must be used to create local builders' yards . . . that is, yards which can both supply materials, equipment rental, and skills, to the neighborhood. And we have specified, further, that each neighborhood must have at least one designated neighborhood builder – a contractor, living in the neighborhood – who will undertake small scale construction jobs in the neighborhood, and who can also take on the construction of public works projects in the neighborhood, under contract with the city.

These local "neighborhood builders," will not only then help to stimulate the economy, by making sure that public funds stay in the community, and recirculate. They also have another essential role: when the planning efforts of the community are decentralized, neighborhood by neighborhood, it is necessary that each neighborhood spend a considerable amount of time each year, preparing the necessary documents, and thinking out what its public spending programs are going to be. Although it is reasonable to expect that the neighborhood committee will undertake much of this work as a group, experience also shows that it is extremely helpful . . . almost necessary . . . if there is one "anchor person" . . . a person who knows the prices of materials and projects, who is familiar with the full range of possible expenditures covered by this plan . . . in short, who can guide and stimulate the other members of the neighborhood committee, and who can then take on the responsibilities for some of the work, when contracts are issued for actual construction.

The neighborhood builder whom we envisage plays all these roles.

(...)

However, of course, the provision of neighborhood builders alone, will not entirely solve the economic problem of North Omaha. Beyond the organization of neighborhood builders, in a community-wide contractors' association, it is also necessary that the community – and specifically NOCDA – play a much wider and more powerful role, in order to stimulate development. The ultimate goal of this plan is to direct the spending of public funds in such a way as to stimulate the economy, and create an atmosphere of confidence, in which small scale private investment will then triple or quadruple the total funds flowing into the community, and thus reach the necessary $72 million within the next ten to fifteen years.

(...)

Since some form of outside investment, which does not cause displacement is needed, we believe that the community must initiate a program in which new families and businesses, who clearly show themselves willing to become part of the community, and who wish to help transform and improve the community, in terms which make sense to the present members of the community, can be attracted in, and will thereby bring their dollars with them, to stimulate local economy.

It is our belief that this kind of program, which will require a vigorous marketing effort, and a vigorous public relations effort, can only be done by the community acting as a developer, and making "sweet deals" in which potentially valuable land is given at

bargain rates, to those incoming families and businesses whose plans for development meet certain important criteria.

This kind of vigorous program requires that the community as a whole has two essential powers:

1 The power to buy, hold, and sell land.
2 The power to undertake development activities, on its own, or in partnership with incoming residents.

In addition, it is clear that the benefits of this kind of program will be undermined, if development is undertaken by absentee landlords or developers, who have no immediate personal interest in the community, since in the case of absentee developers, the income gained from the development, does not recirculate to the benefit of the community.

This means, that the community must also have sufficient power, and sufficient resources, to be able to buy out any families wishing to sell their homes or land, and thus prevent these homes and land from falling into the hands of outside speculators.

Once again, this requires that the community have the legal power, and funds, to buy, and hold land.

We have therefore specified (in chapter 8, and in chapter 10, article 15), that the North Omaha Community Development Agency is not only empowered to advise the city in regard to all planning decisions, in North Omaha, but also has the full powers of a redevelopment authority.

We propose that the City Council negotiate with the relevant taxing jurisdictions to direct the LRA to turn over all North Omaha property which it now holds, to the NOCDA, in order to give the NOCDA an initial stock of land, for its development efforts. We have also specified, in chapter 5, that a certain minimum proportion of block grant funds must be spent each year by NOCDA, in buying land, to add to this stock of property.

And we intend that the NOCDA, backed by the powers and structure created in this plan, will be in a strong enough position to enter into positive development enterprises with various local public and private interests.

The guidelines which will restrict these developments to those that can be most helpful to the community, are clearly spelled out in chapters 4, 5, and 8.

And the power, which will give the NOCDA the capacity to raise money from private banks and private developments, is inherent in the orderliness of this plan. We believe that the plan so clearly confers an orderly and economically positive environment, on the community of North Omaha, that the confidence necessary to invite loans, investment, and land purchase, by suitable private individuals, partnerships and corporations, will be created within a year or two.

Chapter three
physical structure: basic assumptions

Let us assume now, that steps can be taken to improve the economic conditions of the North Omaha community, along the lines spelled out in chapter 2, and we assume, also that the community and neighborhoods have the kind of recognized formal authority described in chapter 1. We are finally ready, then, to discuss that aspect of the

community which gave us the original impetus to the drafting of this plan: the physical layout of streets and neighborhoods, the condition, and construction and reconstruction of buildings.

(...)

To reach a vision of a new North Omaha, and of what this might be, we take as a starting point the observations already made in chapter 1. That is, we take it as fundamental that the new plan will be respectful of the entity we call North Omaha, as a human community, and also respectful of the smaller neighborhoods which people have defined for themselves, the local neighborhood associations.

As we have said in chapter 1, the level of respect which this plan gives to these two new kinds of human entities, is rather new – new at least, in the fact that these entities are to be recognized formally, as legal entities which enter into the process of city planning.

If we take this respect seriously, we shall see that the physical environment to be created for such a community, must also have a "new look"; for the great respect given to the human groups, at the level of the whole community, and at the level of the individual neighborhoods, must also show itself in the physical structure, in the physical place of the community.

That is to say, just as we shall be aware in the new political process, that there are new human groups functioning at community and neighborhood levels, so we must also be aware of this new respect given to human groups, when we simply drive through the community, or visit it, or come to work or live there.

Specifically, this requires that certain concrete physical changes will indicate the presence of a community – for instance, the clear definition of its own centers and its own boundaries. And, we shall expect to see, also, the signs of each individual neighborhood, active, within its own limits, with its own small local centers, its own boundaries, its own smaller individual health. In short, we must be immediately aware of the community as an association of small, partly independent neighborhoods, each with its own unique character, and its own definition.

In the next few pages, we shall try to describe what kind of general physical organization will actually need to exist to support this vision.

If we imagine a beautiful community, one which is loved, one which is taken care of, with an intimate and definite relation between people and the places they live in, we see a rather extended, rambling part of the city, but organized in such a way that, within reach of any point, there is always at least one special point, one center, one beautiful place, which attracts us, draws our attention, gives us relation to it.

These "special places" may be quite different from one another. In fact, they really need to be different, because each one is unique, captures the uniqueness of the area around it, is a point which gives us something to hang onto, something to remember, something to distinguish.

In one case it might be a very beautiful grove of tall trees – like those standing along the freeway site, in the Lake Bristol Neighborhood. A stand which is so beautiful that there are benches and seats under it, a view to look towards, perhaps a specially cared for grassy spot beneath the trees.

In another case it might be a market, a market visible from several major streets, with awnings, cars, taxis, people, vendors, a bustle of activity.

In another case it might be tall buildings, brightly painted; it might be a children's park, with large animals, brightly colored, standing outside making up the playground. . . .

It might be a row of shops, one row of shops, each one very carefully cared for, each perhaps quite personal, small in scale, all selling some kind of furniture. . . .

In another case, it might be a particularly beautiful old house, a large mansion, repainted now, acting as a kind of clubhouse or community center to the few blocks that are around it. . . .

Now imagine that we choose these special places or "centers" so that they are always reasonably close to one another. That is, they are chosen to be close enough together, so that as you move about in the community, you are always related to them – always coming from one of them, or going towards another, and that you can always catch a glimpse of the next one, from any given one that you are in.

This means that these centers are not isolated spots, which merely make life pleasant at a few special points . . . they are peppered throughout the community, and form the fabric of the community, they are the points of orientation to which one most naturally associates oneself.

And now imagine further, that we define a system of tree-lined streets, or avenues, which function as links to tie these local centers together. The centers will then form a network in an even more literal sense, since it becomes natural to move around the community, on these avenues, or tree-lined streets, always moving from one local center to the next.

This network of central special places, then, makes up the fabric of the community . . . it is the orienting stuff which we remember, and which gives the whole community its physical presence. And the network is the backbone of the community. Informal, charming, variable, each place within the network is unique to the character of its inhabitants . . . yet the whole network provides the community with a coherent character, a character that becomes familiar, pleasant, easy to remember.

This is an intensely personal structure. It is intimate, governed by individuals, who make each of these special places what they are. And it is easy to see, now, how this very intimate character of the community is interwoven, and provides the backbone for a more extensive structure which exactly mirrors the human structure we have already defined in the last two chapters.

We may also ask, what kind of detailed physical structure we propose to build in the community, within the network of centers.

If we examine the beauty of the old Omaha, which is still visible in many of the streets of North Omaha, we find that the beauty, and harmony, depends, to a large extent on details. That is, it lies in the special character of the porches which line a certain street; in another street it is the particular way that trees are planted in the streets to form the avenues. It lies in the beauty of detail which was used on many of the old houses, the wooden columns, careful paintwork, and beautifully proportioned windows.

The same thing can be extended to the larger aspects of the public space which forms the community. A place feels comfortable when it contains paths that make walking pleasant, seats that allow a person to sit down and catch their breath in the sun, gardens where there are plants or flowers to be enjoyed, neighborhoods which have a corner grocery in the right place, where it forms a hub for people in the nearby blocks, parking lots that are hidden or screened, places where children can play in safety.

Within the network of the local centers that we have described so far, it is therefore our intention that the grace and beauty of the community will be accomplished mainly

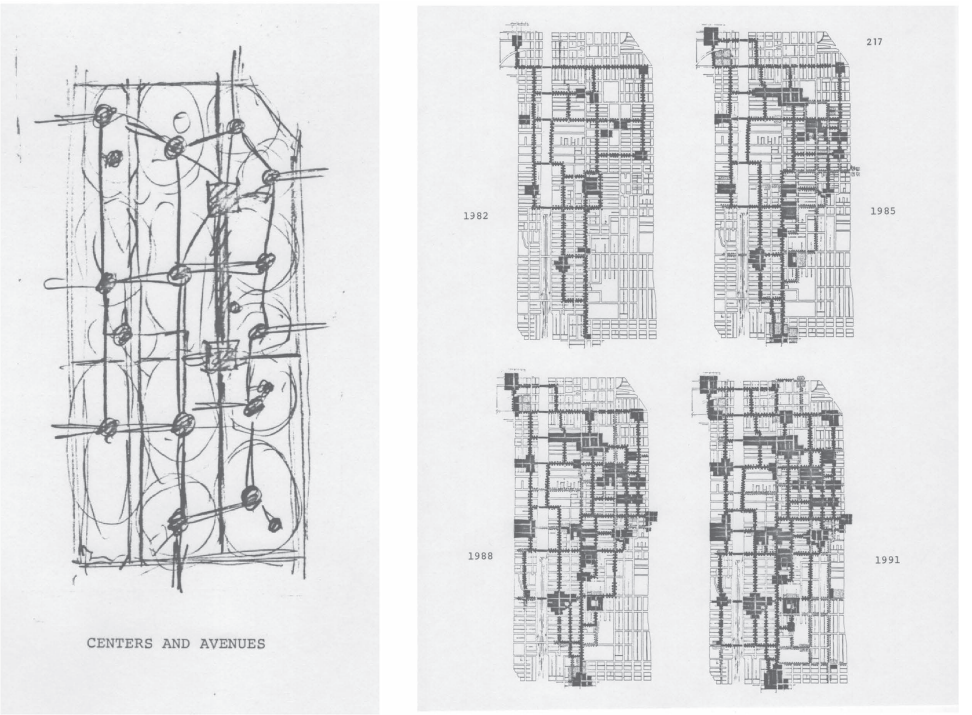


Figure 21.1 Left: The idea of a field of centers at the urban scale in North Omaha. Right: The gradual emergence of neighborhood centers over a period of several years, based on small acts of improvement to the centers and connections between them.

by making sure that these various small kinds of beauty are well understood, and that they are introduced regularly, in the right places, to embellish, and enhance the centers that exist.

We shall not attempt to describe these points in detail, in this present chapter, but draw the reader's attention to the long list of items, which are spelled out in detail towards the end of chapter 4. The concrete details which are enumerated in chapter 4, will form the basis for the physical texture of the new North Omaha. The process by which we shall make sure that these many different things happen, in the places where they are most appropriate, and according to the wishes of the local residents, is fully explained in chapters 6 and 7, especially in chapter 7. We shall see there, that the people of each neighborhood have the responsibility, each year, for placing some of these small things which make the neighborhood nice, and beautiful, and comfortable . . . and that the plan specifically guarantees that there will always be some funds available for this purpose.

Of course, it also goes almost without saying that the process of creating the network of centers must be gradual. That is, the process of redefining the centers which form the important points in the community and neighborhoods, and the process of defining the links, or avenues, which make the network by connecting these centers, must both be gradual.

This is dictated, in part, by the fact that there simply is not enough money available to do it quickly. The flow of cash from block grant funds and from public works funds is necessarily small . . . and a large part of these funds must be spent on other items, not directly related to the physical environment, which are needed to re-establish the local economy. We estimate that it will take at least ten to fifteen years of steady growth and planning, in order to accomplish the healing of the community, which we imagine here, merely for economic reasons.

But there is another, second, reason for making this process of redevelopment gradual, which is not concerned with money, but which has its basis in the requirement that the work must be done with human quality.

It is certain that the origin of any beauty which the community will have in the future, must lie in the state of the community, as it is now. Even though the community is in poor condition economically, there are many beauties latent in the various streets and neighborhoods now. The close connection between the people who live in the community and the physical fabric of the community, does not exist, merely because this is where they happen to live, but because many people recognize the beauty of the houses, the beautiful trees, the informal, almost rambling way in which small houses surround the streets within the neighborhoods.

The community has risen up to maintain itself, precisely because they are aware of this potential . . . and wish to save the physical community from destruction.

In short, then, the process of choosing neighborhood centers, and the process of choosing and developing links and avenues which tie these centers together, must be gradual, because it must start with the places which have the greatest potential, now, to become lively, or beautiful . . . enhances them, gives them whatever they need to strengthen their good qualities . . . and then, goes on, year after year, to seek out and strengthen the new places which emerge, gradually, from the development process as the next places of the highest potential.

But it is also not enough for the process to be gradual. In addition, the process must come from the people themselves. In all the beautiful communities of the world, wherever we look, in Europe, in the ancient towns of North America, in Africa or Asia . . . the beauty of the community is always a direct creation of its people. The community of north Omaha will not become truly beautiful, unless it is made up from a thousand details, contributed by different individuals . . . different families, different businesses, different neighborhoods.

It is ultimately this, the special genius, the wonderful character of a certain porch, a certain garden, a certain grove of trees, a favorite store on a corner, a workshop producing goods, a market, a street where children always play football or baseball, a favorite corner for the old folks to sit in the sun, a barbershop where all the local gossip happens, houses painted by their owners, buildings decorated with a touch of pride . . . all this can only come about directly from individual people.

Our present process of city planning – and especially those versions of it which encourage mass development – has often lost this beauty, and this special human character. But we know, from our original mandate as planners, and from the original discussions which we had with the representatives of the NOCD, that this issue is fundamental to the people of the community. What they want, is a process by which the community can gradually take on this special personal, and lovely character, year

by year, as a result of the direct efforts of the people themselves, getting involved in the decisions, helping each street with special touches, created by the individuals who live there. . . .

This requires much more than mere repair of dilapidated buildings. Of course, it is true that many buildings which are now falling down, or in poor condition, must be fixed. But what is required here, is something much greater. It requires that the process of spending money, to fix up the houses, and the shops, and neighborhoods, be done within a framework which guarantees that this more personal quality, this love that people have for their community, can be reflected in the outward face of buildings, in the streets, and in the gardens. And it means that the soft character of the old North Omaha can be recaptured and preserved . . . not wiped out, by crude actions of large scale developers.

For all these reasons, it is essential that the process of development be very gradual, decentralized among the different people of the community . . . and that the process takes place, in a framework which will allow this gradual, human face to show itself.

And of course, at the same time, it is also essential that the repairs which happen, in a given year, have immediate impact on the community. It is not enough to say, loosely, that all development should be small in scale, and decentralized. If the development is very thinly scattered throughout the community, then even after two or three years it might seem as though nothing had been changed, nothing had been visibly improved. For this reason, it is essential that the relatively modest human efforts, which are made to repair a given neighborhood, or a given street, are always concentrated, so that even after one year's work, something visible has been improved, and everyone who passes through the neighborhood can see it, and admire it.

For this reason we have specified, in chapters 6 and 7, that the development which happens in any given year, is always concentrated in a small area, which we call the target area. This means that even though each increment of development is small in scale, and personal, it is also highly concentrated, highly visible, and highly effective.

This kind of targeting does not merely have implications for morale. Of course it is more beautiful, if the community has a few visible target areas which, a few months after starting this plan, already begin to glow. It looks better and will cheer people up. But the same thing also has immense economic implications. For of course, if there are indeed a few centers, which begin to develop, to look good, to be rebuilt, replanted, and repainted . . . then this at once begins to create an atmosphere of economic confidence, which will do just what is needed to provide a confidence in the money market, and the stimulus for new development.

So the centers, which we define as the backbone of the community, and the network which these centers create, are not only essential because they provide a backbone, a recognizable framework for the community. They also enter into the process of development in an immediate and practical sense . . . because it is this network of centers, which begins to grow from the beginning, and creates, from the beginning, the feeling that something definite is being done . . . and that the community has started to come to life again.

