Media Boundaries and Conceptual Modelling Between Texts and Maps

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To Aud Eide, 1932–2015. RIP.

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Preface

The humanities are going through a period of deep change. This is partly due to developments in the society at large, but it also springs out of changes in our way of thinking and working. The linguistic turn has been succeeded by a spatial turn (Bodenhamer et al. 2010, Gregory & Hardie 2011, Tally 2013) and the digital is changing the foundations for research as well as for teaching. As humanists we should face these challenges by adapting to the new, to the digital and to the spatial, while keeping focused on traditional scholarly questions of great importance and consequence.

This book forms part of the humanities tradition by facing one of the fundamental problems since antiquity, namely, that of representation. How do different media represent reality, fiction, myth, and others parts of the human lived world? It intersects also with the digital by addressing the problem with the help of a digital humanities method: computer assisted conceptual modelling. And it acknowledges the spatial turn by investigating the boundary between what has traditionally been the two main media for representation of geospatial information: texts and maps. The topic and method will be exemplified by a study of eighteenth century border protocols from the multi-cultural area of Northern Scandinavia.

The book aims at making a contribution to the further development of digital humanities as a discipline. It will build a bridge between digital humanities and intermedia studies. This bridge will carry theoretical considerations as well as practical results. The book will strengthen the theoretical foundation for research and teaching in spatial digital humanities. Specifically it will develop further critical discussion of the practice of digital mapping, offering a theoretically based understanding of such practices from a humanities perspective. More generally it will contribute to the theoretical discussion of modelling in digital humanities.

The book introduces a new area of research, namely, *transformative digital*

intermedia studies, located at the cross section between digital humanities and intermedia studies. This will be done by introducing *critical stepwise formalisation* as a method specially suited for studying media differences. The aim is to use the computer to get beyond human meaning-seeking interpretations of media expressions. The book establishes a method for studying media differences, using texts and maps as a worked through case study. It is meant as a starting point rather than an endpoint. My hope is that it will be used to understand how modelling is related to media differences, how texts and maps are related in complex ways, and how they can best work together.

The book is a result of a long research process, starting in 2005 with a chat with my PhD supervisor Willard McCarty. The story up until the finalisation of the PhD thesis is described in Eide (2012*a*) and will not be repeated here. This book is based on the PhD, but it is reworked in a number of ways. Bits and pieces of the argument have also been published in articles and book chapters. References are given in due course to these other publications.

I will refer to the long list of helpers published in the Eide (2012*a*) for all the people who were important in the PhD research and in the writing of the thesis. Here I will mention the ones who contributed specifically to this book. Needless to say they have no responsibility for the omissions and problems still remaining in this text. Dear Arianna Ciula, Jonas Bakkeli Eide, Lars Elleström, Willard McCarty, Tim Ingold, John Unsworth, and anonymous reviewers: thank you for your help in the final steps towards this book.

The results presented in this book has been discussed at a number of conferences, seminars, and workshops. I am grateful to all participants who have asked questions, raised concerns, and criticised my presentations.

Dear Heidi, Oda, and Jonas: thank you for being with me in this process. We may fall, but we never stop climbing.

Part I

Chapter 1

Introduction

1.1 Digital humanities

Humanists have interacted with computing machinery for more than sixty years.[1] This is not only a history of using the computer as a tool, but also of how computers have influenced our thinking. The challenges posted by algorithmic thinking have been met in different ways in the humanities over the years. Ideas from different areas of the humanities have been in active interaction with computer science, with influences going in both directions. One example of influence from the humanities to computer science is the history behind the development of XML[2] (DeRose 1999, 19–21).

The larger research strategy behind this book is to develop transformative digital intermedia studies as a means to understand better the differences between media with different modalities and with different semiotic systems. In order to focus the project on a manageable task, the book describes a study of the differences between maps and texts. The method used is critical stepwise formalisation, a type of conceptual modelling applied to geospatial information read from texts. The results from the study are put in the context of previous research and theory in order to establish a deeper understanding of general rules behind the media differences.

A turning point in the history of digital humanities was the establishment of the Text Encoding Initiative (TEI) in 1985.[3] TEI has proven highly

[1] The labels we have used to denote such interaction have changed over the years. For the history of what is now called digital humanities, see for example Hockey (2004).

[2] Extensible Markup Language. URL: http://www.w3.org/XML/ (checked 2015-04-03).

[3] The TEI Concortium has created and maintains a set of guidelines for how to best

influential, and a significant part of the work in the digital humanities has been connected to it. It also led to a development towards text encoding as the main method to formalise texts, at the expense of other solutions, such as databases (Vanhoutte 2010, 129-131). The latter has been there all along, but always playing a minor role compared to text encoding.

In order to use the computer for advanced textual work, models have to be established. This happens partly at standard level, as the creation of the TEI guidelines exemplify (Burnard 2013). It also happens at document level, either by making a local model for one specific set of documents or applying a pre-existing standard such as TEI (Eide 2015*a*). Modelling has been an important practice in digital humanities, complemented by a growing number of theoretical studies.

1.2 Modelling

Modelling is a core method in digital humanities, with close links to modelling in other disciplines including the social and natural sciences and computer science. Models as we use them are representations of something which are created for the purpose of studying what is modelled more closely (McCarty, 2005, 24).

Modelling as it is described in this book is also linked to modelling in cultural heritage. The latter has traditionally focused on database development and the development of documentation standards, but since the 1990s there has also been a development of formal ontologies, exemplified by CIDOC-CRM.[4] Modelling in cultural heritage is a distinct tradition from modelling in digital humanities, but work towards comparing and interlinking the two has been ongoing for more than a decade (Ore & Eide 2009, Ciula & Eide 2014). In this book, modelling from both traditions will be combined with an understanding of media transformations recently put forward in Elleström

encode documents. It can be used for different purposes; making printed and digital editions of texts are important examples. These guidelines are widely used in the humanities. URL: http://www.tei-c.org/ (checked 2015-04-03). For the history of TEI, see for example Burnard (2013).

[4]The International Committee for Documentation (CIDOC) of the International Council of Museums (ICOM)—Conceptual Reference Model (CIDOC 2013). CIDOC-CRM was made and is still developed by interdisciplinary teams of experts under the auspices of CIDOC. Webpage: http://www.cidoc-crm.org/ (checked 2015-02-22).

(2014). Some key aspects of modelling will be highlighted here, whereas model theory will be discussed repeatedly later in the book.[5]

A key aspect of modelling in digital humanities generally and in transformative digital intermedia studies specifically is the focus on interactivity and on studying the modelling process with the aim of learning from it. The focus is on modelling rather than on models.

This book will show how computer based modelling can be used to study media differences, which is an important part of the history of the humanities. The tradition is especially strong for comparisons between the textual and visual arts. We now have the means—technical as well as conceptual—to examine these questions in new ways, change them, and add new questions. This book focuses on the relationship between two media: the one medium with a specific relationship to space, namely maps, and the medium that traditionally dominates Western culture, namely texts. In Chapter 8 other possible comparisons will be suggested.

The importance of this specific comparison goes beyond its function as an example of general media differences. Maps have developed a special role in the humanities through the spatial turn. Understanding the theoretical implications of practical work is important in the application of computer based methods in the humanities, not the least in the area of spatial information implemented in Geographical Information Systems (GIS) and as deep maps.[6] The possibilities for integrating texts and maps and for creating map based narratives are important in the spatial humanities. They deserve both theoretical and practical studies.

This book is conceived as a theoretical study; yet, the use of computer assisted conceptual modelling and visualisation of specific works links it to practical examples of mapping. The computer application is another link to practical work; it can be seen as a tool implementing a method. The models created in the modelling exercises represent readings of the source documents; the models implement theories of the source expressions. As the method is dynamic and data driven, the tool must also be dynamic and flexible.

Computers have been used in text analysis for many years. While the last

[5]For general introductions to modelling in the digital humanities see McCarty (2005, 20–72) and Flanders & Jannidis (2015).

[6]Deep maps are 'increasingly more complex maps (using the term broadly) of the personalities, emotions, values, and poetics, the visible and invisible aspects of a place' (Bodenhamer et al. 2013). GIS and deep mapping will be discussed later in this book.

decade has seen a significant rise in the interest in macroanalysis,[7] computer assisted text analysis at micro level has not given comparable results or caused a similar level of interest. Text encoding in TEI is an established method for working with digital texts with wide applicability, not only in scholarly editing. However, certain types of analysis is hampered by the tree structures imposed by the underlying formalism of TEI.

Modelling as it is applied in transformative digital intermedia studies goes beyond text encoding by introducing critical stepwise formalisation as a text analysis method, representing features of the text as both sequential, tree based, and graph structures. Models of texts expressed in TEI encoding are useful as input to the stepwise formalisation, but such pre-existing models are approached in a critical way and are the source of re-modelling in the experiments.

1.3 Text and map

In an interview at the farm Solem in August 1742, Ole Nilsen said that 'North of there, no peasant farms are found.'[8] How can we put the knowledge expressed in this sentence on a map? First we need to know where to put the 'there' referred to and how far north 'north of there' implies. Given that we are able to decide on that, how do we express the fact that no farms are found? We could make the area north of 'there' blank. But blankness on a map does not say 'no farms', it rather says 'nothing of interest'—after all, we know there are things everywhere—stones, trees, streams. And maybe a farm or two, even if the map is blank.

How can we better understand such problems? Any text containing descriptions of an existing or fictional geography could in principle be examined in search for geographical information that is impossible to express on maps. Such problems are more likely to be found in some texts than in others, however.

In the 1740s, Major Peter Schnitler was appointed by the Danish government[9] to explore the border area between the middle and northern parts

[7] Macroanalysis is often called distant reading.

[8] 'Norden der fra, er ingen bonde gaard' (**S1**, 152). Throughout this book I will use the short form **S1** to refer to the first printed volume of Schnitler (1962), a set of border examination protocols from the 1740s.

[9] Norway was part of Denmark at the time.

of Norway and Sweden.[10] Significant parts of the text in the manuscript that he handed over to the Danish government consist of transcripts of local court sessions carried out by Schnitler in order to gather information about the local population as well as their knowledge of the border areas. The material includes information directly relevant to the border question, as well as general information about these areas. The text corresponds to similar material collected through work carried out in other parts of Europe at the time (Burke 2000, 125–132).

The text used in the case study is comprised of testimony taken from farmers and nomadic herders who likely did not use maps but described their landscape in terms of wayfinding. **S1** represents a coherent edited document which includes a multitude of quite different voices: 'Sami reindeer herders, Norwegian farmers, and military officers—thus bringing a set of different perspectives into the geographical conversation' (Eide 2012*b*). In addition, the text was available as a computer-readable TEI document, making use of it convenient at the technical level.

In order to expand on which types of differences between maps and texts I assume to exist, I will provide another introductory example, taken from Schnitler's protocols and from a map he made in the same period. In order to see how this fits together, I will first give a short description of Schnitler's method.

The text of Schnitler's protocols reflects a history of information aggregation. First, he would collect data. The court protocols were written, and older written evidence was attached. Then, based on the court protocols together with other sources of information, including his own observations, Schnitler would write aggregations describing larger areas. Based on his sources, Schnitler also drew maps of large areas to indicate where the border should be located.

On the one hand, his project was based on information from the witnesses, transcribed so as to remain truthful to each person's understanding of the situation on the ground and the manner of his explanation. On the other hand, in Schnitler's aggregations only the hard facts obtained from the witnesses survived. This process was completed with the maps. It is claimed that the truth is supported by the map as a medium (Jacob & Dahl 2006, 32). 'The map becomes a visual memory of the discourse, in which time is frozen. Although texts can also strive to be outside time, in general it

[10]For the historical context, see Eide (2012*a*, 49–87) with further references.

is maps that have a stronger tendency to lie outside it' (Eide Forthcoming 2015*b*). This process could be difficult, however.

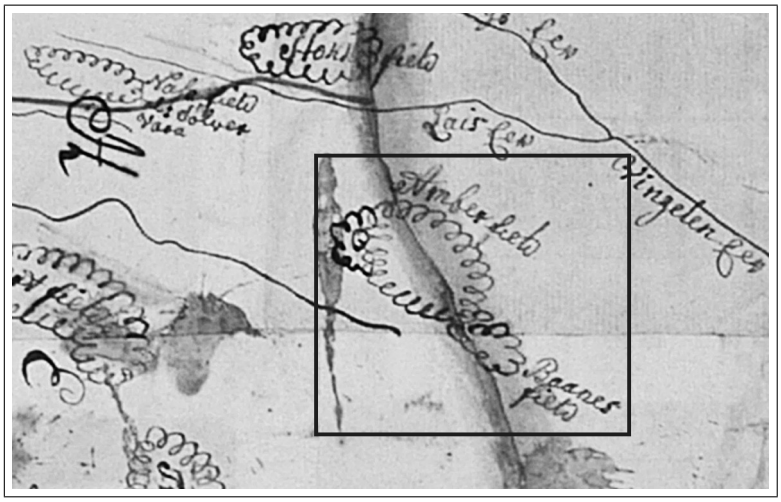

Figure 1.1: Fragment of Schnitler's map from 1744, 'National Archives of Norway, Map collection, GA 269, Peter Schnitler, kart over Nordland amt 1744.' Printed in Mordt (2008, appendix). The locations of Amberfield and Baanesfield are marked by me with a rectangle. The line crossing the two mountains is the border.

It was in Schnitler's interest to remove any inconsistencies in the witnesses' statements when he created the aggregations. The example given in Figure 1.1 shows how that could be difficult. The border is indicated by the line going north-south on the map fragment, crossing the mountains Amberfield and Baanesfield. In his aggregation, Schnitler discusses two different views held by groups of witnesses living in different parishes, in which either one or the other of the two mountains is seen as the border landmark. Schnitler says he is not in a position to choose between these two views, as he has not been able to gather the two groups of witnesses together to reconcile the matter. He argues that the most likely solution is Amberfield, with Baanesfield being a part of it, to make both groups of witnesses more or less right. Still, both mountains are included in his list of border mountains with an 'or' between (**S1**, 174).

They are both included on the map as well, but the 'or' has disappeared. The two mountains are situated close to each other on the map; the former is larger and transected by the border, and the other is smaller and crossed

at the edge by the border. Whether the differences between them in size and in location relative to the border on the map are due to Schnitler's view on the choice most likely to be correct is something I do not know.[8] But it is worth noting that, while in his written aggregation the 'or' concept was easily expressed, this concept was not something he could express with similar ease on the map.

How can we systematise problems such as the two exemplified above? Is the information a map can convey different from the information a text can convey? Are maps more truthful than texts? Are maps outside time? These are among the questions to be discussed in this book.

1.4 The book

This book is divided into eight chapters. In Chapter 2, maps, texts, and their relationships to landscapes will be introduced. In Chapter 3 I will present critical stepwise formalisation as a type of modelling through an example of how it can be applied to texts and maps. In Chapter 4 the modelling experiments will be presented, before Chapter 5 summarises the key findings into a typology.

Part III will generalise what was shown in the case study and offer a critical discussion of not only the relationship between texts and maps but also of intermediality more generally and of modelling in digital humanities and beyond. Chapter 6 will focus on what the broader area of art and media comparisons can say about the differences between texts and maps. Chapter 7 will investigate how this may influence the work of computer based digital mapping, but also how digital techniques can be used to partly overcome some of the limitations pointed out in the previous chapters. Chapter 8 will draw some conclusions for modelling in digital humanities as well as beyond and suggest some areas of further research.

The book as a whole goes beyond studies of maps and texts to introduce transformative digital intermedia studies through an example of critical stepwise formalisation. It presents empirical evidence as well as theoretical considerations. Along the way, the relationship between texts and maps is studied. Differences are established, and ways in which maps and texts can

[8] According to our best knowledge today, Baanesfield and Amberfield were either two names for the same mountain, or the mountain denoted by the former was a part of the one denoted by the latter.

complement each other and work together in geocommunication systems are highlighted.

Chapter 2

Texts, maps, and the landscape

People move in space, and we live our lives in time. In the time-scale of a human life, our surroundings are changing at different speeds, from the unmoving rocks through the slow shift of the course of a river, the growth of a tree and the slow walk of an elephant, to the frenetic sniffing of a mouse. Moving through a landscape, finding one's way, can involve all these different rhythms of change, but when we tell others how to traverse the same ground, or record our experience with the intention of communicating the journey somehow, they figure in our account quite differently.

My main area of research is expressions of the traversed environment in documentary form, as texts and maps. But in order to understand the expressions, we also need to understand their themes—that is, how humans and other animals find their way and their subsistence in the environment. Writing and drawing about wayfinding should not be seen as isolated from finding the way; they are not the same, but they are still connected. If the spatial is tamed into representations (Massey 2005, 20) it is important also to take the untamed space and time into consideration.

The differences between a story and a painting may be clearer than the differences between a description of a landscape and a map of the same landscape. However, this book will establish how these two sets of differences are similar in important ways. Both images and words can be used to bring embodied thinking about wayfinding and the landscape into the world of communication, but once either words or images are chosen, certain parts of the reality becomes easier to convey and other parts more difficult. People will overcome such difficulties, for instance by combining different ways of expressing themselves, but the differences between what can be conveyed

through words and what can be conveyed through images are still there.

In this chapter the stage will be set through a study of maps and texts. Wayfinding will be compared to navigation in order to clarify the practices behind the documents. Navigation is assisted by a map and is done from location to location in space, whereas wayfinding is something we do without a map, when we find our way from place to place in a region.[1] There are two foci in this chapter: what a map and a text is, on the one hand, and what it means to find the way, on the other.

Later in the book, modelling experiments will be described. The source texts used in these experiments are border protocols from eighteenth century Scandinavia. That makes it natural to use example material from the same historical period in this chapter: both foci mentioned above are outlined as they are seen from a Northern Scandinavian historical perspective. While no two historical periods are identical, I will still argue that there are important aspects that transcend the local in this material. This point will be explained in more depth later in the book.

In this book as a whole, the understanding of humans as it has developed through the millennia of thinking leading up to and including what we now call 'the humanities' is the scholarly centre. There are, however, other perspectives on human thinking and communication. One is based on the study of humans as part of the larger group of animals inhabiting our world. I will include some recent research in the areas of psychology, anthropology, and neuroscience in the study of how humans move in the world. This includes how movement is steered by the brain in interaction with the rest of the body and with the environment. This discussion will question fundamental concepts. Is it really the case that 'space' and 'time' define the living conditions of animals? Should one use expressions such as 'environment' and 'events' instead? Is there something in our minds that can be called a 'cognitive map'?

This is connected to how we relate to the world we live in. Do we have representations of the environment in our minds? We know things about the world, and somehow this knowledge is held by our brains. Is it structured in a way that makes 'representation' the correct term? I doubt it. But it is beyond the scope of this book to give a well-founded answer to the question. I will use the expression 'representation' to describe what is in the brain because it is common in the literature. Its use may be metaphorical, but it

[1] This opposition, taken from Ingold (2000), will be explained later in the chapter.

is so widespread that I will not avoid it.

I find it hard to make a clear distinction between me as a creature thinking about space, navigating through space and representing space, on the one hand, and me as a researcher, on the other. I will not pretend not to have knowledge from far back in my life, from long before I embarked on a scholarly career. We all have such knowledge, and it is usual to do research in areas we know about from outside academia. It would be ridiculous to ask a botanist to lay aside all childhood knowledge of nature. But it is important to be open about where ideas come from, as far as possible. It is about showing my evidence, or my lack of evidence. It is about truthfulness based on the scholarly criteria of my time.[2] In many types of human endeavour, we strive towards truth. I believe it to be true that Schnitler mostly tried to find and express the truth about the border issues, and I am trying to say true things about his work as well as about the relationships between texts and maps. However, truthfulness means different things to me from what it meant to Schnitler.[3]

The quality of this work is based on my ability to understand and interpret my object of research. I study it to understand it better, and I express my understanding in the present text. The researcher cannot escape being an active participant. In studies of cultural expressions, the gaze not only has a target; it also has a source. Someone is watching. In this case, 'someone' is me. My writing is a local process, as all science is performed locally, even though the aim will always also be to escape the local (Schaffer 2010, 277–8).

This physical locale happens to be a hotel room in San Francisco. The rewriting may happen in London, Oslo, or even at camp close to where Schnitler started his journey. I will walk his landscape. I have walked the landscape of the descendants of some of the Sami and Norwegian witnesses. I have walked there with some of them. But I can never walk in the shoes of Schnitler or the witnesses. Schnitler had to cope with significant cultural

[2]This understanding is in line with the critique of the so-called orthodoxy of science in Ingold (2010). I see myself as an inevitable part of the setup of the experiments to be described in Chapter 4; they are performed according to a certain perspective. This does not mean that they are not rigorous, but it means that the researcher, as the wayfinder, is an active participant rather than an outside observer—being there is central.

[3]The relationship between truth and truthfulness is an important issue, but it will not be discussed in this book. I merely note that people strive towards truth, that they base themselves on different standards of truthfulness, and that the concept of 'truth' is disputed. For a thorough analysis, see Williams (2002).

and linguistic barriers, and so did the witnesses. The distance is not only between now and then, between us and them. It is also between them, then. When Schnitler and some of the witnesses held their discussions through an interpreter they clearly had to make an effort in order to understand each other; communication was also difficult, although to a lesser degree, when he talked to Norwegian farmers.

The importance of the dialogue is to be found at several different levels. Schnitler talked to the witnesses. At this level the form of significant parts of his protocols is court transcripts, documenting a type of dialogue. At a more abstract level, the dialogue is a way to understand how we can work with historical sources in general. Dialogues are also important in order to understand what is going on between a person and the natural environment in which he or she finds him- or herself. They are also necessary for understanding the relationship between me as an interpreter and the text I am interpreting. Bakhtin (1981*a*)[4] saw literary texts as dialogical, in a way that seems to fit the later concept of intertextuality.[5] Whatever the dialogical aspects of writing are in general, it is clearly the case that Schnitler was involved in dialogues when he wrote significant parts of his text. A dialogue with a physical other helps in forming our thoughts; we often learn what we know by saying it out loud, much as we learn a landscape by walking it.

The potential for meaning in a dialogue is rich. It includes encyclopaedic knowledge, but not only that: the environment is also a provider, a participant (or perhaps a set of participants) in the dialogue. Linell uses Gibson's term 'affordance' for what the environment offers, for relations of possibility between animals and their environments.[6] 'People configure meanings and understandings from arrays of affordances' (Linell 2009, 332). Linell sees affordances as similar to meaning potentials, but he uses 'affordances' for potentialities in concrete utterances, and 'meaning potentials' for the semantic potentialities of linguistic resources. If a witness describing the landscape

[4]I read an English translation of Bakhtin, so the original Russian citations are not included. The original article was published in 1975, but written around 1934–35.

[5]I will not discuss dialogism in written texts here. See Tønnesson (2004) for such a discussion in the light of Scandinavian history texts.

[6]Gibson coined the word 'affordance' based on the verb 'to afford', implying complementarity of the animal and the environment. Affordances are relative to an animal; what is a type of affordance to one animal is not the same type, or even no affordance at all, to another (Gibson 1986, 127–8). The surface of a lake affords support to a flea, but not to a dog. In fewer words: Affordances are value-rich ecological objects which can benefit or injury someone (Gibson 1986, 140).

can see a mountain he or she mentions from where he or she is speaking, he or she can use gestures and words to include this mountain. It is then an affordance in the dialogue.

The landscape we find our ways through can thus be seen as a part of the dialogues, together with stories told and remembered and memories of past travels. This is in line with Gibson's concept of the 'region', later taken up by Ingold. Gibson does not define the concept, but it is clear that an important difference between 'region' and 'space' is that the latter is a geometrical object, an abstraction, whereas the former has a meaning to someone.[7] A moving observer sees the world from no fixed point of observation and cannot, strictly speaking, notice the perspective of things. Through extended movement he or she can develop a perception of a part of the environment from everywhere at once (Gibson 1986, 197). This 'everywhere at once' is a region, according to Ingold (2000, 227). This will be revisited below, after sections on maps and texts.

2.1 Places and maps

In this section, a definition of maps will be given, followed by a short introduction to the history of cartography and some notes on map poetics. The historical view will see maps as particular documents in line with other meaningful representations of space in human culture; thus, it provides another take on the issue from that given by a definition. A fundamental distinction throughout the book will be between the map as a document, on the one hand, and on the other, the functions of maps—that is, maps used in processes and events.

In actual language use, the possible senses of the word 'map' vary widely; it can denote anything from documents through ideas to structures in the brain. The uses include a number of metaphorical senses, but whether a sense is metaphorical or not, or to what degree it is metaphorical, is not always clear. I had to clarify the meaning of the word 'map' to be used in the experimental as well as in the theoretical comparisons between texts and maps. The reason for this is the way critical stepwise formalisation works. The text used as source is a specific media product and strictly speaking we do not need to define what a text is in order to use it, as long as it is clear that it is a text. The target, on the other hand, was only defined by the

[7] This concept of space is different from the encultured space discussed in Massey (2005).

qualified medium 'map' when the modelling started.[8] Thus, it was necessary to establish a precise meaning of 'map'.

The definition offered in this section is prescriptive rather than descriptive. Although it is connected to actual use of the word and is based on previous definitions, it is not intended to include all senses of the word that are actually used, not even all common senses. Throughout this book, I will use the following definition of 'map':

> A map is a document on a flat, curved or $2\frac{1}{2}$ dimensional surface[9] showing the distribution of physical, geographical and other features, with each point in the representation corresponding to an actual geographical position according to a system. The map includes texts to disambiguate the whole map as well as parts of it. The features represented on the map have a certain permanence, and they are represented independent of any particular point of view.

The definition is based on definitions made by central authorities in cartography and lexicography such as Bagrow (1951, 13), ICA (2003), and OED (2012*a*, I. 1. a.). But the recent history of map definitions has added some complexity. Harley & Woodward (1987) argue that the traditional definitions, specifically Bagrow's, are no longer adequate, because in recent years a broader outlook has emerged. They see maps as 'mediators between an inner mental world and an outer physical world' (Harley & Woodward 1987, 1), and thus, maps represent one of the oldest forms of human communication, existing long before physical map documents. All in all, this leads to a view that most societies used maps. 'Mapping—like painting—precedes both written language and systems involving number, ... there have been relatively few mapless societies' (Harley & Woodward 1987, 1). This wide definition of maps is shared by Jacob & Dahl (2006, xiii) as well, and it is comparable to the traditional use of 'mappa mundi'.

[8] Specific *media products* are single expressions, whereas *qualified media* are 'media categories – artistic and nonartistic – that are historically and communicatively situated' (Elleström 2014, 19).

[9] '$2\frac{1}{2}$ dimensions' is a cartographic concept for a map in which the height is expressed as real height. The map can for example be an object made of polystyrene. It is not fully 3 dimensional because there is only one Z value possible for each X, Y pair; caves cannot be visualised. Terrain contours visualised on computer screens are also called $2\frac{1}{2}$ dimensional even if they are expressed on a flat screen, as they visualise $2\frac{1}{2}$ dimensional data.

One of the arguments for expanding the definition was to avoid a Western bias (Woodward & Lewis 1998, 7–9). Although I accept the problem, I do not agree that expanding the definition of 'map' solves it; such an expansion is neither necessary nor sufficient. In order to fight against Western bias one has to accept the cultural expressions related to understanding, navigating, and discussing the outer world as truly different in different cultures.

Of course, when one is writing a history of cartography, the expressions used will have to be translated into categories in the language used in the text. But I cannot see how using such a wide and unclear concept as 'map' as the cited authors define it is helpful. The claim made by using this common word is, quite simplified, that the systems used by modern orienteering runners, Sami reindeer herders in the eighteenth century and pre-Columbian Aztec administrations were fundamentally the same. This is in line with the claim for an existing general map schema across the world.[10] I think both claims are wrong.

I understand the intention of using the word 'map' in comparisons between different systems around the world. It is also clear that popular use of the word includes such extended meanings; few people would call 'cognitive map' an oxymoron. A descriptive definition must include such senses. But in my research I need a word denoting map documents. The word we have to denote such documents is actually 'map', so that is what I will use.[11]

What Woodward & Lewis (1998, 4–5) call 'performance cartography' is not a map according to this definition. It is rather an example of 'geocommunication', which will be discussed in more depth below. A prototypical example of maps as they are defined here is the topographical map, a large-scale map with contour lines that represent elevation. Maps have no single point from which the whole mapped landscape is seen; they have no single perspective. The landscape is seen from 'everywhere and nowhere'—each point of the map is seen from the same angle, as opposed to pictures where the whole depicted area is seen from one single viewpoint.

The 'everywhere and nowhere' perspective is quite close to how topographical maps are actually made based on aerial photography. In such a map production process, each point on the map is seen from two different places above the surface, at slightly varying angles. These are the airplane's

[10]The claim is put forward by MacEachren (2004, 198–205).

[11]This is only a part of the reason I have for using this definition. Section 2.3 below is to a certain extent a continuation of the argument for it. The discussion will be taken up again several times later in the book.

locations in the air when each of the photographs making up the stereoscopic image on which the map is based was taken. World maps as we know them could not have been made without this 'everywhere and nowhere' perspective. If a sphere is depicted using linear perspective, half of it will not be in the picture.

