



# **A Path through Space**

This doctoral dissertation began with a wish to understand the way designers and architects use space in the creative process – how that space was constructed or given, and how it influenced the design product.

As such, it is the culmination of several years of wonder, investigation, education and research into the active use of space, first at the Aarhus School of Architecture and Southern California Institute of Architecture in Los Angeles, later through my own architectural practice and research of the North American suburb.

In the course of this dissertation, I will argue that there is a difference between the space of the design process and the final architectural space, which we can occupy with our bodies and use every day. That the one is not just a mere reflection of the other, but rather that the space of the design process indeed does have constraints and opportunities that to a large extent are undiscovered, unformulated and even ignored. From that context, I will seek to understand the way designers and architects work. I will try to formulate and conceptualize what I call ‘embedded spaces’.

The dissertation consists of four parts, which each have a distinct function formulated in text, prototypes, experiments and visualizations. The first part, Unfolding, is a description and discussion of the way we understand and form our concepts of space. The second part, Investigation, has the character of descriptive design theory; in other words, it is a detailed account of how selected architects and designers have used space as a design tool. The third part, Construction, has the character of prescriptive design methodology; in other words, it is an account of the potential use of space in the design process and a suggestion of ways to do so. The fourth and last part, Conclusion, will distill the issues and discussions that have been raised throughout the dissertation and conclude directions for further research.

## **THESIS**

The thesis of this dissertation can in short form be defined as: *The ability to integrate a multitude of parameters and properties in a design product is closely dependent on the structure and concept of the space in which a design process takes place.*

I think it would be quite appropriate to pose a few initial questions to this thesis and to discuss which parts of the thesis that is most relevant for the argument.

First, what does it mean to integrate *parameters* and *properties* in a design product? Which parameters, which properties and which design products does this include, and what does it mean to integrate in this fashion?

The entire dissertation presumes that a design process, at least to some extent, can be formulated as a set of parameters that has been qualified by certain rules and procedures through the construction of a design space. These parameters may be dimensions, functional demands, economic and political constraints, characteristics of the media used, or the results of an analysis or mapping, which all are realized as properties in the final product. The design product may be very broad both in scale and in media. It may be as small as the fork we use every day. It may be as large and complex as a building or a city, or it may be immaterial as a design strategy or a computer application. The concept of integration is derived from integrated design, hence the larger context and research effort, that this dissertation is a small part of, at the Danish Center for Integrated Design.<sup>1</sup>

Second, what is the *dependency* between the integration and the space in which that integration takes place? Is the dependency tight and causal or does space offer the flexibility and dynamics that is usually associated with a design process?

Third, what is the *space* in which the design process takes place? Is it abstract, real or just a shared terminology?

The intention with embedded spaces is to describe the position of a design space that is both virtual and real, both embedded in the final product and the space in which the designer is embedded. Therefore the research problem<sup>2</sup> is at the same time very broad in its investigative nature – crossing widespread issues both in time and space – but also very specific in its subject matter; the use of space as a tool for integrated design. In other words, it is a complex terrain seen through a single lens.<sup>3</sup>

The dissertation is composed by experiments, constructions and texts, to which it should be noted that the knowledge produced in the experiments and constructions, is just as important to the argument as the knowledge produced through pure textual discourse. This is not just a deliberate attempt to keep the dissertation pragmatic, but also an attempt to define what a scientific production of knowledge in architecture may be.<sup>4</sup> Therefore, the experiments and constructions are neither background nor foreground, neither just illustrations to text nor what is being described. Experiments, constructions and texts are all essential parts to the path through this dissertation.

## **PREMISE**

The project presumes the following: a) the different areas and aspects that together make up architecture and design can be examined as discrete parts, specific issues and problems, or as dynamic and changeable interactions between such discrete parts, and b) the act of designing can be examined as a cognitive process that follows a specific methodological pattern, scope of thinking or individual conceptualization that may describe the design activity and bring clarity to the way architects and designers work. In general, these are the presumptions of design theory and the basis for design education and design research.