NEIGHBORHOOD BUDGET

NEIGHBORHOOD O.I.C. Target Area 1 25th & Corby

BUDGET YEAR 1981 Target Area 2 24th & Miami

TOTAL BUDGET $191,360

		Avenues Connecting Centers	Target Area 1	Target Area 2	Not in any Target Area	16
1.	IDENTITY AND ECONOMIC STRENGTH OF THE COMMUNITY 1981 TOTAL: $29,240					
	Increase percentage of local property ownership, and reduce number of absentee landlords					
	Influx of new families and businesses					
*	Purchase of land and property (through NOCDA) at least 27%		11,580	6,000		
	No displacement of present residents					
	Create new jobs in the community					
	Increase development of the NOCDA				200	
	Subsidize property tax for present owners				1000	
*	Mortgage insurance and interest subsidies at least 20%		2000	4000		
	Development of a local style of building					
*	Employ local contractors and local labor force in local construction at least 15%		2500	2000		
	Formation of local contractors' association, which works to encourage the use of local contractors					
2.	CONNECTION AND INTERDEPENDENCE WITH THE SURROUNDING CITY 1981 TOTAL: $5,850					
*	Creation of facilities which will attract people into area at least 20%		2000			
	Replacement inside the community, of services offered only outside			3000		
	Organize community controlled business at boundary					
	Creation of jobs which employ people from outside					
	Provision of through traffic without endangering neighborhoods			850		
	Development of freeway exits to increase commerce					
	Modification of industrial areas at edge of community					
3.	WELL-MARKED IDENTIFIABLE CENTERS IN COMMUNITY —0—					
	Identification of one or more major centers					
	Clear contribution to communal feelings at the greatest of these centers					
	Creation of public space in these major centers					
	Channeling of traffic through these centers					
	Growth of economic activity at or around these centers					
	Community market					
	Community builders' yard					
	Provide facilities which promote public life: gymnasia, theater, museums, restaurants					
	Keep large commercial development only at the centers					

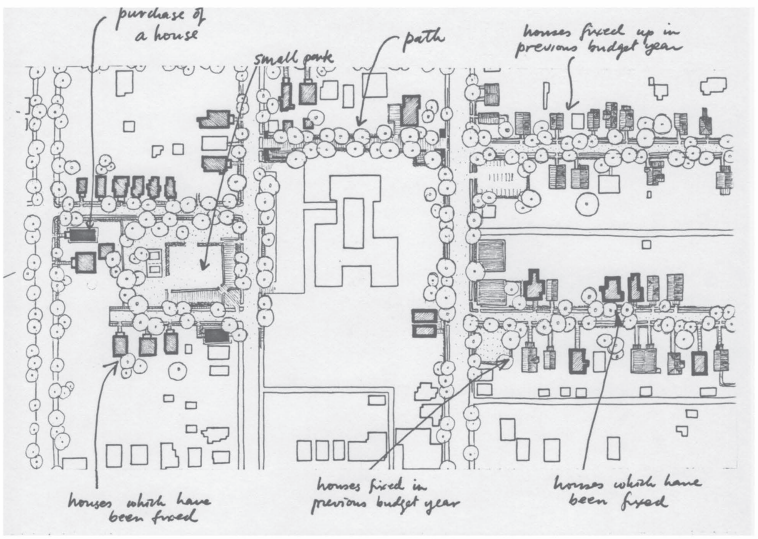


Figure 21.2 Top: Worksheet for the distribution of available funds according to criteria that support the emergence and strengthening of centers.
Bottom: Specific acts of improvement.

Summary

The following list summarizes the programs and actions which have been defined.

1 IDENTITY AND ECONOMIC STRENGTH OF THE COMMUNITY

Increase percentage of local property ownership, and reduce number of absentee landlords
Influx of new families and businesses
Purchase of land and property (through NOCDA)
No displacement of present residents
Create new jobs in the community
Increase development of the NOCDA
Subsidize property tax for present owners
Mortgage insurance and interest subsidies
Development of a local style of building
Employ local contractors and local labor force in local construction
Formation of local contractors' association, which works to encourage the use of local contractors

2 CONNECTION AND INTERDEPENDENCE WITH THE SURROUNDING CITY

Creation of facilities which will attract people into area
Replacement inside the community, of services offered only outside
Organize community controlled business at boundary
Creation of jobs which employ people from outside
Provision of through traffic without endangering neighborhoods
Development of freeway exits to increase commerce
Modification of industrial areas at edge of community

3 WELL-MARKED IDENTIFIABLE CENTERS IN THE COMMUNITY

Identification of one or more major centers
Clear contribution to communal feelings at the greatest of these centers
Creation of public space in these major centers
Channeling of traffic through these centers
Growth of economic activity at or around these centers
Community market
Community builders' yard
Provide facilities which promote public life: gymnasia, theater, museums, restaurants
Keep large commercial development only at the centers

4 CLEAR IDENTITY FOR INDIVIDUAL NEIGHBORHOODS

Each neighborhood has population of 1000 or less
Truck traffic kept at edge of neighborhood
Each neighborhood has well-defined boundary lines
When the boundary is along the freeway, there is a buffer there
Gates or markers at transitions in and out of neighborhood
Strengthen activities of churches, clubs, other social groups
Provide clubhouse or meeting center in each neighborhood

Each project respects the general character of the neighborhood in which it occurs
Neighborhood residents responsible for planning approval of building projects in the neighborhood
Train neighborhood builder and equip his workshop

5 EACH NEIGHBORHOOD WITH ITS OWN CENTERS AND SUBCENTERS

Gradual identification of the most important neighborhood centers
Development of public meeting space at centers
Neighborhood green located at center
Orientation of areas around the center, toward the center
Inclusion of local commerce at centers, and only at centers
Starting a business where goods are produced
Repair of store facades at centers
Subsidy of retail business insurance
Dispersion of nuisance activities (jitney stands, liquor stores, etc.)
Bus stops located at centers
Ornamental gardens

6 CONNECTING AVENUES BETWEEN THE CENTERS

Avenues connecting centers singled out for special treatment
Trees planted along the avenues
Through truck traffic kept off the avenues
Other local streets narrowed
Freeway interchanges and bridges made to coincide with network and if freeway extended, it is below grade
Sidewalks widened and given special emphasis
Avenues repaved where necessary
Sidewalks repaved where necessary
Special street lighting installed along the avenues
Road crossings built at centers

7 ALL LOCAL AREAS WITH THEIR OWN CLEAR AND SEPARATE IDENTITY

Each local area is defined by a specific piece of space which must be positive
Construction and use of common land
Provision of outdoor seats at focal points in these local areas
Public space for children's play
Each garden marked with hedges, fences, or low boundary walls and seats
Repaving and fixing up alleyways
Path connecting two common places
Trellised walk
All commercial and industrial parking kept within definite bounded areas, walled, or surrounded by buildings

8 CONNECTION BETWEEN INDIVIDUAL BUILDINGS AND THEIR LOCAL AREAS

Fresh paint on buildings
Build or repair front porches
Provision of small retail shops in houses
Opening a small business or workshop in a house

Repairing the outbuildings next to the alley
Preservation of grassy strips between sidewalk and street
Maintenance and repair of front yards
The human touch: part of the labor is self-help

9 REPAIR OF INDIVIDUAL BUILDINGS

Family involved in all phases of design and construction
House repair work responsibility of neighborhood builder
Repair of outer skin (weatherization)
Grants and loans for interior improvements needed by family
Family, not building official, determines the extent and design of improvements covered by grants and loans
Grants for emergency repairs
Purchase of equipment for small businesses

Let us assume, now, that the city has made its annual contribution to the planning process, by making definite allocations to the community and neighborhoods, and by continuing to recognize the autonomous existence of the community development authority (NOCDA), and the autonomous and independent neighborhoods.

Within the framework of this allocation, the community must now take the step of carrying out its own development, in a way that does the most to enhance its own wholeness and connectedness.

We shall assume, then, that the community has an available budget, allocated according to the principle of chapter 5, which is to be spent in certain definite categories, also specified in chapter 5. The community now has two obligations: first, to use this budget to increase its own wholeness, at the global level, and second, to provide the individual neighborhoods with a well-defined context, in which they may pursue their own development activities, according to the procedures laid down in chapter 7.

To do this, the NOCDA will now take seven specific steps, (and these steps must be repeated each year, after the city has made its budget allocations).

1 IDENTIFY EXISTING CENTERS
2 DEFINE AVENUES TO CONNECT EXISTING CENTERS
3 DEFINE NEW COMMUNITY CENTERS
4 DEFINE TARGET AREAS
5 ALLOCATE BUDGET FOR DEVELOPMENT WITHIN THESE TARGET AREAS
6 OBTAIN CITY APPROVAL OF BUDGET
7 LET CONTRACTS ACCORDING TO DETAILED ALLOCATIONS.

We now discuss these seven steps one by one.

. . .

22 The construction of new neighborhoods for Guasare New Town, Venezuela, excerpts, 1983

This sequence of settlement layout, part of the process for the design of the Guasare New Town in Venezuela, is one of similar sequences in a number of projects including Moshav Shorashim (Israel) and Santa Rosa (Colombia). The section printed here is concerned with the layout of the neighborhood itself including the lot subdivision and house groups; other sections in the full report deal with the design of individual houses. Co-authors with CA were Artemis Anninou and Martine Weissmann.

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Introduction

In this document we shall describe the form, character, and method of production of the houses in the neighborhoods of Guasare new town.

It is intended that Guasare new town will make a major break-through in the problem of housing production, in Venezuela, and in the world. In particular, the housing in the neighborhoods is intended to have a humane and personal character, intimate in feeling, and strongly related to the individuality and needs of the users. It is intended to remove, entirely, the alienation and despair produced by so-called mass housing, in most forms of housing production throughout the world.

Each neighborhood will be laid out according to a system of fundamental principles which are described in chapter 1. These principles define the position of streets, location of major public space and public buildings in the neighborhood, minor streets, subdivision of lots, and arrangement of lots to guarantee the climatic suitability of the individual houses.

The density and layout of lots is such that individual lots will have about 470 m^2 each, thus making it possible for each family to build a good house, and also keep a large garden for agriculture, fruit trees, animals, or recreation. This is in keeping with the rural character of the region, and with the character of life and vegetation in the immediate Guasare area.

The range of financing packages will be such that every single family who comes to the Guasare area will be entitled to receive a lot which they can pay for very slowly, according to their capacity to pay: and there is a sufficiently wide range of financing schemes so that every single family will be able to have a house of some kind, large or small.

In a typical neighborhood of 200 families, only about 20 houses will be built without the involvement of families. One hundred and eighty houses will be built according to the wishes of the family, and according to the specific needs of their own day-to-day life. Of these 180 houses, about 30 will be fully financed and built in one time period. Of the remaining 150 houses, all will receive financing sufficient for the construction of one or two rooms: and other financing programs will then ensure the possibility that the family can add new rooms every year or two, and complete a house of 80 m^2 within four to seven years.

Most of the construction in this very rich and varied program will be provided by a professional construction company, according to the specification of the families.

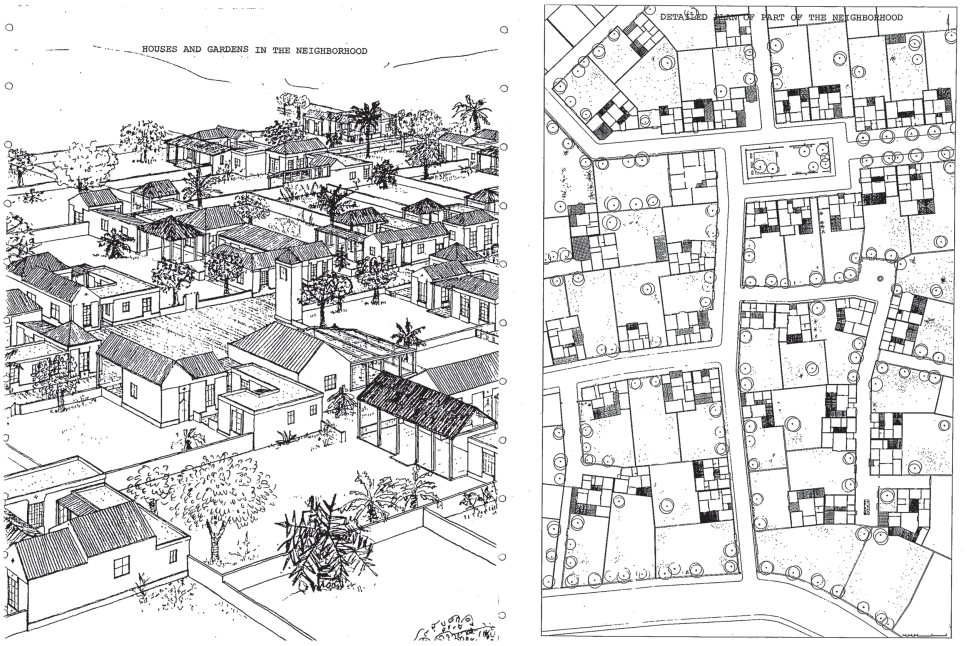


Figure 22.1 Left: Houses and gardens in the neighborhood.
Right: Detailed plan of part of the neighborhood.

However, in addition, the methods of financing will allow self-help (construction undertaken by the families themselves), or additions done by small local builders. Each neighborhood will have a local builder's yard, managed by Proguasare, which will provide materials and assistance for self-help construction, and which will simultaneously coordinate and administer the process by which families design their own houses, and have them built by the construction company.

The program of construction will have one additional quality, which is essential to the well-being of the new town. It is so organized that all houses will have some garden walls, some trees, some ornament in the construction itself, and some beautiful colors on the outside of the houses. Thus the streets are themselves taken care of by the program of construction, and made into happy, beautiful places which reflect the spirit of the people . . . and have more relationship with traditional Venezuelan building than with the mass housing of recent towns.

In the following chapters, we shall define the detailed programs and processes needed to implement this general plan. The chapters are organized as follows:

1 The layout of the neighborhood.
2 The layout of individual houses.
3 Financing and administration of houses.
4 Construction and embellishment of streets.
5 Outline of a contract for implementation.

Chapter one the layout of the individual neighborhood
1. Location of neighborhoods in the town

We begin by describing the large scale structure of the town in such a way that we see clearly how the individual neighborhoods will be embedded in the town.

Essentially, we may envisage the town as a system of arterial collector roads, with neighborhoods hanging on these collectors like a bunch of grapes. At the center of the system of collectors the town has a square or main center: thus we may see the neighborhoods as hanging on the collector roads, and also connected, by the collectors, to the main square of the town.

This conception is described in the following diagram, which was worked out together by CES, ISA and Kevin Lynch during discussions that took place in September 1982 in Maracaibo.

The critical conditions that must be met, for the proper implementation of this diagram are the following:

1 The neighborhoods are not too large and not too small. Specifically, we believe that they need an area of about 6–9 hectares each. If they are much smaller than that, they do not have enough structure to mean anything. If they are larger, they will become too amorphous and not capable of providing people with local identity.
2 Each neighborhood has a small central square.
3 Each neighborhood has one "mouth" where it meets the collector road, and which provides the neighborhood with its entrance. This mouth connects directly to the central square of the neighborhood.
4 The neighborhood has a collector along <u>one</u> side only, and remains open for growth and development on the other three sides. The neighborhood must not be surrounded by collector roads.

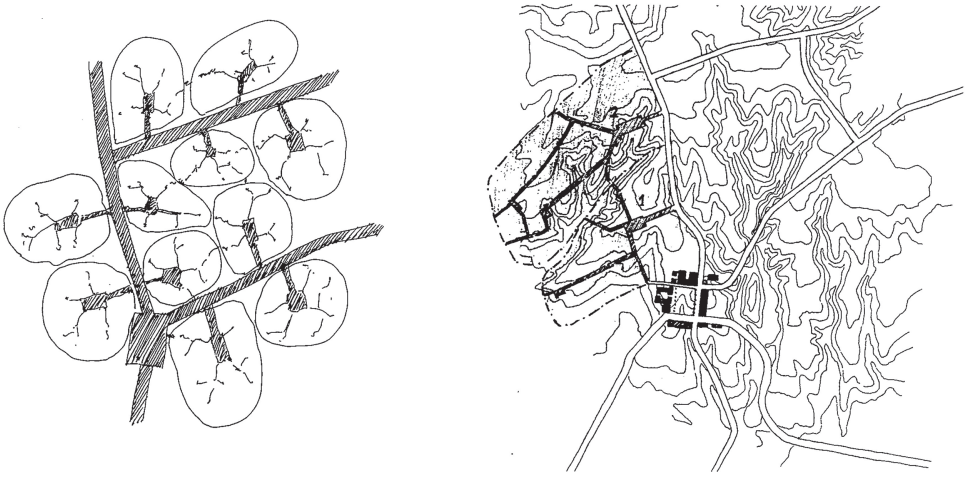


Figure 22.2 Left: Diagram developed by CES, ISA and Kevin Lynch.
Right: Version of the ISA master plan intended to meet seven critical conditions. The first two neighborhoods which are to be built in this plan are designated by shading and marked 1 and 2.

5 Local traffic within the neighborhood is extremely slow and mainly pedestrian.
6 There are a few small local link roads and paths, from one neighborhood to the next, but these are always minor, and are placed so that they never destroy the function of the main square and the mouth of the neighborhood as its primary channel of movement to and from the outside world.
7 As the town grows, new neighborhoods and new collector roads may be built to extend the population and area of the town, but always in such a way as to preserve the essential structure defined by these few parameters.

The Guasare master plan, prepared by ISA, has been written in such a way as to guarantee that these seven conditions will be met.

The following report describes the production of houses in all neighborhoods, but frequently uses the specific details of neighborhoods 1 and 2 as examples.

2. The internal layout of the neighborhood

We shall now define the global structure of the neighborhood. We may summarize this structure by stating certain general rules for each neighborhood. The form of each neighborhood which is created by these rules may be summarized by means of the following diagram.

Structure of a typical neighborhood

1 We assume that each neighborhood is served by a main street, which opens like a mouth, from the main artery outside the neighborhood, at right angles to the artery. This conforms to a common pattern of markets, visible throughout Latin America.
2 We assume that this main street is wide and pleasant, probably with trees. It may have pedestrian traffic down the middle, or down the sides, or both, but it also allows for the passage of cars.
3 The main street leads to some kind of square, or wider opening, or park, in the middle of the neighborhoods.
4 At this point there is an important public building, preferably a church, if this is still realistic, otherwise a school, or other public hall of some kind. In some cases, school, church, etc., although appearing as a main building in one neighborhood, may serve another next-door neighborhood which has a different public building at its respective center.
5 This public building is elaborate in some important sense, in that it contains feeling and ornament, and has the capacity to function as the psychic center of the neighborhood.
6 Opening off the main square of the neighborhood there are a number of secondary streets, five the maximum, depending on the size and shape of the neighborhood. They are rather long and straight streets, and they provide for the main vehicular traffic in the neighborhood. The secondary streets are located in the neighborhood in such a way as to allocate equally the main vehicular traffic in all different parts of it.
7 The secondary streets are given a slight angle, off the grid, so that they are oriented by a few degrees towards the middle of the neighborhood. Thus, although they will tend to be roughly parallel to the sides of the neighborhood, they are

given a slight radial bias to make them lead, psychologically, more strongly to the center of the neighborhood, and to create a closer feeling between individual houses and the center.