Another fundamental characteristic of maps is that they do not depict moving things such as individual persons and cars. 'Pictures are artificial displays of information frozen in time' (Gibson 1986, 71), and this includes maps. This is so obvious it is usually left unsaid,[12] except in discussions with children, and it can be used for cartographical jokes. An experienced creator of orienteering maps once made a map for a 'fun run' where a tractor was included. Although it was a tractor that would obviously never move again on its own, and it may have been more permanent than some of the other mapped features, such as paths, it was still immediately recognised as a joke. A symbol in the map legend with the word 'tractor' next to it was clearly an anomaly.

I will use the definition above throughout the book. In the cases where I refer to discussions which are based on other map definitions, I will make it clear which definition is being used. However, a definition is not enough to understand what maps are: we also need to look into how they are produced and used. Here I will outline some aspects of the history of cartography followed by a few words on map poetics. I have a double purpose in doing this. First, I will say more about what kinds of documents maps are through clarifying their historical and contemporary production and use; and second, I will provide background for the issue of human wayfinding to be presented later in this chapter.[13]

There is a long tradition in Western societies of studying the history of cartography, often in connection with map collections. Traditionally, maps

[12] A related point is sometime made, that the price of producing paper based maps push the features mapped towards the ones which will be stable for a long time in order to slow down the need for new editions (Goodchild 2008, 180). This is partly solvable using dynamic maps, which are computer based maps where the map image can change, often connected to user interaction. This solution is only partial, though: large scale maps of high quality are based on surveys, and surveying is expensive. So it may still be necessary to emphasise stable features.

[13] Even if I disagree with the definition of 'map' used in Harley et al. (1987), I am impressed by the quality and breadth of the work, and the discussion to follow is deeply indebted to it. It is a pity that the volume covering European eighteenth century cartography was not published in time to be used in this book.

have been seen as a product only of the advanced text-producing cultures of Europe and Asia. In Bagrow (1951), the chapter 'Maps of primitive peoples' ('Die Naturvölker') is given only four pages out of the volume's total of 312 pages. Bagrow's approach makes sense when we consider his idea of maps, which is in line with mine, as well as the sources known at his time.

One of the main problems in tracing the history of cartography is the close relationship between maps and other graphical forms in many cultures. How can we define some of the graphical art as maps if there is no concept similar to the modern map in the culture, and no systematic differentiation between maps and other documents is expressed?

In cultures where a distinct cartographical art started to develop some 3,000 years ago this is simpler.[14] But in order to talk about traditional mapping in the Arctic, as in pre-European North America and other places, the definition of 'map' is expanded, as we saw above. Harley & Woodward (1987) discuss differences between cultures in regard to the use of maps in prehistory, emphasising that the use or non-use of maps results from choices made by the people of the culture in question, and we can never fully follow the reasoning behind such choices. 'Not all prehistoric and indigenous peoples choose to be interested in graphic forms of expression or communication' (Harley & Woodward 1987, 48).[15]

In order to avoid confusion, one must differentiate between the wayfinding skills of many indigenous peoples, which are well documented, and the practice of making maps; in Ingold's words: the difference between mapping and mapmaking, as will be seen below. Very different wayfinding means have been used by different peoples. Also the language expressions used for landscapes and for finding the way through them are very diverse, as documented by Levinson (2003).

We should not overemphasise navigation as the purpose of maps. Each society must be understood on its own terms, and other motives, such as ritual or cosmological, may be more important than practical navigational needs. It may be that, for early peoples, mapping of topographical information had less to do with navigation than with a need to lessen fear by representing the feared; that visual and intellectual mastery led to symbolic mastery (Jacob & Dahl 2006, 132–3).

[14] Even for these specific cultures the claim of a pre-modern cartographical tradition is disputed. For an alternative version, see Wood et al. (2010, 20–7).

[15] In this context, they clearly use 'map' to refer to documents, not to mental representations.

To the extent maps are used for navigation, the physical environment is important for the mapping stimulus. Harley & Woodward emphasise how the Marshal islanders and Inuit use maps for navigation,[16] as they travel through extensive areas of undifferentiated terrain, whether ocean or coastal tundra. For other peoples, this would be different. 'Land-based tribes, at least those not living in the deserts, need no such artifices and have not normally produced them for their own use' (Harley & Woodward 1987, 48). This fits well with the historical environment of the Sami as well as that of Norwegian and Swedish farmers. For the Sami, artefacts that may be called 'maps' in the context of cartographic historiography were not only (probably not at all) something they carried with them in order to find the way; they served entirely different purposes. This again begs the question why they should be included in our category 'map'.

We know that many first nations used things that we would today be inclined to call maps. The Sami made drums with cartographic aspects. Several extant Sami drums from early modern times can be seen as bearing map-like features; that is, they have landscape images referring to specific features in the real landscape (Keski-Säntti et al. 2003). But as a tool for navigating the terrain of Northern Scandinavia they would be even less helpful than a mappa mundi would be for finding the way from London to Paris; they may give a few clues, but if you do not know the way, you had better ask someone or use other aids in addition to the 'map'.

I know of no extant navigational maps from before our period of interest, the 1740s, that were made by a Sami for use by Sami people. Hypothetically, they could have made map sketches in the snow, but we do not know. It is likely that their wayfinding was not map-based, and their geographical storytelling used map-like physical artefacts very little, if at all. They would communicate about space and wayfinding using words, including names, and maybe connected to tone patterns in joiks[17] as well as to gestures, in addition to the geographical communication and teaching inherent in travelling together.

Maybe it is as simple as this: while the states made graphical representations of their physical territory, the Sami made graphical representations

[16]It is not totally clear if they mean maps as physical artefacts and, if they do, how widely physical maps were actually used. For other views, see for instance Di Piazza & Pearthree (2007) on traditional Polynesian wayfinding and Collignon (2006) on Inuit.

[17]The joik, a traditional Sami form of song or chant, can be used to refer to a person or place (Tirén 1942, Graff 2004).

of their spiritual territory. The centralised state needed to separate its territory from that of other states, whereas a Sami community may have needed less spatial and more spiritual integration and separation. Even if individuals or a group know how to represent space in diagrammatic form, they may still not see the usefulness of such a technique for making navigational maps. They use it when they need it, and in our case that seems to be for spiritual purposes. If the need should arise for making navigational maps—for instance, for travel beyond their own territory or to communicate across cultures—they may very well have been able to do so. But seemingly this rarely if ever happened.

The major difference between colonisers and colonised was probably not the ability to make maps, but the motivation to do so. It is not necessary to keep a physical copy of a map you can redraw from memory. But in order to store information from multiple situations and sources, in order to make translations from local, indigenous information to a universal world map, the qualified medium of physical maps is very useful (Jacob & Dahl 2006, 37–8). The ritual and political reasons behind Western mapping are also central; maps were not only about navigation for eighteenth-century political leaders in Europe either. Maybe they were not even primarily meant for navigation. Wood et al. (2010, 30) claim that the main reason for the 'map explosion' around the year 1500 CE is the need of early modern states for various types of control. Maps were used as tools for establishing authority through geographical inclusion and exclusion.

This view is supported by the role maps grew into in these societies. Maps are significant for modern Western thinking. Their role as visual memories of discourses makes their conclusions visible, and thus credible (Monmonier 1996). A map makes reality objective, and thereby identical for everyone. By turning reality into an object, it shows ontological power (Jacob & Dahl 2006, 30). Maps are part of power games; finding one's place on a map gives a right to occupy the lands. They can be used by the powerful to demonstrate and extend their power, but also by the marginalised to fight for their rights (Tobias 2009).[18]

According to Brodersen (2003, 10), our worldview (*Raumerfassung*) as modern Western people is based on the 'objective' atlases we used in school. So it is difficult for us to know what kind of worldview people living under other conditions may have had. Our knowledge is not just shaped by using

[18]See also Massey (2005, 109–11) on critical mapping.

maps; based on findings about neuroplasticity in recent neuroscience, could it be that the physical brain is affected by growing up in a map-based society?[19] This may also be a reason why maps work so well for us. Scaled maps are so common to us that we do not understand how people can do without them. But maps of this type are very abstract. People in other cultures may have very different ideas, not map based but still functional (Brodersen 2003, 44).

But what is this thing we know so well? What are maps to us? The last decades has seen a growing theoretical discussion of how maps work, and map poetics, the study of how to make good maps, is now a well established field of research.[20] It is based on the fundamental understanding of a map as primarily an image; an image, however, of a special kind.[21]

When we look at a map, we see symbols spread out on the space of a document, on paper or on a computer screen. In seeing the document as a geographical map, we expect the symbols to be associated with objects in an external space represented by the map. For topographical maps, the external objects will be in an existing terrain. Even though the main function of most maps as they present themselves to the viewer is referential, other criteria are also used to select what is put on the map and where it is placed, including legibility and aesthetics.

Maps are made up of signs. However, map signification operates at two different levels, intrasignification and extrasignification. Each symbol on the map is a sign, but the map as a whole also works as a sign. While the intrasignificant codes are exploited by maps, the extrasignificant codes are the codes by virtue of which maps are exploited (Wood & Fels 1986).

At the level of intrasignification, maps operate as bridges between types and particulars. Each symbol on the map asserts an equivalence between a conceptual type and a location on the map. Because this can be read by a map user as the statement 'This is located there,' it also connects to one particular thing. But not only a particular; as an instance of a type, the

[19]The traditional view of a brain structure relatively immutable after early childhood is gradually being countered by findings revealing many examples of brain plasticity well into adulthood. One study showing changes in the brain spurred by thorough training in navigation in adults is Woollett & Maguire (2011). This research is not yet conclusive, but we may speculate that the brain also changes when map based navigation replaces non-map based wayfinding.

[20]The label *map poetics*, however, is not in common use, but I find it natural to denote the thinking around making useful and pleasant maps thus.

[21]This begs the question what an image is. It is beyond the scope of this book to answer that question in any detail; for a thorough discussion, see Elkins (1999).

cartographic sign on the map image also represents the type. In the legend, the particulars are absent; there the cartographic sign represents only the type, not any instances of it.

Map semiosis can be divided into three dimensions:[22]

Semantics: The relation between sign-vehicles and referents (objects of reference), operating on the individual sign level.

Syntactics: The relation between a specific sign-vehicle and other sign-vehicles.[23]

Pragmatics: The relation between sign-vehicles and interpretants (concepts), operating on the individual sign level.

So semantics is about the relationship between each sign-vehicle (each graphical symbol we see on the map) and things in the real world referred to by the map—for instance, the relationship between a black dot and one specific boulder. Syntactics refers to the relationships between two or more sign-vehicles as we see them on the map, such as the relationship between the black dot and a nearby black line which semantically may represent a specific physical road. Pragmatics is the relationship between the sign-vehicle we see on the map and concepts we think and communicate about. The idea of a boulder may be very clear for an orienteerer with experience in using maps where such sign-vehicles are often used, whereas a map user whose experience comes only from city maps may have only vague ideas of what 'boulder' may represent in the context of maps.

The sign-vehicle functions as a mediator between thing and meaning, for example between a specific boulder in the landscape and the concept of 'boulder'. The context for the interpretation of a sign-vehicle is the map schema. Map schemata are possessed by humans and are used to understand the intrasignificant signs on maps (MacEachren 2004, 198).[24] The principles

[22]This is based on map semiotics as it is developed in MacEachren (2004) and Brodersen (2005). Their semiotic systems are based on Peirce. What we usually see as a map symbol is called 'sign-vehicle' in order to avoid confusion with other uses of the word 'symbol'.

[23]There has been a discussion if maps have syntax or not, cf. Head (1984) and Robinson & Petchenik (1976). Syntactics is different from linguistic syntax in that it is not connected to a linear sequence MacEachren (2004, 234–6).

[24]The claim that such schemata are actually possessed by humans is disputed (Ingold 2003, 53). However, the concept fits well into MacEachren's broader system, and I will follow his use of it here.

behind such schemata are in line with the principles of the map definition above, although the concept of map schemata is specifically used to understand how we read maps. In addition to general map schemata shared by many if not all people, specific groups such as orienteerers may share more specific map schemata.

Texts are integrated parts of the map image, often in the form of place names. Texts are also used in the perimap outside the map image,[25] for example, as common nouns connected through the iconic/symbolic form of a map symbol in the legend. While place names represent particulars, common nouns in the legend represent types. The string 'road' next to a black line in the legend shows the map user that such black lines represent the type 'road'. The string 'A 24' on the map image next to a black line shows that this particular road bears the identifier 'A 24'.

The same sign-vehicle can be both indexical and iconic, and also can have some symbolic signification on a map, either as such or through the text linked to it. Texts are not needed for particularisation; the fact that a sign-vehicle is located in the map image already shows that it represents a particular feature. The particular feature is always already located; a map is not just an image, but an image behaving like a topological diagram. It is the location of a symbol on the map that confers its indexicality and its particularity. Texts on the map, when present, take part in the particularisation process by showing the name of a particular.

There is a pictorial-associative-geometric continuum from mimetic to arbitrary. Most maps signs are not pure symbols; they also have iconic traits, or degrees of iconicity. Space standing for space is one of the ways a map can be iconic, but not the only one. A sign can be iconic in different ways; although size may represent size, as when the symbol for a city represents the area of the same city, size can also represent population. In the latter type of mimesis, space is not standing for space, but rather for numbers of people, for instance when one type of circular symbol of a certain size represents cities with a population between 100,000 and 500,000 people (MacEachren 2004, 258).

Maps are special because they juxtapose highly motivated (mimetic) and highly conventional (abstract) signs. An example of this is that a map can use space in accordance with the general map schema to represent space, but it can also use symbols whose spatial characteristics have no correspondence

[25] I borrow the concept of a 'perimap' from Wood et al. (2010, 67).

to spatial attributes, such as a cross representing a church building. So maps are clearly images, but images with a strongly formalised way of expressing references using a wide variety of signs and sign types.

Even if digital maps change the way we interact with maps and more people become not only map makers but also map publishers, and even if digital maps have a potential for dynamic appearance lacking in paper based maps, the fundamental workings of maps is still very much the same. It may be the case that continuous use of digital maps and further technical development will lead to other map schemata being developed. Still, it is hard to see how maps will not continue to be based on semiotic systems similar to the one described above. This will be further discussed in Chapter 7.

2.2 Textual landscapes

This section will discuss texts as they are used to express spatial understanding. Although I will argue below that one can find the way through a landscape without using language, it is clear that wayfinding as a social activity has been connected to language for a very long time; first oral, then also written. I will focus on texts that establish landscapes, that is, sequences of words expressing a spatial narrative or description. Just a place name ('London') is not a text in this sense, but 'I went to London' and 'London is east of Oxford' are texts.

I will not go deeply into the discussion of what a text is, I will just note some key points relevant to my work, partly in the form of examples. I use the word 'text' to refer to what is sometimes called 'verbal text,' that is, I do not subscribe to the extended meaning of texts as any object that can be read.

There are fundamental differences between oral and written texts. No equally important distinction applies to maps; the concept 'oral map' does exist, but is used in very specific situations only.[26] Written texts are held by physical documents to be activated through reading, which happens visually. Oral texts may also be held by documents, such as magnetic tapes or digital sound files, and may be created interactively by voice synthesisers; in all cases their contents are accessed as sound waves through the air. A third

[26]The concept of an 'oral map' refer to verbal descriptions of landscape or of maps; thus, an oral map is a type of oral text.

way of accessing text, through braille reading, is beyond the scope of this book.

In the following I will focus on written texts, but I will come back to oral texts as part of the wayfinding discussion as well as in the discussion of the source material for the experiments. In the theoretical comparison between texts and maps to follow in Chapter 6, oral texts, written texts, and maps will be seen as three groups, each with their specificities and similarities.[27]

I will clarify what is meant by 'text' by starting from a dictionary definition and then proceed to present a somewhat broader picture. In the Oxford English Dictionary there are five senses of the word 'text'. Sense 1 is central here and sense 2 is also of some relevance. Sense 1 relies heavily on the concept of words:

> **1. a.** The wording of anything written or printed; the structure formed by the words in their order; the very words, phrases, and sentences as written. (OED 2012*c*)

The rest of the definitions under sense 1 and all of the ones under sense 2 are connected to authenticity: the original instead of the translation, the words of the author instead of the ones of the editor, and so on. Sense 1 specifies 'text' as an ordered set of words as they are expressed as a set of signs in a document. This is not the full story, however. All the action words ('wording', 'written', 'printed', 'formed', 'written') give a clear indication that even if a text is static, its creation and use is still central to the definition.

The clearest and most thorough establishment of a concept of 'text' in the context of digital humanities is Sahle (2013, 1–98). His model of texts describes six aspects which cover signs as well as content, documents as well as language. This includes a distinction between the material and the intentional aspects of a text, which is important to my discussion.

The material object of a text is the marks and sounds of language. A document carries a text in a material sense, while a reading fulfils the intention resident in the text. A text is a text when it is read and understood. The text is never dead but is imprisoned in dead material, that is, in documents such as books (Bakhtin 1981*b*). A text has to be read from a document, and the relationship between a text and its document is based on their different forms. The document is a spatial thing, whereas the text is read as a

[27] For historical discussions of oral and written texts see for example Ong (2002), Scribner (1981), and Olson (1994).

sequence of signs, at least at a very basic level. The relationships between texts and their spatial documentary forms will be revisited in Chapter 6.

If we see the reference function of texts in light of the semiotic system for maps discussed above we see that texts at a basic level tends to be dominated by symbolic signs. Most texts have no indexical space, and when the space of a textual document gets more indexical, the text will become more like a map. Examples include concrete poetry and other documents where the textual symbols form graphical patterns.[28] The point where the textual space becomes a map is the point where one from the expression in phrase 2.1 alone will deduce that the place referred to by 'Oxford' is east of the place referred to by 'London'. The exact location of this point of change depends on several factors including the text, the paratext, the reader, and the situation of reading.

London Oxford (2.1)

The reference function of a text can be used to refer to concepts as well as to an external world, in line with the map's pragmatics and semantics. This is what Frege (1892) called *Sinn* and *Bedeutung* and is the topic of major discussions in twentieth century analytical philosophy. The reference functions of place names are complex and vary significantly across cultures. It includes the textual double reference function, to places in an external world and to concepts in the mind of the reader.[29] Place names may be expressed not only as written and oral textual expressions, but also as music. Place names in texts relate differently to their contexts from what place names on maps do. We will return to this distinction in Chapter 6.

Over the course of European macro history there is a general development from the oral to the written and also from reading out loud towards silent reading.[30] Reading is a social thing; it gives access to a literary culture. Having and using such an access has consequences for the individual and for society (Olson 1994, 41–2). The witnesses we find in Schnitler's protocols lived in oral cultures influenced by writing. While the exposure to

[28]See Squire (2011) for a discussion of several types from antiquity including 'magic squares'.

[29]See Basso (1996) for a discussion of highly descriptive and connotative place names among the Western Apache.

[30]The story is more complex, for discussions see Olson (1994) and Manguel (1997). For secondary orality, one of the complicating factors, see Ong (2002) with further references.

symbolic representation systems such as maps, texts, and religion varied between the Sami and Norwegian populations of the lower classes, it is hard to find any clear patterns of fundamental difference. Members of both groups were exposed to religion. They all found their way through the landscape. A significant portion of the members of both groups knew how to read, but few knew how to write, and in general, they were not schooled. None of them used maps much, if at all.

Due to the Sami mission established in 1715, a higher percentage of the Sami were able to read compared to the Norwegian farmers (Steen 1954). Still, being able to read is one thing, the consequences of being part of a textual culture is something else. An important difference is that the Norwegians who learned to read became part of a pan-European textual culture. The Sami, with the exception of the minority who also knew Norwegian or Swedish, did not. The Norwegian-speaking population was culturally closer to the state, not least because of language, whereas the Sami population had to relate to two quite different cultural systems.

And none among the groups related information about the landscape to Schnitler through documents they had written or drawn themselves. Only civil servants did that. When Schnitler approached the lower classes, it was to take up their oral statements. It is as if documents are connected to religion only: the inscribed drum to the Sami pre-Christian religion and the books to the Christian faith. Describing the landscape was something they did through oral words. This indicates strongly that wayfinding skills were not likely to have been influenced much from reading skills; surely not among the Sami, but not much among the Norwegian farmers either.

That had consequences. Oral text is steered by certain rules, and in order to be taken down in a court protocol, the ruleset of written text also apply. When we relate to our own understanding and knowledge of an area, we access our knowledge in a way which is different from how we read a text, and different from how we use a map. No matter how we actually remember, which may vary between persons as well as between cultures, we must organise what we know in certain ways in order to express it to others.

The personal memory is expressed in the language of the society in order to be shared. It is coded in specific signs, anchoring it in a document for future use. Where speech expresses meaning as agreements of mutual understanding, written texts in medieval Europe worked as reminders of such agreements. Later writing developed into representations of the agreed meanings, not the least through the standardisation of legal documents (Ol-

son 1994, 180–8). There is no reasons to believe this process to be complete among the lower classes in Northern Scandinavia in the eighteenth century, but for Schnitler as an officer with a university education in law it probably was.

2.3 Finding one's way

To move from documents to what lies behind them: how do people find their way through actual landscapes? This has been the topic of much research, of which only a few examples will be given here, taken from psychology, anthropology, and neuroscience.[31] The aim of this discussion is to use an understanding of our general behaviour in the landscapes we live in to understand better how people use intellectual tools, in this case, texts and maps. This will also give us an insight into the possible geographical thinking of the witnesses Schnitler met, including the tools they may have used, which may help us to understand better the source text for the experiments to be discussed in Chapter 4.

Even if many maps and most geographical texts are not primarily made for navigation, texts and maps describing landscapes are still linked to wayfinding in an indirect sense. The ability to find the way is an important part of the skills needed to make maps and texts about landscapes. We are not only embodied creatures moving through external landscapes (Gibson 1986, Ingold 2000). We are also semiotic animals living in an environment of signs (Olsson 2007). Where is the human body in reference to the spaces of texts and maps? Interacting with documents are bodily processes. Two levels of such processes can be identified:

1. The body as the host of the creation and reading process: the brain, the eyes, the hands.

2. The bodily memories of movements used when we create and read texts and maps.

To bring this down on the ground: the witnesses gave their testimonies to Schnitler; the missionary translated them; and Schnitler understood in his limited way what they meant and wrote it down. The abilities of all parties

[31] A short version of this discussion was published in Eide (2014*a*).

to understand and communicate were connected to their abilities to find the way in a landscape. The relationship is complex, but it is there. And when I read the text today, my understanding is based on my own experience in finding the way—in general, in landscapes such as the ones described, as well as at some of the actual places they described. In the experiments described in Chapter 4 I used a computer to try to remove as much as possible of my own experiences from being parts of my readings, but in normal human reading, we use them.

Understanding wayfinding is therefore necessary in order to understand the witnesses and how they ended up verbalising their knowledge in the ways they did. It is also necessary in order to understand not only the roles of the other people present in the court, but also what was actually taken down in the protocol, and how we can read it today. This section will lead to a theory of how people in the eighteenth century found their way, using semi-nomadic Sami people as an example. This is necessary background for interpreting what they said about the landscape. But the discussion of wayfinding goes beyond how the eighteenth century Scandinavians may have done it to general human tools and techniques. The results will not be all-encompassing, but they are to varying degrees relevant for many people, including myself. Chapters 5 and 6 of this book will open up that broader perspective.

I will not make any claim for an accurate mimetic representation of what we do when we think and move, neither in this section nor in the book as a whole. What I try to get at are the implications of ways of thinking about spatial narratives and maps on the one hand, and actual navigation practices on the other.

Most cognitive processes are not accessible to conscious inspection (Boyer 2010, 376–7). What is under cognitive control is reflective information and beliefs, whereas intuition can be described as a highly specialised, domain-specific cognitive system which is out of sight of the conscious mind. Wayfinding is an old skill, evolutionarily speaking, and it is very likely that we share much of this system with other species, presumably in interaction with specific human abilities. Evolution nudges us towards behaviour that on average increases fitness. Evolved intuitive systems are not necessarily innate, but capacities are; they are learning systems in which contextually appropriate intuitions can be developed.

An undeliberated system for wayfinding[32] seems to be important. The explicit map-based navigation we use when travelling through unknown territory has a much more efficient counterpart which can be experienced as a subconscious wayfinding in which one 'feels' where to go. A skilled traveller has access to the parallel processing capacity of the brain in addition to the linearity of language-based reasoning when he or she finds his or her way. Tuan (1975) reports, for example, that people drive long stretches of well-known roads without remembering large parts of the drive afterwards. We can observe the same when people talk intensely while walking: if they do not know the area well they may get lost, but in a known environment they usually find their way without conscious effort. This is in line with the distinction made by Arnheim (1997, 233–4) between intuitive and intellectual perceptual thinking.

We have rich and only partly understood systems for thinking and communicating about and moving in our environments. These systems are connected to many different tools we have created in order to assist us, from place names, chants, songs and stories, to paper maps and digitally based geocommunication systems such as GPS. Calling whatever is in our brains 'maps' is understandable in a popular setting, because it connects this complex and only partly understood system to something we know. But in a scholarly context, we should be careful to examine what is being implied by such a metaphorical use of the word 'map'.

At least since the mid-twentieth century, human brains have been thought to contain mental or cognitive maps. The concept of the cognitive map was introduced by Tolman (1948). He did not claim that these cognitive maps were similar to map documents in form, he only stated a functional similarity; still, the choice of the word led to a widespread view that in our heads we actually have something quite like a map, decontextualised and based on a bird's-eye view.

Although the existence of the cognitive map is widely accepted, there is strong evidence against it. I will discuss the critique from two angles: first based on the views of the psychologist Gibson and the anthropologist Ingold, then based on some recently published neuroscience. While Gibson and Ingold are actually critical of the idea of a cognitive map, few neuroscientists problematise the use of the expression. In the latter case, the arguments I

[32]This concept is taken from Tuan (1975); he, however, used 'navigation' instead of 'wayfinding'.

present are mostly based on my understanding of their scientific results.

Animals are capable of wayfinding and place-learning.[33] Gibson's theory of reversible occlusion gives a good explanation of how this works. A 'vista' denotes what is seen from an extended region when the animal moves around, it is a semienclosure. The views are not from specific points, but, in principle, from all points as they are seen in the animal's continuous movement. Different vistas are serially connected. In the terrestrial environment each vista is unique: it is its own landmark, unlike the mazes so often used in experiments. When the vistas have been put in order by exploratory locomotion, the animal apprehends the structure of its habitat. The apprehension is not so much in the form of a bird's-eye view, it is rather like being everywhere at once.

> The getting of a bird's-eye view is helpful in becoming oriented, and the explorer will look down from a high place if possible. Homing pigeons are better at orientation than we are. But orientation to goals behind the walls, beyond the trees, and over the hill is not just a looking-down-on, and it is certainly not the having of a map, not even a 'cognitive' map supposed to exist in the mind instead of on paper. A map is a useful artifact when the hiker is lost, but it is a mistake to confuse the artifact with the psychological state the artifact promotes (Gibson 1986, 199).

According to Blakemore, a map is a tool for unknown territories: 'a map is a concise system of communication which aids someone who has insufficient knowledge of an area being traversed' (Blakemore 1981, 6). Ingold (2000) asks what the difference is between a person familiar with an area using knowledge to find his or her way and a stranger with a map. Are they both map users, the former one using the cognitive map in his or her head? Ingold argues strongly against this view, stating that there is no such thing as a cognitive map. Places exist as nodes in a matrix of movement, a region, consisting of stories of past and future journeys. Thus, the two persons

[33]Unless otherwise stated, the word 'animal' will include the human species. It should be clear by now that I do not subscribe to a strict opposition between nature and nurture, or indeed between biology and culture. My source material comes from an area where the echoes of race biology are still audible (Skorgen 2002; Schanche 2000). But letting that difficult history of research push us into sustaining a dated belief in a clear-cut boundary between biology and culture does not serve the purpose of understanding the lives of humans and other species of animals (Ingold 2000, 1–2).

finding their way, one with a map and the other familiar with the area, use quite different strategies. *Map navigation* is done from location to location in space, whereas *wayfinding* is done from place to place in a region.[34] We use complex procedures rather than complex structures to find our way; wayfinding is a skilled performance. Ingold stresses the difference between a view *in* the world and a view *of* the world:

> Ultimately, the justification for extending the map metaphor into the domain of cognition must lie in the assumption, more often than not unstated, that what the map affords is a representation of things in space that is independent of any particular point of view (Ingold 2000, 224).

The view we have of a landscape we find our way through is not the bird's-eye view. A map of a landscape, however good and detailed, is not anything like what we see while travelling through it. It takes a recalculation effort to understand what a mountain we know from the map will look like from below in the landscape. When we move through a path of observation, we sense the landscape as an object we are within. In this context, it makes sense that mountains seen from different sides sometimes have different names.[35]

According to Ingold's view, there is no decontextualised map in a person's head that he or she uses when he or she is finding his or her way. Our knowledge of the environment is instead formed and re-formed as we travel through it. The traveller is neither using a map nor making it, he or she is mapping, that is, wayfinding, for mapping is different from mapmaking: 'All wayfinding, I argue, is mapping; all navigation map-using. Thus mapping is to map-using as wayfinding to navigation' (Ingold 2000, 231). Animals live in a world of everywhere-as-region, that is, the world as it is experienced by a wayfinding traveller along the way of life. For humans alone among species, cartography may transform everywhere-as-region into everywhere-as-space—that is, the world we navigate with maps, imagined from points of view above and beyond.

The capacity for mapping is not a prerequisite for wayfinding, but a consequence of wayfinding in the environment. Retelling a journey may or

[34] 'Navigation' and 'wayfinding' are here used in the specific meanings assigned to them by Ingold (2000). The following paragraphs will make it clearer what they refer to.