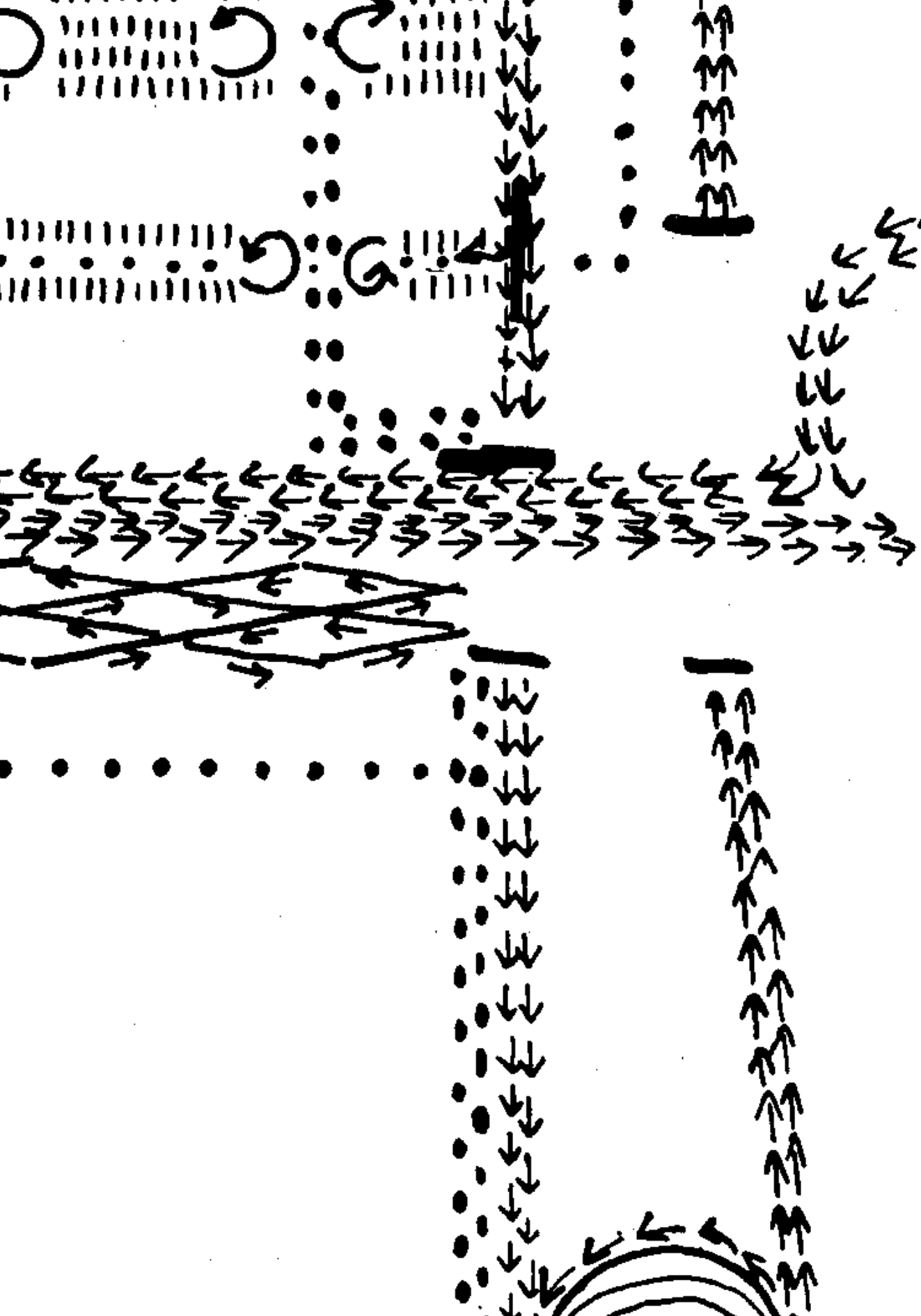
The dissertation further acknowledges that it is based on reductions of the real world and that there always will be aspects of cognition, perception, interaction and aesthetics, which cannot be formulated in their entirety, but which still are essential to the design process. It acknowledges that the design process is a recursive process that begins in our very fundamental experience of space, which is reduced as parameters of the real to be embedded in the design space and end up as the realization of properties in the real world – from the real, through abstraction, to the real. The topic of the dissertation is the mental structures of the process that connects the real with the real. Therefore, I will take the liberty to ignore and even exclude aspects that may be relevant and interesting in another context, but which have no relevance to the thesis of this dissertation. Some aspects may be included, if they have a particular relevance for a specific discussion. This could be the perception and experience of the finally produced architectural space, which is irrelevant for the discussion of the space of the design process, unless it is that exact relation between the two spaces that is being scrutinized.