8 The width of the secondary streets varies from 7–10 meters. At the points where the secondary streets reach the boundary of the neighborhood they become narrower, so that they do not allow for main vehicular access in and out from the neighborhood at these points. Some of the secondary streets could possibly turn into pedestrian streets for about 30–50 meters before they exit the neighborhood.

9 Opening off the secondary streets there are tertiary smaller streets which are primarily for pedestrians, though they allow for limited car traffic, when necessary. These smaller streets are, in effect, pedestrian streets, that are narrow enough to allow car movement and parking without danger to children.

10 These tertiary streets are about 4–6 meters wide; they are rather short, and there is a gate at the point of their entrance.

11 Some of these tertiary streets reach the boundary of the neighborhood and pass through a small gateway to the next-door neighborhood. Others terminate within the neighborhood itself.

12 The smaller tertiary street has an intricate structure and shape, generated by its adaptation to the configuration of the site and by its intention to give access directly to the house volume and not to the garden of the house. Therefore, the tertiary street allows easily for change of direction, for change of street width, for the occasional formation of very small, almost tiny squares at the points of change of direction or at their ending points.

13 The streets and public open spaces of the neighborhood will be created with one major concern in mind: to make them lively, in the right and appropriate scale for people walking along them or sitting there. Therefore, public open spaces have not been separated into distinct areas for cars, others for pedestrians, others for parking, and so on, an arrangement that tends to bring them to disproportionately large dimensions. The streets of the neighborhood provide for all these different activities and functions in a unified way, reflecting concern to create livable and human streets and squares.

14 There are no parking lots in the neighborhood, since they create dead areas in the fabric of the town. Parking will be provided along the main, secondary, and tertiary streets. The existing length of these streets provides for one-side parking for about 150 cars, about 70–80 per cent of the houses of the neighborhood.

15 Each neighborhood contains one builder's yard, a building supply store, subsidized by Corpozulia, which will provide many houses with materials for construction, and also provide professional assistance in construction.

16 Many houses in the neighborhood are given the opportunity to have a small local shop at the front of the house.

3. The size of lots

One of the most crucial aspects of the neighborhood is its density, directly reflected in lot size.

In the early studies of Guasare, and especially those undertaken by the urban design group in Maracaibo, the lots proposed tended to be small and narrow – something like the traditional city lots of Santa Lucia.

The assumption inherent in these lots was that, because of their narrowness, they would have a continuous built frontage, and would therefore produce a strong "urban" character. Since modern developments are so often characterized by loss of coherent space, and loss of coherence, this desire on the part of the urban designers was understandable.

It is, nevertheless, we believe, quite strongly mistaken as a direction for the project.

The studies made by the financial group (Echenique et al.) have clearly shown that lot size is one of the principal factors that will attract people to the Guasare new town. The location of this new town is not especially desirable. People will not choose to live there unless it has some clear advantage over other places. In the Guasare region, the most obvious advantage that can be given is, quite simply, size of land.

Careful inspection of the present developments in the Guasare region, and their character, points in the same direction. The character is above all rural. There are trees, animals, groups of small outbuildings. The land around a house is not an urban "yard" or "garden" but a potentially productive area, which can produce food for the family (in the form of vegetables or animal care), and can also provide incidental space for various kinds of economic activity (storage of tires, machinery, building supplies, etc.).

This points, unequivocally, towards a relatively large lot size for the houses of the new town.

Furthermore, it is clear that the regional character, with its intense damp heat and very slight breeze, strongly requires a format, or layout which is as open as possible, to allow breeze to circulate, and to maintain a reasonably open character. This means that lots must not be long and narrow (as they are in higher density towns, or in other regions of Latin America), but must be as close to a square as possible, since this will increase the openness and pleasantness of each lot and its associated garden. This rather obvious point about the shape of the lots must be firmly underlined, since tendencies of conventional urban design theory may lead to long, narrow lots, for the reasons stated. We believe that construction of long, narrow lots in Guasare would be an extremely drastic mistake.

After studying these factors carefully, we have come to the conclusion that the average lot should have a size of about 470 m^2, and that this lot should never be less than about 15 meters wide. If the lots were rectangular, this would imply a distribution of lots ranging in shape from 15 x 30 m to 22 x 22 m but always relatively wide, so that the breeze can flow comfortably through the lot and through the house.

However, as we shall see in the next section, more careful consideration of the same factors indicates that these lots should not be simple rectangles, but should be composed of two adjacent rectangles, one approximately 11 m x 11 m and the other approximately 16 x 22 m, making a total of 470 m for the two parts together.

4. Lot subdivision and microstructure

We are now ready to describe the microstructure of the project in detail. By microstructure we mean the detailed local arrangement of lots.

In most modern neighborhoods, the lack of feeling and endless sense of sameness is aggravated by a type of layout in which exactly similar lots and houses repeat themselves, block after block, in an unending repetition in which it is extremely difficult for individual persons to feel their own uniqueness, or to feel themselves at home.

This problem cannot be solved artificially by merely changing layout in a random fashion, since this merely produces an equally strange sense of unreality, which does not help the problem at all.

What is needed is a clear understanding of deep structure, which generates variety in a natural way, so that each part of the town becomes unique, for good reasons, which make intuitive sense, and which create an authentic and profound sense of individuality at each point.

In this project we believe that we have finally reached a break-through in modern housing planning by identifying a series of assumptions which, taken together, do produce just this kind of organic variation, in an authentic way. These assumptions are the following:

1 We assume that each house has a garden.
2 We assume that the house itself, is a compact cluster of buildings which are built around an open courtyard or patio which communicates with the garden.
3 We assume that the controlling factor which governs the location of a house, with respect to garden, is the wind direction . . . since breeze and cooling must play the governing role in a house correctly adapted to the climate of the Maracaibo region.
4 We also assume that each house, itself, arranged around its patio, is a compact and beautiful entity, with a reasonable sense of enclosure and identity.
5 We also assume that the garden, outside the house and patio, must itself be a compact and sensible shape, suitable for agriculture, trees, children playing, and other uses. This requires that the garden itself must also be a compact and simple shape, so that land is not wasted in narrow strips around the house.
6 We assume that the street system will not govern the organization of the neighborhood, but that an adequate pattern of small streets can be adapted to the house lots, once the pattern of the house lots has been determined in such a way as to meet the previous considerations.

On top of these assumptions, what we have done, quite simply, is to identify a series of rules which must influence relative layout of house, garden and street in such a way that the interaction of these rules produces a syncopated, non-repetitive structure because their interaction is so complex, and because it also varies naturally from point to point in the terrain.

The rules we have identified are the following:

1 The house is a courtyard structure of about 11m x 11m and covers an area of about 120 m^2. This area includes both house and patio.
2 The garden is an area about three times as big, that is, of about 350 m^2 additional.
3 Each of these two areas must, as far as possible, preserve its integrity as a positive space. This means that the lot (house plus garden) is not necessarily a single rectangle, but must be seen as a joining of two rectangles, one about 120 m^2, and the other about 350 m^2.
4 The house and patio are open to the garden, and there is a natural view through this opening from the house patio into the garden beyond.

5 The location of the house is clearly known at the time of the lot subdivision. Thus at the time of lot subdivision, the position of the house on the lot, and the position of the garden are already defined. This is an unusual practice, since in normal practice, the house may usually be placed anywhere within the setback in the lot, within the setback limits. In the system we are proposing, the actual position of the house will be defined at the time of the subdivision.
6 The relative location of house and garden in any given lot is determined by two factors: the slope, and the wind.
7 In general, if the house is on a slope, then the house is placed uphill, and the garden is placed downhill. This is essential, since a house with a garden uphill from it creates a very unnatural situation which strongly inhibits use. It means that the line connecting the center of the house and the center of the garden should be as nearly as possible at right angles to the contour lines.
8 In the case where the land is flat, the house and garden are placed in such a position that the prevailing breeze blows from the garden into the house patio, and then into the house. This requires that the line connecting the center of the house to the center of the garden should be as close as possible to the line of the prevailing breeze.
9 In the hilly case, where we require the house to be up the slope from the garden, the breeze will also blow from the garden into the house, since on hills breezes most often blow up the hill anyway, and have a direction which is governed by topography, not entirely by the overall direction of the breeze in the region. The two previous rules are therefore consistent, since both create conditions where the breeze blows from the garden into the house.

Although these rules are quite elementary, we have discovered that the interaction between these rules, when they are carefully followed, produces a highly asymetrical, syncopated structure of the type illustrated in the following diagram.

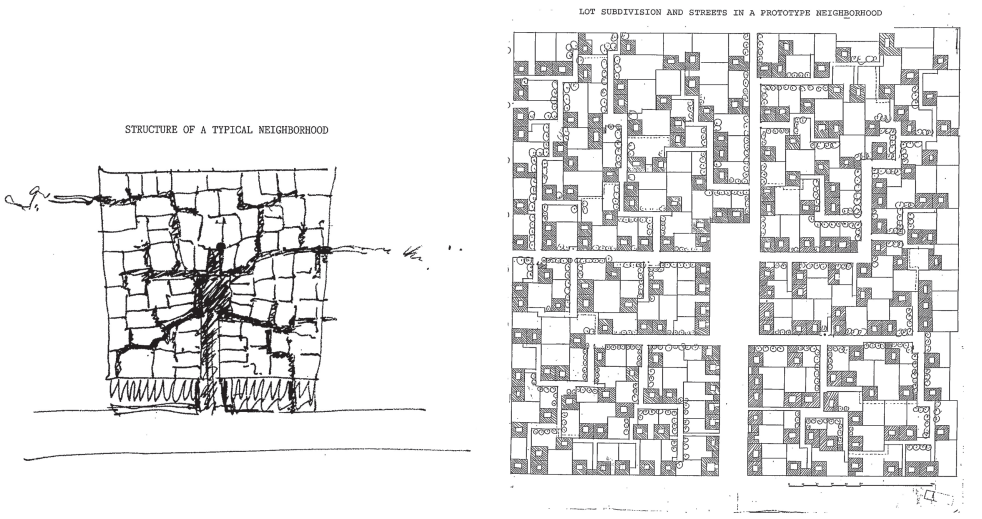


Figure 22.3 Left: Structure of a typical neighborhood.
Right: Lot subdivision and streets in a prototype neighborhood.

Lot subdivision and streets in a prototype neighborhood

In order to create this structure, it is necessary to build it up one lot at a time by paying attention to the rules.

If the rules are followed strictly, then lots will, in general, not be rectangles, but coupled pairs of rectangles, which are in line with either slope, or prevailing breeze. The overall structure is unpredictable, because the local interaction of the rules creates an aperiodic structure in an entirely unpredictable way.

In order for the rules to work effectively, it is essential that the two rectangles which represent house and garden respectively be as pure as possible. The functional reason for this is that the positive space thus produced is more useful and calmer in its nature. This means that arrangements in which the garden forms an L-shape are ruled out as far as possible.

Once the general structure of lots has been arrived at in this way, local streets are then introduced between the lots in such a way as to follow three further rules:

10 Every house fronts directly on the street. This means that the edge of streets is made of houses, not of garden walls, and produces an important social feeling in the neighborhood.
11 The total length of streets is as short as possible.
12 In order to reduce street length, and reduce the cost of services, it may be helpful to relax rule 10 slightly. If we allow ten per cent of all houses to be off the street, and to be approached by a front path through the garden, it then becomes possible to reduce total street length from about 17 meters per house to about 12 meters per house: an enormous saving, which makes the layout more economical.

The resulting neighborhood structure has a simple and almost endless variation, which is extremely charming. When we combine this layout with the sense of physical streets that is described in chapter 4, we believe that we have for the first time solved the problem of combining modern techniques of subdivision that are necessary in a rapidly growing new town with the charm and delightfulness that make each person feel at home in the uniqueness of their own lot and the uniqueness of their own street.

The precise rules and procedure for layout are specified in detail in the next section.

5. The layout and subdivision process

The archetypal form of neighborhood, which has been described above, will take different forms in each of the different neighborhoods of the new town. This will happen because each neighborhood must be adapted to a specific set of conditions which vary from one neighborhood to another. The following factors will control the overall form of the neighborhood:

1 Its size.
2 The location of arteries along its boundary.
3 Its topography.
4 Its orientation with respect to the center of the town.

As a result of the interaction of these four factors, with the general structure described in the last section, each neighborhood will take on a unique configuration. For example,

we show the first two neighborhoods, below. Each one has its particular configuration as a result of its unique combination of size, shape, bounding arteries, topography, and orientation.

We shall now present the organized steps which are needed to generate the interaction of the structure, and local factors, for a particular neighborhood. In order to create the neighborhood plan it is simply necessary to lay out each neighborhood, step by step, in the sequence presented below. We propose that this work be done directly by planners or architects of Proguasare, possibly with the help or consultation of CES (the authors of this document).

All the following steps must be done on the site itself, after careful inspection and feeling for the actual place.

Rules for the layout process

Step 1: Define the size and boundaries of the neighborhood

After the general position of the new neighborhood has been selected, spend some time trying to understand the reality of the site and its configuration, slopes, ravines, big trees, small rivers. Then, having in mind that the size of the neighborhood varies between 6 to 9 hectares, try to find out where the most natural boundaries of the neighborhood will be. At least one of the boundaries of the neighborhood must be defined by an existing collector road, or by the extension of an existing collector. Ravines or small rivers, or pronounced changes in the direction of slopes on the ground will naturally define some of the boundaries of the neighborhood.

Step 2: Locate the main entrance to the neighborhood

Along the collector that defines one of the boundaries of the neighborhood look for the place that will be most appropriate for the main entrance into the neighborhood. This place will have to provide for access towards the main square of the neighborhood, and will therefore have to be somewhere close to the middle of that part of the collector road that shapes the boundary of the neighborhood. It should also be a place that would seem the most natural as a turning point from the collector road into the neighborhood.

In case there is more than one collector road along the boundaries of the neighborhood, the main entrance should be placed along that collector which has the stronger link with the central square of the town.

Step 3: Locate the main square of the neighborhood

Now try to find the best place for the main square of the neighborhood. It should hold an area somehow central in the neighborhood, it should be clearly visible from the collector road and therefore not too far from it, and it should be on a place that is beautiful, probably flat with some big trees, probably also it could be a high place in the neighborhood compared with the rest. The place that you will identify should feel large enough to contain the main square of the neighborhood, whose size will vary between 20 x 45m to 25 x 60m, depending on the size of the whole neighborhood.

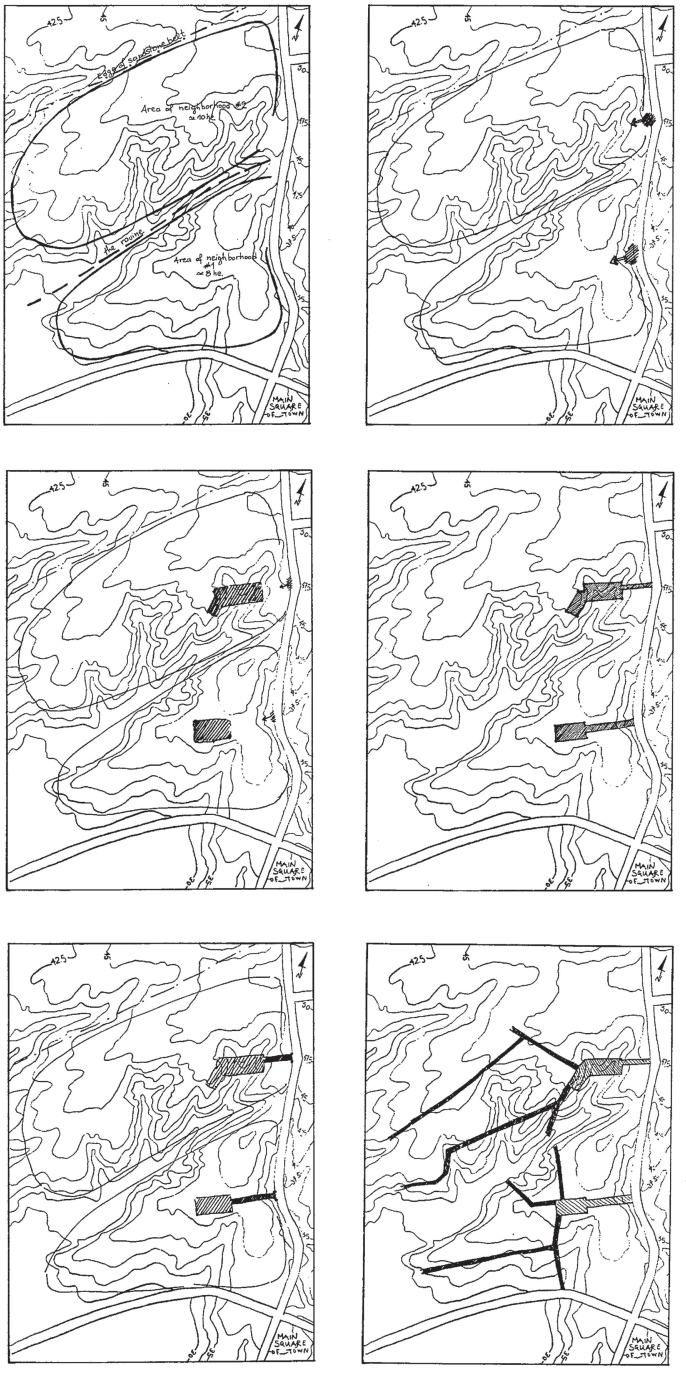


Figure 22.4 Top left, step 1, top right, step 2; middle left step 3, middle right step 4; bottom left step 5, bottom right step 6.