[35] In the Innunait place name system described by Collignon (2006, 166–9), such differences within the society are common. Places systematically have different names based on the relative location of the speaker using the name.

may not include what we call a map, and if it is included, the map may be either used or created in the process. If a document is created, it is usually not the main purpose of the event; instead, it is created just to be used as a tool, once. An oral text, on the other hand, is usually created when a story is told using a map.[36] A written text will be able to capture central aspects the oral narrative, but rarely all the explicit relationships to the map: gestures are commonly used, which means that such storytelling borders on performance cartography. In that sense it is not cartography; instead, it is more like geocommunication.

Retelling travel stories may also be used in map-making. An example is the technique of map biography (Tobias 2009). The perspective is different from the one we saw above, as the map is now turned into the end product and becomes the main purpose of the event.

> It is at the point where maps cease to be generated as by-products of story-telling, and are created instead as end-products of projects of spatial representation, that I draw the line between mapping and mapmaking (Ingold 2000, 234).

What is it to know where one is? It could be to locate oneself on a map. But in ordinary wayfinding, it is rather to situate one's position within one's movement matrix—that is, within a region. One can stop and relate where one is to where one has been and to where one might be (Gibson 1986, 200). In the latter case, identification is not spatial as in the former, but instead based on stories and memories of journeys previously made. Knowing where you are in the wayfinding sense is deeper than in the navigational sense. Thus, navigation, which is map-based, differs fundamentally from wayfinding, which is based on past journeys or narratives of such journeys (Ingold 2000, 238–40).

In my opinion, Gibson's and Ingold's claims that there are no cognitive maps in people's heads are well supported. But can the belief in cognitive maps be undermined by showing it is not true? Few people would argue that the thing we have in the head is a map in the meaning of a document. It is some sort of metaphor. Seen this way, the cognitive map should be judged on its strengths and weaknesses rather than on its truth value. The metaphor may be useful even if it is clear that what we have in our heads is very different from maps.

[36] Exceptions include pantomime.

How good is the metaphor? Is the purpose of our minds' place-handling system really the same as the purpose of a map? The differences between wayfinding and navigation indicate that they are not at all the same. A metaphor will always carry over from the direct to the metaphorical sense. 'Cognitive map' easily slips over from 'fills a similar purpose to that of a map' to 'is nothing more nor less than a map'. Because maps lack many possibilities that other cultural expressions have,[37] this may lead to under-communication of the qualities of cultural forms of expression that go beyond what maps in a stricter sense can express. If we accept that a ritual or a narrative is a map, there is a danger of going on to think it is just a map, a notion which is in line with a problem in Jacob & Dahl (2006): they focus so strongly on the qualities of maps that we risk losing all the qualities of the textual or performative systems that go beyond what a modern map can be used for.

Thus my argument against the metaphor of the 'cognitive map'. In neuroscientific descriptions of the mammalian wayfinding system, which I will now briefly discuss, the metaphor likewise does not hold up, even though it is frequently used. Again, it does more harm than good.

The word 'map' is used in neuroscience to denote the whole or parts of the systems in the brain that take care of our wayfinding and spatial organisation. I will take as an example the research into systems for spatial information in the hippocampus and the entorhinal cortex of rats, where the word 'map' is commonly used. These systems are claimed to be similar to human systems.[38] The established model contains four cell types vital for orientation: place cells, grid cells, head-direction cells, and border cells (Moser et al. 2008; Solstad et al. 2008). Together they form a system for spatial orientation. The researchers use the word 'map' for the system, in scholarly as well as popular articles.[39]

It follows from the system of four cell types that the representation in

[37] At lest this is what I show in this book for one type of cultural expressions, namely, texts.

[38] For ethical reasons, many types of experiments are only done on other species than humans. The results from research into the human brain are consequently less clear. It is an open question how applicable the findings are to humans. One could assume similar systems are used by humans as by rats, as it is often the case that similar systems are used by different species; still, it is not uncommon that quite different systems are evolutionarily developed to solve similar problems.

[39] For examples in scholarly articles, see the two cited above. For more popular presentations using 'map', see for instance Knierim (2007).

the mind is not an image, but a structure from which an inner image is a possible reconstruction.[40] Further, with the head-direction cells, on the one hand, and on the other, the fact that a place cell fires when the animal moves close to the place in the real world connected to that specific place cell, it is clear that the location of the animal in the world is a part of what is acted on in the brain.

So, given an analogous system in humans, what we have in our brains are not maps. They are neither pictorial nor decontextualised, but rather dynamic representations where our current location is expressed in a network of places. This is more in line with Gibson's and Ingold's views than it is with the idea of a conceptual map. It can easily be seen as a network of places in a region. Acquiring information and organising it into a stable representation also seems to work better when one moves around in an area than when one looks at it—at least if one is a rat (Rowland et al. 2011). That is, landscape learning works better when the animal navigates than when it observes, just as Gibson described.

Even if the word 'map' is still used by many scientists for systems in the brain, Nicolelis presents a rather different view in a podcast interview:

> I don't even use the word 'maps' anymore. 'Maps' gives us an impression of a static 2D or 3D; and that's the reason they were used, actually. When Penfield first described them in humans, and Sherrington, in animals, I think this was actually the intent: to show that there was a static, carved-in-stone representation of the world. But I think that, once this revolution comes–in neuroscience, I mean–the word 'maps' is going to disappear; because they carry too much baggage with them.
>
> I like to talk about dynamic representations, or dynamic models. That's what I think the brain is doing: the brain is creating; continuously creating and updating (Nicolelis 2011, 21).

I will summarise my arguments against the use of 'cognitive map' in two main points. First, it is too far from reality. I have shown that neither seen culturally nor biologically can whatever systems we have in our minds be called maps based on a strict definition of a map. The concept has been tried out in the form of an as-if proposition. Such propositions tend to be taken as statements of fact until they run aground on their own limitations. This

[40] This is also in line with the view of mental images in Arnheim (1997).

seems to be what is happening with the cognitive map in neuroscience now. And second, the idea of mental maps mixes levels and makes the different categories hard to understand. A map is a tool produced by humans for use by humans. Maps are documents, and thus they cannot have any intentions of their own.[41] Our brains form parts of a system we use to find our way in our environment. The map can be used by our wayfinding systems, and some of the functions of a map can also be found in our wayfinding systems, but that does not make anything in the brain a map.

We should be conscious about the metaphors we use, for wayfinding systems as well as more generally. Rather than 'map', I would suggest the use of 'geocommunication system' or, simpler for many people today, 'GPS'. Tolman (1948, 189–92) used the metaphor 'cognitive map' to distance himself from explanations based on passive stimulus-response. In that perspective, the cognitive map is more active and points towards Gibson (1986) and Ingold (2000), but as there is no map reader in the mind, the word 'map' gives wrong associations. We see an active brain-body-environment system for wayfinding, and we should discuss it using concepts signalling that. We do not know its inner workings in detail, but we know what it accomplishes.

I have not said the last word in this book about the word 'map'. It will continue to be a difficult concept throughout. But by clarifying the definition and also how the map relates to the various systems used by animals to find the way, I have established a starting point for further discussions.

One of the strengths of the model put forward by Ingold (2000) is that it explains in a reasonable way how people can learn geography. Although remembering stories and toponyms will be part of such a learning process, wayfinding in the environment is probably more important. For the Sami of the eighteenth century, language was not mainly a decontextualised system as in printed text, but rather a system for expressing knowledge about concrete, practical tasks—not lists of isolated names. The Sami met place names in a context of travel narratives and other stories, often told while travelling. Thus, Jacob & Dahl's claim that in societies with few maps, 'the best way of learning geography is based on the memorization of a descriptive text or of lists of toponyms' (Jacob & Dahl 2006, 345–6) cannot be right. The

[41] Even if digital maps may be non-static in the sense that they change, they have no will to change; they are rather changed based on somebody else's intentions. So even non-static maps are not active in the sense actors are. A totally different thing is that we often say that 'the map says' or 'the map shows'. This is anthropomorphising, in line with what we do for other documents: 'the book says'.

people who produced those lists in the first place were most likely to have done so while travelling, and only through later scholarly work the lists came out decontextualised. The alternative to maps was not fragmented textual descriptions, but rather wayfinding in the environment.

With the speed of travel of, say, a Sami group moving from their winter to their summer area, there would be time for many stories about the landscape they travelled through, to be remembered by a young person not as a decontextualised set of words but as a total experience of words, tone, landscape view, smell of melting snow and mud, sounds of cracking ice, sore feet and cold fingers.[42] Perception is strongly linked to memory, integrating past with present perceptions (Arnheim 1997, 80-81). Walking the same landscape 30 years later, the brain-body system of this now adult person would have many ways to trigger the memories of stories heard as a child, similar to Proust's famous madeleine discussed in Chapter 6 below. Who needs a map when even a young Sami has the experience of many journeys?[43]

In communicating spatial messages, speech and joiks were used. Gesture and dance— 'performance cartography'—may have been important as well. Drawings and models may then have added other qualities, including some sort of stability, although this stability might only last for a short time; strokes in the sand have more permanence than speech, but they are not something you can bring with you. And even if speech in itself is ephemeral, a person available for answering oral questions may still represent a permanent source of information.

Even people travelling over larger areas, such as hunters, did not need maps. An example of this is that there is no description of map use during hunting in Thuri (1931).[44] General landscape knowledge and many pieces of detailed knowledge, as well as the likelihood of meeting someone to ask, would provide good assistance in finding the way. Many of the Sami lived in open areas where landmarks are quite visible in good weather. And what does it mean to be lost? A Sami travelling in a known type of territory with his or her equipment did not necessarily need to find the way quickly. Such

[42]Turi et al. (1910) give detailed and lively descriptions of such situations.

[43]The quality of the walk as a memory system was established independently in antiquity (Eide Forthcoming 2015*b*). We can only speculate as to whether knowledge of such systems learned through his scholastic university education helped Schnitler in understanding common people in Northern Norway.

[44]For reasons unknown to me, the author insisted on publishing the second book under the name 'Thuri' although the first one was published under 'Turi'.

travellers have what they need to survive for an almost unlimited time, and eventually they will find someone to ask or a place they recognise.

2.4 Geocommunication

What happens at the border between texts and maps? One key question is why people use either texts, maps, or both of them when they communicate about wayfinding and navigation. The use of the word 'map' in light of the use of the objects we call maps shows clearly the importance of the word 'geocommunication'. Geocommunication is a key concept which must be understood in the light of the fundamental differences between texts and maps, but it is also a place where the two can be united.

As we saw above, the map metaphor is widespread. Why is this so? Is there a general push in modern Western cultures towards expanding the scope of the word denoting what we today call a 'map' in English?[45] If so, how can that be? There is a gap between actual wayfinding on the one hand, and representing landscape in language or on a map on the other. I claim that this gap is filled by linking the representation to the activity—that is, by extending the area of use for the word 'map'.

This discussion will focus on four categories of things: The landscape itself, our internal representations of it, tools used to find the way through it, and communication about it. 'Map' is often used for any of the latter three (Harley et al. 1987). It seems to be tempting to use the same word for all three categories. This is not new; the medieval word 'mappa mundi' denoted both physical maps and other things such as textual documents (Schneider 2006, 26). Today's neuroscientists commonly use the word 'map' to denote systems in the brain.

If we compare the use of the word in Harley et al. (1987) to the definition in Section 2.1, we see two different semantic fields which are partly overlapping. The latter is a specific type of document. The former is connected to processes of problem solving and may denote anything we use to find our way, including systems in the brain, texts, songs, and documents. Even a system helping us to find the way through an abstract system, such as a map of knowledge, is often included in this sense of the word.

[45] I assume this to be similar in other parts of the world, but I have not made sufficiently general studies to make any claims.

In modern Western societies, we have a strange double view of maps which makes sense in light of the division between document and function. Many people love maps as beautiful objects. Just as exhibitions of manuscripts are popular among people not able to read their contents, so are exhibitions of maps popular among people independently of the reference functions of the maps. But after the first 'wow!' when a beautiful map is seen, the reference function tends to come into focus. Then the impression of a beautiful sixteenth-century map develops into the view of a less than useful map which is full of errors. The map is still beautiful, but it also becomes a dated document signalling its historical era. What does such a map tell us about how the mapmaker conceived the world? This historically oriented understanding sees the map as a tool.

When we focus on the referentiality of maps, the focus on the documents in themselves loses ground. Then the work of the map[46] becomes the important part. This is clearly linked to the tendency towards using the word 'map' not only to denote documents with spatial reference, but also to denote anything that helps us to understand a landscape and to find our way. We move from document to function. In this latter sense, the word 'map' is used for every tool we use, from documents via toponyms to systems in our brains.

In order to pursue my investigation, I need to be clear about the definition of maps. Only then can a comparison be meaningful. We need a technical term 'map' to be used to precisely refer to a certain kind of documents.[47] I believe that neuroscientists working in animal and human wayfinding would be well served by taking up the suggestion of Nicolelis (2011) to reconsider the use of the word 'map' in their description of what takes place in the brain. Still, it is clearly the case that people use the word 'map' to denote function as well as form, and in descriptive presentations of language use, this must be taken into consideration.

The importance of keeping a specific word for map documents lies in distinguishing them from texts, other tools, our thoughts, and the landscape itself. A map is not a silent geographical text, and geographical texts are not

[46] According to Wood et al. (2010, 1), maps work in two ways: first they function as maps, and second, they do active work to change the world, converting energy to work by linking things in space.

[47] 'Precise' does not mean that the border between maps and non-maps is clear. There will always be documents which can be both maps and non-maps based on context and how they are read.

speaking maps. They are different parts of the hybrid information system available to humans for understanding and finding their way through their surroundings—of what Brodersen (2005) call a system for geocommunication. 'Map' in the general meaning of the word, in the meaning of Harley et al. (1987) and of the function discussed above, denotes this system for geocommunication, in part or as a whole.

Geocommunication is a vivid field of development in the Digital Humanities, as we will see in Chapter 7. Geocommunication tools can be used for deep mapping and represent attempts to break out of the restrictions of the map. This book may be used by some of their developers and users to understand better if and how this can be done.

2.5 Texts and maps as graphical objects

We have discussed texts and maps as abstract systems, and we have seen how they are used as practical tools. We have also touched upon the actual physical restrictions connected to making and accessing documents. Writing a manuscript on parchment is different from typesetting and printing a book, and it is different from typing on a computer keyboard. One pen is better than another, as one keyboard is, and one computer program

These differences are related to media types as well. Reproducing a map is different from reproducing a text in a manuscript culture, and the difference is not the same as the one between a printed book and a printed map. Thus, in addition to the continuum from text to map with various hybrid and intermediate forms in the middle, we also have an axis of production and consumption systems. This is not a key issue in this book, but it is necessary to keep it in mind when we relate to historical documents.

Based on my practical experience from making texts and making maps: there are clearly limitations in each qualified medium connected to the abstract systems they adhere to. While a pencil works differently from a pen on wet paper, and writing by hand is different from using a keyboard, the fundamental differences I am focusing on in this book operate at a more abstract level. As we will see in the next chapters, they are not based on one qualified medium being less useful than another. They are rather about one qualified medium being incapable of expressing the information expressed in the other.

Chapter 3

Critical stepwise formalisation

In Chapter 1, modelling in digital humanities was introduced with an eye to modelling in other disciplines. In this chapter *critical stepwise formalisation* will be presented as a special type of digital humanities modelling. For the sake of clarity concrete examples linked to the experiments to be described in Chapter 4 will be used. The introduction of the method will be anchored both to the practical use case and to theory. The chapter will be concluded by a presentation of the general principles behind the method. The discussion will continue based on the intervening parts of the book in Chapter 8.

Critical stepwise formalisation consists of studying a media expression through the process of adapting it into a new expression in another qualified medium. In the practical use of the method described in this book it will happen through capturing the spatial understanding expressed in a text in a computer based conceptual model and then transferring that model stepwise into a map. The aim of producing maps from texts is not to create the end product, as in modelling for production, but rather to study the process, as in modelling for understanding (Eide 2015*a*). The aim of the experiments was not to create exhaustive models of the objects under study, but rather to find out where the process reaches it limits. Which types of understanding proves difficult or impossible to model or to visualise?

As we saw in Chapter 1: models as we use them are representations of something which are created for the purpose of studying what is modelled more closely. The expressiveness of the sources will be studied by manipulating models of them. Experiences from the modelling is also useful in the development of modelling tools. The process of critical stepwise formalisation is not only a process of formalising and visualising data, but also a

process of developing, improving and adapting tools for such formalisation, analysis, and visualisation.

3.1 The modelling stages and fall-off

The text to map modelling process consists of five stages. I use the word 'stage' to denote an overall structural milestone in the modelling process, whereas 'step' refers to each transition in the modelling of one specific fact. I did consider various alternatives for these stages. Based on the experience from the preparatory phase I ended up with the stages presented here, which all have useful explanatory power.

Seen from the perspective of my work, the process of developing and testing the tool was a learning process which clarified to me exactly how stepwise formalisation could be put to service in this project. The history of this process is documented in the data package. Each of the stages will be described in more detail in the following sections, before this chapter concludes with a general description of the method. The stages are:

1. The source text, which is the starting point
2. The primary model
3. The formalised model
4. Geographical vector data
5. Visualisations in the form of maps

The information from the sources was re-expressed in a way that can be processed by a computer. An example is shown in Figure 3.1. This does not mean that it is rendered falsely precise, but that it is possible to create various sorts of maps given different interpretations of the data and different approaches to mapping.

The actual modelling work was done in a computer application I have developed, called GeoModelText. The computer application used in the stepwise formalisation can be seen as a tool implementing a method. The models created in the modelling exercises represent readings of the source documents, and each model implements a theory of the source text. As the method is dynamic and data driven, the tool also had to be dynamic and flexible. The

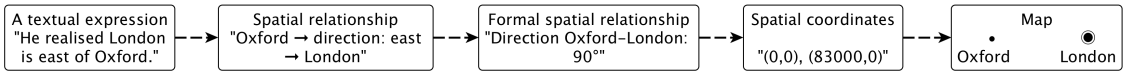

Figure 3.1: Example of stepwise formalisation.

process of stepwise formalisation was not only a process of formalising and visualising data, but also a process of developing and improving the tool for such formalisation, analysis, and visualisation. The process is necessarily iterative and based on close human-machine interaction.

As described in Eide (2013), some information cannot make it unchanged from one stage to the next. I use the phrase *fall-off* for this. Each step in the process of the stepwise formalisation makes the model a bit more formal. The interesting part of this process is the fall-off. We will see examples below of types of information that does not survive to a different level of formality.

Through this process I translate a set of geographical information from one qualified medium to the other. The series of fall-offs shows what is lost in the process. Not all that is lost is necessarily lost because of differences between the media, but the fall-offs include candidates that must be studied further to see what they are evidence of.

It must be stressed that the concept of fall-off does not imply that information is actually lost. The data representing each and every step in the process are stored. The more formalised versions, the ones from which something has fallen off, are the ones used in the later stages, but each step in the process is kept available for later scrutinising.

Critical stepwise formalisation is a transitive modelling process (Eide 2013). Each of the stages is a model of any of the previous stages. Thus, each map is a model of the source text. The maps can be quite different, so each map is only one possible model of the text. Indeed, this is the case for each stage. In critical stepwise formalisation, only a limited number of models are created, out of a much larger number of possible models.

The tangible results from a critical stepwise formalisation modelling exercise is a series of outputs from computer runs. This includes the target media products as well as fall-off. The output is complemented by lab notes written by the researchers, as in any experimental process. The modelling stages in the computer system are also stored so that the processes can be re-run. The dataset will show the problems faced in the adaptation of each of the studied

expressions and indicate how the researchers addressed them. The lab notes are used to understand the context of the output and the reasoning behind the choices made.

In this book I will describe the experiments and the results found in them; thereby the process will be explained. In order to understand more of the actual modelling and experiment processes, the implementation found in the data package, including the source code for GeoModelText as well as a runnable java applet and the datasets, should also be studied.[1] This applies especially to anyone who wishes either to replicate the experiments or to use the tools for other purposes.

3.2 The experimental process

The goal of the model building is not the model as such, but rather the process of modelling—that is, to learn from creating and manipulating the model. How does this learning take place? What happens during the process of model building that provides new insights? Which methods and tools are used?

The object studied through the modelling described in this book is **S1**. I studied its expressiveness by manipulating a model of the text. I had some initial ideas about the kinds of results to be found; however, it turned out that some of the main findings were not what I had anticipated, so I had to adjust my understanding as well as the modelling. The process of adjustment was repeated several times.

Experiences from the modelling also helped the development of the tools. The initial modelling work and preliminary experiments gave feedback to the continued development of GeoModelText. The modelling showed what the mechanisms of the system needed to be, and this made it easy to try out and alter the functionality of my modelling system as I went along. The model building also helped me to discover what text—that is, which parts of **S1**—to use in the case studies.

So modelling was used in the development of the setup of the tools, as well as in preparing for the use of the tools in the case studies. The model

[1] The data package is archived with the long term preservation system of the Norwegian Social Science Data Services (NSD), URL: http://www.nsd.uib.no/nsd/english/ For current use the data package is also available from my resource page, URL: http://www.oeide.no/dg/dp/

was then used extensively throughout the case studies. The various aspects of modelling open different perspectives on the work and also on the results. However, the separation between the various aspects of modelling was not clear in the earlier stages of the process, and, as will become clear in the following, distinguishing fully between them is not possible even now.

Most of the experiments were performed in a qualitative manner. Counting and comparing occurrences in the model to find results were done in only a few cases, and the quantitative methods I did use were quite simple. Mostly, the occurrences were evaluated individually in line with traditional research in the humanities, in which knowledge about specific instances of a textual phenomenon is in the first instance the main goal (Galey 2010, 99).

The computer application developed for the modelling, GeoModelText, is not meant to be used for a full analysis and modelling of all information, or even all geographical information, in the source text. It has been created in order to analyse enough to make inferences about how the source text works in the context of the hypothesis to be tested. Human readers are meaning-seeking. We easily skip over details when we read and understand a text. Even if the assertions made in critical stepwise formalisation are simple, the structures developed become quite complex, showing the many-faceted information found in a seemingly simple text. The interactivity is key here; the act of modelling is the important part, more than the models created.[2] The same goes for exploratory mapping, as we will see in Chapter 7.

The modelling methodology discussed in McCarty (2005) has clear similarities with the view of wayfinding we saw in Chapter 2, where learning a landscape and how to find one's way through it happens through moving in the world. According to Campbell (1960, 380), all genuine increase of knowledge takes place by a process of 'blind-variation-and-selective-retention'.[3] Vincenti (1990, 242–3), transferring the idea to the area of airplane engineering, stresses that 'blind' in this sense does not mean random, nor unpremeditated, nor unconstrained; it just denotes that in order for the outcome of the variation to be new, it cannot have been completely foreseeable. Blindness starts where past knowledge ends. We do not know fully what will happen along the way we walk. Even if the landscape may be known in great detail, other aspects (for example the weather) are not; there may be fog. Knowl-

[2]This is further discussed in Eide (2013).

[3]Campbell used the word 'blind' because 'real gains must have been the products of explorations going beyond the limits of foresight and prescience, and in this sense blind' (Campbell 1960, 381).

edge is always partial. Like an infant making the world real to himself or herself by acting on it (Piaget 1967, 7–8), we make the landscape real by travelling through it, and we make our models real by manipulating them.

The analogy between wayfinding and modelling is intriguing, and we will return to it later. It does, however, have its limitations. The goals of the processes are different; learning about a text is not the same as reaching the place one is aiming for in the landscape. Further, 'manipulation' is not a natural way to think of wayfinding; we do not interact with the landscape by manipulating it, but rather by moving through it. But for both modelling and wayfinding, knowledge is gained through active engagement, with the model in one case and with the landscape in the other.

In exploratory modelling, predefined vocabularies are problematic, but often necessary. Standards are important, and in my project I use them in many areas. Shortly I will present the two most important ones for the modelling, CIDOC-CRM and TEI. We will see an example of the danger of using standards in modelling in the case of TEI below: the underlying technology makes it difficult to do certain things. The system lets us see only what it shows us. This is more than just a practical problem. A model is a simplification of a complex phenomenon, in my case something expressed in ordinary language. Any standard, even an open and extendable standard such as TEI, creates this model in certain ways. We run the risk of not seeing what is outside the ways of the standard (Zafrin 2007, 66). The same applies to CIDOC-CRM. By using it as an inspiration rather than as a complete system, I reduce the risk of being unsoundly limited by it.

Any model will adhere to a modelling language, but this language may be more or less specified, and more or less mutable during the time frame of the experiment. It is impossible for any human being to see all the possibilities, but a skilled data analyst still has the ability to see a phenomenon from different angles. The experience used in this work is partly gained from the study of standards, but the standards were set aside before the actual modelling work started. The work was exploratory, led by experience and knowledge. It was informed by TEI and CIDOC-CRM, but not restricted to any predefined modelling language.[4]

The implementation of the model was in line with the principles behind

[4]As will be shown below, the starting point of the modelling (the source document) and the end point of modelling (the geographical vector data) were expressed in standards: TEI and GML, respectively. The use of standards as inspiration refers to the modelling process between these two points.

CIDOC-CRM, a modelling language used to describe the implicit and explicit concepts and relationships found in cultural heritage documentation. CIDOC-CRM has not been developed as a tool for modelling readings of texts, but it is still useful as a guideline for such modelling. As a simple example of how this may work,[5] consider the following sentences, taken from the introduction to a court interview:

> Of the witnesses supposed to be the most cunning on the border issue, were and stood up in the court 1: Ole Larsen *Riise*, ... For these the Kingly *Order* was read out loud ... and they gave their *Bodily* Oath —[6]

Assertion	**Source**
(1) There is an x who is a witness	The text
(2) x is a person	The meaning of the word 'witness' and 'person' in this context
(3) x gave an oath	The text

Table 3.1: List of assertions based on statements in the example text (Eide 2008, 31).

Several assertions can be read from this example, including the ones in Table 3.1. The model in Figure 3.2 is based on the assertions in Table 3.1, thus also on the statements in the quote. In Figure 3.2, the rectangles with captions starting with E represent entities, whereas the ovals with captions starting with P represent the properties linking each of the three triples[7] together. The rectangle on the top is the domain of all the three triples, whereas the rectangles on the bottom are the ranges. The model in Figure 3.2 focuses on the event of swearing an oath. This event was carried out by a person. Through this event, the oath as a conceptual object was created, and

[5] The example is taken from Eide (2008).

[6] 'Af Viidner, som skulde være de Kyndigste paa grændserne, Fandtes og fremstillede Sig her for Rætten 1: Ole Larsen *Riise* ... For dennem blef høyst bem^{te} Kongl: *Ordre* lydelig oplæst ... og de aflagde deris *Corporlig* Eed —' (**S1**, 1).

[7] A triple is a subject-predicate-object statement expressed in a formal language. In CIDOC-CRM, the subject of the triple is called the domain, the predicate is called the property and the object is called the range. I use the same terminology in my modelling.

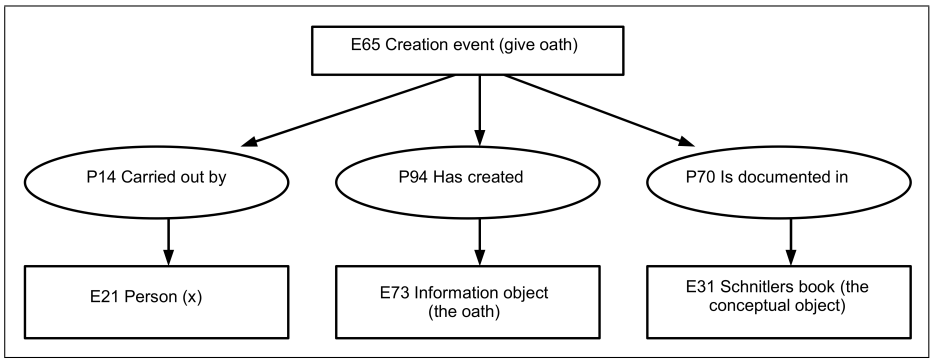

Figure 3.2: Example of a CIDOC-CRM model based on the assertions in Table 3.1, thus also on the statements in the example text (Eide 2008, 31).

the event was documented in Schnitler's text. Other facts are not included in the model—for instance, that the name of the person in question is Ole Larsen Riise.

What was shown in this example is too simple to be useful as anything more than an illustration. But such small building blocks, consisting of entities and properties, can be used to make statements about the world as it is described in the text, in a way that the computer can sort, arrange and combine.[8] Once we have a number of such statements, the computer can be used to investigate them. Such investigations are vital to the experiments. Some 35,000 names, other references to places, and co-references, as well as other links between elements, are stored as statements in the CIDOC-CRM-inspired formalism in GeoModelText. This dataset, with its close connection to the source text and the ability to manipulate it, is the core of the experimental system.