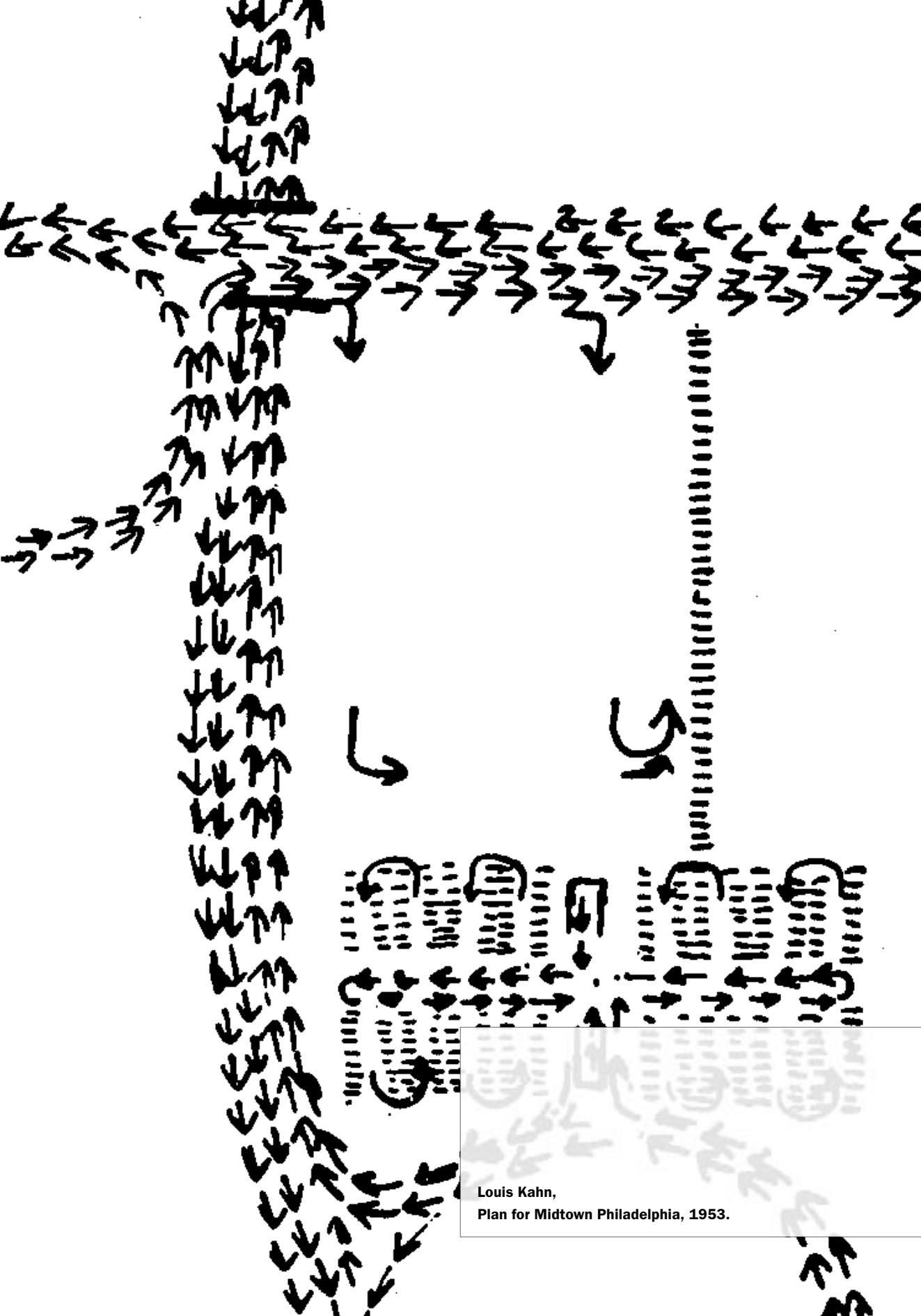
The time frame of the dissertation is defined as the 20<sup>th</sup> century, beginning with Frank Lloyd Wright's Unity Temple in 1903, continuing with R. M. Schindler's Space Architecture in 1912, the urban critique of Robert Venturi and many others in the late 1960s and 1970s, and ending with the development of an electronic digital space in the 1980s and most recent projects regarding current media and synthetic realities.