Step 4: Locate the main street into the neighborhood; this street links the main entrance into the neighborhood with the main square

At this stage you already know the position of the main entrance, and the position of the main square. The next step is to create a link between them. This link will be the main street of the neighborhood, and the only vehicular street that will provide direct access into the neighborhood. This main street into the neighborhood is one of the widest streets of the neighborhood, its width depending on its length, with a two-way vehicular lane, and with wide sidewalks with trees. Or, in some cases, it can be made of two separate vehicular one-way lanes on either side of a wide pedestrian "alameda" in the middle, planted with trees.

Step 5: The corners of the main street and the main square

At this stage you know the position of the main entrance, the position of the main square and its approximate size and shape, and the position of the main street that links the main entrance to the main square.

Now you must shape these places precisely on the ground by putting stakes on the corners of these places, and by extending a thick rope along their sides. It is necessary to do this in order to experience the feeling of these places as accurately as possible.

First, place two stakes where the main entrance into the neighborhood is. These two stakes will have to mark the width of the main street that will vary between 10 to 15m, depending on its length. Imagine that at this place will be a gate to emphasize the point of entrance into the neighborhood.

Now, shape the main street that will lead from the main entrance to the main square. Place the main street as nearly perpendicular to the collector road as possible; that will give a more natural way of entering from one place to the other. However, a slight angle may be necessary because of the topography of the site. Extend two ropes along the two sides of the main street, all the way from the main entrance to the main square. Walk along the main street, imagine one-storey houses touching each other on both sides, and also distinguish the vehicular lanes of the street from the pedestrian areas, probably by laying some ropes on the ground. Walk up and down on this street several times trying to get its scale right. You might have to adjust its width or its length slightly until you get it to feel right.

Now proceed to the staking of the square. Place four stakes in its corners and extend rope along its four sides. Try to get the scale of the main square of the neighborhood right. Think that it is not the main square of the whole town; therefore it should not be so big as to compete with the main square of the town. Also it should not be too small, so that it can receive the activities of the neighborhood. It should be an intimate place, not too big, not too small, surrounded mainly by one-storey buildings. Think also of the area to be given to pedestrians, and of the area where vehicular traffic will mainly occur.

You may have to go through several small changes and adjustments until you get the right size and shape of the main square and the main street.

Step 6: Locate the vehicular secondary streets of the neighborhood

The vehicular secondary streets are 7–10 m wide and they provide the main vehicular circulation in the neighborhood.

There are three criteria that will guide the location of the vehicular secondary streets in the neighborhood:

a All the secondary streets will have to lead in some way to the main square of the neighborhood, and none of them will exit directly to the collector road or to the main street of the neighborhood.
b The location of the secondary streets will be guided by the configuration of the ground. A secondary street could be on the ridge of a small hill, or it could follow as closely as possible the same contour line.
c The secondary streets should be located in such a way that they serve all different parts of the neighborhood in an equal way.

There are 3–4 vehicular secondary streets in each neighborhood. Globally, they must be placed to create a radiant kind of configuration, all of them converging towards the main square. Sometimes a secondary street can lead into another secondary street that then leads directly to the main square.

First make a decision about the approximate location of the secondary streets, and specify the way they will lead to the main square. Try to form a simple pattern of secondary streets. Walk along them, and visualize them by laying ropes along their edges. After you have walked along them several times and have become familiar with them, and probably after some changes and adjustments, you will start to have a better understanding of all the secondary streets of the neighborhood as a whole. When you feel they are right, make good sense, and create a simple and coherent pattern, put some stakes along them to finalize your decisions.

Step 7: Place the public building of the neighborhood on the main square

Now choose a place on the main square where the public building of the neighborhood will be. It should hold a prominent and appealing place and its location on the square should be such as to contribute the most to the wholeness and liveliness of the square.

Step 8: Subdivide the area along the main street and around the main square of the neighborhood

The first part of the neighborhood to be subdivided is the area of the main street and the main square. These two places are the densest areas of the neighborhood, since they form its center. Therefore, it is mostly the houses themselves, and not gardens, that will form the sides of the square and the main street.

Make the lots along the main street and around the main square narrow and long; their frontage should be 10–12 m wide, and they should be about 35 m long. The part of the lot facing the street should be given to the house. The houses will form a continuous frontage, most of them touching each other.

Step 9: In each neighborhood identify the distinct local areas

TO be subdivided in sequence one after the other

The main and secondary streets of the neighborhood, located already on the site, define distinct areas in the nieghborhood. The boundaries of one area are defined either all

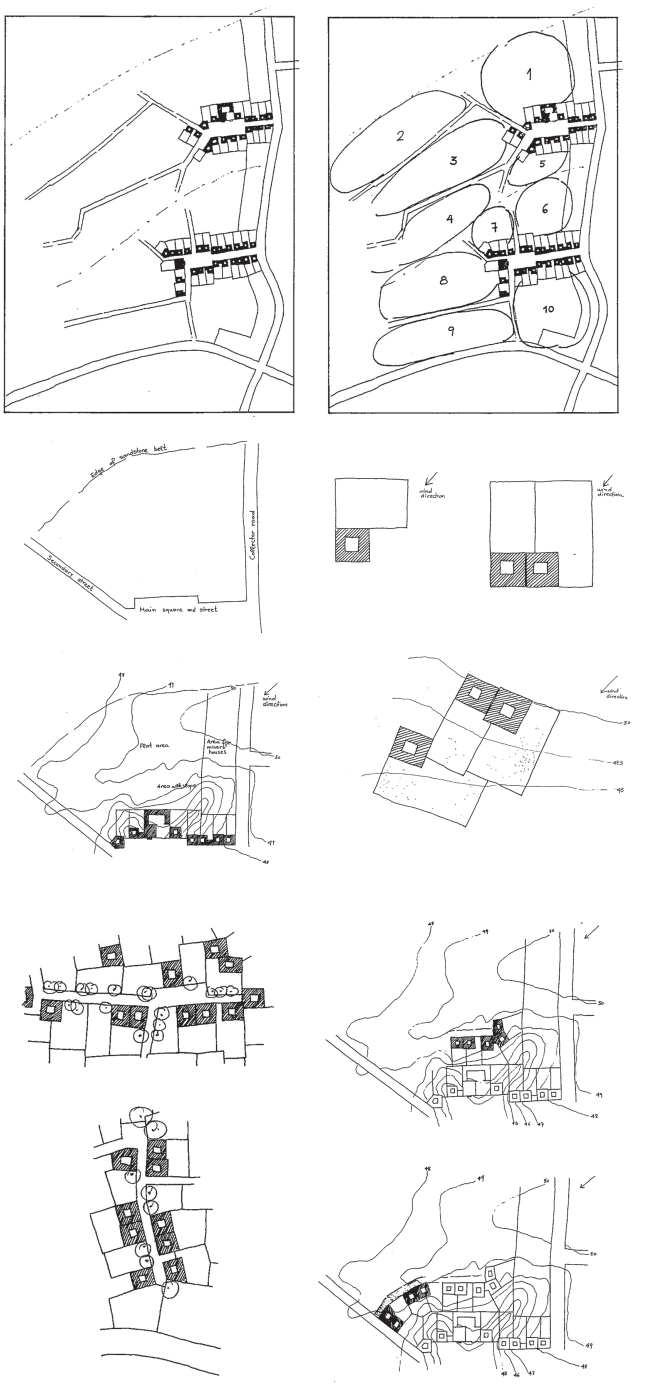


Figure 22.5 Steps 8 and 9, and the beginning of the lot subdivision process.



Fig 22.6 Continuation of the lot subdivision process, the shaping of the streets, and the drawing of the neighborhood map.

of them by secondary streets or by a combination of main and secondary streets, and in some cases by the collector road too, depending on the actual location of the area in the neighborhood.

Now start subdividing one area after the other. In the following steps we will demonstrate the steps that have to be followed in the subdivision of such an area.

We choose local area #1 as an example to show the subdivision process in its detailed sequential operations.

Step 10: Start the lot subdivision in the local area

This step of the layout of the neighborhood is the most crucial. All the microstructure of the neighborhood, its small streets and paths, and small local squares which will serve each specific area of the neighborhood will be established. During this step it is necessary to accomplish two things simultaneously:

a Subdivision of lots
b Location of smaller streets and local centers that will serve each area of the neighborhood defined by the main and secondary streets.

These two things will happen step by step in a series of cycles, as we shall see.

Step 10a: First you try to get a good feeling of the local area to be subdivided

What its boundaries are, the already subdivided areas along the main and secondary streets, if any, where the wind blows from, the configuration of the land with its slopes, important trees and views, etc.

In the example that we present the situation is the following:

Step 10b: Now you start creating lots, in groups of 5–10 lots at a time

You do not lay out all the lots in the local area as one step. Together with the new lots a piece of street to give access to them will be laid out also. In cases where the street to provide access to the newly laid out lots has already been located, the lots laid out along it will have to pin it down and form it carefully.

Step 10c: Now you place the first group of 5–10 lots, using the following principles

Each lot consists of two clearly defined entities; the entity of the house, arranged around a patio, and the entity of the garden. Both of them have compact and simple shapes, and usually they are rectangles. The area of the house is on the average about 120 m and the area of the garden about 350 m^2. However, there is a wide range of variation concerning the size of the lots. There are two controlling factors which govern the location of the garden with respect to the house:

1 The wind direction: The garden is placed on that side (or sides) of the house that allows the wind to blow from the garden into the patio and the house, and

the center of gravity of the garden and the center of gravity of the patio of the house thus forms a line that approximates the direction of the wind.

2 The slopes of the site: For houses that are being located on the slopes of the site, the location of the garden with respect to the house won't be guided by the direction of the wind, but by the slope: the higher part of the lot will be given to the house, with the garden being located on the lower parts of the site.

Step 10d: The drawing, and legal specification of each lot, must contain both the house and the garden, clearly shown as separate entities

STEP 10e: Next, you place a segment of tertiary street, which gives access to these 5–10 lots.

In order to place this segment of tertiary street you have to bear in mind the following general rules about tertiary streets:

a Each tertiary street consists of distinct smaller segments of street, connected together in such a way as to create a coherent whole with a clear structure. The structure of the tertiary street can be described as follows: each tertiary street has its main segment, stem-like, that starts off the secondary street and extends deeply into the local area. Off the main segment of the tertiary street smaller segments, branch-like, ramify into different parts of the local area in order to provide access to all houses.

b Along the tertiary streets various small local centers can emerge, a widening along the streets, or a small place at the meeting point of two smaller segments of street. These are places for children to play, or for people to sit under trees.

c Car movement between neighborhoods never occurs along tertiary streets. Therefore, each tertiary street, regardless of its possible continuation into the next neighborhood or its termination within it, is a dead end for cars, and should be arranged in such a way as to provide for turning points for cars, usually in the form of a miniature T-street junction.

When a segment of the tertiary street is being placed and shaped, two conditions must guide the actual operation of shaping the segment:

a The segment of the street, by itself, is a clear entity, with its own good shape, its own direction governed by the site configuration and by its intention to give direct access to the house volumes themselves rather than to their gardens. A segment of the street will be fully established through a sequence of steps; some lots in the beginning will hint at it, at its approximate location and shape, and then some other lots which will come later will pin it down, give it precise dimensions and shape.

b The segment of the street is part of the whole tertiary street system and it has to contribute to the making of a well-structured and coherent tertiary street network in the local area. Therefore, when laid out, its connection with the existing segments of streets is very important. There is a hierarchical and sequential movement from the secondary street into the main stem of the tertiary street,

then into a smaller street that branches off the main stem, and possibly into even smaller paths that ramify off this branch.

Each segment is placed in such a way as to meet these conditions as well as possible.

Step 10f: Now you repeat the cycle of steps 10c, 10d, and 10e, over and over again, until the whole area is subdivided

In order to explain this, we now illustrate a sequence of six cycles, which simulate the lot subdivision of area #1 that we have chosen to present as a detailed example, with the necessary explanations of details.

Cycle 1

First group of lots. This particular part of the area was chosen to be subdivided first because of the rather irregular land configuration. The slope of the ground dominates the wind on the layout of these lots. First part of street is hinted at, not yet clearly nor fully defined.

Cycle 2

Second group of lots is laid out, again following the requirement about the slope. A new piece of street is laid out also. It is a continuation of the street located in the previous step, and it connects with the secondary street. These two parts of street will form the main stem of the tertiary street that will lead from the secondary street into this area.

Cycle 3

This group of lots lies on a flat piece of land, and therefore their layout is governed by the rule about the wind. The first ramification of the tertiary street is hinted at, with a small widening at its end suggested by the layout of that particular corner lot that forms it. Also a small alley in between two lots has been laid out to provide access to the lot at the back.

Cycle 4

Lots are laid out now along the main stem of the tertiary street. Their precise layout will pin down the street, will give it its width and shape. A new branch of the tertiary street is hinted at to provide for the way into the unsubdivided part.

Cycle 5

Most of the lots of this step are on a flat piece of land, and those which are on slopy land, the slope does not oppose the direction of the wind. Therefore all of them are laid out according to the direction of the wind.

The second ramification of the tertiary street is pinned down and it takes the form of a small square, which will continue to some smaller paths already hinted at.

Cycle 6

The last lots of the area are laid out. They fill out unsubdivided land, and they pin down streets already hinted at before.

Step 11: After the subdivision of the lots in the different areas of the neighborhood, you should shape the secondary streets precisely

The secondary streets have been located earlier. Their direction and approximate width are known. However, their final precise shaping and formation cannot take place together with the subdivision of the lots. At this time you will have to give to the secondary street its exact width; it can vary from 7 to 10m, so that it will provide for a two-way lane for cars and for sidewalks. The width of the secondary street will be a function of its length, and it does not have to remain the same for its full length. It can narrow down when approaching its end, or a turning point. However, the change in the width of the secondary street should not be arbitrary. It will have to produce a street that consists of one or two or three parts that are easy to drive along, pleasant to walk, and produce a coherent street.

In some cases along a secondary street a small square, an intimate place might emerge. Its size and placement should be such that it does not compete with the main square of the neighborhood, but creates another small center in the neighborhood.

All of these will have to take place together with the lot subdivision along them, so that public space and house will form together a coherent whole.

Step 12: Produce a map of the neighborhood that contains all your decisions made on the site

After you have completed your work on the site of laying out the neighborhood, it is necessary to make a precise recording of all the stakes put on the site. On the basis of this survey, you will make the final drawing of the neighborhood. You may need to make some minor changes or adjustments, but do not alter the major structure of the neighborhood in its major aspects. That will spoil the relationship of the layout of the neighborhood with the reality of the actual site.

In some cases it may be necessary to conduct the final steps of the layout process, which include the lot subdivision and location of smaller streets away from the site. However, in any case, all of the first six steps, which determine the overall structure of the neighborhood, will have to take place on the site.

. . .

23 Toward a personal workplace, excerpt, 1987

CES worked with two major furniture manufacturers, Haworth and Herman Miller, to develop workplace furniture and workplaces that are personal and human-centered, and that ordinary people could emotionally connect to – quite different from the anonymous office furniture that is ubiquitous today. These designs were never manufactured beyond singular prototypes. But they have increased relevance today,[1] *as the nature of work changes, and the difference between home and workplace lessens. Although the color photographs that were originally included with this article could not be printed here, the reader may find them useful, and are easily located in the original publication in* Architectural Record.

Originally published as "Toward a Personal Workplace," Christopher Alexander with Artemis Anninou, Gary Black, and John Rheinfrank, Architectural Record*, Mid-September issue, 1987, pp. 130–141. Republished by permission of* Architectural Record.

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Introduction

People spend most of their time at home or at work. The house (or apartment) and the office (or workplace) are therefore the two environments that play the most significant role in people's lives. Yet in our time, houses and offices are almost universally empty of real vitality. They are missing a depth of feeling and richness of function that lets people reach into those parts of their everyday life and work that are really important. Of the two, houses are slightly better because, in a few cases, people's own idiosyncracies produce something which has some kind of life because it comes from the heart. This does not happen, of course, in large housing projects.

When it comes to offices, the disease is almost lethal. The current open-plan office has become a stereotyped environment – dry, image-ridden, . . . utterly without human qualities. Our research has shown that office workers are almost unanimous in their dissatisfaction with the places where they work.

And yet the manufacturers of office furniture, who control the modern new-office environment, continue to make products that are disturbingly similar in their tasteful

1 This chapter introduction is being written in July 2021, when it has been clear for months that the global Covid-19 pandemic will very likely result in major changes to the architecture and physical location of work.

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sterility: cloth, steel, plastic, gray, pastel orange, brown, soft carpeting, uniform light, modular partitions, hung worksurfaces, white noise. The environment produced by office furniture has realized the nightmare of Orwell's *1984* at a level so subtle that many managers are not even aware of it. This is the deathly world that 58 million people in the U.S. are forced to inhabit eight hours a day. Producing this environment is a $7-billion-per-year industry.

During the last few years, we have been trying to find some drastic way of cutting through this enormous problem – trying to find a way in which office space, produced on such a gigantic scale, can get some life, can support the life of the people who work there. During the studies we have made, we have come to a number of dramatic conclusions about the nature of office environments, the nature of production, and the nature of design.

What follows is a short description of our conclusions. We are trying here to project a possible new world in which a person's work environment is ordinary and pleasant – a place to be loved, where real work can be done, a place where the plastic imagery is gone. The results of our work exist in the form of an office-furniture system conceived and designed for mass production, and now almost ready to be produced on a preliminary basis. It is unlike any furniture system now available in its hardware, materials, space conception, and design. It is intended to launch the creation of an entirely new kind of workplace. We believe that this type of furniture has the capacity to "sweep the board" in sales.

New sensibility

The work on this new system of office furniture is part of a general effort we have made during the last 10 years to create new environments for single-family houses, apartment houses, mass housing, public buildings, office buildings, and urban space. All these projects show a new sensibility and a new effort to make things that are more childlike, more rooted in human feelings, and more comfortable as environments: you want to be there in the same sense that you want to curl up in a corner with a pillow on a Saturday afternoon, or be in the shirtsleeve atmosphere of your own workshop.