The thinking behind CIDOC-CRM is exactly what was needed for this project. It combines event-oriented modelling with a solid understanding of cultural heritage based on the study of many information systems and

[8]We saw in Chapter 2 examples of expressions such as 'the map says', which were actually anthropomorphising; the map says nothing, it is we who read it. The same is the case here: the computer does nothing in the sense of having an agenda, so when we use expressions such as 'the computer sorts the data', it actually means that someone uses a computer to sort the data. Such expressions are not only a fundamental feature of human languages, but also an example of how we see our tools.

discussions with many professionals.[9] The central idea of CIDOC-CRM is that the notion of historical context can be abstracted as things, people, and ideas meeting in space-time. The model also contains identification of real-world items by real-world names ('appellations'), a generalised classification mechanism ('types'), temporal entities, and location of temporal entities in space-time and physical things in space, along with many other things. TEI has also been shown to be reasonably well in line with CIDOC-CRM (Ore & Eide 2009), which makes it convenient to build my CIDOC-CRM-inspired system on top of information from my TEI source documents.

CIDOC-CRM was used as an inspiration; I did not adhere to it as a formal system. CIDOC-CRM-conforming models are both wider and narrower than the models I made: wider because CIDOC-CRM is a core ontology,[10] going beyond the day-to-day level of implementation detail that I need to address; but narrower, because it strives toward a true model of its area of study. An instance of an information system based on the ontology should be in line with our best understanding of the historical circumstances. The model in itself should be free of contradictions even if the instantiation data may be contradictory. In this project, however, a model of text reading was built up which had no other scope than what was known by an eighteenth-century military officer, and which might include all sorts of contradictions and vaguenesses found in the text.

This tension between CIDOC-CRM and the project models was productive also in the process of stepwise formalisation, where I used RDF,[11] a

[9] One of the uses I made of the standard was to study the way it was developed, by taking part in the meetings of the CIDOC-CRM SIG. I am grateful to the SIG, and especially the chair Martin Doerr, for this opportunity, which was of significant importance to this project.

[10] 'Ontology' is a polysemous word, with a large and somewhat fuzzy meaning potential. I will not discuss the tradition of philosophical ontology here, see for example Frigg & Hartmann (2012) for an overview. A presentation of ontologies from a computer science perspective can be found in Gruber (2009). Attempts have also been made to connect the two, see for example Zúñiga (2001). In computer science, the word is used to denote practices and results of practices in data modelling, in which a formal model of what exists in a specific domain is built up. The 'core' signals that the model does not have classes for particulars; there is a class for 'Place Appellation' but no class for 'London'.

[11] Resource Description Framework (RDF) was created as a language for representing information about resources on the World Wide Web. Webpage: http://www.w3.org/TR/rdf-schema/ (checked 2015-02-23). The RDF data model is based on the idea of making statements about resources in the form of subject-predicate-object expressions, that is, triples, similarly to what we saw in CIDOC-CRM above. I use triples

modelling language which demands less semantic investment than CIDOC-CRM. An example may clarify this: At the basic level of RDF expressions, one can make the statement in sentence 3.1. An animal, or even a fictional person or a spirit, may be an actor in RDF. The concept of being an actor is not really modelled in RDF; 'created' is just a label of a property.

$$\text{the eagle} \rightarrow \text{created} \rightarrow \text{the mountain} \tag{3.1}$$

In CICOC-CRM, on the other hand, the role of being an actor is restricted to human beings, because in museum activities, as well as in historical facts seen from the perspective of a museum database, nonhuman actors do not exist. CIDOC-CRM does not deny that there are thought systems, as well as computer-based implementations of models of such systems, in which nonhumans can be actors, but such systems are outside the scope of CIDOC-CRM.

So I use the ontology as an aid in my modelling work, as one of the sources of inspiration and as a rigorous contrast to my text-based modelling. '[CIDOC-CRM] is also thought as an intellectual guide in the requirements analysis and conceptual modelling phase of cultural information systems' (Doerr 2003, 79). This is in line with my use.

3.3 Starting point: the text

The text of **S1** was the starting point for the model building. The description of it will cross over into the next stage, the primary model, because there is no clear-cut boundary between the two. After all, the stages are milestones in a process, not isolated elements.

The relationship between edition and complete work is complex in the case of Schnitler and the border archives.[12] The text of **S1** does not represent a complete work. It only includes parts of the protocols written by Schnitler; other parts were published in 1929 and 1985.[13] Further, the protocols only constitute parts of Schnitler's border-related work, and an even smaller part

both in the primary and in the formal models. In the latter I use RDF triples to express statements from my model at a certain level of formalisation.

[12] I use 'text' and 'work' in line with the tradition in scholarly editing in which works are instantiated as texts; see Gabler (2012) for a discussion with further references.

[13] For a history of the document and its editions, see Eide & Sveum (1998) with further references.

of the whole documentation of the border process. So the text I started with was already a fragment.

The whole of **S1** is modelled extensively; that is, all names and all recorded co-reference links are included in the model. Some selected parts are modelled in greater detail. In the initial modelling and experiments described in this section, these parts were chosen quite randomly. The aim was to assist in the development of GeoModelText, as well as to learn more about the method to be used and how the different parts worked in experiments. This led to the insights I needed in order to choose the parts of the text to be experimented on in the case studies described in Chapter 4. I used the whole of **S1** extensively, but only the parts modelled in detail were used intensively.

The method used in this research works well on fragments of texts. The experiments are not about completeness in the sense of the study of a complete text. The hypothesis is formulated in a way which makes it irrelevant for testing it whether a full or a partial text is used in the experiment, as long as it is long enough to show the features in question. Critical stepwise formalisation is a method to study media differences, and in principle the size of the input media product does not matter as long as it is large enough to be useful in the analysis. In this case, the parts of the source text modelled in great detail are sufficient for the purpose at hand. Each of the text fragments offers a good understanding of a landscape to an informed reader. All statements about the spatial world in these pieces of text are modelled in detail. That is the type of completeness needed for the experiments.

As for modelling and media transformations in general, the establishment of one text based on another is a transformation which necessarily adds and removes information. Such processes have happened twice in the history of Schnitler's protocols: from handwritten manuscript to printed text, and from printed text to digital encoded text. What are the consequences of these transformations for the research described in this book?

The digital text used in the experiments is based on a printed edition, **S1**, which is different from the handwritten manuscripts in the National Archives in Oslo. The manuscripts consists of hand made strokes that form letters according to an established system. While the relationship between letter form in the manuscript and the abstract character selected in transcription is never indisputable, it is still reasonable straight forward in cases such as Schnitler's protocols. Thus, the printed text is a reasonable accurate rendering of the manuscript. The digitisation of the text is throughly proofread so the digital version is very close to being character by character identical with

the printed text.[14] Furthermore, the analysis in the research described in this book is based on the meaning of the text rather than visual aspects of the manuscript page, so it is not central to distinguish between semantically equivalent but visually distinct versions of a character.

Another difference between the handwritten text and the digital document is the usability of the computer to sort and organise the material. While this was surely useful for this project, the establishment of the model was still based on human readings of the text. The tagging of the names in the TEI version was done manually, as was the additional modelling, which included other place references, event references, properties, and other types of information. Thus, in principle the model could have been created based on manual readings of the manuscripts, however time consuming that would have been. All in all, the digital text forms a true representation of Schnitler's manuscripts in the context of the purpose of this research.

When this project started, the digital version of **S1** was available as a valid TEI-encoded text, together with a register of all the witnesses found in **S1**, also in valid TEI, with links to the paragraphs of **S1** for which they were the sources—that is, to the paragraphs making up the testimony of each witness.

Text encoding is to make explicit, computationally tractable statements about the text. These statements are inserted as tags in the digital text according to specifications found in an encoding system. TEI represents an open and extendable system, but it still puts restrictions on how texts can be modelled. It is based on a number of assumptions and choices. These choices 'bring certain things into focus and blur others, allowing us to pay particular attention to particular aspects of what's out there' (Unsworth 2002, sec. III.1). The TEI model of a text is based on a specific reading or set of readings of the text. The restrictions of TEI define the kinds of models that are possible to express in TEI-conformant documents. Representations created in TEI highlight some aspects of the text at the expense of others.[15]

Creating editions of pre-existing texts has been the most important application area for the TEI guidelines. The methodology of my research is

[14]For details, see Eide & Sveum (1998).

[15]Thus, a TEI representation can be more or less useful. This is in line with our discussion of metaphors in Chapter 2. Like a metaphor, a TEI representation can be more or less true to the original. This is an important question. However, in research based on the encoded text, the question of how useful the representation is, is also important.

different.[16] How does the model building in this project relate to the TEI-encoded document, on the one hand, and to the text as such, on the other? The TEI version of **S1** represents a starting point for my project. It is a good starting point because the TEI file includes useful machine-readable information about the text. But I had to go beyond what is conceivable within a TEI document. The TEI document is partly left behind and replaced by a richer and freer system.[17] I needed a tool where I could enter statements which are based on the text but not bound to the structure of it—neither to the sequential structure of the intended reading order of **S1**,[18] nor to the tree structure of the TEI document. What I needed in order to build my model was difficult to process in an XML-based formalism.

Triples represent a useful addition. Utterances in the form of triples make up the core units of the computer-based conceptual model I developed. However, I still needed to maintain both the sequential structure of the text and the tree structure of the TEI document, and I needed to do so in an adaptable system. To the best of my knowledge, no modelling tool existed which integrated the sequentiality of the text, the hierarchy of the TEI document, and the triple structure of conceptual models in the way I needed to combine them. So I developed my own.[19]

Why were all three aspects necessary? An example of actual modelling using GeoModelText will indicate an answer. Figure 3.3 shows the main data entry screen, which includes three main windows. In the window to the left, the text can be seen ('Paa den Nordre Siide ...'). The sequentiality of the

[16]Even if the encoded text in a scholarly editing project also represents a model of the source text, the main goal of text encoding in such projects is not the modelling process but rather one or several published editions (Eide 2015*a*). This is in line with Ingold's division between mapping and map making we saw in Chapter 2: a story told may involve the creation of a map without the map being an intended end product, as in modelling as described here. Another situation is map making, which is in this respect more like scholarly editing with an edition as the main goal.

[17]The weakness of TEI for my use is one of the main strengths of TEI for many other users. In many a scholarly editing project the limitations I cannot accept represents a useful organising structure to the work. It is well established in digital humanities that different tools give different levels of manipulatory power and thus open up for different types of research.

[18]The linearity of texts is a deep topic to which I will return in Part III. For now, it suffices to say that most of **S1** has a clear intended order of reading at micro level.

[19]A full functional description of the tool is not given here. I will, however, describe the main elements of the tool when I describe how it was used. More detailed documentation can be found in the data package.

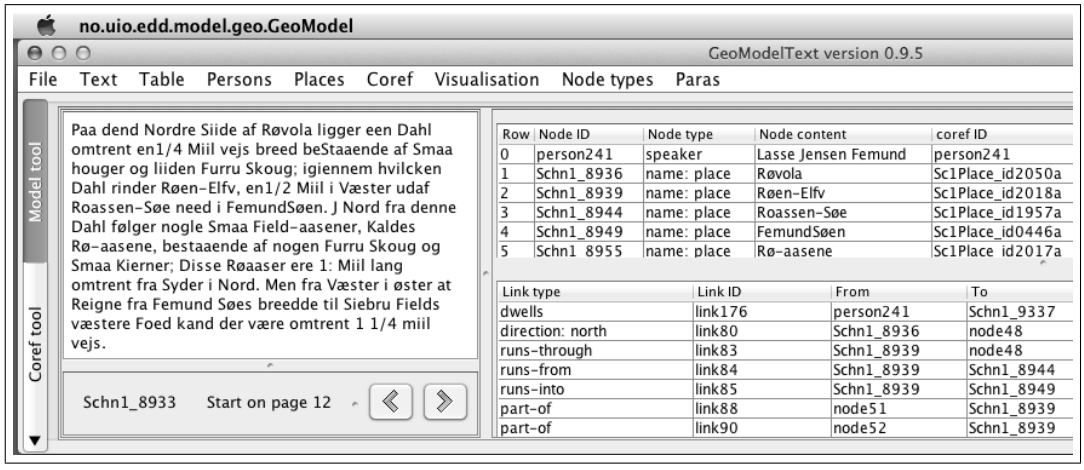

Figure 3.3: Screenshot from the modelling tool.

text is needed in order to read it, letter by letter and word by word. The TEI structure of the document is also present, albeit less directly visible. For one thing, the tags can be shown in the text window at the user's discretion. This is within the paragraph. Structural information captured from the TEI document is also included at higher levels—for example, the number of the page in **S1** from which the text was taken and an identification of the current paragraph. This can be seen at the bottom left of the screen.

The data imported from the TEI document also include information which goes beyond the textual parts on the left. It includes, for instance, the fact that certain words in the text represent personal and place names. Each line in the upper right window in Figure 3.3 represents an entity which can be included in triples as domain or range. Some of the information in the upper right window, such as the fact that Lasse Jensen Femund is the speaker of the paragraph and that Røvola and a number of other strings are used as a place names in this paragraph, was taken from the TEI document.

The lower right window shows information which goes beyond the TEI model. It is used to enter full triples stating, for instance, that Røen-Elfv flows into FemundSøen. One of the reasons for breaking free from the sequential structure and the tree structure lies here. Even if pieces of information about the same objects tend to be located close to each other in the text, the domain and range of such triples can also be at significant distances from each other in the text. One example of the latter is co-reference relationships,

which will be discussed below.

The modelling system in GeoModelText is based on a principle of accumulation. First, it stores the printed version of the text in the form of a digital replica. Second, it also includes hierarchical information and some meta-data fetched from the TEI document, and third, it includes triples entered manually by me as a user. As I had it in my power to develop GeoModelText further while I was doing the modelling work, I could make new subsystems for any of the three perspectives of the data and also for any combination of them. Once a set of triples was added, I could study them and create additional tools to examine and manipulate the statements.

When I claim that my system goes beyond the TEI document, I am not implying that it leaves the TEI document behind. The TEI document with all the information about the XML context-free structure is there in GeoModelText. The sequentiality taken from the text printed in the book is also there. But in addition, I have tools to add other structures—structures which go beyond what can practically be handled in a text or XML-based system.[20]

3.4 Building the primary model

A prerequisite for the experiments was a thorough close reading of the parts of **S1** used in the case studies. All the geographic information I was able to read out of the text was included as connected facts in GeoModelText. This was needed in order to fully detect the expressiveness of the text in the area of geographical information. It was important to include all the geographical information readable from the text. If I omit information, then the map may not represent the text, even if it represents the model.[21] Automatic algorithmic tools alone could not be relied on; a human reader was necessary in order to understand all that the text is able to convey, and to understand it in a precise way. I used repeated rereadings of the text with the model in hand in order to make sure that everything was included.

The primary model was created in a semi-automatic way, using two distinct techniques. First, a digital representation of information extracted automatically from the TEI version of Schnitler's text was created, and sec-

[20]This is further discussed in Eide (2014*b*)

[21]This is based on a division between geographical and non-geographical, with is not straight forward. It will be discussed further below.

ond, I added information by manually entering statements into the model, using the tools in GeoModelText. This process was outlined in connection to Figure 3.3 above. I model statements as they are expressed in the text written by Schnitler. I do not model what I believe to be true on the ground, but rather the possible world expressed by Schnitler in the text, based on my interpretation of the same text.

In modelling, one must decide what contextual information and associations to regard as relevant to the model. The sentences and paragraphs of the original text represented a context surrounding each of the expressions I modelled. Further, the reader of the text will have contextual knowledge. Some of this context is used in the creation of the model, but less than what would be used in an ordinary reading of the text. Removal of contextual information, or rather the decision not to see it, is an important part of the modelling process. Excluding all context is impossible, but I limit the contextual information I use quite drastically.[22] My method accepts the fact that potential contexts exist that I cannot see, but in addition, I have decided to pretend not to see even what I can see, also when it is clearly relevant for understanding the text, such as a general understanding of the landscape of Northern Scandinavia.[23] The experiments described in chaper 4 will show how far I was able to get using this approach.

Some external sources are used in the reading on which the modelling is based, including an index from the 1962 edition in which place names are disambiguated. This index is used to find out when two strings in the text, two usages of place names, are intended to refer to the same physical place—that is, when they co-refer. No knowledge from other sources as to the spatiality of places and relations between them, such as their relative

[22]In all reading of text the potential context is unlimited, it can include 'just about anything in the circumstances of the utterance, and just about anything in the participants' knowledge or prior or current expertise' (Hirst 2000, 279). However, even if it is true that the potential for context is unlimited, the context available for a reasonable reading of a specific text is still quite limited. A work such as **S1** is situated by the genre and self definition of the edition, expressed by the paratext, in a way which effectively exclude many potential contexts as irrelevant. So does the manuscript on which it was based.

[23]The strength of unknowing, decontextualised computers is similar to the problems of situatedness and embodiment in artificial intelligence research, as discussed by Pfeifer & Scheier (1999, 71–3), seen from the other side. What are problems in artificial intelligence are assets for my work (McGann 2001, 190–1). In digital humanities we exploit the fact that computers are less goal oriented than we are, less framed in sympathetic exchanges with desire for meaning, so they can help us to find other readings than the ones we see.

locations, their size and form, is included from context; it is included in the model only as far as it is stated in the source text. This forces the model to include information from the text only in this area.

Co-reference is closely connected to context and turned out to be problematic in the modelling. The same can be said about time. They will both be explained in some detail in the following, before I come back to the primary model as such and clarify what it actually is.

3.4.1 Co-reference

When two or more textual expressions refer to the same object external to the text, we call it 'co-reference'.[24] Co-reference is a fundamental feature of language. A simple example is the fact that 'Peter Schnitler' written on the title page of **S1** refers to the same deceased person as does 'Peter Schnitler' written in this book. In order to link together statements about real-world objects found in **S1**, information about co-reference had to be stored. However, co-reference also turned out to be one of the areas in which context became difficult. I will here briefly introduce co-reference, before I explain why it caused problems for my work.

Co-reference occurs when texts refer to a world external to documents.[25] A co-reference is a relationship that exists between two strings of text or other expressions, A and B, by virtue of the fact that both A and B refer to the same real-world object Φ. To record a co-reference is to make a statement that A and B both refer to Φ. If such a recording is made in the form of an explicit link, we have a co-reference link in the information system in which it is stored.

In order for the model to represent a reading of **S1**, the fact that co-references exist in the text has to be taken into consideration. Co-references are stored in GeoModelText as links between expressions referring to the same real-world object; in this project, all such expressions are strings. Co-referring strings can be names, but they can also be other strings referring

[24] For more information about co-reference with further references, see Eide (2009). For a technical definition, see CIDOC-CRM version 5.1.2, entity E91 (CIDOC 2013, 34). E91 is currently taken out of the standard for further deliberations, which may lead to co-reference being modelled in an extension.

[25] Co-reference also cross over media borders. A dot on a map, an image, and a word in a text can all co-refer to the physical place we commonly use 'Røros' to refer to. Here, co-reference will be discussed in the context of the source text.

to one specific real-world object (for example 'the lake'). Co-reference links are transitive, so chains of co-references can be built up.[26]

An information system for co-reference handling, such as the one implemented in GeoModelText, will add links between different strings. To do this, an identity relation has to be used between the things the expressions refer to; a clear concept of sameness is needed in order to investigate whether two strings co-refer. It is a necessary condition for co-reference that things keep their identity over time. A concept of sameness can be expressed in an identity definition. In this project, co-reference is used for historical persons and places. I will indicate what such an identity definition may be for those types.

A possible identity definition for historical persons is outlined in Eide (2009). It is based on the fact that a person can be seen as the living entity filling a specific location in space at any time during his or her existence.[27] This is sufficient for the current work. For persons there were few problems in this project, only a limited number of ambiguous names. Co-reference for persons can be hard to establish because of lack of knowledge, but never because of fuzzy boundaries.[28]

The identity definition for places is more complex. According to Gibson, the surface layout of places comprises attached objects, as opposed to persons, who are detached objects and can move around. 'Places can be named, but they need not have sharp boundaries' (Gibson 1986, 34).[29]

The traditional methods for co-reference resolution for places include the use of maps and gazetteers. Using a map gives access to a more complex

[26]In historical sources, one can use such co-references, internal to one source as well as between different sources, to link together a set of references to a co-reference chain (Asdal et al. 2008, 91–2). Such chains can be recorded in an information system. Each referring string can then be a part of a distributed network of co-reference sets which can be implemented within one system as well as between different systems operated by different cultural heritage institutions. This is fundamental for the achievement of information integration across resources, as an addition to the use of common schema and formal ontologies (Meghini et al. 2009).

[27]It is worth noting that such an identity definition for persons will not work for fictitious persons, but as all important persons discussed in **S1** are claimed to be historical persons, this is not a problem in the current work.

[28]The co-references for persons were established in an earlier project (Eide 2004).

[29]This is in line with the difference between openness and closeness in mereotopology (Mark et al. 1999, 286–7). While persons are closed, that is, they have natural physical border, many places are open.

set of relationships than only co-reference. By connecting each place to a geometrical feature, such as a point, a line, or a polygon, different places can be combined geometrically with each other. Each map can be integrated with any other map covering the same area, as long as they both use well-defined coordinate systems. Co-reference then becomes a geometrical operation in line with other types of possible relations, such as overlap, coverage, and disconnectedness.[30]

But there is more to places than spatial relationships. One set of texts may discuss a municipality with the name Åsnes, and another set of texts may discuss a parish with the same name, Åsnes. The area of the municipality and of the parish may be identical at a specific point in time time. Still, in some contexts it would be wrong to say the two sets of texts are discussing the same entity. Further, if one text discusses the medieval town of Nidaros and another text discusses the modern city of Trondheim, the two place names may be said to co-refer, even if the names are different and the areas covered by the two entities are different; the medieval town covers only a part of the area of the modern city. What links them together is the fact that they are in some way seen as the same social, religious, and political entity. So co-reference can be based on social criteria as well as spatial relationships.[31] One example from **S1** is the following, in which a place name refers to both a farm and a church: 'Its Church is called *Folder*Eid from the farm on which it stands.'[32]

I am not able to specify a clear identity definition for places which would work for **S1**. A place is a social construction, and places referred to by strings of text are never trivial to identify. Co-referring will inevitably fix the meaning of a place reference in certain ways, removing some of the flexibility in verbal text.[33]

Even if no general solution to the identity problem is found, it is quite clear that co-references were used by the witnesses and by Schnitler. They would know if they meant to refer to the same place in different statements.

[30] A number of such relations are defined in mereotopology, as described by Smith (1996). A formal set is found in the RCC model (Guesgen 2005).

[31] This is linked to the distinction between space and place, of which a recent good discussion in the light of gazetteers can be found in Southall et al. (2011).

[32] 'Dends Kiercke kaldes *Folder*Eid af den gaard hun Staar paa' (**S1**, 149).

[33] Place name flexibility is also present in maps: one can connect a name on the map to a point, line or polygon, but it can also be connected to a general area without borders, for example when naming mountains.

The solution I chose was to make pragmatic attempts to understand the intended meanings of textual expressions. If it was clear that Schnitler and the other voices in the text meant the same place when they used two expressions, the strings were said to co-refer and the co-reference link was recorded in GeoModelText. When I was in doubt, the expressions were left disconnected.

Through a semi-automatic process based on information from the place name registry, co-reference information was recorded for places throughout **S1**. As a result, 86 per cent of the almost 18,000 encoded references to places have one or more co-references recorded.[34] Because of the conservative nature of the work, there are few false positives and an unknown number of co-references which were not recorded, so presumably the real level of co-reference in **S1** is higher.

3.4.2 Time and events

Modelling of textual space also has to take time into consideration. Based on Gibson's argument presented in Chapter 2, time and space could also be seen as events and environment, respectively.[35] Events are linked to the places at which they happen, and the links are known to the persons participating in the events. Dates were encoded as such in the TEI version of the text, but references to points in time are more useful when they are connected to persons and places through events (Eide & Ore 2007). The concept of 'event' is used in line with **E5 Event** in CIDOC-CRM, that is:

> changes of states in cultural, social or physical systems, regardless of scale, brought about by a series or group of coherent physical, cultural, technological or legal phenomena (CIDOC 2011, 4).[36]

[34]Details of how this was done can be found in the data package. Through adding this information, chains of co-references were established. If we look beyond this project, these co-reference networks will be open for future connections to external resources as well, in line with the suggestions in Meghini et al. (2009).

[35]This is comparable to the view in (Arnheim 1997, 129), where time and space are seen as structural categories for sequence and coexistence. I will not go into the nuances in these different views here, just note that these concepts must be seen in the span between concreteness and abstraction.

[36]Many of the events we see in **S1** could have been represented by subtypes of **E5 Event** in the CIDOC-CRM, such as **E7 Activity** or **E67 Birth**. Such sub-typing is not formalised in this project.

This is in line with how the concept is used in Gibson (1986, 242). Events and processes are not distinguished in the modelling, but there is another distinction of significant consequence for the modelling. The events we find textually described in **S1** operate at two levels, leading to quite different modelling strategies:

1. Each interview is an event, forming a legally significant part of a court session. This event has the time, place and many of the participants recorded in **S1**. A statement in **S1** is the written record of the interview event. Each paragraph in the testimony-based text includes one answer or a part of one answer. The uttering of an answer is a sub-event under the interview. These events and sub-events are idealised in the written record; still, legal circumstances make it quite clear that they did take place, and did so in a formalised way.

2. The records of the interviews may contain references to events. Examples include eucharists, births, and weddings mentioned by the witnesses. A string referring to such an event is recorded as an entity with type **rs: event**[37] in the model.

The truth conditions are different in these two cases, based on the different roles they play in the text. While Schnitler is responsible not only to the King but also to God for the truthful record of type 1 events,[38] events of type 2 are the responsibility of the witnesses alone. Even if Schnitler presumably would not record anything he knew was wrong even if it was stated by a witness, at least not without commenting on it, he was, strictly speaking, entitled to do so if he felt it appropriate.[39]

These event types are modelled differently, and that leads to different mapmaking strategies as well. Type 1 events are best represented by specific maps expressing what is said in each interview, whereas type 2 events are better represented by symbols on a map.[40]

[37]'rs' stands for referring string, so the expression 'rs: event' stands for a string referring to an event.

[38]He is responsible to God because of the oath, which is a legal-religious construction.

[39]This is in line with a speaker's responsibility for so-called 'that-sentences', or of the truth value of exhibited facts, in analytical philosophy. For a discussion of modelling of such constructs, see Eide (2008).

[40]In the mapmaking of this project, that is. In other situations a different scale and perspective will lead to other mapping strategies being more appropriate. One example

Places and events are closely connected, but the perspective decides how the connection plays out.[41] Seen from the perspective of the event, the place is what connects it to the landscape. Seen from the perspective of the place, which is the map perspective, an event is a feature of a place. In this latter perspective, events are part of the past of a place, of its history.[42] However, while a place in itself has a natural location on a topographical map, a place's history of events is more in the nature of thematic mapping, describing features of a landscape rather than the landscape itself.

Understanding events was important in order to understand how the text functions but events as such did not turn out to be central to the experiments presented in Chapter 4. However, in other applications of critical stepwise formalisation, for example linked to social networks, events are likely to be more important.

3.4.3 What is the primary model?

So, what exactly is the primary model? It is a state in GeoModelText, based on data stored in various files. These files are partly populated by entering data into GeoModelText. Other parts of the primary model are fetched from the pre-existing TEI files. All the files are loaded automatically when the programme is started.

The state in GeoModelText which is the primary model consists of all the place and personal names in **S1**, as well as a number of other strings referring to persons, places, and events. It also contains information about co-references between specific personal names and other references to persons, as well as between specific place names and other references to places. Through the sets of co-references it includes objects representing the historical persons and places mentioned in the text. It also includes some additional information such as events.

Finally, the primary model contains other typed relations between per-

would be a thematic map presenting all witnesses, where each event of type 1 would best be expressed as a symbol on the map.

[41] For a philosophical discussion of the differences between events and objects, see Casati & Varzi (2010, sec. 1.1).

[42] This idea of a place is close to the concept of space in Massey (2005), where it is linked to different overlapping histories. In general, space and place are used in a number of different ways in different contexts. What is called 'place' in this book is called 'period' in CIDOC-CRM; 'place' in the latter is strictly a spatial object with no cultural aspects.

sons, places and events, many of them cross-categorical—for example, a relation between a person and a birth event with the type 'was born', or a relation between the birth event and a place with the type 'took place at'. These two relations may represent a reading of a sentence of the type 'He was born at the place ...' All such relationships are based on my reading of the text and are kept close to the form in which they were expressed in **S1**.

Some of the information is recorded for the whole of **S1**, including place and personal names and co-reference relationships between them. Other types of information are added only to the parts of **S1** used intensively in experiments. In Chapter 4, examples of the creation and use of the primary model will be shown, making it clearer how it works at the practical level.

3.5 Towards the formalised model

Recall how the modelling process was divided into five stages: *text, primary model, formalised model, vector data,* and *map.* Why is the formalised model a natural milestone in the process? It is created after all the recalculations and choices needed in order to make numerical expressions based on the directions, distances, sizes, and so on found in the source text are done. The stage is just before the translation into vector numbers starts, so it is a natural milestone between two types of processes.

The process from the primary model to the formalised model includes different types of individual steps, which will be described in this section. The starting point is the primary model. I am responsible for the whole process of stepwise formalisation, but the responsibility is expressed in two different ways. In parts of the process I enter information into the system manually, although supported by the system; in other parts the information is created by algorithms based on parameters.