I presume that the reader is familiar with basic concepts of space, architecture in general in the 20<sup>th</sup> century and with the use of current media and major design applications.

## **COMPONENTS**

I will use five components or building blocks to construct the knowledge needed to evaluate the thesis as described above. All these components will be described in the part *Unfolding* but can also be found throughout the dissertation. They are:





Louis Kahn,  
Plan for Midtown Philadelphia, 1953.

1) *Space as a phenomenological experience*, as the subject/object relationship between the individual and the space of the world that surrounds us.

2) *Space as a cultural construction*, activated and mirrored by other scientific and artistic areas. This component will especially be present in the part Unfolding.

3) *Descriptive design theory*, which is used to investigate how selected architects have used space as a design tool. This component is primarily grounded in a broad use of design theory but also in the history of art and architecture. Since the focus of the dissertation is specific on the use of space in the design process, this descriptive component has that same focus. This means that even though descriptive design theory makes a wide range of accounts of how design processes work, it is only applied to the use of space.

4) *Normative design methodology*,<sup>5</sup> which is used to construct three conceptual frameworks for methods of embedded spaces: media, structure and model. This component is also present in the part Investigation as a test of how space *could* be used and in the part Construction as a suggestion of how space *should* be used.

5) *Synthetic spaces generated by digital media* and the influence that such technologies have on the development of concepts of space and space itself. This component has especially been formed in recent years through the intense use of virtual design tools and is present in this dissertation through experiments done at CAVI (Center for Advanced Visualization and Interaction, University of Aarhus) and WorkSpace (University of Aarhus).

## **A SENSE OF THE OUTCOME**

In the part Unfolding, I will describe and discuss, how we understand and conceptualize space. Concepts like 'red' and 'hard' may be easy to come to terms with, but that is not the case with space. It seems that the more we try to define and categorize space, the easier space disappears between our hands. There are always aspects of space that escape our concepts or categories. I will unfold the understanding of space from the very broad discussion of different concepts of space, then narrow it down through a discussion of space as a cultural construction, and end up with a possible definition of design space. Aspects that together will form the concept of space through which, this dissertation should be read.

In *A New View on Space*, I will argue that the way we understand space and the words we use to describe space is a function of our interaction with the world around us – that space is a phenomenon – as a subject that is faced with the possibilities and experiences of space, trying

to make sense of it all. As long as the un-lived mental space is a construction of the mind, it is derived from our own experience of spatial causality and potential, and formed by the culture we are a part of. I will argue that the way we categorize space and concepts of space is often diffuse and counter-productive. Two widely different categorizations of space will be drawn forward: the dispersed range of categories of space by the architect Franz Xaver Baier and the accumulation of all aspects of space in the concept of the aleph by the geographer Edward Soja.