The fundamental problem being confronted in all these places is the same: What is the nature of an environment where a person feels the weight of his own heart, the sweetness of his own existence, the sweetness of the world, and the comfort of real life, as opposed to the mass-existence and manipulated efficiency of Modern and Postmodern architecture?

These concepts are easy to grasp at a small scale, but much harder to deal with at a large scale. Nevertheless, it is at the large scale, embodied in our firm's largest building projects and new system of office furniture, that the significance of the problem and its solution reach their most important level. Especially in the area of office furniture, this represents an enormous challenge, since present manufacturing, responsible for a huge part of the environment in which people spend their lives, has not even begun to address this problem. So far, the problems addressed have been either the problem of efficiency (as in the *Action Office* and its successors) or the problem of image (as in most lines of furniture now being produced).

We are concerned with the problem of the worker's genuine comfort and well-being, and in a recent series of industry discussions, we discovered that some office-furniture manufacturers explicitly reject these concerns in favor of the opinion and comfort of the architect, interior designer, facilities manager – i.e., whoever buys the furniture.

Even workers themselves are brainwashed into believing that their emotional well-being is unavailable *in principle* in the late 20th century. For example, during the process of making the living room for a house outside San Francisco (opposite and following pages), our client asked: "Is it really all right to have this much fun?" He is a banker. The possibility that an environment could create such a joyful feeling, and yet be normal and accepted, was amazing to him. The people who work in offices have similar expectations. Although many of them hate the environment they work in, few imagine that anything fundamentally better is even possible. Yet it is just this which we are trying for in all our building projects, and in the office furniture we describe in this article – a new sensibility, in which human activity, human feeling, color and light together create an ordinary human sweetness, something almost entirely missing from the works of this century.

The San Anselmo room

An example of this is a room from a house we recently completed in Marin County, California, for Dan Potash and Maureen McCabe, a young couple with one son. This room has structure, windows, and built-in furniture. Perhaps most importantly, it has hand-painted walls, with a color sensibility that is entirely missing from the work of our time. Kitchen, living room, hearth, and alcove all together, the room opens to the south onto a small paved kitchen garden, and looks west to another patio and to lawns and orchard beyond. The room is defined mainly by its windows, low ceiling, built-in furniture, and its table (we designed and built all of this). Perhaps most significant of all is the color of the room.

Very early on, I asked Dan and Maureen if they wanted to have color. They said they had liked the floor in our office, and asked for a terrazzo floor of the same kind. After experiments with paper I found out that, on the floor, the light in the room seemed to need 51 percent green, 35 percent red, and 14 percent yellow. I then invented a pattern that had the right proportions of these colors, and we made the floor.

Later, when we had built most of the furniture, we came to the colors of the room itself. I had always assumed it would be mainly yellow. So had our clients. However, they asked me to find the most beautiful colors possible, so I began, once again, testing papers on the walls to find out which colors in what proportions created beautiful light. After experimenting I found that the light of the room needed a pale sea green, a light transparent yellow, a pale blackish red, a very pale blue, and a light yellowish green. After stapling these five colors to the wall to check the proportions of color and their effect on the inner light of the room, an assistant and I laboriously painted gouache on butcher's paper. Then we began placing these papers on the walls until the light in the room became as calm and beautiful as possible. We made the most elaborate color mockup I have ever made in such a situation, and at the end of our work the room was entirely papered in rough samples. We then faced the extremely difficult task of transferring these colors to permanent gouache on the real walls of the room. To appreciate the difficulty of this process, one must remember how sensitive color is to minor disturbances. It was impossible, for instance, to take down one of the mockups and build it again, because details of configuration and dimension critical to the eye would get lost in rebuilding. The colors were also incredibly hard to match. We prepared the walls with gesso and then placed a wash of gouache over it. Achieving a slight transparency, which gives the color its light, was technically very difficult. It took

days to match each of the colors, which vary in different parts of the room and which were mixed and matched, originally, by eye. Getting the colors right took two or three days for each of the five colors. It must be emphasized that the kind of color harmony achieved here cannot be realized by matching from a chart, or by using proprietary colors or formulas. As a final touch, I cut the whales and dolphins out of hand-painted blue paper, glued them on, waxed them, and varnished them.

I believe we succeeded to some extent. The color is neither bright nor garish. The amazing thing is that even though the room has five colors on the walls, in an arrangement that many people would consider wild, it is in reality calmer than any other coloring I was able to find and calmer than almost any room I know. The apparently wild color, which is really quite subdued in its harmonies, came about because I placed the paper in a way that was not only calm and quiet, but also full of life.

This room is an example of what we mean by the "new sensibility" or new awareness which we try to put into our houses and public projects. We use it as a starting point to illustrate concretely what we are aiming for in the new system of office furniture.

A new system of office furniture

We now come to the problem of office furniture. The system we have been developing is entirely unlike the example of the San Anselmo room because it is intended for mass production. It is capable, in principle, of creating the environment for millions of workers, in an endless variety of specific configurations. Nevertheless, its essential aim is exactly the same as the San Anselmo room. It is intended to produce places where people feel *normal*, where people feel themselves, as people, with all their human foibles, deficiencies, oddities – everything, in short, that makes life ordinary and worth living. To do this we have tried to define a complete system of furniture that would satisfy people in the workplace in a way that is entirely different from today's technocratic environments. We posed the question: "What would the office be like if people felt as comfortable while they are working as they do in their own homes?"

The system we have designed to answer this question has the following key features:

1 It goes beyond the worksurface/chair/filing cabinet approach and takes full responsibility for the work environment as a whole.
2 It has about 50 components, of which approximately one-half are freestanding pieces (with the balance a series of thick wall panels and other enclosure elements such as floors, ceilings, and doorways). For reasons that will become clear later, most of these components are designed to be manufactured in a wide range of dimensions.
3 We have a layout process that enables groups of workers to lay out their workspaces for themselves, and another layout process that enables each individual worker to lay out his own workspace within the group design, according to his own needs. For simplicity, speed, and efficiency, both layout processes are available on a computer disk.
4 The system has a unique set of "thick wall" components, which are premanufactured stable structures, out of which the rooms are made and which have the solidity and flexibility of design that allows a "custom" atmosphere to be created.
5 Lastly, and perhaps most importantly, the actual pieces of furniture – their design, feeling, and physical character – are entirely different from the kind of furniture now being used or manufactured.



Figure 23.1 Furniture and light fixture designed as part of project.

After years of pretesting this material, we are convinced that the physical character, the "style," the feeling, color, and surfaces of the new items of furniture are the backbone of what we have done, and perhaps the necessary framework for any attempt to make a system of mass-produced furniture that is capable of "going to the heart."

The archetypal character of office furniture

If we decide to make an office-furniture system that is truly responsive to the needs of users, then the individual items must have a special character that is not clearly

predicated by any other thing. We take it for granted that people should be able to imagine the workplace they want, and that the "system" is then capable of responding to and implementing the workplace they have imagined. If we take this requirement seriously, it places an unusual demand on the system. It may be explained as follows.

When a person forms a mental picture of his ideal workplace, this picture will always be made up of elements we may call "archetypal." For example, if a person visualizes a desk, the desk he visualizes tends to be an archetypal desk – a desk which is full of *deskness*. This puts it in a childlike way. However, the psychological requirement is real. If the desk that is actually available in the system is a flat plate hung off a partition, then it will *never* correspond to the thing the person imagines when he imagines his ideal desk. Thus the system and the person imagining ideal workspace for himself have parted company. If the system is to keep company with the user, and satisfy that person deeply, then it must be made of elements corresponding to the archetypal images a person has inside his mind.

One possible objection is that the images a person carries in his mind are variable, they change with style from decade to decade. According to this view, the fact that a person has an image of a so-called archetypal desk is just a throwback to the 19th or some other century, and as soon as people "catch up" with 1987, they will begin to have an image of a flat worksurface cantilevered off a partition. It is precisely this assumption that is fundamentally untrue. Research in images and archetypes makes it clear that these "modern" idioms do not inevitably replace the old ones. For example, in one famous experiment, children who grew up in apartment houses in France and had spent their whole lives in the environment of buildings with flat roofs *still* drew a small house with pitched roof and chimney as the archetypal house of their dreams. The problem with the desk is similar. When we speak of an archetypal desk, it does not mean a desk that physically resembles or imitates an old desk. It is simply that some things have the recognizable and fundamental character of a desk, and allow people to form a relation of the kind they would like to form with "their" desk.

The desks that we have proposed as part of the office-furniture system have this character. One has a sloping top and a back with pigeonholes (opposite, bottom left). The other is flat, almost like a table, with shallow drawers (opposite, top right). Thus they are quite different, but both have an archetypal character. When people see these desks, they tend to say, "I have always wanted a desk like that." This is what we mean by the archetypal character. It is a thing that evokes the response, "I have always wanted an X like that." In the system we have proposed every element has this archetypal character.

The archetypal character not only means that it corresponds to some image in the user's mind – some very ancient image – but also that the thing has a fundamental, practical character that almost cannot be improved upon. For example, consider the low bookshelf with drawers (opposite, bottom right). It has a flat top with an elevated surround that keeps things from falling off. The wide, open shelves allow for a great variety of papers, books, and packages without any unnecessary complexity. The three drawers provide space for a few things that need to be put away in a less dusty or less vulnerable place. Altogether, this is a fundamental and practical object. If you have one in your workplace, it makes you feel comfortable and solid. The comfort is much more than skin deep. It is a fundamental comfort that comes from the fact that you have something basic, solid, and practical around you. An ordinary workhorse. You can rely on it. There is nothing to go wrong. And it makes you feel comfortable not only because it is so practical in the obvious sense but also because it reminds you of

the best and most uncomplicated part of yourself. We believe that all the items in the new furniture system must have this character.

It is not hard to see that this "archetypal" character is absolutely part and parcel of the user-layout process. If we want a person to feel free to imagine a simple and practical work environment for himself, he will, most naturally, build up his mental picture from archetypal elements or objects. If the elements in the system all have this archetypal character, the system will perfectly fit his mood when he tries to define his own workplace. As a result, any minor technical inconveniences or hitches that develop during the process will seem minor because the essentials have been satisfied. On the other hand, a system that tries to satisfy a user-layout process but fails to have this archetypal character will easily irritate the user. If the slightest thing goes wrong, the errors will ultimately not be solvable because the system's elements do not have this fundamental archetypal relationship to the person. If the system does not satisfy him at this essential level, then the details are unimportant. It will never really seem quite right.

Actual furniture

The furniture itself is entirely different from furniture systems in current use. Much present day office furniture feels uncomfortably slick and cheap. In order to create a new line of office furniture in which a person's feelings and well-being are the central focus, we changed the actual character of the furniture completely.

The key to its character is quality – genuine quality, the kind that can be perceived by everybody, the kind that cannot be faked. At the most basic level, the furniture is designed not by slickness of line, not by image, but by the quality of working, performing better than any other.

The pieces of furniture are personal in character, rich and clear in their form and color. Each piece is characterized by its emphasis on detail, accuracy of dimensions and shape in every curve, corner, and edge. Materials are real and solid. Color is life-giving, not neutral. All in all, the pieces are made of simple materials, made with great feeling, and with a variety of materials that emphasize human use and comfort. After preliminary field testing we have found that these items provide an entirely new level of comfort and convenience. The main thing is that they provide genuine dignity. Your work is not an aggressive moneymaking interlude in the middle of the day, but a part of your life. The feeling you have when you work in the environment created by this furniture is that you are free to work.

The user-layout process

The essence of this new system of furniture is that it is intended to make people genuinely comfortable and able to work with enjoyment. This cannot happen if a person feels like a pawn in someone else's game, a cog in a machine. It requires that people are able to define their own workspace for themselves. In order to make this practical, we have devised a new layout process (related to our previous work in pattern languages and generative systems) which enables people to lay out their own workspace. From the outset, the process also builds in the new space conception we have described.

(...)

Our user-layout process has three levels: 1. Layout of the whole office. 2. Layout of a department (5–20 people). 3. Layout of the person's individual workspace.

We built a sample installation as an experiment: an office for the administrative headquarters of Sweet Potatoes, a children's clothing manufacturer in Berkeley (opposite). The installation is in the upper floor of an old warehouse. There are two partners and 11 employees. We began by showing the owners and their employees a written version of the layout process together with a catalog of available furniture components. The following sequence (below right) describes the layout process that was then used for the installation.

Step 1: Definition of work groups. The three group managers (design, administration, and production) are asked to decide the best working groups, the number of people in each group, and the approximate size of space each group will occupy.

Step 2: Definition of common space. The employees are asked to identify and locate the size and nature of common areas. These are specified by the program to be about 15–20 percent of the total available area.

Step 3: Definition of boundaries. The group managers are asked to decide the degree of connection and separation between groups.

Step 4: Main center for each working group. The people in each work group are asked to fix the main center of their group space.

Step 5: Location of individual workplaces. The workers in each group are asked to work together to choose the position of each person's workplace within the group. The program asks for three things: size, orientation, and degree of enclosure of each individual workplace.

Step 6: Choice of furniture for common space. The owner is asked to locate the main furniture for common spaces.

Step 7: Main centers within the individual workspace. Each worker fixes the main points in his workspace: desk, orientation, chairs, main shelves, and cabinets.

Step 8: Minor centers in the individual workspace. Each worker fine-tunes the workspace by means of minor elements.

Step 9: Measuring furniture. From the final layouts, dimensions of each item of furniture to be used are measured off the given configurations and placed on the order list.

The above nine steps are only part of the full available sequence. The plans, sections, and elevations (opposite) reveal that a great variety of spaces results from this process. The space is more personal than conventional office layouts, both in the group structure and in the individual structure. Knowing how to make a furniture system that has these attributes is the trick behind the whole idea of this process. It is essential to stress that this process is entirely different from the layout process available in computerized systems using modular components. These systems allow the user to arrange and rearrange the modules. Our research shows that any process of arranging and rearranging modules is fundamentally limited, and cannot produce the kind of comfort – the deep and simple feelings – that we are seeking.

The reason for this limitation is complex and beyond the scope of this article. It is, however, demonstrable (as a mathematical theorem) that profound adaptation

in which things are comfortably related to one another can only occur when the elements involved are all capable of very fine dimensional variation. This limitation is related to the looser and more "organic" quality of the space conception already described. What it boils down to may be explained by a simple experiment. If we give a person a certain office and then ask him to make a comfortable arrangement of furniture with pre-ordained modular components inside that office, it will be very difficult, and most often impossible, for him to reach a comfortable solution. If, on the other hand, we allow him first to place things he needs roughly (without reference to their size) – first simply putting them in position, and only then defining the sizes and dimensions of the pieces he needs in relation to the whole configuration he has created – then it is possible for him to reach a very high level of comfort and efficiency. The crux is that these pieces can then be made in dimensions that fit the particular circumstance. This "non-modularity" theorem is fundamental to the layout process.

The aspect of the layout process itself which is necessary to make this non-modularity work is that it is a process of differentiation (similar to the process of embryonic development) in which the parts are gradually differentiated from the whole – instead of the whole being made up from modular parts. It starts from the whole as one space, proceeds by dividing it into departments, then into large rooms, and then determines the locations of workplaces, then their shape, then the location of the items of furniture that make the workplace, then *their* shapes, and, finally, their dimensions. This is entirely different from the mechanical "modular" layout processes that can easily be realized in computerized systems. An organic and lively feeling comes about because the process lays out the large structure and then creates the smaller differentiations within that structure. It is the process of differentiation that is necessary to obtain the kind of feeling represented here.

We also found that the layouts produced by this layout process are more fulfilling for the user, and much more profound in the way they are experienced, than the layouts that can be produced by conventional methods. The process itself is also more fulfilling and creates feelings of participation, ownership, and dignity among employees. It also increases feelings of cohesion in the workers' groups. These feelings are of immense importance from the point of view of workers and management.

New conception of space

Our layout process and furniture system are coupled with an entirely new conception of space. Present-day offices are based almost entirely on the conception of the open-office landscape and the system of panels and components, the two dominant ideas that have pioneered work in office design over the last 30 years. However, there are abundant and serious failures in this kind of environment. In our interviews, for example, we found that people frequently felt isolated or, worse, as if they were in a rabbit warren or rat maze. We also found that people's productivity and energy for work are entirely different in new offices and old ones.

Very roughly, we may isolate four main features of the space conception inherent in our new system:

1 It is based on the conception of rooms.
2 It is more rambling and looser in its character than existing systems.

3 It uses "thick walls" to form boundaries and to create space.
4 It gets rid of the external, "public-relations" image of cleanliness and replaces it with a personal feeling, in which each room and each workplace gets its character, its own personality, and its own feeling.

The new space conception we have aimed at has more to do with the nature of work, and with the messiness that implies. It is also much looser in its organization. Pieces of furniture are not stiffly attached to panels in a rigid system. Instead, pieces of furniture are loose and free-standing elements that people can place, combine, and recombine as they wish. The walls are thick and they connect with the existing structure of the building. They enclose space in all dimensions.

The plan (below left) shows a floor in a typical multistory office building. This illustrates the geometric character of the new space conception. The building is assumed to be 180- by 118-feet, which is typical for a contemporary high-rise building, and the floor shown contains working space for about 120 people. The watercolors (opposite) show impressions of the physical character the space might have, if carried out within our system of furniture. The plan and watercolors together are intended to give an over-all sense of the character and atmosphere such an office might have, given the nature and capabilities of the new system.

Large-scale production

We have spent a good deal of time preparing for the large-scale production of this new system of furniture. The furniture itself will need new kinds of tooling, especially since the materials and finishes are unusual (at least by present industry standards). Furthermore, the fact of the dimensional variation hinges on a number of technical maneuvers not described in this article. In any case, mass-production methods are feasible and may be combined, without too much trouble, with the new kind of furniture we have described. It is possible that distribution and service of the furniture may need to be less centralized than most current systems. Although many major manufacturers already keep local showrooms and distribution centers, we believe that the kind of furniture we envision will need further development of this decentralized system of sales, marketing, and service. The computer programs used for layout will be linked to sales and distribution. Since this represents a project of considerable scale, we believe it will be best to begin by manufacturing a small number of pieces of furniture each year (four to six, perhaps) and then slowly building up the repertoire of available elements. This is an almost risk-free method. As the number of available elements grows, the more sophisticated aspects of user-layout and local service can be brought in line with the demand.