Some examples of the former procedure can be seen in Figure 3.4, where we see a window which is used to enter formalised statements under the heading 'Parsed contents' based on a sorted list of primary model statements under the heading 'Contents'. In the first line, the length expression used is 'Fierding miil', which is a quarter mile. (What type of mile is not stated.) So, what we have is $\frac{1}{4} \cdot \frac{3}{4} = \frac{3}{16}$, that is, 0.1875 miles of an unknown type, hence the expression in the column to the right. The statements in the other lines are made in similar ways, noting that 'Maalte Miile' in lines 2, 5, and 6 are taken to mean modern, measured miles, and that in line 4, a day's travel

Contents	Parsed contents
3/4 [Fierding miil] vejs	<spaceDistanceMileUnknown>0.1875</spaceDistanceMileUnknown>
3/4 vejs Maalte Miile	<spaceDistanceMileNew>0.75</spaceDistanceMileNew>
3/8:- miil	<spaceDistanceMileUnknown>0.375</spaceDistanceMileUnknown>
3 dags Reisse	<spaceDistanceDayTravel>3</spaceDistanceDayTravel>
3 maalte miile	<spaceDistanceMileNew>3</spaceDistanceMileNew>
3 maalte Miile	<spaceDistanceMileNew>3</spaceDistanceMileNew>
3 Miil	<spaceDistanceMileUnknown>3</spaceDistanceMileUnknown>
4 1/2 miil	<spaceDistanceMileUnknown>4.5</spaceDistanceMileUnknown>

Figure 3.4: Fragment of the added nodes window of GeoModelText showing an example of computer-assisted manual stepwise formalisation.

('dags Reisse') is read as an expression of distance.

Other parts are written as software algorithms in GeoModelText. When I run an experiment and start a computer job producing a set of output maps, the program begins with creating a formalised model using as an input the primary model, strengthened by manual formalisations like the ones just described. For example, it begins with 1.25 miles of unknown type and 'decides' that this is, say, 10 kilometres, and all occurrences of the direction 'east' are re-calculated to 80°, 90°, 100°, or another number of degrees entered as a parameter value. These choices are also under my control, as the software making the recalculation was written by me, and the parameter values used to recalculate 'unknown mile' and 'east' were set by me.

So the difference between the two ways in which the formal model is created is not who is responsible, but rather how each decision is implemented. In the latter case, an algorithm exists in written form as part of the computer program. In the former case, what is done is also documented (for example in the two columns 'Contents' and 'Parsed contents' in Figure 3.4), but each case is considered individually. I also follow strict rules; algorithms may also be run by humans, but in this case the rules do not have to be followed. I can break the rules; my computer cannot. Another difference is that the values set as parameters for an algorithm can more easily be changed en bloc over many occurrences in order to test different interpretations. Thus, this method is of special importance for open choices where different values must be tried.

3.6 Vector data

Vector data consist of numbers representing places in a geometrical space, together with textual information about the places. They are used in various areas (for example in computer graphics), but in the context of this book, only their use as geographical data is considered. Each geographical object consists of a geometrical primitive such as a point, a line, or a polygon,[43] as well as its location in a geographical space. However, when we look at the text of **S1**, we see something quite different from vector data: there are no obvious links between the two types of information.

Two examples of how different they are can be seen in the expressions 'øster' (east) and '2 miile' (2 miles) from the source text. These two expressions are found in the source text and they are geographical, so pieces of information found through the reading of these two strings are included in the model, but the strings have no meaning in a context of vector data. The stepwise formalisation process is used to make meaningful vector data based on such text strings. We have already seen the first stages of the process, and have now come to the re-coding of data from the formal model to vector data.

This is not straightforward. In order to understand how the locations of places mentioned in **S1** can be expressed as vector data, we need to understand the distinction between absolute and relative locations in cartography. An absolute location is a location specified in a coordinate system. A relative location is a location expressed through a textual expression such as 'two miles down the river from Røros'.[44]

We have access only to place names and relative locations in **S1**; there are no absolute locations. When two places are spatially related by expressions such as 'øster' and '2 miil', we know something about their relative locations, but we know nothing about the absolute location of either of them. If we have a set of spatially related places in the model, we need several steps to convert this to the vector data needed to make a map, including giving one of the places an arbitrary coordinate. A natural choice is to give one place the coordinate $(0, 0)$. Once that is done, the others can be given coordinates

[43] Other and more complex types also exist, but are not used in this project.

[44] The wording is somewhat peculiar because a value in a coordinate system is actually used to specify a place relative to a fix point. In the case of longitude-latitude the fix point is the crossing between Equator and the Greenwich meridian. Still, this is the way these geographical expressions are used.

based on the relationships between them. In other words, we have a set of interrelated places floating at an undefined location in space. The only way to fix it is to give one of the places arbitrary coordinates. Further examples of how this is done will follow in the case studies in Chapter 4.

Finding spatial relationships between places includes the use of co-reference information. This means that any differences between two place names outside of their referring to different real-world places fall off at this stage. Could such differences exist? Could there be spatially meaningful differences between different place names referring to the same place? This is possible in principle, given the descriptive nature of place names in many languages.[45] If the name of a lake included a description claiming that the lake is quite round in outline, this description would then restrict the way the lake could be drawn. However, such possibilities are only speculative; I have found no spatially meaningful differences between different expressions referring to the same place in this project.

3.7 Maps

The maps produced in the experiments follow the definition from Section 2.1. But they are a special type of maps, made from one source only: my reading of **S1** as it is processed through critical stepwise formalisation. The main geometrical specifications of the maps were already made in the vector file. Seen in that perspective, what is added in the map production is only the symbols with their layout, for example colour and form. Still, the difference is felt stronger by a user. Seeing a vector data file on the one hand and a map on the other are two quite different experiences for a human observer.

As there are no references to absolute locations in **S1**, all places are either referred to by the use of names, through other strings referring to places, or through relative expressions. Examples of how these three ways are used to refer to places can all be found in the following citation:

> Their newly settled farms are located, as is the farm Qvælien, easternmost in Northern Finlje, 11 old miles from the border mark Svanesteenen;[46]

[45] For an example for the Sami language see Mathisen (1997, 126–7). See also Basso (1996).

[46] 'Deris Nyebyggerplatzer ligge, ligesom gaarden *Qvælien* østerst i denne bøjd Nordre *Finlje* 11^{ve} gamle Miile fra Grændse-Mærcket *Svanesteenen*' (**S1**, 141).

The place identifiers used in the citation are the following:

place names Qvælien, Northern Finlje, Svanesteenen

other referring string Their newly settled farms

relative expressions easternmost in Northern Finlje, 11 old Miles from the border mark Svanesteenen[47]

The lack of absolute locations means that no reference to a place can be located in relation to any other place reference on the map unless there is an explicit relationship between them in the model, either direct or indirect. They cannot be part of the same map without such a relationship.

When the two places are included on a map, the relationship between them becomes implicit, expressing a spatial relationship. In a text, such expressions must be explicit. When no such explicit relationship, direct or indirect, exists in the text fragment on which the model is to be based, the only way to enter such a relationship into the model, and thus onto the map, would be by guessing.[48]

I have chosen not to make such guesses in the case of disconnected places; that is, when there is no indication of the spatial relationship between places, apart from the fact that both are in a general area such as a county. Then the two places must be made parts of two different maps. How many maps a text fragment leads to the creation of then becomes an important indication of how the spatial information is expressed in the text, because it clarifies how many of the places are directly or indirectly spatially connected.

Two important observations can be made from this. First, the properties are central in the modelling, as they link the entities in the model together. This shows the importance of the triplets representing the textual network of places. Second, any information that exists in isolation, not connected to other parts of the model, falls off. Without any properties connecting two

[47]These two expressions can be seen as two overlapping areas, of which the intersection is the area referred to. Alternatively, they can be seen as forming one area as a whole. The result may be the same when the expression is read by a knowledgeable human, but differences in the modelling process could possibly lead to different results in the experiment. Because of these differences, the interpretation which is not chosen will fall off.

[48]This is because of the choice to exclude contextual information. External knowledge would often have given the location of places on pre-existing maps and thus their spatial relationships to each other.

places in the model, directly or indirectly, they must be put on two different maps.

But something else happens here as well. Once the map is produced, the explicit textual relationships between the places are lost. Each place is located according to its coordinates, and it is related to all other places on the same map as a consequence of the coordinates used in placing them. Instead of explicit relationships between named places, implicit spatial relationships between map objects are established. What was 'east' is now an accurate direction which can be measured to for example 96.5°. This direction is indifferent as to whether the specific relationship was mentioned in the text or can only be indirectly deduced. The networks of places are not longer explicit. This important point will be revisited later.

In order to clarify some of the implications of the making of maps in this project, GIS must be mentioned. GIS stands for *Geographical Information Systems* and refer to computer-based systems only. Many GIS tools exist. In this project I have mainly used the free software application *Quantum GIS*.[49]

Although digital maps are images, their production is based on and steered by a set of numbers, which are the vector data we saw above.[50] The map is seen as a two-dimensional coordinate system with X and Y axes. A point is represented by two numbers, whereas a rectangle can be represented by eight numbers—that is, two for each of the corner points.[51] Figure 3.5 shows an example. Such sets of numbers are what make up vector data.

GIS grew out of a cartographical tradition which aimed at map production. This is still visible today. My use of the tools is quite simple, and I had no problem doing what I wanted, which was to use GIS to display maps. That is, I read vector data into qGIS and define symbols and other features of the map layout in order to produce informative maps. Maps in qGIS are used interactively and are exported as static map documents printed in this book.

Some sort of GIS software is needed to make a map from vector data.[52] Based on the software, as well as on parameters entered by an operator, various maps can be made. The tool in itself is no guarantee that the resulting

[49]qGIS, webpage: http://www.qgis.org/ (checked 2015-04-03).

[50]There are other sources for digital maps not discussed here, for example raster data.

[51]There are other ways to represent rectangles as well.

[52]Strictly speaking, any software being able to visualise vector data can be used, including several web browsers. But in most cases GIS software will be needed in order for the user to experience useful interaction with the map.

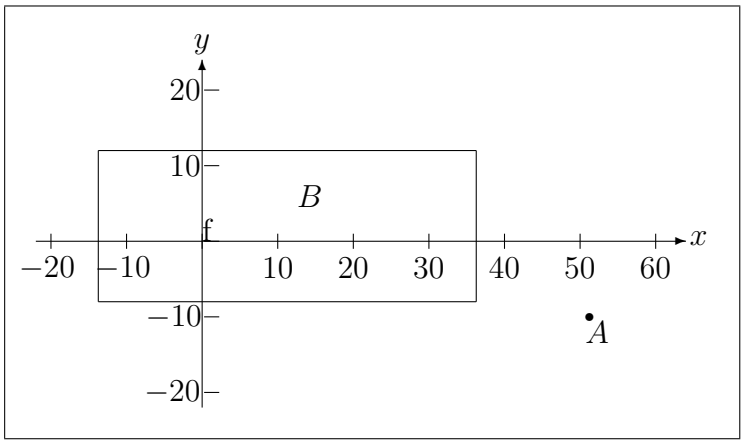

Figure 3.5: Vector data example with point $A = (50, -10)$ and rectangle $B = ((-15, -8), (35, -8), (35, 12), (-15, 12))$.

map will be useful or aesthetically pleasing. Creating good maps is a skill which takes much training, even with the best of tools (MacEachren 2004). The maps I present in this book break fundamental rules for map design and their visual appearances are quite different from conventional maps. That is intentional.

The maps are based on sets of vector data which control where the elements are spatially located and how they look, but not fully. Many choices are made, affecting the visual appearance as well as details of the spatial relationships. The spatial relationships are established in the vector data, but not fully specified in detail by them. One example of this lack of full specificity is that symbols are routinely moved short distances in order to avoid floating into other symbols.

A map represents an interpretation of the data on which it is based, and errors can be introduced at many levels. In my use of GIS for visualisation, I am not interested in different interpretations of vector data by the GIS software; that is, I do not compare how different types of symbols give better or worse maps. I am only interested in different vector data coming out of my model. I focus on significant spatial differences (for example significant differences in distances and directions between places), rather than on presentational differences (for example in symbology).

The algorithmic map production, consisting of computer-based as well as manual steps, is sufficient to find the results in the current project and to doc-

ument my findings, as we will see in Chapter 4. It works reasonably well for small sets of data, typically the data included in the model of one paragraph of text. A system for automatic generation of vector data for larger models was not necessary for this project. It may be, however, that better mapping algorithms would have uncovered things I did not find in this project, and such algorithms may be useful for other research questions. Developing more advanced map drawing algorithms based on conceptual models would be an interesting area for further research.

3.8 Critical stepwise formalisation as a method

This chapter has introduced the method of critical stepwise formalisation through an example of a practical implementation based on one type of media transformation, from text to map. The input was one specific media product, the text **S1**. The example showed one computer application used in one research project. What are the general characteristics of the method which covers not only this example but all other examples which could reasonably be seen as applications of the method?

To the best of my knowledge critical stepwise formalisation has not been used outside of the project decribed in this book. As a new method my claim is that it will prove useful for a number of different studies in the future. In the following I will present the method as a general framework for reseach. I will start by contextualising it within current research and development practice in digital humanities and computer science and then go on to see it in the light of recent theory in intermedia studies.

Critical stepwise formalisation is a modelling method in the digital humanities sense. It is based on the concept of modelling in McCarty (2005) and inspired by the concept of deformation (McGann 2001). It is also based on stepwise formalisation in computer science, a process of making unstructured data more and more structured in a stepwise manner, which is used in various application areas including medicine (Schmitt et al. 2006, Sedlmayr et al. 2007) and mathematics (Gravemeijer 1999, Lange 2008). It is also a semantic technology (Völkel 2011). In this book the concept is reconfigured into a heuristic research strategy: rather than producing output the purpose is to gain new knowledge through understanding and learning from the problems faced in the modelling process. In critical stepwise formalisation, modelling is seen not only as steps in the way from one qualified medium to

the other but also as a series of temporal states in a process of coming to know.

So while modelling as it is applied here is based on techniques from computer science, these methods are applied in a different way. In the 'chain' of models we see for example in E-R modelling[53] we find a development from the conceptual level through the formal to the implementation level, based on an analysis of an area of application.[54] In critical stepwise formalisation the starting point is a concrete media expression. Then a series of conceptual models are built up, one based on the other, until we end on the other side of the intermedial modelling process with other concrete media expressions, this time in another qualified medium.

While the focus in E-R modelling is to build a model for a concrete implementation based on an area of activity, the focus in critical stepwise formalisation is to create a model of a concrete expression which is used as a model for other concrete expressions in a different qualified medium. If the expression we start with is a text, then the other qualified medium can be a graphical expression such as a map or a figure.

Stepwise formalisation as a method in computer science, medicine, mathematics, and elsewhere has focused on reaching practical goals; the method is a way to get from A to B, so to speak. In this chapter I have established stepwise formalisation as a heuristic research strategy focusing on what happens during the course of action rather than on the end result.

Specifically what is lost or what causes problems in the steps from A to B is in focus. The purpose is to gain new knowledge through understanding and learning from the problems faced in the modelling process. The purpose of the method is not to create the target media expression per se (B) but rather to understand the choices made and the problems faced in the transformation process. This is a core element of the method: variations are explored not as much in order to learn from different resulting expressions as it is to learn from the process itself.

Critical stepwise formalisation will always include the following stages:

1. A source media product

2. A primary model

[53]E-R modelling in computer science is an abstract way of describing data with the aim of developing a database. See for example Simsion & Witt (2005).

[54]This description is idealised; practical model development is not a linear process.

3. One or more derivate models

4. One or more target media products

Each stage is the result of a number of steps from the previous stage. Each step is the process in which one statement in the modelling system is changed from one form to another. The whole state of the modelling system at a certain point in the stepwise formalisation is called a stage. So while a step will always be local to one statement, a stage will always represent all statements found at a certain level of formalisation. The stages are arbitrary and could in principle have been chosen differently., but in an implementation applied to a certain research project a stage will typically represent a level of understanding which is meaningful to the modeller.

The method includes a set of media transformations from one media product to a number of media products (Elleström 2014). More specifically it is a transmediation: what is modelled and transferred to the target media products are the media characteristics, not the qualified medium itself.

In order to fully understand critical stepwise formalisation as a transmediation process the modalities of the media has to be taken into consideration. Media modalities will be discussed in Chapter 6, and will be used in a further discussion of critical stepwise formalisation as a transmediation process in Chapter 8. What is important to understand at this point is the double relationship between critical stepwise formalisation and intermedia studies. Critical stepwise formalisation is based on the theoretical understanding of intermedia studies, specifically as it is expressed in Elleström (2014). The other side of the coin is the use of the method to create concrete results. Intermedia studies can be enriched by the results from this kind of computer assisted modelling. Results from the study described here, and from future studies using critical stepwise formalisation, will be available as evidence for future work in intermedia studies.

What is put into the model is not the computer's 'understanding' based on methods such as topic modelling or counting of words. It is rather the deep understanding of a knowledgeable human reader. Then this deep understanding is forced into the well defined boxes of a modelling language, and then moved to different boxes, forcing even more deformation of the contents. The human operator will then study the problems of this process based on a deep understanding of the long tradition of representation, semiotics, and interart/intermedia studies in the humanities.

The relationships between different media and different art forms have been studied for a long time and a deep understanding has to be based on an equally deep study and comprehension of how the media creates images, feelings, and understanding in the human recipient. This includes media differences operating at various levels involding material, sensorial, spatiotemporal, and semiotic modalities of each qualified medium, and of each media product (Elleström 2010). It influences what we comprehend at the levels of meaning and aesthetics. Like semiotics it focuses on some part of the reality at the cost of others. 'The strength of semiotic analysis is its capacity to pinpoint vital mechanisms that produce basic meaning. The weakness is its limited capacity to go into hermeneutical depths.' (Elleström 2013)

Critical stepwise formalisation is not a solution to all problems related to media differences, but the movement back and forth between modelling, semiotic studies, and hermeneutical analysis is a useful way to develop a deeper understanding of media differences. Intermedia studies and critical stepwise formalisation are not only means to understand media differences better but also to obtain a deeper understanding of media and of specific media products. It is common for many methods in digital humanities that they complement rather than replace previous methods. Another example is macroanalysis, which is not a method to replace close reading but rather to complement it.

While critical stepwise formalisation is not strictly speaking depending on the use of computers, a good modelling tool will greatly improve the usefulness of the method. It is necessary for the detection of media differences as something more specific than general traits to model the source media product in great detail. The central idea behind the method is to get beyond the normal meaning-generating readings made by humans. At the same time the method differs from statistical methods such as macroanalysis by the focus on the meaning of a media expression as it is captured by a human reader rather than on countable tokens. The size of the material is larger than what can be easily handled by a human mind, but smaller than what is usually used for statistical analysis.

Part II

Chapter 4

Case studies

This chapter will describe case studies in which modelling in the form of critical stepwise formalisation has been applied. The research was a detailed source based study of how geographical descriptions read from a text can be expressed as maps. The case studies exemplify how critical stepwise formalisation can be applied to intermedia studies. The goal of the model building was not the models and maps as such, but rather the process of modelling—that is, to learn from creating and manipulating the models.[1]

4.1 Results from the setup processes

The model and the tools used to create it were necessary to run the case studies described in this chapter. During the setup of the modelling system, new knowledge about the object of study was also gained. This provides a useful background for the results to be found in the case studies.

I will start by presenting the three most important areas in which the development of the tool and the creation of the model led to better understanding of **S1** and of how I could experiment on its model. These results led to changes in my understanding of how the model represents the text and opened up new areas in which to seek answers to the research questions. Thus, it influenced how the scene was set for the case studies. They were interim results pointing towards the next stage of the research project, but also towards the main results.

[1] A summary of some of the results from the case studies can be found in Eide (2013).

4.1.1 Directions

In **S1**, a system of at most 16 directions seems to be used: **north**, **north north east**, **north east**, and so on. In order to formalise these directions, I started entering single numeric values for them. This was a rather naïve reading of the data; on second thought, it became clear that when something is east of something else it does not follow that it is in the exact direction of 90°. It is rather in a general eastern direction. On examining this more closely, I came to the understanding that each direction can best be seen as a sector in which possible locations can be found.

What would a word like 'east' mean to Schnitler, or to the witnesses? Looking into the longer history of spatial expressions in Norway, we can see how Holtsmark (1961) describes the Nordic medieval system in which a direction includes the area around the angle. Old Norse used a system of 8 directions. In line with this system, **north** can be taken to represent degrees $337\frac{1}{2}$ to $22\frac{1}{2}$, **north east** $22\frac{1}{2}$ to $67\frac{1}{2}$, **east** $67\frac{1}{2}$ to $112\frac{1}{2}$, and so on. This system was still in use in Norway in the eighteenth century.[2] It can easily be doubled to a system of 16, which is still used by many people in Norway today.

In the Sami system, the word used for 'north' also means 'towards the sea' or 'down the fjord'; see 'dâveb' in Nielsen & Nesheim (1932, vol. I: 500). Similar double meanings are also included for the other cardinal directions. This sea-oriented directional system is presumed to be the traditional one. I have not been able to trace any usage of this system in the statements from Sami witnesses, and it is likely that the interpreters would change any expression based on it to the Norwegian system as part of the translation.

In principle, any specific direction within the sector is as good as any other when I choose a value for my formalised model. Any such direction will represent one possible reading of the text. If we have no other information, we cannot say that one reading is better than another. As a starting point, I used the middle value of the sector in all cases, knowing that I have a leeway based on at least 16 directions, that is, of at least $22\frac{1}{2}^\circ$.

So 90° is used for east, as originally planned, but this is now seen as an arbitrary choice, and it is changed in the case studies in order to show different interpretations of the text. Any value between $78\frac{3}{4}^\circ$ and $101\frac{1}{4}^\circ$ is equally likely to represent east, and any value between 0° and 180° is

[2] Personal communication from the lexicographer Oddrun Grønvik on October 25, 2010.

possible.[3] Other values would be considered wrong. Witnesses being wrong is also a possibility, of course, but in this project I model their statements, not what I consider to be true in the landscape.

4.1.2 Distances

The expression 'mile' needs to be divided into at least five different types of miles used in **S1**.[4] In addition, there are other expressions of relations used, such as statements of closeness and contiguity.

Each use of each of the types is unique. As there are no exact measurements behind the statements in the text, we are dealing with a set of particulars which are only roughly similar. These particulars are grouped, as people do when they use expressions such as 'mile'. People used to travelling a landscape can give reasonably accurate measurements of distances after having walked the terrain.

However, it is difficult for me to evaluate what was meant by their statements, because many of the types are unknown to me. What kind of mile is used and what length each of them was supposed to have is unknown to a modern reader in many cases. We do not even know what a measurement is meant to measure, spatial distance or travel time, even if the names may indicate one or the other, for example 'day's travel' ('dagsreise'). It is even questionable whether spatial distance and travel time were indeed different types of measurement seen from the eighteenth-century perspective. One of the few concrete facts we do have is the length an official (new) mile was supposed to have: 11.3 kilometres.

So the situation for distances is similar to the one for directions discussed above. Exact distances cannot be known. This means that not only *can* I choose an arbitrary value within a range of possible values and potentially change this choice, I actually *have to* make such a choice.

[3] Although 16 directions are used in some expressions in **S1**, with phrases such as east-north-east, we still do not know if not systems of 8, 4 and even 2 may be used in other situations. This is similar to the problem of precision in Ptolomy as discussed by Isaksen (2012). Examples of systems of 2 are found in Europe (Eastern vs. Western Europe), and also in Norway (Northern vs. Southern Norway). Expressions such as Northern and Southern used in farm names in **S1** seems to be based on a system of 4.

[4] There are also other length measurements used in **S1**, such as rifle shot; se the discussion in Eide (2011) for details.

4.1.3 Coordinate systems

What are the consequences for my work of the lack of absolute locations in **S1**? The idea of absolute locations in cartography is based on an imaginary coordinate grid superimposed on the surface of the earth according to mathematical rules. The whole or a part of this grid is copied down to the document becoming a map, forming its fundamental spatial structure. Any expression in the syntactics[5] of such a coordinate system identifies an absolute location in the geographical sense of 'absolute'. On a map, interpolation gives absolute locations for the entire surface of the map, although it is expressed explicitly for the grid only. For a text, a similar effect is found if one place is specified absolutely and other places are specified in relationship to this first place. But the specifications of the related places are less accurate, and their locations are not absolute.

In **S1** there are no absolute locations. No coordinate system is ever mentioned. A place name consists of one or more words which evoke the notion of a particular place (Olsen 1928, 5). This evocation may depend on the context. If we are reading about Australia, 'Victoria' may evoke a different place than it would if we were reading about British Columbia. In the discussion here, place names are seen together with other strings referring to places. All such strings, including place names, refer to a place in the real world by virtue of its letters and by its textual context. The referring string also co-refers with places in other representations of the real-world, including maps, texts, and human memory.

An important characteristic of digital mapping is that information can easily be combined spatially. If one makes one map layer based on **S1** and another map layer based on one of the maps Schnitler drew, then both of them can be combined with a third layer based on a modern map of Scandinavia. This is done by linking coordinates for a number of fixed points and then extrapolating the alignment of the other parts of the map layers. The result will be inaccurate and will include errors, but it may still be useful for many purposes.

In this project such a process is excluded by definition. I have specifically forbidden myself any links to such external information in the interpretation involved in building up the model. The experiments are done without the use of pre-existing maps. This means that I cannot use the fact that I know where

[5] 'Syntactics' is used by MacEachren (2004, 234–6) in the general semiotic meaning of 'interrelationships among signs' because 'syntax' is not really appropriate for maps.

Trondheim and Røros are located in order to add geographical coordinates to the place names. I have only what I can read from the text, and the text contains only relationships between places referred to by place names or other strings of text. Any map I create will thus be floating outside all predefined coordinate systems. If I know nothing about the relationships between a place and other places from the text, it can only rest alone in its own map.

4.2 Experimental setup

The starting point for the experiments described in this chapter is a text and a hypothesis. The text, **S1**, was introduced in Chapter 1 together with a rationale for using it in this research. My hypothesis to be examined in the experiment is:

> Types of geographical information exist that can be stored in and read from texts, but that are impossible to express as geographical maps without significant loss of meaning.

I evaluate the hypothesis by running a series of experiments on a computer-based conceptual model of **S1**. By modelling the geographical information I read from my source text into conceptual structures, and by trying to express these conceptual structures as maps, I test the hypothesis.

This chapter will show how the results from the experiments support the hypothesis. When all the spatial information which can be read from small sections of **S1** is extracted from the text into a model and maps are made based on this model, one cannot avoid losing something important. I will describe in detail how the experiments were done, and what exactly was lost in the process from text to map. I will also show that the loss of information was not caused by the modelling itself, but rather by inherent differences between **S1**, on the one hand, and maps as they are defined in this book, on the other. All the answers found in the experiments are based on **S1** alone; a generalisation of the results will follow in Part III.

The experiments were organised as four case studies, based on the methodological and practical experiences from the development, setup and testing described in Chapter 3. The text fragments used are natural units within the text, and each of the fragments was treated as a separate unit. Two of the case studies were based on complete witness statements, and the other

two on shorter sections consisting of Schnitler's own words, that is, on parts of **S1** not presented as a direct representation of other people's testimonies or manuscripts.

The two witnesses whose testimonies are used in the case studies have been chosen to be different as persons: one is an old Sami who was previously a reindeer herder, and the other is a young Norwegian farmer living on a farm he settled himself. They lived quite close to each other.

4.3 Case 1: Povel Olsen

Povel[6] was a settler on the shore of lake Frostviig. He was born at the farm Leerbaken[7] in the same area around 1708.[8] *Povel* lived on and farmed a newly settled farm, as did his younger brother and neighbour, who was also a witness (**S1**, 143). Their homesteads were situated 15 kilometres to the north-north-east of where they were born, as the crow flies.[9] Both the brothers belonged to a community of hard-working peasants; they grew up in poverty and were able to scratch a living and a surplus for taxes out of quite marginal land. Povel was interviewed on July 25, 1742 at the farm Sandviig,[10] which was less than 10 kilometres from the farm on which he grew up, and some 20 kilometres as the crow flies south-south-west of the farm he settled. He was clearly in his home area when he was interviewed.

His statement amounts to 13 paragraphs with a total of 771 words. This is a medium-sized interview. Several parts of what he said in court were not recorded as such; instead, they were replaced by statements that his answers were in line with those of specific previous witnesses. This is in line with standard procedure.

In the following, two paragraphs from his statement will be studied in

[6]Olsen is not a surname, it is a patronym; Povel was the son of Ole. Therefore I use the given name to denote people like him. This was different for people like Peter Schnitler; Schnitler is a surname. As for Sami people, their naming system was not acknowledged by the government (Hansen & Olsen 2004, 322) and the Norwegian names we know them by in the sources are likely to be different from the names used in their Sami communities.

[7]Modern name: *Leirbakken*, farm no. 8 in Lierne (Berg 1996, 153–4; Rygh 1897, vol. 15: 287).

[8]His age is claimed to be 34 years in 1742 (**S1**, 141).

[9]All measurements in the biography are based on modern maps.

[10]Modern name: *Sandviken*, farm No. 22 in Lierne (Berg 1996, 427–40; Rygh 1897, vol. 15: 288).

detail. For each of these two paragraphs, an English translation of the text will first be shown, together with the Danish original, and then the modelling and experiment process, including the creation of maps, will be discussed. Then the scope will be widened and the results from the modelling of all of Povel's statements will be discussed.