In *A Culture of Space*, I will argue that these concepts and understandings are cultural constructions, which are developed in a shared environment. From Stephen Kern's detailed description of developments in space and time around the turn of the 20<sup>th</sup> century, I will conclude that the way we use space in a design process is largely based on space as a cultural construction, which again is defined in an atmosphere of a wide range of different areas in art, culture and science. Further, I will discuss Kern's argument that especially the two concepts of relativism and constituency plays a role for the use of space. The concept of relativism is developed through modern physics and non-Euclidian geometry, especially with reference to physicists and mathematicians like Albert Einstein, Max Jammer and Nicolai Lobachevski, while the concept of constituency is developed through an understanding of 'room' and 'architecture' in the early modern architecture and a postmodern critique of space, especially with reference to the architects Frank Lloyd Wright and Robert Venturi.

In *Design Space*, I will argue that the use of space in a design process may be described as a design space. We may look at design and the act of designing in two different ways: as an operational way which could resemble a one dimensional chain, where every single part of the design process has a specific place and role to play, and as a constructive way, which defines the spatial relations between the different components of the design process which may flow freely. The operational view on design is rather traditional and oriented towards an industrial production as described by John Heskett, while the constructive view on design is newer and oriented towards an information society as described by Rikard Stankiewicz. In this way, I will argue, that space not only may be used as a metaphor for the design process, but also as a structure for its management.

Overall, we may conclude from the part *Unfolding* that many of the things we think about space and the ways that we try to handle or come to terms with space as a phenomenon are through constructions; either in the hands of our own understanding and relations to the

world or in the hands of the culture we all are a part of. In describing space, we may disperse it into a wide range of categories or accumulate all its parts into one piece. However, and most important of all, we have the ability to work with and manipulate the way we handle and use space. It is not a sacred given beyond our control. It is a medium or tool through which we experience the abstract and concrete world around us, and through which we manifest our intentions back onto that same world. As such space itself and the way we think about space has a great potential as a tool in a design process.

In the part Investigation, I will conduct a descriptive design theory to show, how space has been used as a tool by architects and designers, how it has been given new and productive functions. Three areas of investigation are spread out over the period of the dissertation, which at the same time represent three developments of space – in early modern architecture, in a postmodern urban critique, and in the synthetic space of the first spatial computer applications of the late 20<sup>th</sup> century. The aim is to investigate, how architects and designers throughout the 20<sup>th</sup> century have used different understandings and concepts of space.

In the 1910s and 1920s, the architect R. M. Schindler defined a fundamental understanding of space as a medium for architecture that he called Space Architecture. From that understanding he developed two applications of space: as a manifest that would separate him from the international style and as a tool for the dimensioning and design of architecture, through what he called ‘reference frames in space’. In this way, space was to Schindler both a sign of modernity and an interface between his abstract formal ideas and the practical execution of architecture.

In the late 1960s and early 1970s, a critique was raised of the sacred position that formal space had been given in the reign of modern architecture. Architects like Robert Venturi and artists like Dan Graham, Robert Smithson, Ed Ruscha and others argued that space had a far greater influence and potential than mere formalism. Venturi argued for the symbolic and semantic content of space, which in the undefined wastelands of the American suburb was more present than spatial formalism. This urban informal space was a great attraction for artists, who used that space as a medium for contemporary expression.

From the mid 70s, computer applications began to be used in the construction synthetic spaces that were freed from – but yet in correspondence with – the real world. First as a space planning tool for area layout in buildings, but later also as a spatial model that contained a

wide range of design parameters, especially towards the practical execution of architecture and later again to the production of spatial renderings of the proposed project. This development in the use of space can be traced in the development of one of the most influential software: AutoCAD by AutoDesk.

Overall, we may conclude from the part Investigation that the design space is different from, and yet closely connected to, the produced space in the end of the design process. That space throughout the 20<sup>th</sup> century has been given a wide range of applications by using different views on space: as a manifest, a Unit System, a symbolic gesture and a synthetic model.