It is our hope, and our goal, that this system of furniture will gradually reshape the industry. The individual elements, the process of user design, and the space conception described above are all feasible and practical for the very large buildings that now exist. We believe that the system and furniture described above are as suitable for high-rise buildings in New York and Chicago as they are for low-rise buildings in Phoenix or Los Angeles. The clincher is in the comfort and pleasantness of the furniture, and of the space that it creates. In field tests we find that the furniture creates an entirely different *human* relation between people and place from the one most people are used to today.

Instead of being alienated, and trying to tolerate the work environment, people feel as comfortable with this furniture as they do in their own homes. It creates environments that bring out the best in people because it leaves them *as* people. We hope that the slick and image-ridden workplaces of the present will give way to a world of genuine comfort in which people can think, work, and be themselves.

We are now full circle. The new sensibility described at the beginning of this article and already realized in a variety of our recent building projects – is, by its nature, personal and unique. It is non-mechanistic, concerned with feeling and with life. It creates deep feeling because it relies on deep feeling during the process of creation. Of course, some people are skeptical about the possibility of capturing this quality in a mass phenomenon of *any* kind. We believe that what we have illustrated here is a marriage of high technology, modern production methods, computers, and ultrasophisticated theory of generative processes which is capable of bringing these human qualities to light, even in a mass phenomenon, and on a level which will, one day, produce environments for thousands, or millions, of people.

At present, the office-furniture industry in this country manufactures the equivalent of some 742,000 workstations per year. We believe the process and concepts we have shown here are capable of transforming the mechanistic process and attitude that has dominated the industry during the last 30 years by introducing a new attitude in which human feeling dominates. We are convinced that this new attitude can be successfully married with large scale technological transformations, and that the new furniture that we have described here has the power needed to make this transformation.

Some parts of the work described in this article were done in communication with the design staff of Richardson Smith, Columbus, Ohio. Credit is also owed to other companies, including:

Patagonia, Inc., Sweet Potatoes, the Xerox Corporation, Philips n.v., and to individual clients including Andre and Anna Sala, Dan Potash and Maureen McCabe, and Ann Medlock and John Graham. Among them, they have given us the opportunity to conduct an almost continuous, in-depth inquiry. We should especially like to thank Dick Haworth, whose ideas for a new and vital workplace have been an important influence. Through his patronage, he provided the first opportunity for the Center for Environmental Structure (CES) and Richardson Smith to work together. We should also like to thank Tom Hench for his encouragement.

The following members of CES are responsible for the design and construction of the San Anselmo room: Christopher Alexander, Gary Black, Mark Briner, Chester Cervellino, Stephen Duff, and Kleoniki Tsotropoulou.

The following members of CES are responsible for the conception, design, and development of the furniture system described in this article: Christopher Alexander, Artemis Anninou, Gary Black, Mark Briner, and Eleni Coromvli.

The watercolors are by Christopher Alexander.

24 Construction management contract, 1994

Within a construction process run by the architect-builder, this sample contract was written as an attempt to show how the integration of design and construction, including the idea of making a building without relying on a detailed, final picture of it at the beginning of construction, might be handled in a construction contract. This contract explicitly gives the architect-builder the authority to make changes to the design during the process of construction.

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Construction management contract

This contract is made on this _____ day of _____, between _____ (hereinafter called Owner), and the Center for Environmental Structure (CES or Construction Manager and General contractor of record), for the purpose of building the _____ at _____ location, according to plans prepared by the Center for Environmental Structure.

Article 1. Definition of project

The work is shown on the drawings that are attached to this contract as appendix 1, and specified by the 23 construction operations attached to this contract as subcontract proposals in appendix 2.

The following aspects of the work will be built as specified in the drawings:

a Siting of the buildings as shown on the site plan.
b Configurations and dimensions of building(s) and rooms as shown on floor plan sheets.
c Additional interior and exterior work determined by CES during construction.

It is understood that the drawings have been obtained for building permit purposes, and are not to be construed as binding architectural plans and specs.

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Article 2. Base price

Signed subcontract proposals attached in appendix 2 spell out the relative specifications and costs. Based on these documents, the base price of the building(s) will be $_____, plus whatever changes shall be agreed to by the Owner in writing.

Article 3. CES responsibility

CES shall provide management services and supervision necessary to execute and complete construction of the project.

CES will, as construction manager,

1 Enter into binding subcontracts with subcontractors,
2 Organize and manage the subcontractors,
3 Make changes to the design,
4 Determine how to spend the available budget so as to most benefit the building(s),
5. Administer construction work so as to meet our understanding of applicable codes,
6 Inspect finished work,
7 Obtain lien releases from subcontractors in exchange for final payment,
8 Keep full and detailed accounts as may be necessary for the construction of the project on behalf of the Owner, and will make those records available to the Owner at any time,
9 At completion, shall provide to the Owner a copy of the marked up job-site drawings, for the Owner's use and records.

In all matters of subcontractor dealings, in all matters of design changes, and in all matters of money management, the Owner grants CES complete authority to exercise its judgement on behalf of the Owner.

Article 4. CES general philosophy

It is believed that the approach to construction laid out in this contract and based on the fundamental assumptions above will secure for the Owner the highest quality building(s) possible within the available budget.

Specifically, this approach is designed to eliminate the profit motive of the general contractor. By setting a fixed fee for the management of the job and maintaining open records of all transactions, the typical overbidding by the contractor to protect himself from unforeseen overruns and contractor's markups on materials and subcontracted work are eliminated. In the typical contractor-owner arrangement the overbid money becomes windfall for the contractor and does not benefit the building(s) or the owner. In the model laid out in this contract all available money is spent for the betterment of the building(s).

This method also provides the framework for efficiently dealing with changes which are a fundamental part of making a good building. In the typical Owner-Contractor agreement any changes are discouraged by adding an exorbitant surcharge to the direct costs of the changes, effectively providing the contractor a windfall profit. Even

changes which reduce the costs are typically charged as extras. In the method laid out here changes are not subject to additional surcharges and are charged at their actual costs.

CES encourages the Owner to review all subcontracts, and to propose alternative lower priced subcontractors. CES will evaluate the subcontractor proposals and award subcontracts if CES determines that it is in the best interest of the project, and provided that these proposals are consistent with the construction schedule.

Article 5. Summary of construction operations

The construction will be organized under the following construction operations, with the following sums allocated to them. Detailed breakdown, showing subcontract amount, 15% contingency, and CES management fee is given in appendix 3.

1 GENERAL CONDITIONS _____
2 FOUNDATIONS _____
3 FRAME _____
4 FLOOR STRUCTURE _____
5 ROOF STRUCTURE _____
6 EXTERIOR WALLS _____
7 INTERIOR WALLS _____
8 ROOFING _____
9 MISC METAL _____
10 WINDOWS/DOORS _____
11 BRICK AND TILE _____
12 PLASTERWORK _____
13 PLUMBING _____
14 ELECTRICAL _____
15 HVAC _____
16 ROADS AND PARKING _____
17 CIVIL WORKS
18 INTERIOR FINISH WORK
(allowance) _____
19 CABINETWORK AND FURNISHINGS
(allowance) _____
20 PAINTWORK _____
21 GARDENS AND LANDSCAPE
(allowance) _____
22 OWNERS REQUESTS _____
23 BIDDING FEE _____
TOTAL BUDGET _____

The total dollar amount under subcontractor's subcontract proposals and the total dollar amount under contingency will be used by CES to build the building(s). The use of this money is under the sole discretion of CES acting as the manager for the Owner, and may be applied to cost overruns or for any items required by CES to improve or upgrade the building(s).

Article 6. Management fee

The Management Fees will be paid directly to CES as outlined under Article 9. The management fees will be used by CES to manage the project and will pay for CES management labor and overheads.

The total management fee paid to CES is $_____ plus 20% of construction for all construction above $_____.

The portion of this fee paid to CES for managing the construction of the project as outlined in this contract will be $_____ plus 16% of construction for all construction above $_____. This sum will be paid to CES according to the arrangement described in article 9.

The remaining portion of the fee ($_____ plus 4% of construction for all construction above $_____) will be paid to CES to cover bidding, organization of subcontractors and setup: $_____to be paid as a lump sum, on notification by CES that the bidding work has begun; the remaining $_____ plus 4% to be paid on completion of the setup work.

Article 7. Allowances

Allowances are included in the main contract and subcontract documents for certain items not specified in detail. This portion of the budget is to be used by the Owner. The Owner can spend up to the allowance amount. If the Owner spends less than the allowance amount, the Owner will have the option of applying the savings to other allowance items. If the Owner wishes to spend more than the allowance amount, then they must spend less on subsequent allowance items or supply additional funds.

Article 8. Contingency

To protect the Owner and the job against unforeseeable fluctuations of price, unforeseen site conditions, and other changes, each of the budgeted amounts in article 5 contains a contingency of 15%. The contingency money is to be used entirely at CES discretion, for the benefit of the building(s) as judged by CES. CES shall have the right to distribute and redistribute this contingency money as it sees fit, in order to meet difficulties and changes which arise in the building(s), and whenever possible, to make improvements and extras which CES believes will increase the harmony of the emerging building(s).

CES's intention is to maintain as much of the 15% contingency money as possible, and use this money to pay craftsmen who will make various finishing touches continuously throughout the job.

Article 9. Payment procedure

The Owner will open a project checking account and make deposits to the account according to the schedule below. CES will be signatory on this account, and will have control of the project checkbook.

The basis for payment will be the list of Construction Operations. Summary in article 5 and detail in appendix 3.

The Owner will make deposits to the project checking account according to the following schedule for each operation:

50% of the price of the operation will be deposited to the account upon notification of the commencement of that operation.
35% of the price of the operation, on demand, when a reasonable portion of the work is completed.
10% of the price of the operation when notified by CES that the operation is at least 85% complete.

The remaining 5% will be paid according to the provisions of article 14.

As each check is deposited to the account, CES will withdraw the appropriate amount from the management category (as shown in appendix 3) to make payment for construction management fees, up to 95% of the total management fee. The remaining 5% of the total management fee will be deposited to CES upon final completion.

All records from the project account and all invoices for materials and labor, and all subcontractor's billings will be available for the Owner's review.

Article 10. Subcontractors

Subcontract proposals for items 2–21 are attached as appendix 2. These proposals, signed by the various subcontractors constitute an addendum to the general contract, and serve as the basis for the project specifications and the construction budget. At the appropriate time CES will obtain subcontract proposals from subcontractors for any remaining items.

In performance of this task, CES will seek out and hire subcontractors which in CES's opinion are most appropriate for the particular job. The criteria may be price in one instance, timeliness in another, and quality of work in another. CES is under no obligation to find the "lowest" subcontractor, nor the "best" subcontractor.

Should a subcontractor default on their subcontract, for any reason, CES will endeavour to re-negotiate or find another subcontractor to perform the work. CES will proceed in a manner which it determines is in the best interests of the Owner and the project with respect to time, quality, flexibility, and price, but CES is under no obligation to provide subcontracts or subcontractors at a guaranteed price.

The relationship between CES and the subcontractors shall be a contractor-subcontractor relationship. Within the confines of such a relationship, CES will include its best efforts to provide appropriate guidance of the subcontractors in the performance of their work. CES is to be sole agent on behalf of the Owner. The Owner or any agents of the Owner aside from CES, are explicitly forbidden from giving any directions to, or making any requests directly to any of the subcontractors. The Owner may, of course, make requests through CES as provided in article 11.

Article 11. Design decisions and changes initiated by CES

Part of CES philosophy is that there are no defined plans and specifications. CES will have authority to make design decisions and design changes as it determines necessary, without written confirmation from the Owner, as long as these decisions do not

increase the total budgeted cost. Whenever possible CES will confer with the Owner but CES is not obligated to do so. Design decisions and changes may be generated by any of the following causes.

CES-initiated design changes may be generated in response to the emerging building(s). As the buildings and rooms begin to take shape, doorway sizes and locations, window sizes and locations, wall locations and wall lengths, cabinets, finishes, etc. may have to be altered. These decisions can only be made on the site, during construction, as the building(s) is taking shape.

CES-initiated design changes will be required to keep the overall price of the building(s) in budget. As a result of some unforeseeable problem, or as a result of an overage due to a previous design change, it will become necessary to make changes in the building(s) to offset the overages. This is not something that *might* happen, it is something that *will* happen. Although often seen as negative, these types of changes are more often than not positive changes which ultimately result in producing the best buildings.

CES will confer with the Owner in major design decisions which the Owner has identified as important ahead of time, and before making any major design changes, but CES has the main commitment to "listen" to the emerging building, and to do what is in the best interests of the building(s). The owners will be consulted on and encouraged to participate in the detailed layout of _____as they have requested.

Article 12. Changes not covered by article 11

Changes not covered by article 11, and resulting in an increase of cost, will be approved in writing by the owner. In cases where an increase of cost is anticipated, the owner must approve the change in writing before CES can begin the work. If the owner does not approve it, the work will not be done.

Article 13. Time

The work to be performed under this contract shall commence within 15 days of the signing of this contract. The work shall be completed in accordance with the schedule provided pursuant to the paragraph below.

Both owner and CES desire to complete the project in _____ months starting from the date of commencement. CES will provide the owner with an estimated construction schedule for the project. This schedule shall indicate the dates for the starting and completion of the various stages of the construction and shall contain the necessary information to allow the owner to monitor the progress of the work. It shall be revised as required by the conditions of the work and those conditions and events which are beyond the control of CES.

The Owner agrees that if the building process is slowed down, by any act or neglect of Owner, by any separate contractor employed by the Owner, by any unreasonably slow process of decision making or design negotiation from the Owner, CES will then be entitled to an appropriate increase of management fee, to make up for the extra time. If the building process is slowed down for any other reason not caused by CES negligence, CES and the Owner will negotiate fair compensation if any additional management fee is required. Adherence to time conditions is of vital importance to the proper running of the job site, and is of material importance to the successful completion of this contract.

Article 14. Substantial completion

The date of substantial completion of the project or a designated portion thereof is the date when construction is sufficiently complete in accordance with the drawings and specifications so the Owner can occupy or utilize or, in fact, does occupy or utilize, the project or designated portion thereof for the use for which it is intended.

The date of substantial completion shall be established in writing, signed by the Owner and CES. At that time, a punch list of items to be completed or corrected (if any) shall be prepared by the Owner and CES along with a time schedule for their completion or correction, and the remaining unpaid balance of the contract including the 5% subcontract retentions will be deposited to the construction account.

Article 15. Lien releases

CES warrants that all money paid by Owner, except management, will be used on the building to pay for materials, job expenses, subcontractors and craftsmen.

CES will obtain partial waivers of lien for all payments to subcontractors and will forward these to the Owner.

Article 16. Final payment

Following full completion of the work as defined by the punch list (article 14) and final inspection and acceptance of the work in writing by the Owner, CES shall have authority to make final payments to subcontractors, and to withdraw final payment of the management fee. To protect the Owner CES agrees that they will not use these funds to make final payments until the subcontractor has provided the appropriate final lien releases. When all payments have been made, CES will issue a duly executed final waiver of lien.

Article 17. CES obligation and first year repairs

CES will maintain $_____ from the contingency in the job account, for a period of one year after final completion. This money is to be spent for repairs and annoyance items which occur after final completion. CES will use the $_____ at its discretion, to fix items that are unsatisfactory to the Owner. If one year after final completion, this money or any part of it remains unspent, CES will use the balance in consultation with the Owner, to make some nice small improvements to the buildings. CES shall have no further obligation, beyond that covered by this money, for making repairs or improvements on items considered unsatisfactory by the Owner. CES will also make its best efforts to help the Owner enforce the warranties provided by subcontractors.

Article 18. Job expenses

Owner will maintain working telephones on site at all times. Owner will supply working electric service and water to the job site. Owner will supply toilet, storage, cleanup facilities and lunch room for subcontractors men at all times. Owner will reimburse CES management personnel for mileage to and from CES office, at 27 cents per mile. CES will pay the phone, electric, water and toilet bills, together with mileage

reimbursements out of the job account. Estimated costs for these items are included in the construction budget under general conditions. If these costs run above estimate, overage to be carried by Owner.

Article 19. Unknown conditions

The work may include modification or connection to existing structures. It is not possible to anticipate all problems which may arise, in the work of connecting to such existing structures. If unexpected conditions that affect the performance of the work and vary from those indicated by the contract documents, are encountered, base price of project and schedule shall be equitably adjusted for such unexpected conditions in writing between CES and the Owner upon claim made by CES.

Article 20. Insurance

The Owner will carry all necessary general liability, fire, and earthquake insurance and any other insurance which may be required to protect the Owner against claims which may arise from operations under this project.

CES will purchase and maintain the following insurance to cover CES's operations under this agreement:

1 Workers' compensation insurance in full compliance with workers' compensation laws of the State of California for all employees of CES and other persons directly associated with CES's management team.
2 CES will, in addition, request that all subcontractors provide certificates of workmen's compensation insurance for their employees. In any case where this is unavailable, CES will carry the necessary workmen's compensation on its own policy and deduct the cost from the subcontract price.

Article 21. CES special construction methods and philosophy

The Owner recognizes that the methods and philosophy of CES include unusual use of materials, and unusual combinations of high level and low level finish. The building(s) will not necessarily be designed to typical California industry standards for residential or public buildings, and the Owner's desire to break with these prevailing standards is explicitly part of the intent of this contract.

Owner approves the form and content of the CES subcontract forms attached to this contract as appendix 2, and recognizes the right of CES to make substitutions as provided in the subcontract agreements.

The Owner is specifically bargaining for CES's exercise of its independent judgement in carrying out the above-described construction methods and philosophy.

Article 22. Safety

CES shall take necessary precautions for the safety of CES employees on the job, and shall comply with all applicable provisions of federal, state and municipal safety laws.

CES shall have no responsibility for the abatement of safety hazards resulting from work at the job site carried on by other persons, or by subcontractors. Subcontractors will be responsible for their own safety, but CES and CES employees will encourage safety on the site.