4.3.1 Paragraph 42735[11]

The first paragraph to be examined reads:

> The landscape west of the settlers here is spruce and birch forest with mountains, and there are no neighbouring farmers, before 8 miles to the west *Harran* in the parish of *Overhalden*. However, a few *lap finns* dwell in between.[12]

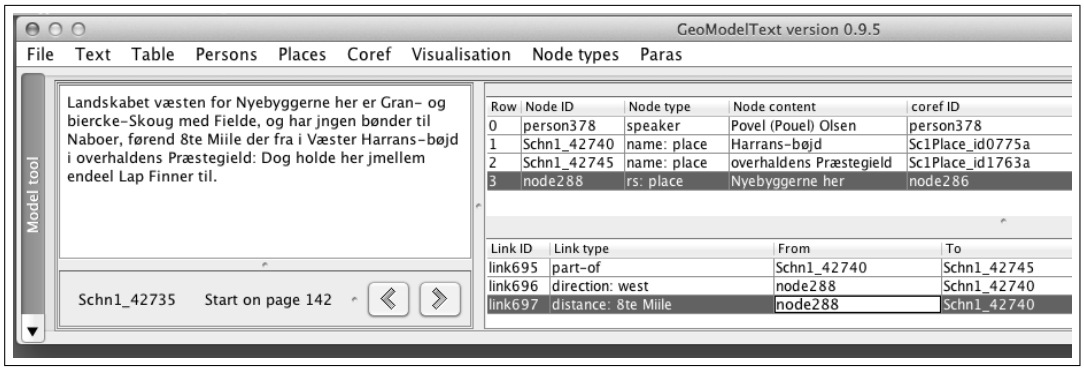

Figure 4.1: Screenshot from the modelling tool showing paragraph 42735.

Primary model

Two place names were identified in the TEI version of this paragraph: 'Harrans-bøjd' and 'overhaldens Præstegield'. A third place identified in the text during manual modelling was 'Nyebyggerne her' ('the settlers here') seen as a

[11] 42735 is the ID number in GeoModelText.

[12] 'Landskabet væsten for Nyebyggerne her er Gran- og biercke-Skoug med Fielde, og har jngen bønder til Naboer, førend 8te Miile der fra i Væster *Harrans*-bøjd i *overhaldens* Præstegield: Dog holde her jmellem endeel *Lap Finner* til.' (**S1** 142)

- **speaker:** Povel (Pouel) Olsen
- **place name:** Harrans-bøjd
  - Harrans-bøjd → **is part of** → overhaldens Præstegield
- **place name:** overhaldens Præstegield
- **rs: place:** Nyebyggerne her
  - Nyebyggerne her → **in direction west is** → Harrans-bøjd
  - Nyebyggerne her → **in distance 8 miles is** → Harrans-bøjd
  - Nyebyggerne her → **in direction west is** → Landskabet væsten for Nyebyggerne her
- **rs: place:** Landskabet væsten for Nyebyggerne her
  - Landskabet væsten for Nyebyggerne her → **in direction west is** → Harrans-bøjd
  - Landskabet væsten for Nyebyggerne her → **has type** → Gran- og biercke-Skoug med Fielde
  - Landskabet væsten for Nyebyggerne her → **is inhabited by** → ingen bønder
  - Landskabet væsten for Nyebyggerne her → **is inhabited by** → endeel Lap Finner
- **type:** Gran- og biercke-Skoug med Fielde
- **non-existance:** ingen bønder
- **rs: people group:** endeel Lap Finner

Figure 4.2: The statements in the primary model of the text of paragraph 42735.

place, that is, the place settled by the settlers. A screenshot of GeoModel-Text as it was used in the modelling of this paragraph can be seen in Figure 4.1, with the speaker, the three place references, and also three relationships between the places.

A list version of the part of the model which was created based on this paragraph can be seen in Figure 4.2. The three places referred to in the text and the distances and directions between them are modelled. In addition, a fourth place is added, the landscape west of the place where the settlers have their farms. Even if this area is not really described as a geographical object, features are connected to it. To be able to include these features in the model, 'Landskabet væsten for Nyebyggerne her' ('The landscape west of

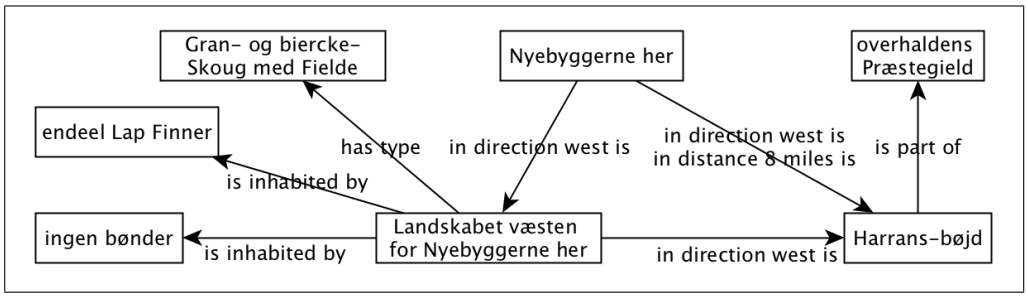

Figure 4.3: The relationships between the statements from Figure 4.2 expressed graphically.

the Settlers here') is added as another string referring to a place. The place is located between 'Nyebyggerne her' and 'Harrans-bøjd', which is shown by two triples with 'in direction west is' as properties.

The spatial relationships between the places with links to the inhabitants and types are shown as a graph in Figure 4.3. Each 'place name' was encoded as such in the TEI document, whereas 'rs: place' denotes referring strings other than place names. The triples are shown in Figure 4.2 with arrows between the domain, property, and range.

There are several features connected to 'Landskabet væsten for Nyebyggerne her'. First, it is given a type, which is a description of the landscape type of the area. Then there are two triples with 'is inhabited by' as their properties. In order to understand these two, the reading of the text must be explained in more detail.

It is stated in the text that the settlers have no farmers as neighbours before Harren, which is 8 miles to the west. The positive part of the statement is modelled as such: once one goes 8 miles to the west, one will find the place Harran, part of the parish of Overhalla. In Harran there are farmers to be found. These farmers are the nearest farming neighbours to our settlers, at least in that direction.[13]

The problem is the explicit statement that there are no farmers in the area between the settlers and Harran. This is modelled in the triple with 'ingen bønder' ('no farmers') as the range. This modelling is problematic in two different ways. First, is this really modelling the negative statement?

[13]I could have added an undefined number of farms as part of Harran, but I omit this for the sake of simplicity.

How should we say in the language of the model that there are no farms in a specific area? The negative statement must be modelled differently from how we model the other similar-looking fact, namely, that there are 'endeel Lap Finner' (some Samis) in the area. In the latter case, the land of the Sami is a part of the area, spatially speaking, but we are not modelling any farms. The witness is not pointing to a farm, saying 'that farm is not in the area I am talking about'. He is rather saying something about the area: that it is an area without farms. Thus, it has to be modelled as a triple in which the domain is the area where there are no farms, the property is 'is inhabited by' and the range is 'no farmers'. This can be done, but we will see below that it is difficult to map such a statement.

To make this distinction clearer, it is necessary to understand that we have two different types of statements. First, we have a negative statement: there are no farmers in a certain area. Then we have the two other statements, of an area where a few Sami people dwell and an area with spruce and birch. In the latter two the ranges are actual entities—Sami people and vegetation, respectively. So instead of a specification of the landscape, as in the case of nonexistence, we have here a relationship between the landscape and other existing things.

Another problem with the modelling is the fuzzy borders of the areas. We do not know the northern and the southern borders of the area where there are no farmers. The borders of the area are fuzzy, and I cannot know if it is similar to the other areas we discussed above, because the text is silent about this. In the model, all three areas—that is, the one with spruce and birch, the one without farmers, and the one with the Sami—are seen as the same spatial area. This is an interpretation; I have made a choice about how to read the text. Other choices fall off.

Formalised model

In order to get from the primary to the formalised model, choices had to be made. How should the statements shown in Figure 4.2 be interpreted? Based on the results from the previous chapter, the direction 'west' was formalised to 270°. As for the 8 miles, we do not know what kind of miles they are talking about, so the category 'miles unknown' was used, in this case formalised to 8000 meters.

The property expressing the fact that Harran is part of Overhalden was formalised as 'part of'. The last three properties, of types 'has type' and

'is inhabited by', were added not as properties connecting two places together, but rather as properties expressing some further information about the place that was the domain of the expressions, namely 'Landskabet væsten for Nyebyggerne her'. The formalisation of the expression 'ingen bønder' ('no farmers') is one solution to the problem of negation, a solution which makes sense in the context of the current argument.

In addition to this, co-references are added to the place references, connecting them to the other textual expressions referring to the same places. This means that for Harran, the ID used in the further modelling will be the value of the element in the place name index, and the link to this specific use of the place name is no longer maintained.[14]

Vector data and maps

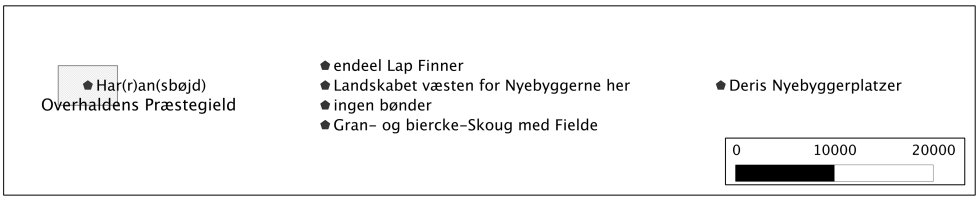

Figure 4.4: Map based on the model of the text of paragraph 42735. Scale in metres.

Before maps could be created, some further choices had to be made, including the size of the polygon for 'overhaldens Præstegield' and the fact that the other places are expressed as points. The most striking feature of the map, which can be seen in Figure 4.4, is the fact that it consists of only a few elements. It is also true that a rectangle looks rather strange as a symbol on a map of this area from that time. There is, however, nothing in the decontextualised text speaking against the choice of a rectangle. It is also worth noting that even if the points are points in the vector data, they

[14]The use of co-reference does not add any links to this part of the model, as none of the place references in the paragraph co-refer. However, alterations of place names can be seen in the map in Figure 4.4; for instance, 'Harrans-bøjd' (the form used in the specific paragraph) is replaced by 'Har(r)an(sbøjd)', the form from the place name index encapsulating various spellings of the name.

are presented on the map as small polygons. There is no way to present a visible point other than as an area.

A number of statements are added as texts in the middle of the map: 'Gran- og biercke-Skoug med Fielde' ('Spruce and birch Forest with Mountains'), 'ingen bønder' ('no farmers') and 'endeel Lap Finner' ('some Samis'). Together with them is the area they are connected to, 'Landskabet væsten for Nyebyggerne her' ('The area west of the Settlers here').

The symbol for 'no farmers' is awkward, well in line with the problems we had in the modelling of this fact all the way. Why use a symbol to show absence? Why not use absence to show the absence instead? The answer is that lack of any symbol for farms in the middle of the map would not say 'no farms'. A blank area on a map is usually too general to say anything about farms specifically.

The use of point symbols for the four items in the middle of the map is arbitrary and looks strange. However, to use polygons would not have been any better, as we know too little about the areas. How large should the polygons be? Normal map polygons have clear borders. Should the four areas be identical? Graphically fuzzy polygons could be a solution, and another solution would be free-floating texts without any symbol at all.

Be that as it may, the fact that it is difficult to find a good way to put these things on the map is an indication that we are on the track of something interesting. And the fact that the negation pose additional problems is an important finding which will be discussed further both in Chapter 5 and in Part III.

4.3.2 Paragraph 42677[15]

I will now show the results from experimenting on another paragraph, this time a slightly longer one with a few more relationships than the previous. The study of this paragraph focuses on the choices made when establishing the formalised model and how this has consequences for the maps. The text reads:

> 3rd question: *Answer*: South of their settled farms is a 1/2 mile from there the farm *Qvæljen*, 1 mile the farm *Leerbaken*; the landscape in between there is spruce and birch forest with some

[15]Parts of this section, including Figures 4.6 and 4.7, was published in Eide (2013).

> mountain *tops*; in the area between the lake *Frostviig* and the lake *Qvæ* lie the 2 *Qværn* mountains under the farm Qvæljen; whose farmers, like the others in Northern *Finlje*, live off their meadows, fishing, shooting and often must rely on pine bread, as grain rarely grows there. —[16]

Primary model

The places referred to by names and other referring strings, as well as the spatial relationships between them, are listed in Figure 4.5. All the places except 'Nordre Finlje' are explicitly connected to one another, directly or indirectly. Some details about the use of the land and about the landscape types are omitted in this example to show more clearly the spatial relationships, as is the implicit **part of** reference to Northern Finlje.

'Qværn berger' could have been interpreted differently. It could be that it was not used as a place name, but rather a common noun phrase referring to the two mountains where they cut millstones (*qværnstene*). This would, however, not lead to any substantial changes in the modelling; the only change would be that the place name would be replaced by a referring string.

Formalised model

In the creation of the formalised model, many interpretations had to be made. The following is a list of a few of them:

1. South: 180°, that is, straight down.
2. Default width and length of a place polygon when no measurements are given: $4000 * 6000$ meters.
3. Default distance in X and Y direction of something between something else, when distance is not given: $500 * 200$ meters. This puts one of the outer objects right and a little up; the other one is left and a little down from the centre object.

[16] 3de Spørsmaal: *Resp*: Sønden for deris Nyebygde Platzer ligger der fra 1/2 Miil dend Gaard *Qvæljen*, 1: miil dend Gaard *Leerbaken*; Landskabet der jmellem er Gran- og Biercke-Skoug med nogle Field-*Ruver*; J dend Strækning jmellem *Frostviig*-vandet og *Qvæ*-Søen ligger 2de *Qværn* berger under gaarden Qvæljen; Hvilcke Bønder, Ligesom de andre af Nordre *Finlje* leeve af deris Eng-land, Fiskerie og Skytterie og Gemeenligen maa holde Sig af Furru-brød Som Sielden der Korn Voxer. — (**S1** 142)

- **place name:** Qvæljen
- **place name:** Leerbaken
- **place name:** Frostviig-vandet
- **place name:** Qvæ-Søen
- **place name:** Qværn berger
- **place name:** Qvæljen
- **place name:** Nordre Finlje
- **rs: place:** deris Nyebygde Platzer
  - deris Nyebygde Platzer → **in direction south is** → Qvæljen
  - deris Nyebygde Platzer → **in distance 1/2 mile is** → Qvæljen
  - deris Nyebygde Platzer → **in direction south is** → Leerbaken
  - deris Nyebygde Platzer → **in distance 1 mile is** → Leerbaken
- **rs: place:** 2de Qværn berger (node287)
  - 2de Qværn berger → **is part of** → Qvæljen
  - 2de Qværn berger → **is between** → Frostviig-vandet **and** Qvæ-Søen

Figure 4.5: Primary model of the text of paragraph 42677.

4. The length of a mile when type is not specified: 8000 meters.

Map

In order to make vector data and the map, I had to decide if a place is a point, a line, or a polygon. The choice is based on perspective, and often the scale of the map will decide. I have chosen to see places as polygons if their areas contain one or more other places, but as points otherwise.

The choices above led to the map shown on Figure 4.6. Choices 1 through 4 above were all more or less arbitrary, however. What if other values are chosen? I tried to replace the values in GeoModelText with the following ones:

1. South: 160°, that is, south with a slight eastern bend. It is well within what would generally be accepted as south, in the eighteenth century as well as now.

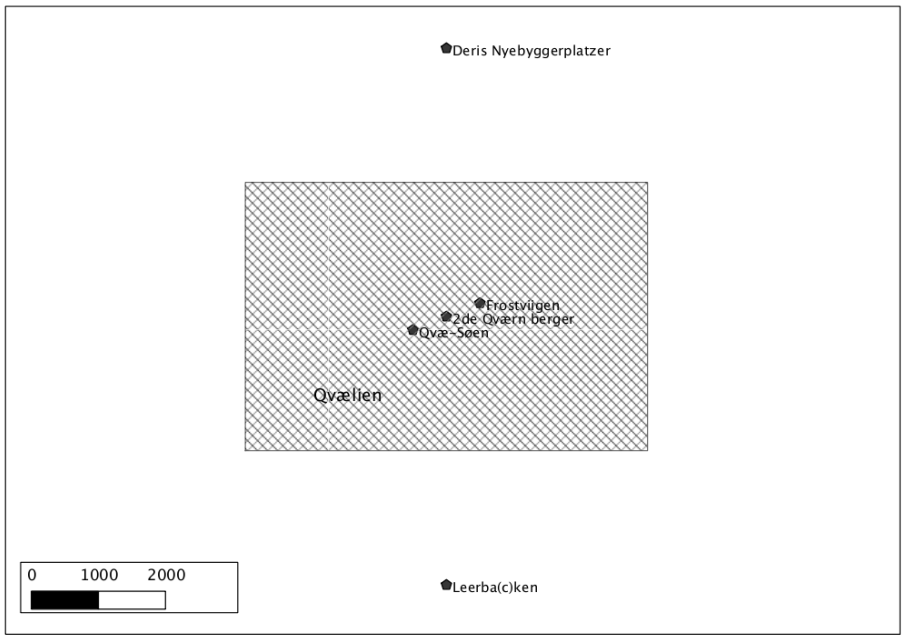

Figure 4.6: Map based on the model of the text in paragraph 42677, version 1. Scale in metres.

2. Default width and length of a place polygon when no measurements are given: $1000 * 500$ meters.

3. Default distance in X and Y direction of something between something else, when distance is not given: $1000 * 2000$ meters, which puts one of the outer objects up and a bit to the right; the other one is down and a bit to the left from the centre object.

4. The length of a mile when type is not specified: 6000 meters.

This resulted in the map found in Figure 4.7. Note that all the symbols remain the same, but the geometrical impression is still quite different. Although there are some similarities, the two maps clearly depict different landscapes. However, they are both supported by the formalised model, and, more importantly, they are both supported by the text of paragraph 42677. So they both depict the same text.

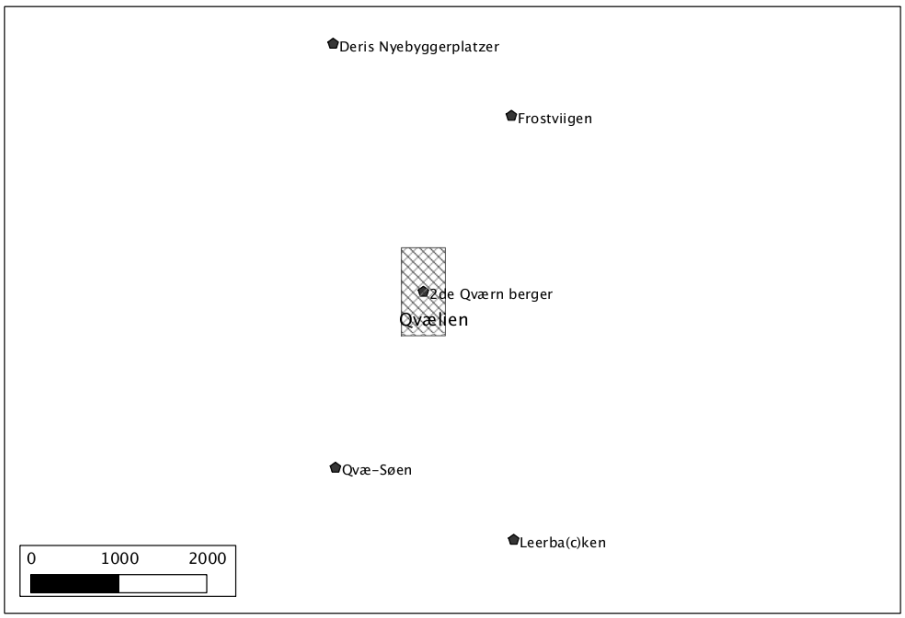

Figure 4.7: Map based on the model of the text in paragraph 42677, version 2. Scale in metres.

This example shows how the text opens up possibilities for different spatial models, which is an example of what I refer to as *underspecification*. The degree to which a text such as **S1** is underspecified is striking, given that it looks like a detailed description of the landscape. This will be discussed further in Chapter 5, where the term 'underspecification' will be formally defined, and the consequences of this result will be analysed and interpreted from different perspectives.

4.3.3 The rest of the paragraphs

Povel's witness statement includes eleven more paragraphs, in addition to the two studied in detail above. These eleven paragraphs contain variations over the same problems as the ones we have already seen, which will not be repeated. However, I will mention briefly some additional things that came up.

There are several references to how people related to the land in the witness statement made by Povel. This is geographical because it is connected

to the landscape, but it is also historical. How can a geographical model be distinguished from a historical one? The history of an area is connected to its geography, and vice versa; time and events are interconnected with space and place. The question of geographical information that cannot be put on a map depends on such distinctions. If some of the information in question is seen as historical only, and not geographical, then the question becomes irrelevant; it is not mappable because it is historical. But it is impossible to draw a line between history and geography, between time and space (Massey 2005, 47–8).

The question of context—in this case, the border between language understanding and world knowledge—is problematic. Several examples of this problem are found in Povel's witness statement. If an area is said to be close to another, the two areas are generally seen as not overlapping. This follows from reading and understanding the text. And when a place is part of another place, the latter covers the former fully, but the two are not equal. This latter understanding is also a part of understanding the textual expression.

There are, however, considerations along similar lines that are not parts of the understanding of the text, but rather of the context I have chosen to exclude. These considerations include the fact that a river is a lengthy object with a certain size, or that a lake is not rectangular. As I have made the distinction, these two latter examples are not part of language understanding, but rather of world knowledge; that is, they are parts of the context I chose not to see.

4.3.4 Seeing Povel's statement as a whole[17]

We have seen maps based on the spatial information in each of the two paragraphs studied in detail above. The automatic vector data generation of GeoModelText was not developed to a level where vector datasets, and thus maps, could be created for the full model of the statement made by Povel in his testimony. The totality of his statement will instead be discussed based on a systematic study of the number of places discussed in the interview and how they are described and connected.[18]

[17]Parts of this section, including Tables 4.1 and 4.2, was published in Eide (2013).

[18]Generating maps based on larger models is an interesting path for future research. However, the publication of such research may be better served by interactive digital publication than by the book medium.

The same problems apply for the whole of his statement as for the smaller datasets we have already investigated: many choices must be made, and some things are hard to map. In what follows, I will focus on the former. It is quite clear from the evidence already presented that it would be possible to make a whole series of different maps based on the model of Povel's full statement. The examples in Figures 4.6 and 4.7 show the principle. For most of the objects, there is more or less leeway in how they can be interpreted.

A statement giving only a very limited leeway would be 'A is exactly 1.03 km from B, in a direction of exactly 87.6°'. There are no such statements in **S1**. For distances, measured miles are the best we can hope for; they are supposed to be 11.3 km, but they are not measured accurately. The longest distance for which 1/4 mile is used is 2 1/4. The next possible value, 2 1/2 miles, is 11 per cent greater than 2 1/4 miles, so the precision is less than ±5 per cent. For one 11.3 km-long mile, even this maximum precision would give a leeway of more than 500 meters in each direction. In general, the precision seems to be significantly lower.

As for directions, the best would be a 22 1/2-degree section. So the best specified relationship between two places would then be a distance ±5 per cent in a 22 1/2-degree section. Most of the relationships are less specified than that, many of them significantly less. Some places are not spatially related at all. Where there are no spatial relationship at all between two places, neither direct nor indirect, GeoModelText splits the vector model into two different map layers.[19] The places cannot be put on the same map.

If two places are connected through distance or direction, or through either **part of** or **between** relationships, then GeoModelText puts them in the same map layer. Then choices are made as to the relative locations of the places. In some cases, these choices were taken within a rather limited room of possibilities, while in other cases the possibilities were close to unlimited. The case of no spatial connection at all is the case of unlimited possibilities, which is also where GeoModelText gives up the attempt to connect them.

The fact that I put places on different maps if they have no spatial connections is based on a choice. I could have chosen to make an arbitrary connection between spatially unrelated places in order to combine them in the same vector layer, in the same way as I chose the distance between two

[19] Technically speaking, what happens is the opposite: places are in different layers from the outset, but are combined into the same layer when spatial connections are found. However, the result is the same.

places arbitrarily when they had only the direction between them specified. The choice was made because it was important to maintain a distinction between an explicit spatial relationship, even a poorly specified one, and no such explicit relationship at all.[20]

Povel's statement includes some 80 references to places, referring to 47 different places.[21] The largest set of interconnected places coming directly out of the model of the statements made by Povel based on these criteria contains 29 places. One other set includes 5 connected places, whereas 8 small sets have one or two places.

Places		
Type	**Count**	**Relative**
Total number	47	100.0 %
Has length	2	4.3 %
Has width	0	0.0 %
Has direction	2	4.3 %

Table 4.1: Statistics for place form for Povel Olsen.

Relationships between places		
Type	**Count**	**Relative**
Total number	48	100.0 %
With direction	12	25.0 %
With distance	13	27.1 %
Part of	17	35.4 %
Between	14	29.2 %

Table 4.2: Statistics for relationship between places for Povel Olsen. The sum of the different types is higher than the total number because some of the place relationships have both direction and distance specified.

[20]Implicitly, the context of the protocols, and of each interview, give the general area where all places are located. But this belongs to a part of the context I chose not to consider.

[21]47 is a maximum number of distinct places because some of the actual co-references may not have been detected, so that the real number of different places may be lower. More co-reference links could reduce the level of disconnectedness, but not remove it.

Some simple statistics for the formalised model of Povel's statement can be found in Tables 4.1 and 4.2. Looking at the form of the places first, it is clear that the level of specification is very low. Size is given for only two of the 47 places, and in those two cases only length, not width, is given. The general direction (for example that a lake stretches from northeast to southwest) is also given for two places. There is almost no information in the text as to what the places look like, and thus, few clues telling us how they should be drawn. Some size restrictions are given by the relationships to other places, but only in a very vague way. In some cases, other indications related to both the form of a place and the relationships to other places are given, such as rivers connecting to lakes at specified places. But only a few such indications are given, and they are quite vague.[22]

All the places in the formalised model of Povel's statement have connections to other entities in the model. Places for which no relevant connections were found never made it into the formalised model. But this does not mean that all places in the model have *spatial* connections to other places. Places may have other types of connection, such as being the location of an event. Most of the 47 places do have spatial connections to other places, but the spatial specificity varies. Table 4.2 also shows the different connection types and the number of connections having each of them specified. When both **direction** and **distance** are given, we have the most specified relationships. **Part of** and **between** are less specific, spatially speaking.

The stress on spatial connections is not, strictly speaking, connected to the question of whether two places have a relationship that can be expressed on a map. Some non-spatial relationships can also be put on a map: if two places are related only by both being farms, the relationship can be expressed by the use of the same symbol on the map. Still, such relationships do not help us in solving the fundamental problem. There is still no *spatial* relationship indicating where one is located relative to the other. They cannot be put on the same map in any other way than by guessing the location of one of them relative to the other. Their both being farms tells us that they can be represented by the same symbol, but not their spatial relationship.

One of the non-spatial relationship types between places is their belonging to the category of border signs. Some of the places that are put on different maps because there are no spatial relations between them are connected by

[22]There are qualitative descriptions in the text as well, but they would not help us much in drawing the shape of polygons on a map.

the fact that they are all border signs. Although this common feature makes it possible to combine the places into a group on a map, by using the same symbol for them, it does not say how they should be spatially located relative to one another in the map.

However, if we see the fact that the places are border signs as links to the spatial object of the border line, wherever that may be located in the understanding of Povel, this would have been different. There is cometimes a fine line between having a type and belonging to or touching a spatial object. Both the fact of being a farm and the fact of being a border sign include belonging to a class, but the class memberships are based on different principles. This becomes clear when map production is attempted. The border as it was conceptualised by one person could have been defined as a line object, with all the places with type **border sign** located on this line. Further, the fact that they are mentioned in a certain order can possibly be used as an indication of their spatial order.[23]

I chose to see the claim that a place is a border sign as a type classification rather than a statement that the place is located on the border. It is not clear to me whether and how a border existed in the minds of the witnesses. After all, the absence of an agreed-upon borderline was the main purpose of the whole border process. However, the use of type was a choice which could have been made differently. The other choice—seeing all the border signs as points on one long linear object—would have reduced the disconnectedness of the maps, but it would not have removed it.

The fundamental problem is the following: In a communication situation it is common to mention a well-known place without specifying where it is in relation to other places. This will still give its location to an informed reader. This is in line with the place name definition given by Olsen:

> A place-name, then, is a word, or word-complex, that within one particular community — no matter whether great or small, but of a certain s t a b i l i t y — instantly evokes the idea of one particular place through an a s s o c i a t i o n b y c o n t i g u - i t y. (Olsen 1928, 5, highlighting in original)

The place name gives the location of the place through this association, and through the location it also supplies spatial relations to other places. These relations are not drawn from the text, but from the knowledge of the

[23]The is investigated for a somewhat older material in Schmidt (1983).

reader. The writer is also a reader under this perspective: the first reader. Some of the readers, even the writer, may not know where some of the places are. Then they will have to fall back on the spatial relations given by the text in order to get an idea of the whereabouts of the places based on other places whose location they do know. In my modelling, a situation where the reader knows about none of the places referred to by the place names is simulated.

4.3.5 Summing up

We see two things in the discussion of Povel's statement. First, there are passages of the text which are difficult to model, and which are hard to express on the map. Second, there is no way to choose one and only one correct way of expressing what we are able to put on a map. Povel was not chosen as an exemplary witness in order to show these problems. Similar passages are frequent throughout **S1**.