In the part Construction, I will conduct a prescriptive design methodology to focus on four non-exclusive issues that are central and important to the use of design spaces.

In the chapter Media, I will discuss, how the technical aspects of certain media influence the construction of synthetic spaces with an outset in the construction of the panorama (1787) as described by Bernard Comment. The issues of techniques, media and technology are often ignored in the construction of design spaces, but are in fact crucial, and it is even more so the case, when we today use advanced modeling and visualization applications. I will argue a) that spatial constructions are technical media within a cultural phenomenon, b) that these media may reach a crisis of technical abundance, and c) that the subject (user or observer) is an integrated part of this entire construction, in the way that media form the way we construct space. I will argue that when we use a medium to construct design spaces, it is based on certain techniques and technologies and that the use of techniques may reach a level of crisis where the original medium is dispersed. Further, I will argue that it is impossible to separate the observer's mediated experience of space from the medium itself. Even though the panorama is a construction from 1787, this is still true for many of the spatial constructions and constructed spaces, we use today in the design process.

In the chapter Structure, I will discuss how the structures of space influence what we construct in them. With an outset in Albert Einstein and John Rajchman, I will argue that these structures of space are often both effective and affective, both static and predefined, and dynamic and processual. This will be qualified by the genetic mathematical structures of Karl Chu and by the topological kappa-tau space curves as described by Rudy Rucker.

In the chapter Model, I will discuss that there has been a wide range of situations where space has been used as a model, but that this concept needs to be clarified. To this, I will use

the description of painting as model by Yve-Alain Bois, who introduces four categories or characters of models: the perceptive model, the technical model, the symbolic model and the strategic model. These four categories or characters can relatively easily be applied to an architectural use of space as a model, but do need to be expanded and discussed further.

I will also argue that the use of space as model is far from neutral. When we create passages between worlds apart with space, we spatialize data objects in the context of a space already created. Such a method is neither foreign to semantics and metaphors, where the initial meaning of an object of expression is truncated deliberately, nor to architecture and design, where references and paraphrases are frequent tools. However, such a method calls for an acknowledgement that medium chosen for the construction of the model and metaphor, is not a neutral entity. Just like language and writing has certain constraints to literal metaphor, so does space have certain constraints on the construction of spatial metaphors. This use of space will be investigated through metaphorical constructions, like mapping of geographic and political data onto a virtual landscape, the use of space as a shared terminology and cyberspace as a spatial representation of a hidden world.

Overall, we may conclude from the part Construction that certain themes or aspects are central to the use of space in a design process, based on my conceptual unfolding and my investigations. These themes will form the basis for my own construction of spaces, as I will suggest they be used.

In the part Conclusion, I will connect all the strings and paths, which have been laid out during the course of the dissertation, and conclude the potential of working with the proposed methods of embedded spaces. I will propose three characters of embedded spaces – a performative, a pragmatic and a rhetorical character.