Article 23. Warranties

CES warrants to the Owner that all materials and equipment furnished under this agreement will be new unless otherwise specified, and that all construction work will be of good quality, free from improper workmanship and defective materials. Any warranty or guaranty obtained by CES from any manufacturer, shall be deemed to have been obtained for the benefit of Owner. CES will collect all equipment manuals and deliver them to the Owner together with all written warranties from equipment manufacturers, and CES will have no further obligation with respect to them.

Article 24. Attachments

The signed subcontracts and documents attached hereto as appendices are expressly incorporated into this contract. To the extent the attachments are inconsistent with the main contract, the terms of the main contract shall govern.

Article 25. Arbitration

Claims, disputes and other matters in question between the parties to this agreement arising out of or relating to the agreement shall be decided by arbitration in accordance with the construction industry arbitration rules of the American Arbitration Association then in effect, unless the parties agree otherwise. This provision shall be specifically enforceable in any court of competent jurisdiction.

Notice of demand for arbitration shall be filed in writing with the other party to this agreement and with the American Arbitration Association. The demand shall be made within a reasonable time after the claim, dispute or other matter in question has arisen. In no event shall the demand for arbitration be made after the date when the applicable statute of limitations would bar institution of a legal or equitable proceeding based on such claim, dispute or other matter in question.

The award rendered by arbitrators shall be final, and judgement may be entered upon it in accordance with applicable law in any court having jurisdiction.

Unless otherwise agreed in writing, CES shall carry on the work and maintain its progress during any arbitration proceedings, and the Owner shall continue to make payments to CES in accordance with the contract documents.

This article shall survive completion or termination of this agreement.

Article 26. Attorney's fees

In the event that either party files suit to enforce the provisions of this contract, the prevailing party shall be entitled to a reasonable attorney's fee as cost of suit, to be fixed by the Court.

Signed

_____

For the Owner date
for CES date
APPENDIX 3

Breakdown of construction operations

	SUBCONS	15%	CES	TOTAL
1	GENERAL CONDITIONS	_____	_____	_____
2	FOUNDATIONS	_____	_____	_____
3	FRAME	_____	_____	_____
4	FLOOR STRUCTURE	_____	_____	_____
5	ROOF STRUCTURE	_____	_____	_____
6	EXTERIOR WALLS	_____	_____	_____
7	INTERIOR WALLS	_____	_____	_____
8	ROOFING	_____	_____	_____
9	MISC METAL	_____	_____	_____
10	WINDOWS/DOORS	_____	_____	_____
11	BRICK AND TILE	_____	_____	_____
12	PLASTERWORK	_____	_____	_____
13	PLUMBING	_____	_____	_____
14	ELECTRICAL	_____	_____	_____
15	HVAC	_____	_____	_____
16	ROADS AND PARKING	_____	_____	_____
17	CIVIL WORKS	_____	_____	_____
18	INTERIOR FINISH	_____	_____	_____
19	CABINETWORK AND FURNISHINGS	_____	_____	_____
20	PAINTWORK	_____	_____	_____
21	GARDENS AND LANDSCAPE	_____	_____	_____
	OWNER'S REQUESTS	_____	_____	_____
22	BIDDING FEE	_____	_____	_____
	SUBTOTALS	_____	_____	_____

Craftsman/subcontractor agreement

This agreement seeks to obtain the best possible work for the owner by obtaining design and construction input from the craftsman, encouraging an old world attitude of quality toward the work, and by giving flexibility of on-site design decisions to CES. This agreement is made on this _____ day of _____ 19_____, between THE CENTER FOR ENVIRONMENTAL STRUCTURE (hereinafter CES) and the craftsman defined below (hereinafter CRAFTSMAN). All subcontractors are referred to as craftsman even when a company or organization is providing service, and even in the case of heavy engineering works, in order to emphasize the craft-like nature of the work which CES expects.

CRAFTSMAN/SUBCONTRACTOR _____
JOB DESCRIPTION _____

For details of job description see page 3 of this contract

PRICE _____

Part 1
General conditions

Article 1. Purpose

The purpose of the work is to build a building under conditions which allow craft, care, love of the building(s), love of work, and the life of the emerging building(s), to be created to the maximum extent possible. The nature of this subcontract is designed to make this possible, while protecting the interests of owner, manager and craftsman.

Article 2. Definition of the work

The craftsman will perform the work defined in the job description attached to this contract, and signed and dated by the parties. It is agreed that this work is defined and modified by the conditions of part 2, articles 7–11.

Article 3. Price and payment schedule

For performing the work specified in article 2, the craftsman will be paid a total price of $ _____

The first 80% of the price will be paid to the craftsman in progress payments based on percentage of work completed, as approved by CES.

15% of the price will be paid to the craftsman after completion of the craftsman's work, and after written declaration by CES that the work is satisfactory and complete.

The final 5% of the price will be paid to the craftsman after final completion of the construction contract, and after sign-off of the punch list by the owner.

Article 4. Craftsman responsibilities

The craftsman is responsible for:

1) Insuring compliance with applicable codes.
2) Adhering unequivocally to the price set forth in this contract.
3) Following good construction practice.
4) Either 4a or 4b. One must be checked.

4a) Providing affidavits of workmen's compensation insurance. ___
4b) Making provision to be carried on CES's workman's compensation insurance. _____

5) Providing the owner with a completed package as set forth in article 5.
6) All penetration of building components shall be neat, sleeved, and fire-stopped and shall not compromise structural integrity or watertightness of the structure.

7} Craftsman will clean up all dirt, blemishes and trash generated by his job, and haul away, leaving the site clean of his work.
8) Craftsman will come back to repair or modify any items not adequately completed, at the direction of CES when final punch list is made between CES and owner.

Article 5. Craftsman's goal

The ultimate purpose of this agreement is to secure the craftsman's work under conditions which make the craftsman's work a work of beauty and pride and self-respect, and in which the craftsman leaves behind work he is proud of, and can cherish in the future.

It is specifically understood that the craftsman's goal is not only to be paid for his work, but that the beauty and satisfaction of the work itself provide part of the craftsman's reward. To this end, the craftsman shall be treated as an artist who has some power and control over his work as necessary to allow the creation of a beautiful and fitting work within limits accepted by CES.

Article 6. Guarantee

Craftsman warranties his work for a period of _____ and will repair or replace any item found defective within the warranty period.

Part 2
Rules governing evolution of the work

Article 7. Basic rule

The essential agreement governing this contract, is that the price remains fixed, and that changes made by CES or by the craftsman, are always made while keeping the price fixed.

Article 8. Craftsman's own time for beautiful extras

It is explicitly present in this agreement that in performance of article 5 (part 1), the craftsman will spend some time over and beyond the call of duty, to make a few very nice details. The craftsman will choose the time, location and nature of these details, and will do them with the intent to make a good job of the project. These details should be checked with CES manager before performance.

Article 9. Extra labor and materials allowance under CES control

As part of the performance of this contract the craftsman will provide _____ crew-days of labor and a _____ materials allowance to undertake any extras directed by CES. A crew is _____ These extras are specifically over and above the performance of the base task defined in the job description, and are intended to provide small extras which will make the job better and more beautiful.

Article 10. Substitutions

CES shall have the right to make substitutions within the basic job description, reducing some portion of the work, to pay for an increase in other portions. Substitutions to be negotiated with craftsman, and not to increase total price.

Article 11. Flexibility during construction

There is an essential base condition to this contract: In order to make the best building(s) possible, it is not always possible to define the work exactly, ahead of time. The use of working drawings as a precise determination of construction responsibility does not allow the proper life to appear in the building(s), and is specifically eschewed by this agreement. The purpose of this agreement is to give CES and the craftsman the necessary flexibility during construction, while protecting the owner in regard to price.

In order to protect the owner from unacceptable cost overruns, the parties have agreed that the work will be done for a fixed budget, and that the owner will have the work specified in this subcontract performed for a definite fixed sum.

In order to protect the craftsman from having to perform more than he can fairly do under the fixed sum contract, the craftsman has the right to re-arrange the work after negotiation with CES. When CES makes requests not covered or anticipated in the job description, and which clearly costs more, CES and craftsman will then negotiate to reduce work or material or labor in one portion of the subcontract, to make up for the new needs. The owner accepts this arrangement as the necessary consequence of a more flexible approach to building, and a fixed price contract. It means that some items may be built to a reduced specification or not built at all.

The essential purpose of this contract, is to produce a fair and balanced solution of this base condition, in a way which is fair to all parties. It must be emphasized that all parties, CES, owner and subcontractor, have an interest in making sure that this condition is fairly met. The parties agree to this condition and accept it as essential to all performance of the work.

Part 3
Special conditions

Article 12. Schedule

CES will give craftsman 15 days notice prior to start of job, and craftsman will commence work on the specified day. Work is to be completed within _____ days thereafter.

Article 13. Lien releases

Craftsman will sign a partial lien release executed with each progress payment.

Article 14. Changes requested by CES which require additional compensation

This contract, as written, only covers those items of work defined in the signed job description, or explicitly dealt with under the items of flexibility section (article 5).

Items of extra work outside the range of flexibility, which arise as a result of requests made by CES, shall be negotiated and charged separately to the owner.

Article 15. Unanticipated work caused by unanticipated conditions or owner's requests

Extra work which arises during performance of the job, whether as a result of unforeseen job conditions or as a result of requests made by the owner, shall be negotiated and charged separately to the owner.

Article 16. Coordination with CES representative

Craftsman is directly responsible to CES representative only, and may not act upon requests made by the owner, unless these are channeled through CES.

Signed _____ Craftsman/Subcontractor
Signed _____for CES
Date:

Job description

The description below gives our current understanding of the particulars for the _____ job for the _____ building(s).

On top of base job, job-price must also include _____ crew-days of labor under CES control, for architectural extras to be defined by CES.

TIMING

Work to be done between _____.

Subcontract proposal request

The enclosed documents show our current understanding of the _____ job for the _____building(s).

The maximum amount allocated for this item is $ _____. It is imperative that you make a proposal which is less than or equal to this amount. If you cannot meet this budget or better it, you may propose a reduction of scope or change of specifications.

Please submit a detailed proposal for this job on page 3 of our enclosed subcontract forms. We shall award this contract to the subcontractor who defines the most attractive proposal. We strongly recommend that you discuss with us, and negotiate in detail, the nature of your proposal, before making your written submission.

Completeness of proposal

This list may not be complete. It is the craftsman's responsibility to study the _____ job in detail, and to include in his proposal everything necessary to do a complete job.

25 *Battle*, unpublished chapter, 2010

This draft of a chapter for The Battle for the Life and Beauty of the Earth: A Struggle Between Two World-Systems, *the book about the Eishin School project in Japan, was not ultimately included.*[1] *There is of course a huge gulf between what CA called, in this book, "System A", the kind of building culture necessary to support humane and wholeness-reinforcing processes of design and building, but that has not yet been brought to scale, and "System B", today's building culture characterized by diverse agents – architects, clients, contractors, builders, materials suppliers, insurance companies, banks and regulatory institutions – that lack common goals of beauty and wholeness, but which can produce projects at very large scale. This unpublished chapter recognizes, possibly for the first time in CA's work, that in today's world the production of large-scale buildings and projects, in ways that are humane and beautiful, may depend on both systems working together.*

The chapter was not included because CA did not feel that there was as yet enough evidence to make the point – although the Eishin project itself was done with both systems working together. The beginning of the project, including the development of a project pattern language, the design and layout of the project on the site, as well as the initial site works of shaping the land and forming the lake, represented a clear example of a process focused on human needs and the development of wholeness in the site plan with CES as architect and contractor. And while a general contractor other than CES, Fujita Kogyo, ultimately was in charge of construction, Fujita worked closely with CES during the building process in the development of details and the identification of craftsmen to build them. CA felt that this hybrid process was effective[2] *and recognized the potential role of this hybrid process in large-scale projects. After the main project was finished, CES Japan, directed by Hajo Neis, carried out several successful smaller projects on the Eishin School campus, acting in "System A" as architect and contractor. But the lack of evidence from other large projects that combined the two systems ultimately prevented inclusion of the idea in* Battle.[3]

1 Christopher Alexander, Hajo Neis and Maggie Moore Alexander, *The Battle for the Life and Beauty of the Earth: A Struggle Between Two World-Systems*, Oxford University Press, New York, 2012. Work on the unpublished chapter took place until about 2010.

2 Alexander, *Battle*, p. 366.

3 Thanks to Hajo Neis, who was the executive architect in charge of this project working closely with CA, for helping articulate the point on CA's view of the (in)sufficiency of evidence with respect to the publication of this chapter in *Battle*.

DOI: 10.4324/9781003187516-28

Because this collection of writings is intended partly to shed light on the development of CA's ideas, publishing a rough draft of the unpublished chapter is justifiable. It may seem a radical departure from CA's views of the need for a "complete working alternative" to typical contemporary building cultures.[4] *But the fact that CA even considered including this chapter helps affirm his openness to new ideas and responsiveness to evidence – but always within a deeply-felt criticism of how the human built environment is presently made.*

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•••

Large-scale building production: unification of the human system and the physical system

System-A by itself, cannot make high volume, high speed construction when needed. System-B can do it and has demonstrated it, in many places.

System-B by itself, cannot lavish the finesse and subtlety which makes it possible to generate the finely adapted buildings and spaces which make life worth living, and comfort the human heart. System-A can do it, and has demonstrated it for millenia.

It must surely be clear, by now, that we need to make a combination of A and B, a combined system, which maintains the best of both worlds, in production, and yet does it in such a way as to avoid making the horrible mistakes we have seen, in abundance, in the shortcomings of new environments, built under system-B conditions during the twentieth century.

There is a wide range of production phenomena, ranging from an "extreme" form of system-A, which can become too focused on craft and hand-made buildings at the expense of time and cost; to an "extreme" form of system-B, which can be crude and poorly made, focusing as it does on profit and efficiency at the expense of quality.

We believe that it is necessary to find a way of combining the best insights and practices of these two systems, eliminating those aspects that do harm, and encouraging those that are best for the whole. This distinction will require some rigor and finesse. The two are interlaced. Each one needs the other.

The big question is, of course, How is it to be done? How – in practice – can this become the focal point of our efforts, so that the forces of system-B can be used to support the purposes of system-A? If we hold this goal clearly in our minds, and we learn how to manage system-A and system-B resources in a manner that moves towards achieving it, there is no reason we cannot achieve our goal.

In order to provide quality and depth in our physical environment, we will have to be sure that adaptation is able to take place, continuously, throughout all the newly constructed buildings. In practical terms, this means that we shall also have to be sure about the level of skill and craftsmanship, that are available, at a reasonable price. And

4 Beginning with *The Timeless Way of Building*, the books in the CES series include the following statement opposite the title page, depending on the book: "[*The Timeless Way of Building*] is the first in a series of books which describe an entirely new attitude to architecture and planning. The books are intended to provide a complete working alternative to our present ideas about architecture, building, and planning – an alternative which will, we hope, gradually replace current ideas and practices."

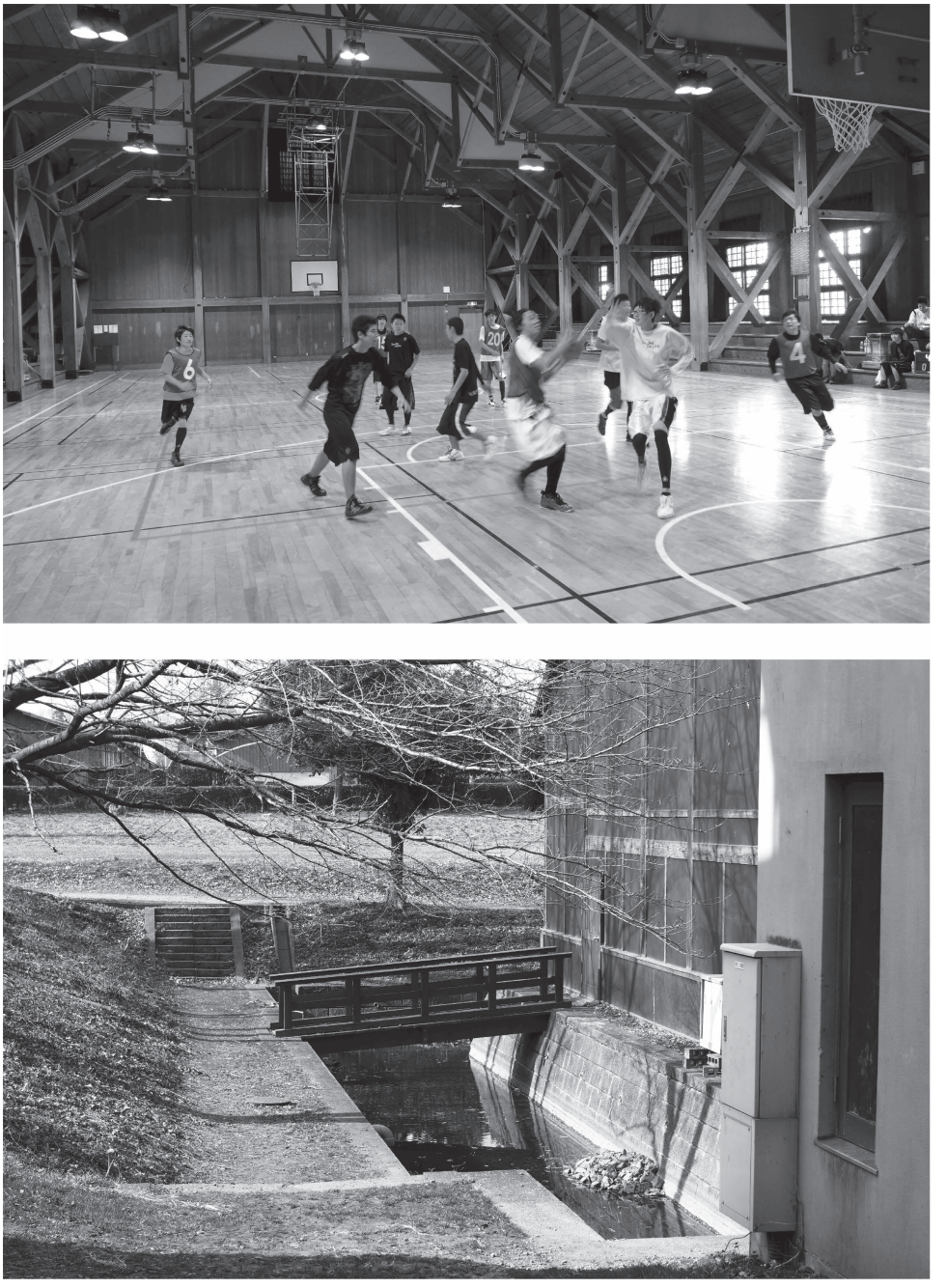


Figure 25.1 Top: Eishin School, gymnasium, 2012.
Bottom: Eishin School, detail of exterior, 2012.