The next cases are based on different persons; first Ole Nilsen, an old Sami reindeer herder, and then Schnitler himself. They will show other problems in line with the ones we have just seen.

4.4 Case 2: Ole Nilsen

Ole Nilsen was born just after 1662[24] in the forest close to the lake Giormsvandet.[25] He was baptised, but learned only a little about Christianity before the arrival of Thomas von Westen, the first leader of the mission and the main figure in its establishment. According to Bergsland (1985, 56–7), he was among the Sami taken in by von Westen in 1923 for a month of intensive work with the goal of turning them into good Christians, as the missionaries saw it.

When giving testimony to Schnitler, Ole documented his lease of land with a document signed by the local bailiff and dated in 1699 (**S1**, 150). In addition to this, he had inherited rights to thirteen *saajve* (Bergsland 1985; Gauslaa 2007, 33–4). The *saajve* refers to a complex system of relationships with spirits in mountains, having spiritual as well as practical consequences in the Sami society (Rydving 2010, 120–3). Ole used the forests in summer,

[24]His age is claimed to be towards 80 years in **S1** (150).

[25]Jormvatnet, now in Sweden, some 15 kilometres north-east of Povel Olsen's farm. All the measurements in the biography are based on modern maps.

whereas in winter he used the border mountain HaarKølen.[26] He occasionally paid the Swedish Sami for the use of the Swedish part of this area. It is interesting that Ole had rights to the areas he used to possess based on all three systems: Sami, Danish-Norwegian, and Swedish.

Ole had lived his life as a reindeer herder, regularly moving distances of 50 kilometres as the crow flies with his animals. He had grown up in the area and also worked for others in areas nearby. He gave testimony almost 100 kilometres away from the area he used to possess. He must have been a well-travelled person who knew significant areas in the mountains as well as in the lowlands.

Ole was interviewed at the farm Sollem[27] in Harrans annex parish. His statement amounts to 28 paragraphs with a total of 2068 words. The statement includes a detailed biography of his long life, which is the main source for the presentation above. The modelling process will be discussed in less detail here than what was done for the previous case study; the situations we saw for Povel were found for Ole as well. I will rather focus on new types of problems that were not found in the previous case. But before I proceed to that, I will give some statistics for the structure of his statement similar to what we saw for Povel above.

Places		
Type	**Count**	**Relative**
Total number	115	100.0 %
Has length	13	11.3 %
Has width	12	10.4 %
Has direction	13	11.3 %

Table 4.3: Statistics for place form for Ole Nilsen.

[26] Hartkjølen, some 50 kilometres south of their summer forests, now mostly in Norway.

[27] Modern name: *Solem*, farm no. 44 in Grong (Strand 1993, 266–7; Rygh 1897, vol. 15: 297).

Relationships between places		
Type	**Count**	**Relative**
Total number	155	100.0 %
With direction	55	35.5 %
With distance	43	27.7 %
Part of	55	35.5 %
Between	28	18.1 %

Table 4.4: Statistics for relationship between places for Ole Nilsen. The sum of the different types is higher than the total number because some place relationships have both direction and distance.

4.4.1 Descriptiveness and connectivity[28]

In Ole's statements there are a total of 215 references to places. These 215 expressions refer to 115 different places.[29] The total number of relationships between places is 155, as shown in Table 4.4. The specificity of the relationships is higher than the one we found for Povel. The percentages of **distance** and **part of** are more or less the same, but there are more **directions** at the expense of **between** here, which gives a higher level of specificity.

When we look at descriptions of places in Table 4.3, the difference is even clearer. **Length**, **width** and **direction** are all used for more than 10 per cent of the places in Ole's testimony, compared to less than 5 per cent for Povel's. So Ole describes form more than Povel. Still, even Ole gives no such descriptions of form for almost 90 per cent of the places.[30] This indicates that even if there is room for some variation in descriptions of the form of places, the level is still low. The witnesses depend on the instant evocation of the particular place in the mind of the people listening—perhaps not consciously, but such dependence seems to be part of their way of expressing themselves.

A limited type of evocation can occur even for unknown places, when a reader understands what kind of a place is described. He or she may know some general things about, say, lakes or mountains in the area. Even without

[28]Parts of this section, including Tables 4.3 and 4.4, was published in Eide (2013).

[29]Similar questions of co-reference as the ones asked for Povel is relevant here, so the number of distinct places may be lower.

[30]When one of the three is given, the other two are usually given as well for Ole. Thus, the numbers of **length**, **width** and **direction** cannot be added up, as mostly the three of them are connected to the same places.

specific knowledge of one single lake, he or she would have some idea of a typical lake. Lacking evocation of the particular, the type can work as a fallback. Still, this is rather limited. Lacking the evocation of the particular place, the reader may also let it pass as unimportant, or, if it is seen as important, he or she may use external means to find out more about the place in question. People present at the interviews could have asked the witness or other participants, whereas officials working with the written testimonies at the court in Copenhagen could have used a map or other written sources, or asked a person with local knowledge.

4.4.2 Only one

If we remember the problem of negation in the previous case study, we can see how it is related to another problem, highlighted in this sentence: 'South of Himself he knows no other Finn than Breed Thomes Tomesen.'[31] The primary modelling of the sentence can be seen translated to English in sentences 4.1 and 4.2. But does this modelling really catch the meaning?

Him (that is, his dwelling) → in direction south is
→ Breed Thomes Tomesen's dwelling (4.1)

Him (that is, his dwelling) → in direction south is
→ only one Sami dwelling (4.2)

The fact that it is based on his knowledge, expressed as 'he knows' in the text, is not really an issue; this is implicit in any statement made by him as part of his speech act anyway. Such a strengthening of subjectivity does not really change anything. The problem is that there is only one Sami ('Finn') in a certain area. I chose to model it as a type event in the primary model. This type event is connected to an unspecified area; it takes place somewhere south of the speaker's dwelling. It follows from this interpretation that the area of only one Sami is not specified as being related to the area in which Breed Thomes Tomesen dwells.

[31] 'Sønden for Sig kiender hand ingen *Finn* meer end *Breed Thomes Tomesen*' (**S1**, 152).

Another solution would have been to connect the two areas. In that case, I could have decided to interpret the area to the south as an area of only one Sami dwelling, and then seeing Breed Thomes Tomesen's area as one part of the area of only one Sami dwelling, or alternatively, seeing both features connected to the same area.

The questions are open, and can only be decided by making choices. Does Thomes' area actually fill the area of only one Sami? Could it be that the meaning of the utterance rather is that the whole area is used by Breed Thomes Tomesen so there is no room for others? The first word of Thomes' name, 'Breed', is a Norwegian adjective meaning 'broad'; one would assume this is used because the person is physically large (or, in an ironic sense, because he is small), but could it rather indicate a person demanding much room for himself?

These things cannot be known from the text. We need external sources to know them; if we have no access to such sources, we are left guessing, as I did in the last paragraphs—or just accepting that we do not know. What is clear, however, is that there is an area to the south where there are no other Sami groups than the one of Breed Thomes Tomesen. A statement that there is only one is also a negation of there being more than one. Is this a fall-off situation similar to the negation situation we saw above? How similar these are will be discussed in Chapter 5.

4.4.3 Unknown border

The areas described by the witnesses usually have borders indicated by place names or other referring strings. Although these borders are not exact, spatially speaking, they are usually clear and reasonably well defined. In one of his answers, Ole is less sure, however:

> Their *area* stretches on the southern side to Vatsdalen specifically *Svanevandet* and *Hoetagen*; how far it stretches to the north of the *Ornes* Mountain, he does not know, at the eastern side it goes to the borders of the farm *Ringsøe* in *Jemteland*. —[32]

[32]'Deris *district* Stræckcker (!) sig paa dend Søndere Siide til Vatsdalen Nemblig *Svanevandet* og *Hoetagen*; hvor langt den Stræckcker (!) Sig Norden for *ornes*-fieldet, veed hand ickke, paa dend østere Siide gaar den til den gaard *Ringsøes* grændser i *Jemteland*. —' (**S1**, 152–3).

In the model, this northern border was modelled as an **rs: unknown place**; thus, it is a place, but we do not know where it is. The string referring to the place is 'Somewhere north of Ornes-fieldet.' The place has the direction from another place indicated, which is in line with what other places have, as we saw in the previous case.

But what about the explicitly stated lack of knowledge? Ole claims there is one. How can we convey it? How can we express on a map the difference between the cases where we lack knowledge because the text does not say, and the cases where the source of the text explicitly stated he did not know? This information made it to the primary model by the use of the type **rs: unknown place**, but such a type falls off during the formalisation needed to make the vector data for the map. Even if it may be possible to find ways to express the level and type of uncertainty in the formalised model as well, it is difficult to do so on the map. We are left with the option of adding it to the map as a textual comment, a solution which is less than ideal, as will be explained in Chapter 5.

4.4.4 Summing up

The main problems found in the cases of Povel and Ole are along the same lines. They will be summarised below. There are differences between the witnesses as to how well they describe places and the types of spatial relations they include in the text. The differences for descriptions must be seen in light of a general low percentage of places being described at all. Reading and extensive modelling indicate that similar problems are found in many other interviews as well.

The main reason for running the case studies was to develop a basis on which to evaluate the hypothesis. In order to find other types of problems, I broadened the field by studying other types of text which can be found in **S1** as well. That added enough issues to build a thorough foundation for the process of scrutinising the hypothesis.

4.5 Cases 3–4: Peter Schnitler

Schnitler and his assistant Røyem are both hands, to speak in the language of manuscript description, in the manuscript behind **S1**.Yet it is clear that Schnitler had the main responsibility for creating the text. We do not know

how much he actually controlled or steered Røyem's work, but we know he accepted it. I will follow the manuscript classification in the archive and use the name 'Schnitler' to denote the actual author of the manuscript while accepting that the manuscript was not his product alone.[33]

In the sections based on witnesses, Schnitler as the author partly stepped aside to let other voices come through. In this section I will study small excerpts from the parts of the text in which his own voice comes through loud and clear. Schnitler, as a military officer born in Denmark and educated in Germany,[34] is different in many ways from both Povel and Ole. He also had a different role, which may open up the possibility of different results from the ones we have just seen. In the study of Schnitler, I will use two examples, one from an aggregation and one from a route description.

4.5.1 Case 3: Aggregation

In Chapter 1, one example of the problems Schnitler faced when he made maps was shown with reference to the map fragment on Figure 1.1. The map fragment shows two places of which either one or the other was a border mountain. Both were put on the map, crossed by the border symbol without any indication of the 'or' found in the text. I do not know how problematic Schnitler saw that specific situation when he drew the map, but it does present a problem when I use critical stepwise formalisation to model the text from his aggregation where he describes the same landscape.

In the following, the three paragraphs from Schnitler's aggregation in which the situation is discussed will be examined. The paragraphs include his aggregation for this specific border mark in extenso. This example is chosen deliberately; although similar discussions occur a few more times, they are not very frequent in **S1**.[35] The text reads:

> XIV. *Amber-* or *Baanes mountain*
> XIV. *Amber-mountain* is in north north west from *Rie-mountain*, the border will pass over the middle of this *Amber-mountain;* be-

[33] In the catalogue of The National Archives of Norway, the title 'Major Schnitlers grenseeksaminasjonsprotokoll' ('Major Schnitler's border examination protocol') are used for all seven volumes, cf. archive EA-4062 Danske Kanselli, Grensearkivet, series F— Grensereguleringen, L0010–11.

[34] His biography and a critical discussion of his role in the border work can be found in Eide (2012*a*, 58–72).

[35] Other examples can be found on pages 168 and 197–8.

cause according to witnesses 7. 8. and 9^{th} of *Helgeland* tax is paid for the western side of this *Amber-mountain*, to *Norway*, and to *Sweden* for its eastern side. —

In *Raens* Parish, the witnesses had never heard of any other border-mountain than *Rie-mountain* in the south, and *Amber-mountain* to the north: But when one came north in *Bejern* in *Gilleskaals* Parish, the witnesses there named another border-sign between *Raens* Parish and *Uma Lapmark*, namely *Baanes-mountain*, which they explained to be located a good day's journey, or 4. miles, to the south east from *Bejern's* first border sign, namely *Stokke-mountain*, and that *Amber-mountain* is supposed to be located a distance west of this *Baanes-mountain*; this *Baanes*-mountain, they said to be a bare mountain without forest, grass and moss, flat on the top, stretching from west to east, and that across the middle of this *Baanes*-mountain the border-*line* went, giving for that the *reason*, that from its eastern end a river flows to the east towards Sweden, and from its western end another river to the west towards *Norway* into the *Vir Lake* in *Raen*. How this *Difference* between *Raen's* and *Bejeren's* witnesses, as regarding *Amber*- and *Baanes*-mountains is supposed to be *reconciled:* cannot be known, as I have not been able to collect the witnesses of both places for a *confrontation;* thus cannot say, if *Baanes*-mountain, and not *Amber*-mountain in *Raen* should be the border-sign. Which is following the witnesses of *Bejerens*; or if *Baanes*-mountain is a tongue or *part* of *Amber*-mountain, and by *Raen's* witnesses is included under the name *Amber-mountain?* In the latter case, the witnesses of both places may be in *accord* and their testimonies stand; *in doubt* it seems to me, as if the preference is for *Raen's* witnesses, that they should know best, and have spoken the truest of their district's borders, namely, that *Amber-mountain* is the border-marker.[36]

[36]'XIV. *Amber*- eller *Baanesfield* ... // XIV. *Amber-field* ligger i Nord-Nord-vest fra *Riefield*, Grendsegangen vil gaae over Mitten af dette *Amberfield;* Thi efter 7. 8. og 9^{de} Vidner af *Helgeland* svares Skat af dette *Amberfields* Vestre Side, til *Norrige*, og af dets østre Side til *Sverrige*. — // J *Raens* Præstegield have Vidnerne af ingen anden deres Grendse-field vidst, end af *Riefield* i Søer, og *Amber-field* i Nord: Men da man komm Nord i *Bejern* i *Gilleskaals* Præstegield, angav Vidnerne der et andet Grendse-Merke imellem *Raens* Giel og *Uma Lapmark*, nemlig *Baanes-field*, hvilket de forklarede, at ligge fra

Schnitler's voice is clearly speaking in this example. Still, he builds each statement about the landscape on one group of witnesses, and he does so in a very explicit manner. In the witness statements in the previous case studies there were no explicit statements about the sources of the information. The source for each and every statement was inherited from the whole set of paragraphs; it was the speaker of the paragraphs.

Schnitler's explicit presentation of the sources for each statement asks for a different type of modelling. The question of voices becomes more complex. If we think of the source of the utterances in the same way as we did in the previous case studies, then it is clearly Schnitler. But by looking at the text above we realise that this is actually a discussion in which the various statements are attributed to groups of people. Schnitler uses his own voice to explicitly recapture statements made by specified groups of witnesses. Thus, the different statements have clearly marked voices within the paragraphs.

There is another difference between the two types of witness representation as well. When the witness statements are presented, each witness is allowed to speak for himself. The text is presented as if it were his or her own words. In this case it is different. Schnitler reproduces each group of witnesses' statements in a summarised way, presenting his own interpretation of their arguments rather than presenting their arguments as if they spoke themselves.

The content is more or less in line with all his aggregations, but the form is more implicit when he is able to reconcile the views of all the relevant witnesses into one coherent story. In cases such as the current one, where a debate takes place, the fact that he rephrases their views becomes clearer.

Bejerns første Grendse-Merke, nemlig *Stokke-field* i Syd-ost 1. god dags Reise, eller 4. Miile, og at *Amber-field* skal ligge et Støkke vesten for dette *Baanesfield*; dette *Baanes*-field, sagde de, at være et bart skallet Field uden Skoug, Græs og Maasse, slet ovenpaa, strekkende sig fra Vester i Øster, og at mit over dette *Baanes*-field Grendse-*Limiten* gik, givendes derfor den *raison*, at af dets østre Ende rinder en Elv i Øster ad Sverrig, og af dets Vestre Ende en anden Elv i Vester ad *Norrige* ind i *Virvandet* i *Raen*. Hvorledes denne *Difference* imellem *Raens* og *Bejerens* Vidner, angaaendes *Amber*- og *Baanes*-fielde er at *conciliere:* det kan vel ei vide; siden jeg ikke kunde have begge Stæders Vidner samlede til *Confrontation;* kan følgelig ikke sige: Om *Baanes*-field, og ikke *Amber*-field i *Raen* skal være Grendse-Merke? Hvilket er efter *Bejerens* Vidner; Eller om *Baanes*field er en Tang eller *particul* af *Amber*-field, og af *Raens* Vidner indbefattes under det Navn *Amberfield?* J hvilken sidste Fall begge Stæders Vidner kan *accordere* og stande ved Magt; *Jn dubio* siunes mig, at præsumtionen er for *Raens* Vidner, at de maa vide best, og have sagt rettest om deres Bøygdz Grendser, nemlig at *Amber-field* giør Grendse-Skielnet.' (**S1** 174).

The fact that Schnitler switched between presenting the views of different groups of witnesses within the same paragraph led to a situation where the model had to include a number of statements in which another statement was the range. This was necessary for storing the **source** relationships—that is, connecting each statement to the source for it. An example might clarify this: In a subject–predicate–object triple, such as sentence 4.3, the subject and object are both entities. But in order to express a source for this statement, the range of the source statement must be the fact that this specific group of people stated that Amber mountain was the border mountain. So the whole statement in sentence 4.3 is the range of the source statement found in sentence 4.4.

$$\text{Amber mountain} \rightarrow \text{has type} \rightarrow \text{border mountain} \tag{4.3}$$

$$\begin{aligned}&\text{The witnesses in Raens Parish} \rightarrow \text{is source of} \rightarrow \\ &(\text{Amber mountain} \rightarrow \text{has type} \rightarrow \text{border mountain})\end{aligned} \tag{4.4}$$

The visualisations shown previously would not really work for this sort of data because complete triples are here the ranges of the source triples. Figure 4.8 shows how the contents of a small selection of the primary model of the paragraphs from Schnitler's aggregation can be listed; it shows the parts of the model directly related to the two mountains. In the model listing, the expressions marked with asterisks; that is, the statements with statements as their ranges are shown in compressed form. They should all have the form of sentence 4.4. Thus, the first triple under the place name Baanes-field should be expanded to what we find in sentence 4.5.

$$\begin{aligned}&\text{The witnesses in Bejern in Gilleskaals Parish} \rightarrow \text{is source of} \rightarrow \\ &(\text{Baanes-field} \rightarrow \text{has type} \rightarrow \text{border mountain})\end{aligned} \tag{4.5}$$

What Schnitler does in this aggregation fragment is something the witnesses never do; at least, they are never shown to do so in the protocols.

- **speaker:** Unspecified writer
  - Unspecified writer → **trust most** → The witnesses in Raens Parish
- **place name:** Amber-field
  - Amber-field → **has type** → border mountain
    - **source:** The witnesses in Raens Parish
    - **believe:** Unspecified writer
- **place name:** Baanes-field
  - Baanes-field → **has type** → border mountain
    - **source:** The witnesses in Bejern in Gilleskaals Parish
  - Baanes-field → **is between** → Raens Gield **and** Uma Lapmark
  - Baanes-field → **in direction west is** → Amber-field
    - **source:** The witnesses in Bejern in Gilleskaals Parish
  - Baanes-field → **in distance a Bit is** → Amber-field
    - **source:** The witnesses in Bejern in Gilleskaals Parish
  - Baanes-field → **has description** → et bart skallet Field
    - **source:** The witnesses in Bejern in Gilleskaals Parish
  - Baanes-field → **has length direction** → west-east
    - **source:** The witnesses in Bejern in Gilleskaals Parish
  - Baanesfield → **is part of** → Amber-field
    - **type:** Tang eller particul
    - **conforms with:** The witnesses in Raens Parish
    - **conforms with:** The witnesses in Bejern in Gilleskaals Parish

Figure 4.8: A small part of the model of the text from Schnitler's aggregation focusing on Amber-field and Baanes-field. 'Unspecified writer' is the general voice of **S1**, which has been identified with Schnitler.

If they did, we must assume they were brought into clarity by Schnitler or other people present in the courtroom.[37]

Now, if we try to make map data based on the set of statements in Figure 4.8, the result would be a map with both of the two mountains in question, Amber-field and Baanes-field, as border mountains. However, this is not in line with any of the two groups of witnesses as their views are presented by

[37]This points out what witnesses are recorded as doing. Another matter is that Schnitler himself sometimes mixes such discussions into witness statements, as is the case when he calls back a previous witness to comment on and confirm what the current witness says (**S1**, 51).

Schnitler; they both claim that one and not the other is a border mountain. If we instead choose to make two maps, one for each group of witnesses, then the maps will be more in line with the differences in views as they are put forward by Schnitler. But in that case, both of the maps would have to be presented together with a text explaining their relationship. The same would be the case if one dynamic map alternating between the two stories were made on a computer: it would still need a text explaining why it alternates.

So the consequence of this modelling is that even if all the statements can be put on one single map, such an expression would distort the meaning of what Schnitler said. The meaning can only be conveyed with the use of either two maps or a dynamic map, but then an additional text explaining important parts of the message would be needed. Schnitler, struggling with his many recorded interviews, shows openly his problems with the incoherent source material. He describes a small evidence-based discussion, in a manner very similar to scholarly discussions.[38] This is in line with his general method (Eide 2012*a*, 88–100).[39]

To conclude regarding the results from this case: the main difference between the part of the text studied in this case and the witness statements is that discrepancies are present within one paragraph and they are made explicit, whereas in the witness statements each statement could mostly be seen as one coherent story.

Taking one step back, we see that a text fragment can be either *coherent* or *incoherent*, spatially speaking, and that incoherence can be either *explicit* or *implicit*. I will later discuss further the consequences this will have for maps. For now, I will just note that in cases of incoherence, making one map for each coherent story seems like a good idea, as was suggested above. We saw on Figure 1.1 that Schnitler was not able to present the conflicting story on the map. Neither am I able to do so on one single map; I would need two different maps or a dynamic one. It also seems that an incoherent text can be divided into a set of coherent ones. Does incoherence always beg for a multiplication of maps? This discussion will continue in Chapter 5.

[38]In their study of scholarly argumentation in archaeology, Doerr et al. (2011) present a similar view to the one expressed in the modelling here, distinguishing the statements as such from the way they are used in the process of argumentation. See also the model for scholarly argument presented in Stead & Doerr (2014).

[39]To detect inconsistencies is an important part of scholarly argumentation. The fact that Schnitler is so detailed and thorough in his attempts to detect and sort out inconsistencies indicates that Schnitler's work can rightly be described as scholarly.

4.5.2 Case 4: Route description[40]

The other example taken from Schnitler's own words is a route description. Route descriptions are common in the parts of the text not reproducing witness statements. Sometimes they are presented as reports of journeys made by Schnitler and his company, in other cases as ideal descriptions. There are no clear differences in how the landscape is described in the two types. A description reads as a representative of a general, ideal travel route and travel time, also in cases where the text describes actual journeys. The one included here is an example of an ideal description:

> The road to *Jemteland* the *ordinary one* goes from
> *Østbye* Farms to Øye mountain can be estimated 1 new mile,
> from there through a little birch forest by the western
> end passing by the Lake *Eesand* in the east to *Remmen* 1 mile
> from there through a little birch forest to *Olvaa-Køl* 1 mile
> from here through the forest to *Handøl*
> the 2 first farms in *Jemteland* 2 miles
>
> New 5 miles —
>
> which road the Swedes in the year 1719 took from the country,[41] although from bending 1 mile longer, about which the next appendix will explain. —[42]

In the modelling of this route description the road from one place to the other is taken as a geographical object. The directions of these geographical objects are not given in the text. If I were to look at the wider context, the general direction would of course have been known, because Sweden is generally east of Norway in this area. But this is not expressed in any way in the text fragment.

[40] Parts of this section, including Figure 4.9, was published in Eide (2013).

[41] This refer to the retreat of the Swedish military forces after the attach on Trøndelag in the late part of the Great Nordic War.

[42] 'Vejen til *Jemteland* den *ordinaire* gaar fra *Østbye* gaarder // til Øye-field kand Reignis 1 Nye Miil, // der fra igiennem en liiden biercke Skoug ved dend væstere // Ende forbie dend Sieø *Eesand* i øster til *Remmen* 1 Miil // der fra igiennem een liiden bircke Skoug til *Olvaa-Køl* 1 Miil // her fra igiennem Skougen til *Handøl* de 2de første gaarder i *Jemteland* 2 Miil // hvilcken vej de Svenske A^{o} 1719: toge her af Landet, dog til Krogs 1 mil længere, hvor om næste bielage giiver forcklaring. —' (**S1**, 54)

Instead of trying to express the model of this text fragment as a scaled map, I tried another option. I visualised the RDF graph of the network of places. This visualisation turned out to have a strong similarity with a topological map. Topological maps have weaker spatial similarity with the landscape than topographical maps. They typically lack scale, and the directions are subject to change and variation relative to the landscape they represent. The relationships between points are maintained, though; a topological map is a map of the network. This is the type of maps one often sees representing train or metro networks.

What would happen if we tried to express this model as a topological map? Is there anything to be learned from such an exercise? The text of the route description does not contain enough information to produce one specific topographical map, but it turned out that one and only one network is readable from it; thus, one and only one topological map can be made from the text.[43]

In addition to what we usually have in topological maps, the text also informs us about the relative distances, so that the topological map in this case is made to scale; the road between one pair of places is double the length of the two other roads. But there is a difference between the connections between the places, on one hand, and the scale, on the other. The former is precisely as it was described in the text, whereas the latter has the inaccuracy inherent in all distances in the text, and thus, the interpretation can be chosen to be different.

A preliminary conclusion to this experiment is that the text does not describe a landscape, which would be translatable to a topographical map, but rather a network, which is translatable to a topological map. In Figure 4.9, such a topological map is shown. This map expresses the information in the route description reasonably accurately, and it does not add much more than what is already in the text, only the precise number of kilometres.

There is currently some interest in using network analysis as a tool for analysing texts.[44] The results found in this case study support this as a viable way for exploring the interrelationships between places as they are expressed in texts. While the links between the places are simple in this example it is important to remember that the connections between places

[43]One can, of course, make several topological maps which look quite different. But two topological maps expressing the same network; that is, the same nodes and links between nodes, are essentially similar and are not seen as different topological maps here.

[44]One example is the Hestia project (Barker et al. Forthcoming 2015).

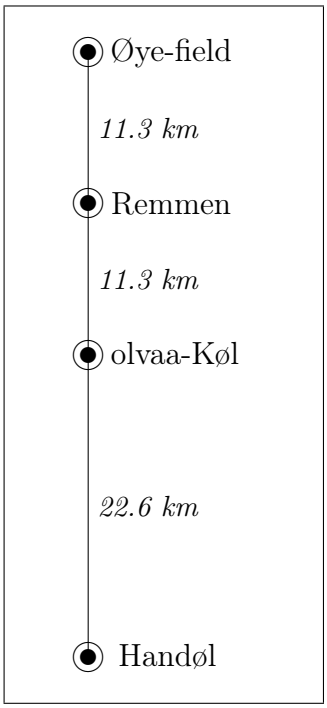

Figure 4.9: A topological map based on the model of the route description above. Topological maps are usually not scaled, but this one is.

can be as meaningful as the places themselves (Massey 2005, 91). As for the current project, this only strengthens the case that one cannot make maps without significant loss of meaning, because what makes something a map and not another graphical figure such as a topological map is exactly what we saw above: the scale and directions to be found in the map.

4.6 Results

In this chapter I have described the modelling of sequences taken from the source text and the critical stepwise formalisation all the way to the maps. A variety of techniques within the general framework of my modelling method have been used.

The modelling has been presented, but it is impossible to express an entire model in the form of a text. This is due to the differences between the textual medium and the medium of a computer interface. How could it

have been different? I am in the process of showing how texts and maps each can mediate only certain aspects of the total reality. In that perspective, it makes sense that the text cannot mediate every aspect of the model.

I will return to the theoretical implications of this later. For now, it is sufficient to note that in order to grasp the model more fully than what can be achieved through the reading of this text, one needs the interactivity of a computer. That is, one should use GeoModelText in the data package along with other tools to visualise the data found there. One must be able to interact with the model in order to understand it better. It is still impossible to grasp the totality and all the details at once, even in interactive use, but by moving around, trying different things, seeing the material from different angles, manipulating the model, displaying exports from GeoModelText, and zooming in and out, one understands more than what can be learned from reading a text.

However, use of the interactivity of the computer program is only necessary in order to understand how the results were obtained. The results as such can be understood and evaluated in comparison with the text. So we are back at the distinction from the introduction to Chapter 3: this text explains the results as well as how they are based on readings of the text fragments, whereas the data package is necessary in order to reproduce the process through which the results were found.

In order to summarise the results, I will look at the process of creating maps based on **S1** from two distinct perspectives. First, I will use the perspective of the starting point—the text; then I will use the perspective of the end point, that is, the map. In the text I find a certain world view expressed. How close can I get to expressing the same world view as a map? The map starts out as a blank space. What is needed in order to fill that space?