## Notes

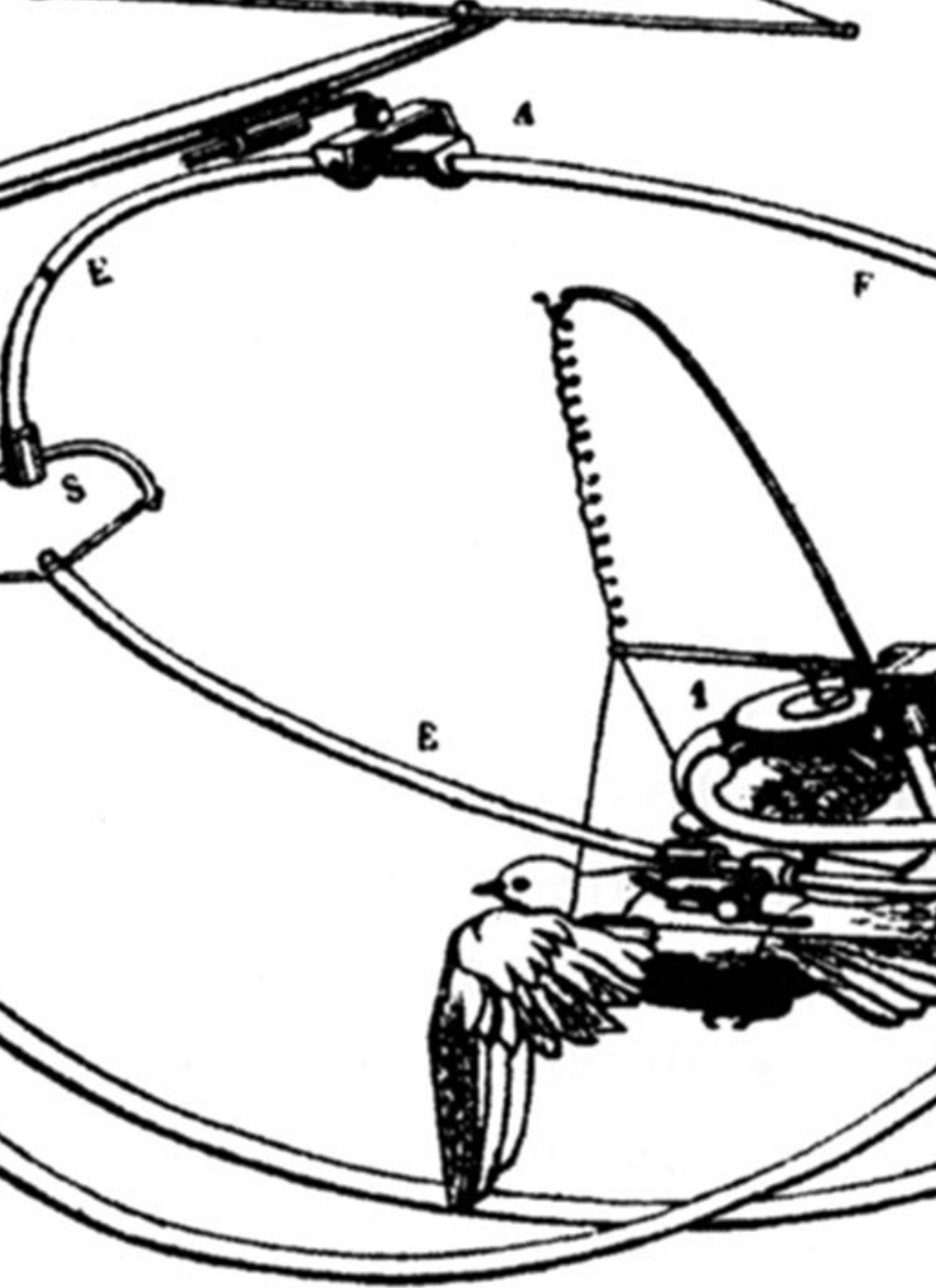
<sup>1</sup> See [www.c-i-d.dk](http://www.c-i-d.dk) for references.