Photographs by Howard Davis.

this in turn means we shall be giving the new production-system the ability to make beautiful buildings.

This is exactly what we did accomplish in building the Eishin campus. When we combined forces to build the Eishin campus, the Center for Environmental Structure provided the know-how of system-A, and Fujita Kogyo provided the know-how of system-B. Together, we did succeed. It is true that we had to struggle, and there were some considerable difficulties along the way. But we did manage to build a beautiful campus, admired by many, and providing a living environment for students and faculty alike.

In this process, two very important goals were achieved.

(1) Furthermore, the beautiful construction was done at a low price, which challenged current thinking.
(2) The work was done at very high speed, meeting a very onerous schedule, without losing the profound positive attributes of system-A.

Might it be possible, in future then, to establish a permanent, amalgamated, new kind of production system in which A and B, together, play balanced roles, and in which the shortcomings of the one are not allowed to swamp the good qualities of the other? Above all else, we would have to be vigilant to be sure that system-B would not, and could not, undermine system-A, as it has been doing in the last few decades.

. . .

To begin with we must establish the social groupings to form the backbone of the social system.

For example, in constructing the Eishin campus, we set up groups of workers, corresponding to the major buildings and groups of buildings, with the idea that the people who made each building, in each grouping of similar activities, would then have their hearts in the work, because they would naturally be able to identify with the tasks and social meanings, of that particular group's activities.

In practice, for example, on the Eishin campus, we had a team of workers who built the structural carcass of the Great Hall; another team worked together, to build the Judo Hall. Yet another group took responsibility for the enormous gymnasium; another for the Dining Hall and catering facilities. The high school classrooms were built by a team who learned how to make those buildings, and there were many of them. The people who built the college buildings, had a particular affinity for the professors, and students, who were more mature, and who engaged in discussion, seminars, and so forth.

. . .

The essential point, and it is a vital point, is that each group of craftspeople, worked together as a team, had the right to maintain the idiosyncracy of that particular building, with its particular details, its human activity and style. The building was not made in a mechanical fashion as buildings are built by large contractors, with uniformity of material and physical character throughout. Instead, each building is given its own particular character, and the craft work that was undertaken in that building came – in style, and temperament – to achieve a particular manner and a practical relation of that building to the things that were to happen there.

This way of building, this organization of building craftsmen, laid the foundation of an atmosphere, in which each place – each corner of the campus, if you will, developed its own particular style of ornament, decided by those dozen crafts people, who

were addressing, from start to finish, the responsibility for a coherent whole. And the existence of that particular, and idiosyncratic whole, came about as a result of the adaptation, going on by that group, in that place, with a pleasure, and an aptitude for the kind of building, and the kinds of windows, the kinds of furniture, the kinds of light, the closed or open character of rooms, according to the work that was going to be done, by the people who were ultimately going to lay down the social patterns and organization and work patterns, so that it made sense to those people who were going to work there, and the detailed effort was in large part shaped by the people who were going to work there as students or professors – and indeed, these individuals helped to shape and guide their home – their own corner of a particular cluster of buildings with its own atmosphere.

. . .

The question is this. How – in practice – can life become the focal point of our efforts, so that the forces of system-B can be used to support the purposes of system-A? If we hold this goal clearly in our minds, and we learn how to manage system-A and system-B resources in a manner that moves towards achieving it, there is no reason we cannot achieve this goal.

When we combined forces to build the Eishin campus, we had two assets:

(1) The Center for Environmental Structure provided the know-how of system-A (with its subtle relationships among the building elements, providing fine-tuned adaptation);
and
(2) Fujita Kogyo provided the know-how of system-B, which maintained a highly efficient construction schedule, with precise and beautifully executed construction details.

In this experiment, we did succeed. It is true that we had to struggle, and there were some very considerable difficulties along the way. But we did manage to build a beautiful campus, admired by many. And it was done at a price which challenges current thinking. It was also done at a very high speed, without losing the profound positive attributes of system-A.

This leads us to believe that it is possible to establish a permanent, fused, creation and production system in which A and B together play balanced roles, and in which the short comings of the one are not allowed to swamp the good qualities of the other. We have to be vigilant to be sure that system-B will not, and cannot, undermine system-A, as is the tendency today.

. . .

System-A is a way of treating the world in its wholeness. It is a carrier of a benign philosophy of life. It is a way of building, and it is a way of making and remaking and repairing our world that goes to the essence of life and to the marrow of the meaning of life. Even now, twenty-five years after the building of Eishin, the many peoples on Earth have still only taken miniscule steps towards this goal. Many of the faults that were visible in 1981–85, are still visible in society today. Some have been aggravated. System-B is still the dominant way of planning, designing, and constructing the environment in most parts of the world.

The clash between these two world systems has lain at the heart of 20th-century social problems. With good fortune, we hope it may now and in the future permit the

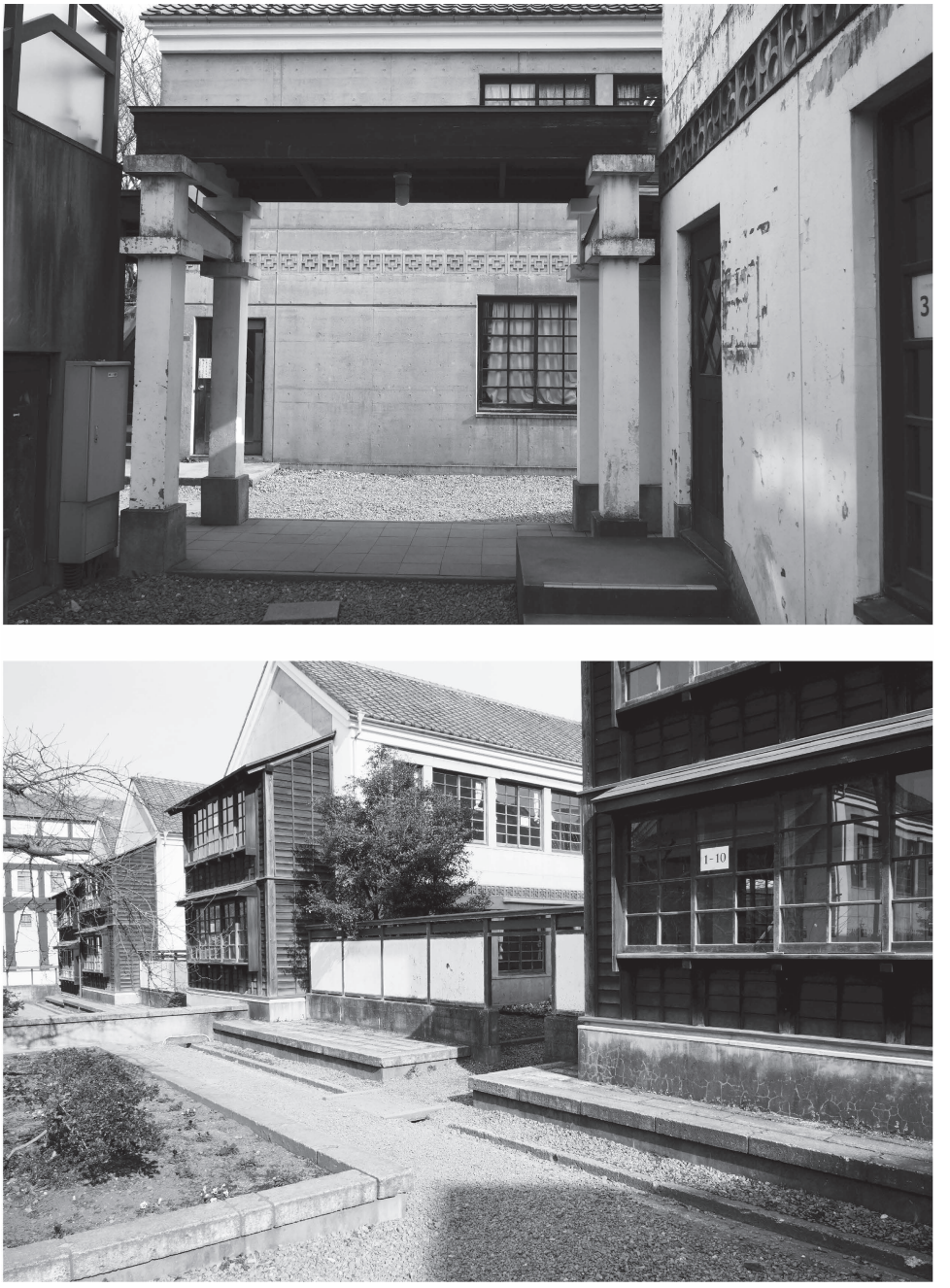


Figure 25.2 Top: Eishin School, view from homebase street, 2012.
Bottom: Eishin School, view of homebase street, 2012.

Photographs by Howard Davis.

resolution of a successful, 21st-century world architecture. It may be the foundation for a civilization that takes human concerns seriously, and that embodies these concerns in the physical landscape and built structure of our future civilization.

In any case, the practical side of system-A, the operational definition of what it means to work in system-A, can be expressed very simply: Direct management of construction which accommodates adaptation will move us towards wholeness. Dynamic instructions, based on the geometric transformations defined in 1, can focus workers on the whole. Their participation in making as opposed to design by an architect, will allow wholeness to appear. Without taking this law as an absolute, or treating it as a fanatic doctrine, it is simply true that wholeness depends on hundreds and thousands of minute adaptations within the whole. That is where its living quality comes from. The wholeness can only happen when the architect, or planner, or craftsperson herself does the work with her own hands – and that can only come into being within a human organization which permits direct management. This is the essential point.

. . .

We have seen clearly that the effort needed to achieve production along the lines of system-A has been considerable, when confronted with system-B, since system-B in its present form, is likely to obstruct the operation of system-A at every turn. But we have also demonstrated that system-B can coexist productively with system-A. This demonstration came from our almost daily cooperation with the Fujita Company, and their cooperation with us. Fraught with difficulty though it certainly was, nevertheless we did succeed somehow in creating an amalgam of A and B. The Eishin project might be regarded as a first-draft, management, test bed preliminary to a second version, based on our experiences in the field.

. . .

The experience of building the Eishin project allows us to begin to outline some standard practices for the amalgam of A and B. With usage, testing and time, this structure can develop and be a strong advocate for, and resource provider to, living communities that help restore health and balance to our environment. Developing such a structure requires several layers of understanding;

- Acknowledgement that there is reality in the distinction of A from B.
- Understanding of A as a system, and of B as a system.
- On-going experimentation and adaptation of construction practices that demonstrate ways of configuring the two systems together in a helpful fashion.

Having built Eishin and analyzed how the project worked, it is now possible to discuss systems A and B at the start of any project, and to carefully consider how the client wishes, design, and construction will interact to produce the best environment possible. Presently, we can identify the following practices as essential and practical for an amalgam to succeed.

- A and B choose to join up to achieve a desired outcome: a settlement, village, town or neighbourhood that helps us recover ourselves and the world we make. Anything helpful to achieve this goal can be part of the design, planning and construction process.
- The overall construction operation is staffed with skilled professionals and craftspeople who represent both systems.

- A design and construction contract is written, which acknowledges basic principles, methods, and procedures of A and B that are relevant for the project.
- Protection of system-B tasks and activities is established: a staff cannot interfere with schedule and timing of major operations conducted by B staff.
- Protection of system A tasks and activities is established: B staff is not allowed, under any circumstances, to compromise the necessary slowdown of work by a staff when experimentation and adaptation are needed.
- A shared understanding of the desired outcome encourages willingness and a process that allows all staff to work through issues, perhaps conflicts, that arise on the ground as the project moves ahead.
- All discussions about problems of design, cost and construction are negotiated in the construction committee, and are solved on a practical level by representatives of both A and B. Clients are also consulted.
- System A starts to do the design work by using principles that have been developed for creating life and beauty in the environment, anticipating that the emerging design will require adaptation as more and more is learned about what the environment is to support and how it fits in the land.
- Starting a project emphasizes vision, patterns and the inclusion of as many participants as possible in order to place the project on a very broad foundation – one that continues to guide progress throughout the project.
- System B's immense access to its network of craft, trades, suppliers and workers are redeployed to the careful and detailed work of building, using system-A method of adaptation. With a shift in attitude about the best utilization of system-B's resources, this is possible.
- System-B does not simply build from drawings. Throughout construction it allows for and participates in testing design and materials, through the use of models and experiments, to ensure that the result extends the wholeness of the pace and future inhabitants.
- The process of adaptation is not undercut by procedures and methods related to prefabricated materials, or by purchasing less expensive materials in order to save money.

Materials that are amenable to adaptation are chosen. For instance, when prefabricated materials are used, they are made from high strength concrete that allows cutting, shaping and, adaptation of members so that everything can be fitted together differently to the degree that it is necessary.

- System A makes continuous inspections of the work, and requests various modifications in design of portions not yet completed. System B complies with these requested modifications, provided that they do not result in reworking, tearing out, or other damage to the completed portions of the work.

In the end, the major sticking point will most likely turn out to be money. Our emphasis has always been on the careful management of money. In practical terms, this means some things are done inexpensively, which, in turn, frees up money to spend on those things that need to be intricately worked out. Any surplus money that is available is invested in the building to enhance further the details that make the

difference. Everyone on the project is paid well, but there is no interest in profit, i.e. money left over that goes to shareholders. Hence, we add the following:

- System B decides to make an investment in the construction of living communities – one with a modest return on investment, instead of making a killing. This makes the reorganized workforce and the new construction methods possible. Hence living communities can be produced on a grand scale.

. . .

What is the responsibility of architects, working in the A+B amalgam? We now try to give a sober answer to this question. We ask the question as architects, as members of a profession facing the enormous responsibility for the earth's environment, and also as non-architect citizens of Earth who are singly or collectively concerned with the results of the worldwide construction process. It is, in large measure up to us – the architects of the world, and everyone who considers himself responsible for our present society – to decide for ourselves, whether we shall go forward with a new idea of architecture that is based in equal measure on system-A and on system-B.

In order to begin a serious discussion of this question, we must first recognize the enormous role which the profession of architecture has currently been playing – worldwide – in propping up system-B to the exclusion of system-A. This is a negative reality of our time. Until we recognize it and analyze it, repair it, and replace it, we cannot give any serious answer to the question.

. . .

A first success for System-A

The authors of this book and our many colleagues have published a number of books in which system-A was sketched, or implied, or made visible, or called for. These include all twelve books of the Center for Environmental Structure Series. The response of the architectural profession to these books, has, so far been quiet, sometimes cool. The ideas which these books describe have often been ignored, or characterized by architects as idealistic and impossible. What the series advocates has been described as a dream world that is out of touch with present day reality. In short, architects have found a way to maintain that system-B is necessary, while system-A is a dream – that it is impossible to create system-A in a practical way in the real world of the 21st century. "Yes," they are likely to say or think, "Maybe system-A can be done on a small scale. But on a large scale, big enough to make real changes in the world, it costs too much; or it demands too much; or it requires too many changes. It may be nice to write about, or read about – but it is impossible to do."

However, the success of the Eishin project in Japan (as an environment), and our practical success in undertaking and managing system-A at a large scale – in short, the social and economic battle that we fought – proves conclusively that this argument is wrong. The fact of the matter is that it is possible to implement system-A on the practical level of a large project. It can be done today, on a massive scale, without increasing cost, and without increasing time.

How did the project turn out so well?

The answer to this question is crucial. For it is indeed true that we were in the end perhaps 80% satisfied with what we did. And it is also true that today's General Contractor method – System-B – does not produce a good result. How should we resolve this apparent paradox?

There are several considerations. First, we must remember that during the civil works phase, the crucial period when the land was formed, the lake was dug, and the building sites were established on the ground, we were fully in charge and responsible. At that time system-A was being followed completely.

Second, we also have to remember that the construction was done with two contracts, that is the General Contractor contract and the second contract called Memorandum of Agreement. It was this Memorandum A which gave us considerable power over the construction. In fact, we had what one could call a mixed contract, largely General Contractor, but partially Direct Management. Thus we were able to do a large amount of daily on-site checking, 6–7 days a week, we were able to do large amounts of modifications and fine-adjustments, we were able to build hundreds of mock-ups, improving the design and providing new designs for many parts at the medium and the small level of construction. And within limits, and under our pressure, Fujita was responsive to our requests. Thus the buildings and the landscape are not the same as they would have been, if they had simply been built from the drawings. This was done under a mixed situation, neither completely B nor completely A. From our point of view it was not done enough under A, and from the point of view of B the construction proceeded in an 'unusual' fashion, with the constant change and dynamic evolution of the buildings and the landscape during construction. It is the injection of system-A into system-B in the form of a mixed contract situation which contributed greatly to make the project successful.

Third, in the design process, we did a great deal of our work with hundreds of large-scale models. These models replicated the real situation very strongly. And we were very much guided by the examination and adaptation of these models. During the construction and modification of the models, we were doing the very same thing that we normally do on a construction site. We were looking for those aspects of geometrical organization, which become clear in three dimensional reality, but which are as yet invisible in plans and drawings. Since we had a chance to work through all the various aspects of organization, exterior space, interior space, ornament, and shape, piecemeal, during the model building process, we did manage, to some degree, to make the buildings whole, before construction.

Fourth, and perhaps most important, the aspects of the project which became most successful were precisely those which we could work out in this way, during the site work and the model building: the layout and volume of the buildings, and the organization of outdoor space.

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