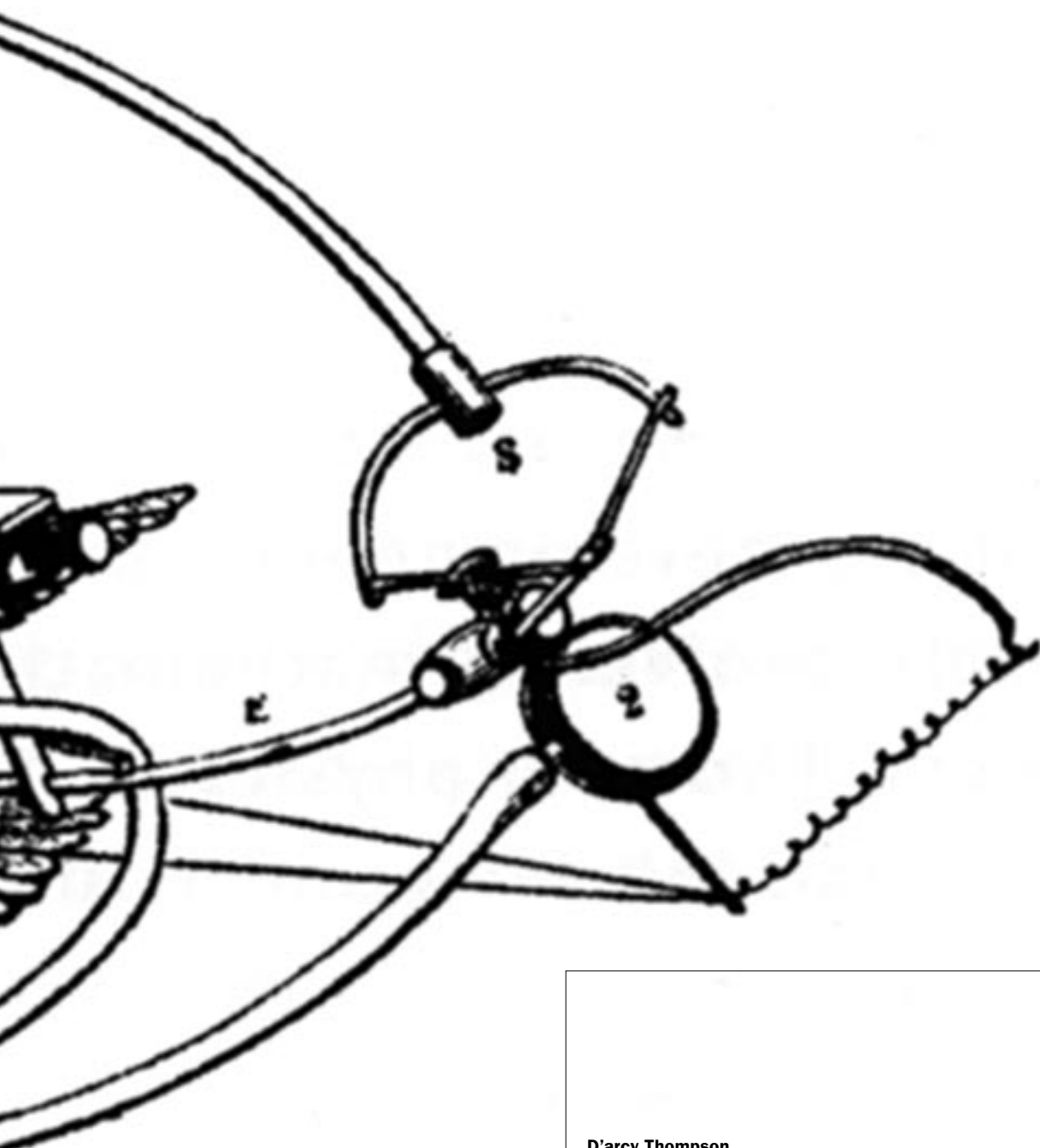
<sup>2</sup> Referring to Booth, Wayne C., Gregory G. Colomb & Joseph M. Williams (1995), *The Craft of Research*, Chicago, IL: The University of Chicago Press.

<sup>3</sup> It should be mentioned, that I do not see these spaces as having an absolute one-to-one correlation as a chain of reproduction. It is far too easy to conclude that the mental 'design space' of the architect or designer, is just a mental manifestation of the final product space – in other words that the architect constructs the final space in his mind, before he constructs it in concrete, glass and steel. The 'design space' is at the same time much more and much less than that.

<sup>4</sup> I have dedicated the entire chapter On Doing Architectural Research to this discussion.

<sup>5</sup> It should be noted that design methodology is generally seen as a part of a broader design theory. By focusing on the methodology alone, I wish to emphasize the normative element of design theory.





D'arcy Thompson,  
From *On Growth and Form*.  
First published 1917.