4.6.1 What the text has to offer

The main relationships between places on maps are spatial. The map expresses accurately the spatial relationships between the various symbols. It is a tautological fact that these relationships are accurate; any two marks on a piece of paper are related in that way, although the relationship is not necessarily accurate in reference to the depicted landscape. In addition to these accurate spatial relationships, the map can express similarity between places through symbology. Each map or map series has a limited number of symbols that can be used to classify places, and identical or related symbols

express some sort of relationship between places, usually at type level. Texts can also be put on the map, but this is usually done for place names only.[45]

The text offers a coherent yet dynamic view of a geographical area. Places are related, but in flexible ways. This is lost when only the explicit relationships between places are expressed on a map, especially because the relationships are expressed accurately. Along the same line, the dynamic aspects of events are lost. Such events are not purely geographical objects; still, they have geographical aspects. Other aspects become less visible on the map.

The shapes of places and the relationships between them are known from the text with only limited precision, ranging from unknown to vague. There is always a level of uncertainty; we always have to read a map which is based on a text with the understanding that the relationships between places are based on choices. How can we then add another level of uncertainty? How can we convey the fact that there was an explicitly expressed uncertainty in the text as to the relationship between two places? How can we distinguish between the lack of specification following the medium, and uncertainty expressed explicitly in the same medium? The only solution I see is to add a statement about the explicit uncertainty as a text to the map.

Incoherence can be expressed in one single text, but it seems that more than one map, or a dynamic map, is needed in order to express an incoherent description. If a spatially incoherent text can be divided into a set of coherent ones, then one can make a multiplicity of maps, where each coherent text gets its own map.

4.6.2 What a map needs in order to be filled

There are no absolute locations described in the text, so places are located only relative to each other. Without any spatial relationship connecting them, two places cannot be put on the same map other than by relating them in a totally arbitrary way. It must be decided where a place is located relative to another place in order to make a map including both of them. This information may or may not be indicated in text, but it is never fully expressed. Thus, any map must be based on choices, even when we have spatial properties linking the places together.

So any direction or distance between two places expressed to the level of

[45] This is on the main map image. A different story is the perimap, the area outside the map image.

detail needed in order to make a map based on the words of **S1** is to a certain degree arbitrary. Further, places being described in the text as located close to one another may be identical, overlapping, or disconnected. This must be expressed on the map even when it cannot be known from the text. The same goes for the borders around an area. The map calls for some sort of borders for many types of places, such as lakes, whereas the text often presents none. When we draw a place on the map, we have to decide on its form and size, but there is little or no such information in the source text.

Chapter 5

Towards a typology of media differences

In this chapter I will summarise how the hypothesis presented in the previous chapter is supported by the evidence presented there and outline some implications of the results. Do they point beyond the study of **S1** towards a broader perspective of texts and maps in general? This will lead up to Part III where maps and texts will be discussed at a more general level.

The results found in the previous chapter came out of a series of case studies. In this chapter I will organise those results thematically. I will outline a typology of the situations in which problems occurred in the process of making maps based on the text. After that I will turn around: if one insists on making maps, how should one proceed? It is possible to make maps in all cases, if one accepts loss of meaning—but what exactly is lost?

The hypothesis presented in Section 4.2 states that types of geographical information exist that can be stored in and read from texts, but which are impossible to express as geographical maps without significant loss of meaning. I have not found one single paragraph in **S1** from which all the geographical information and only the geographical information in that paragraph can be expressed as a map, provided that the paragraph includes geographical information at all. There are always a number of choices to be made (underspecification), and sometimes constructions are found in the text that are hard to express on the map (negation and disjunction).

It is clear that the hypothesis is supported.

5.1 Classification of results

What are the implications of the support for the hypothesis? Which types of information are hard to put on maps? In this section a typology will be outlined. It has been created with the purpose of describing all the results found in Chapter 4. It presents an alternative view to the summary concluding that chapter, in which the 'translation problems' from text to map were seen from two perspectives: what the text expresses, on the one hand, and what the map must express, on the other.

The problems found in the experiments are divided into three types: *underspecification*, *disjunction*, and *negation*. Further, two additional types are included: *impossible figures* and *fully specified textual descriptions*. Impossible figures were not found in the experiments but I include them because I had predicted that they would be found. Fully specified textual descriptions are included as a base type to which to compare the others.

The following typology will be used to organise the results from the experiments:

1. **Fully specified textual descriptions.** *Only one map can be drawn based on the description. If the text mentions something, it is fully specified geometrically.*

2. **Underspecification.** *Based on such a text, more than one map can be drawn, and at least two of these maps are significantly different.*

3. **Disjunction.** *The text includes expressions in the form 'A or B is located at C'.*

4. **Negation.** *The text includes expressions in the form 'There is no A in B'.*

5. **Impossible figures.** *The description of the geographical elements does not add up to a spatially coherent whole.*

Each of the groups will be discussed separately, before some common patterns are outlined.

5.1.1 Fully specified textual descriptions

I have found no examples of fully specified textual descriptions in **S1**. The type is included here as a baseline against which the other groups can be compared. However, in my experiments I have used a language which offers fully specified textual descriptions, namely, the language for vector data, Geography Markup Language. GML is a formal language in the sense of specifying expressions that are explicit and complete. This is an example of a GML fragment:

```
<gml:Curve gml:id="c22222" srsName="EPSG:4326">
  <gml:segments>
    <gml:LineStringSegment>
      <gml:posList>
        10.1 60.02 10.5 60.02 10.5 60.16 10.1 60.16
      </gml:posList>
    </gml:LineStringSegment>
  </gml:segments>
</gml:Curve>
```

Such a 'text' cannot be represented by two different maps as long as all the data are interpreted correctly. This is based on a certain sense of the word 'different', according to which two maps are different if their spatialities are significantly different. If the features of two maps are presented with different symbology (for example different colours on lines), the maps are not different in this sense, nor are they different if one includes small adjustments to the spatial layout of the other. The three maps in Figure 5.1 exemplify this. The maps to the left and in the middle are not significantly different, but they are both significantly different from the map to the right. As a rule of thumb, we can say that two maps made from a correct and complete interpretation of the same vector data are never significantly different. Having different underlying vector data is a necessary, but not sufficient, condition for the maps to be significantly different.[1]

Texts in natural languages look rather different from formulae such as the GML fragment above, and they are usually less specific.[2] Why are natural

[1]The condition is not sufficient because the differences between two sets of vector data may be insignificant.

[2]I do not claim that fully specified textual descriptions cannot be written in natural languages, but rather that they are uncommon in texts as we know them.

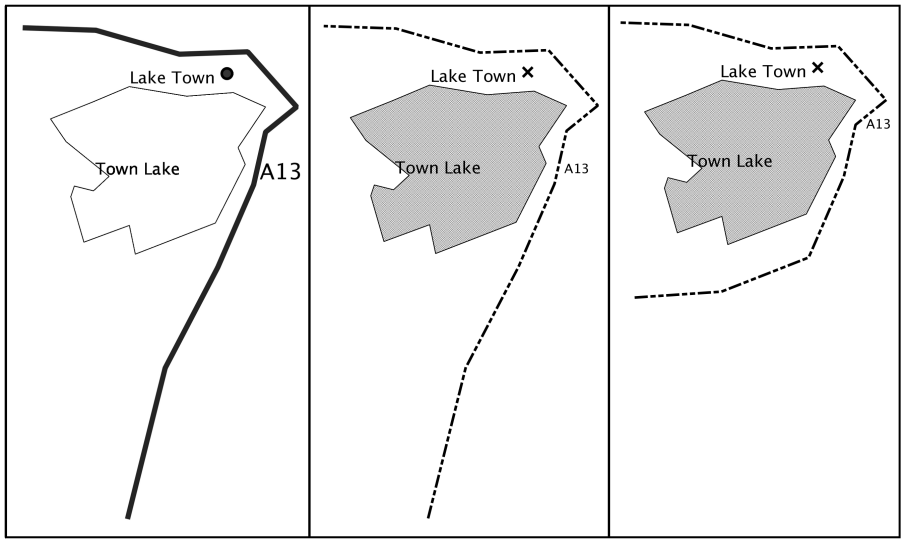

Figure 5.1: Map examples showing differences between symbology and map image. The left and middle maps are different only in symbology, whereas the road is different on the map to the right.

language expressions less specific? My tentative answer is twofold. First, it is based on media restrictions in the sign system of texts. This will be discussed in Chapter 6. Second, textual descriptions are functional even if they are less specific, because one usually does perfectly well without detailed descriptions. It seems that if one needs a high level of accuracy, one chooses other forms of expression than natural language texts, for example vector data and maps, or one marks what one wants to record on the ground instead. In order to explain this assumption I will give some details on how the border was created after Schnitler finished his work.

According to the 1751 treaty (UD 1967), the border between Norway and Sweden is a text. No map forms part of the legal agreement. But the text is, as outlined in the second appendix to the treaty, also an instruction for marking the border in the physical landscape (UD 1967, 17–21), a process that went on for several years after 1751. The marking is regularly reconstructed and is still clearly visible in the landscape, as we can see in Figure 5.2. The instructions are quite detailed, including start dates for each summer season of work, the salary to be given to the assistants, and how the maintenance were to be continued after the border was marked. The aim was to write a

clearly visible border permanently into the landscape:

> §9. The National border in forest areas is to be deforested in a width of 16 Alen, 8 Alen on each side of the line, thereby the border becomes so much safer and the cairns so much more visible;[3]

Instructions were also given to clear away the timber as well as the branches, and who were allowed to use it. The border cairns themselves were minutely described. Of special interest is the sightline issue:

> §14. The cairns will not only be put where it is stated by the commissionaires, but also in between, where the distance is long, and where one cannot see from one to the other, as stated in the following.
>
> §15. The cairns should be put on heights where such are found in the line, for better to be seen;[4]

The cairns were to be built in different sizes depending on their type. The main category, with the larges cairns, were always to be used whenever the direction of the border changes. Further, a map was to be made based on each summer season's work to document the work, in addition to detailed descriptions and measurements. Copies of these documents should be stored locally in order to assist the locals in repairing the border.

So the treaty text, based on evidence from the landscape surveys and negotiated with people present who had taken part in the preparational studies, was used in the physical markup of the landscape. Then maps were made based on the actual situation in the landscape, not based on the textual descriptions alone. The treaty text was used to create a situation on the ground, which was then documented in the form of maps. Not only was this the practice, this was how the work was planned, and the plans were described in the treaty itself. The governments did not just happen to end up

[3] '§9. Ved Rigs Liniens Redressering i Skougen er at i Agt tage, at Linien udhugges til 16 Alners Bredde, 8 Alen på hver Side av Linien, hvorved Grændsen bliver saa meget sikkrere og Røszserne saa meget synligere;' (UD 1967, 18). An Alen was around 60 centimetres.

[4] '§14. Røszerne kommer til at oppsettes ikke alleene udi de Puncter, som nu af Commissarierne ere udnevnte; Men og der imellem, hvor Distancen er Lang, og Puncterne ikke saaledes situerede, at man kand see fra den eene til den anden, som herefter udtrykkelig formeldes. §15. Rigsmerkerne eller Røsserne bør settes paa Høyder, hvor de findes udi Linien, for des bedre at kunde sees;' (UD 1967, 19).

Figure 5.2: An example of how the border between Norway and Sweden is written into the landscape of today. Photograph by the author from the Åsnes border crossing.

using this method, they decided beforehand to use it. They understood the balance between the three media they were using: texts, maps, and cairns in the physical landscape.

Similar texts in need of the context of the landscape to be correctly interpreted are common for local borders as well. The old land register in Norway had no resources to establish borders, neither in the field nor as maps or texts (Holmsen 1966, 154). Nothing in the line of widespread mapping happened before the nineteenth century.

If vector data represent instructions for drawing a map to be read and applied by a computer program, a survey certificate is an instruction to a group of surveyors to be read and interpreted in the field, possibly leading to a physical marking up of the landscape. The two texts are different in their relation to context: the vector data need no other context than a formula which can be used to interpret the co-ordinate system and the numbers, whereas the survey certificate will need the context of the landscape in order

to be interpreted.[5]

Context in this particular case really comes down to the need for interpretation by referring to the landscape. The context of the landscape is whatever is visible or known that an interpreter at a particular moment chooses to draw upon; another interpretation may be different because another interpreter may choose differently. The difference between vector data and a survey certificate is well in line with the difference between this category and the next—that is, between fully specified textual descriptions and underspecified ones.

5.1.2 Underspecification

From Schnitler's perspective underspecification seems not to pose any problem. He described as much as he needed to, and trusted the reader's background knowledge and other sources to fill in the missing details.

However, my project does not primarily aim at understanding Schnitler, but rather at understanding how texts work, using **S1** as the object of study. Then it becomes interesting to study in detail how underspecification works, because it steers what can be said in texts. What can and cannot be said is linked to the differences between maps and texts. Aspects of the different media made it practically impossible for Schnitler to make certain kinds of specification in the textual expressions he created, while making it very hard *not* to make the same kinds of specification when he drew maps.

So the goal is not only to find out how much is actually said, but also what Schnitler did with his underspecified descriptions, and how generally applicable those findings might be. What happens in an underspecified text that does not happen in the fully specified situation? This is what we need to pay attention to, because that is where we might find the significance of underspecification. Why or under what circumstances would anyone think that a fully specified description is necessary?

Underspecification occurs when the geographical information read from a text can be expressed as several significantly different maps. It happens when

[5]The landscape itself may not always be necessary, mapping tools with good spatial data can sometimes be used instead of the real terrain. In Blevins (2010), the paper trail from property transactions which took place in Connecticut in the latter part of the eighteenth century is used to reconstruct a property using digital maps in a GIS system. However, he did couple the digital toolkit with on-site exploration and archaeological evidence.

directions such as 'east' or distances such as '2 miles' are used: lacking other evidence, a number of different spatial interpretations of the statements are possible. I use the following definition of underspecification:

> *Underspecification occurs when a verbal text describes a spatial phenomenon in a way which can be understood as two or more significantly different phenomena by a competent reader, thus, an ambiguity stemming from a lack of information.*[6]

A text can seem to be detailed and accurate even if it specifies very little. In Schnitler, lakes are sometimes described by length, width, and general orientation. Rivers flowing in and out may also be mentioned. Such descriptions appear to the reader to be clear and quite rich, but give us few clues as to how to draw a lake. In order to draw it, we would have to decide on numerous questions about the form about which the textual descriptions are silent. Rectangles would be in line with many of the descriptions of lakes we find in **S1**, but no natural Scandinavian lake has such a form. A river between two lakes may be presented on the map as a straight line without contradicting the textual description, but this also looks strange.

But this is all the text has to say, and quite deliberately so. Schnitler was well aware that it was neither possible nor necessary to be specific about exact directions. He clearly had the same view when it came to other details of the landscape. It was not his goal to enable the reader to reconstruct the landscape based on the text alone. An intended reader of the text would have access to other sources of information as well, including his own knowledge.[7]

Evidence from the experiments indicates that underspecification is very common. None of the text fragments from **S1** studied in Chapter 4 contains all the information needed to make one and only one map representation. There is always a degree of underspecification.

It may not be surprising that Schnitler's witnesses, with the relationships they had to landscape, described geographic features in terms that allow one to find them, rather than in terms that locate them in an absolute grid

[6] 'Underspecification' as it is understood here operates at a different level from its most common use in linguistics, namely, for features omitted when their value can be predicted in phonology. There are, however, uses of the word which are more in line with my definition as well, see for example Nakashima & Harada (1996). They discuss the need for disambiguation of expressions which are ambiguous because of underspecification when the situatedness of the expressions is not clear, which is in line with my focus on context.

[7] Similar points based on texts from antiquity can be found in Eide (Forthcoming 2015*b*).

system. This calls for similar experiments on texts written by people with a well established relationship to maps. Based on discussions to follow in Part III I do not believe this will remove underspecification. The nature of underspecification may be systematically different, however.

The degree of underspecification also varies significantly. If a text contains no spatial information at all, then any map can be said to represent it, but we would usually say that no map does so, not even a blank map.[8] Blankness on a map is an explicit statement about what the cartographer cannot or will not say. Therefore, a fully blank map is absurd in a way similar to John Cage's composition *4'33"*, in which a piano is not played on for 4 minutes 33 seconds.[9]

There is a sliding scale from fully specified textual descriptions to the absence of any description. Strictly speaking, there is always a level of underspecification. Two maps can always be made which are slightly different, even if they appear similar to the reader. For example, small adjustments in location are routinely made in cartographical work in order to improve the readability of the resulting map. The purpose of using the concept 'significant' as outlined above is to clarify that we are not talking about such minute differences, nor are we talking about symbology. Map symbols can be replaced without its resulting in significantly different maps.

The relationship between implicit and explicit is being played out differently on the map than in the text. On the map, the spatial relationships between places follow implicitly from their being parts of a common geometry, whereas in a text the relationships are stated explictly if at all. However, even when no relationships are stated in a text, the fact that there are accurate geometrical relationships between specified places on the ground is implicit. If two place names are mentioned in the same text the reader will assume there is a spatial relationship between them also when no such relationship is given by the text. On maps such relationships are always given and are always explicit. In order to be quite clear about the level of the

[8]Blank maps do actually exist, however rare they may be. One example is *USGS Rozel Point SW, Utah, 2001*, covering an area which is all part of the Great Salt Lake in Utah, USA, as discussed by Monmonier (1996, 132). Such maps are curious, but of no interest to this discussion, as they cannot be said to represent a text which contains no spatial information.

[9]There are other interpretations of Cage's piece, for example that for that time the composition is of all the sound that happens in the auditorium. However, the absurdity of the piano's and pianist's presence remains.

differences between text and maps in regard to the level of specificity, and how this leads to differences in underspecification, I will here show how it works at the basic level of two spatial objects which are located relative to one another.

In most texts, distances are inaccurate, and directions even more so. We saw that the most detailed way to express directions in **S1** is in a system of 16. Each such direction covers 1/16 of the full circle, or 22½°. On the map, the directions are expressed quite differently. Two places shown as points on the map have an accurate geometrical angle between them which can be expressed as a single number, as Figure 5.3 shows.[10] For continuous lines and polygons, the angle between two objects can be expressed as two numbers, as we see in Figure 5.4.[11] Such accurately specified angles are rare in natural language texts.[12]

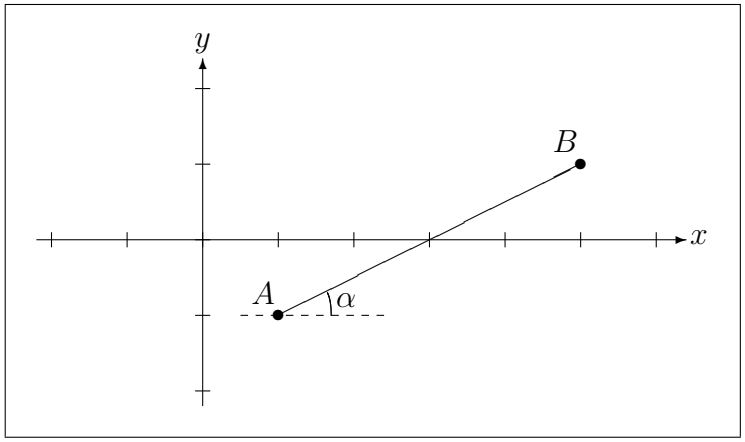

Figure 5.3: Spatial relationship between points as it is expressed on a map. The angle α between them can be measured precisely.

The explicitness of other spatial relations is also expressed differently on maps. Relational statements as they are found in the text (for example 'part

[10]There is some inaccuracy because points on maps are graphical representations covering small areas. But this inaccuracy is insignificant compared to the ones we find in texts.

[11]Discontinuous objects would add complexity to this model, but it would not change the principles. The two numbers α and β in Figure 5.4 define an exact span and must not be confused with the room of possibilities visualised on Figures 7.1 and 7.2.

[12]In the languages relevant to my research, that is. See Levinson (2003) for a broader picture.

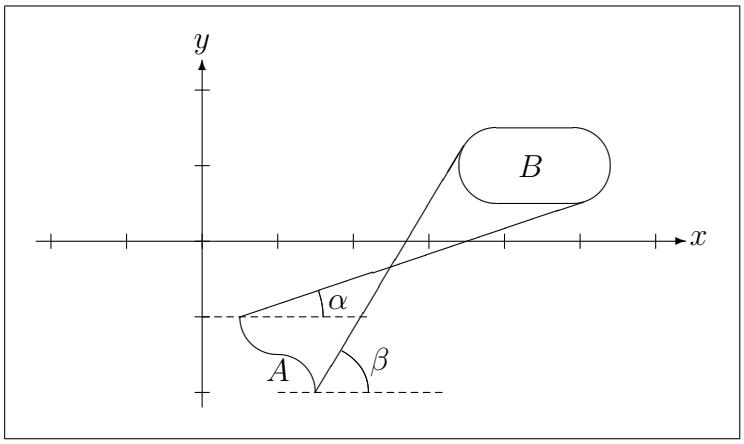

Figure 5.4: Spatial relationship between a line and a polygon as it is expressed on a map. The span of angles α–β between them can be measured precisely.

of' and 'north of') are not expressed explicitly on the map, they are only implicit. Not only that: they are not explicitly *expressible* either.

So information is inevitably lost when we go from text to map. The expression 'A is related to B with an angle somewhere in the area from $11\frac{1}{4}^\circ$ to $33\frac{3}{4}^\circ$' contains less information than the expression 'A is related to B with an angle of 14°', but it also contains more. The relationship in the textual expression is explicit and can easily be typed. In order to express such a relationship on the map, it has to be turned into a spatial object and inevitably becomes part of the landscape. Further, to add precise information is to remove vagueness, and vagueness is also information. When such vagueness cannot be retained in maps, information is inevitably lost. The meaning of the text lies partly in spatial vagueness, a vagueness that has no place on a map, whereas the precise spatial relationships needed by the map are not to be found in the text.

Gibson claimed that not all knowledge can be put into words, that one will always see more than one can say.[13] Thus, one can argue that texts as well as maps will always only convey a subset of what is experienced.[14] In

[13]This is in line with the claim in Arnheim (1997, 97–115) that we think in images.

[14]Different people also see different landscapes when they look at the 'same' thing. What is expressed, in text or map, is a subset of something more extensive. This 'something', which is available from our minds in ways we are not able to specify in full detail, is beyond the scope of this book.

reference to a perceived cat lying on a mat, he claims:

> 'The so-called concepts of extension, of far and near, gravity, rigidity, horizontal, and so on, are nothing but partial abstractions from a rich but unitary perception of *cat-on-mat*. The parts of it he can name are called concepts, but they are not all of what he can see' (Gibson 1986, 261, italics in original).

Gibson was writing about the perception of the environment, but the claim is relevant for maps and texts as well, because the parts of what we see that are expressible as text are different from the parts that can be expressed as maps. The different media can express different parts of our perceived environment. As users of language and of maps, we will tend to construe the environment differently in words than we do on a map. A single, definite map cannot be made based on a text because the text specifies different aspects of the environment.

5.1.3 Disjunction

A text can be either spatially coherent or spatially incoherent. The case of disjunction we studied in Chapter 4 was shown to create an incoherent text. A spatially coherent text is a text based on which one map can be made, once the decisions discussed above are made. A spatially incoherent text cannot be expressed as one single, static map.

Incoherence can be either explicit or implicit. Examples of explicit incoherence include the case where different spatial realities were attributed to two groups of witnesses, summarised with 'Amber or Baanes Mountain' in the heading.

How would one proceed in order to express *either/or* on a map? One could include the fact that two items on the map have this relationship as a text on the map. Schnitler could have done so on his map. The viewer's immediate understanding would still be that both of the objects of choice are located in the landscape as indicated by their locations on the map—in our case, touching the border. The reading of the text on the map could only eventually change this impression. While reading the textual version in Schnitler's aggregation, on the other hand, in which the heading of the description reads 'Amber or Baanes Mountain', the idea of both mountains being border mountains is not established in the mind of the reader from

the outset, as the word 'or' immediately establishes the fact that there is a choice between the two.

In the border negotiations, maps were made with contested areas marked out.[15] These maps show areas which have the properties of being matters of dispute in the negotiations, rather than areas which are either part of Norway or Sweden. The medium of the map pushes our interpretation in the former rather than the latter direction. I will not claim a definitive inability of maps to express disjunction, but the medium clearly makes it hard to do so, and also hard for the map user to understand what is meant if such an attempt is made.

5.1.4 Negation

We saw examples in Chapter 4 of negative data expressed explicitly in a text. They are harder to express on maps. A first intuition is to express explicit nonexistence as a blank area on the map. But the expression of nothingness following from blankness on the map does not in itself say that no particulars of a certain class (for example no farms) are found. It is a different expression of nothingness. When a blank space on a map says 'nothing here', it implies 'no thing of relevance'. Everyone knows there are things there—if nothing else, rocks and vegetation. In a text, one can easily type the negation: 'no farms here' says nothing about the possible existence of other things, such as lakes.

Typing is possible on maps as well, but the options are more restricted. This is connected to the limited vocabulary of a map. Many maps include legends listing, if not all the symbols used, then at least the most important ones.[16] This can be seen as the vocabulary of the map. Similar vocabulary lists are very rarely published with texts.[17] The potential vocabularies of texts are limitless because of the productivity of language and the number of different words used in most texts is much higher than the number of different symbol types on any map.

On many large-scale topographic maps, a lack of blue lines expresses

[15]One example is a map by Knoff and Knoff with contested areas visualised (National Archives of Norway in Oslo, map number 49), cf. **S1** (xviii-xix).

[16]See Wood et al. (2010, 67–72) for a critical view on the map legend.

[17]A possible exception is special purpose publications such as easy readers for language learning. Concordances are made for many texts, but their purposes are different from those of map legends.

'no rivers here', defining 'river' as being of a certain size and permanence. A lack of brown lines makes the claim that there is no elevation over 20 meters, or whatever the equidistance may be, in an area. But maps in which a lack of house or farm symbols has the general meaning of 'no farm' are rare. Thus, texts may contain information that goes beyond what a map can express. A text can say that something is not there for any number of object classes, whereas a map can only say so for a limited number of object types in a limited number of situations. A further difference is that in texts such negations can be expressed locally in one sentence, whereas a map needs other structures apart from the blank area of the map image, such as textual statements in the perimap.

Negation is closely connected to exact numbers. The statement that an area has exactly eight farms is difficult to express on a map, and the difficulty is similar to negation. That is, showing the eight farms is fine, but the claim that there are no ninth and tenth farms faces similar problems to the ones above when we try to put it on a map.

5.1.5 Impossible figures

The concept of impossible figures is more difficult and harder to understand than disjunction and negation, and I found no evidence for their presence in the experiments. This was quite surprising, because when I started the project I saw it as the clearest candidate for a phenomenon that would make the process of creating maps based on texts difficult. I will focus on two possible explanations why I did not find any situations which led to impossible figures. One is that my modelling was not a feasible way to find them, for example because it was not extensive enough. The other possible explanation is that they do not exist in my source material.

Go 2 km north from A and you get to B.
Go 3 km east from B and you get to C.
Go 1 km south from C and you get back to A. (5.1)

An example of what I mean by an impossible figure is the hypothetical text in sentences 5.1. A graphical representation of these relationships can be found in Figure 5.5.

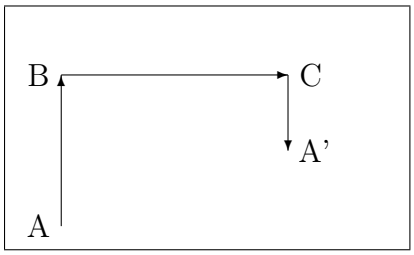

Figure 5.5: The situation from sentences 5.1 expressed as a figure. The text leads to a geometrically impossible figure because it is claimed that A and A' on the figure should be the same place.

I have not found any examples of such impossible figures during the experiments. Can they be found at all using my methods? Could it be that larger, more complex models would give evidence for them? It would be interesting to study this in more detail. It could also be that the pragmatics of language prevents impossible figures from arising. When a space is described differently in a verbal text from how it would have been described on a map, this is connected to the interpretation of the words and sentences, which in its turn is based on how the human mind envisages space. One often feels that the way onward to a place is longer than the way back to the starting point (Brodersen 2003, 57). If one expresses this experience in a statement, it will not normally imply a claim that A to B is actually longer than B to A.[18]

Further, even if the experience and description of a walk from A through B and C back to A may include in its triangle shape two right angles, which is impossible, a statement about the walk will not normally include the claim that the triangle described by the travel actually has two right angles. There are two reasons for this. First, such a description is not meant to be accurate in a geometrical sense. The meaning of the expression 'right angle' is not always 90°, and the roads we walk are not always straight.[19] And second, on the side of the receiver, the pragmatics of language would add another round of consideration. When something 'impossible' is uttered, the listener sees the absurdity and looks for alternate meanings (Grice 1989, 27).

[18]Examples of similar phenomena can be found in the psychological literature, see for example Tversky (2005) for an overview.

[19]Arnheim (1997, 183) points out the difference between a bad right angle and another concept than a right angle. There is no strict border between the two.

The listener could tweak Figure 5.5. into a coherent one by altering angles and distances. In other cases the discrepancy would not be noticed at all. In yet other cases the listener might ask if this can be right. When the response from a listener is uttered, this feeds back to the speaker as a tool to be used in order to understand how new statements can improve understanding. These considerations, combined with the fact that I have found no examples of such impossible figures in Schnitler, has led me to suspect that this group, however obvious it may seem on the surface, is not common in natural language texts.[20]

Negation and disjunction make up parts of the meaning of certain expressions. The model based on the disjunctive paragraph was spatially incoherent; in a sense, the paragraph is spatially impossible. Maybe this is what impossible figures in texts such as **S1** come down to: statements which do not add up when taken together. Maybe the closest we get to impossible figures is disjunction. It could also be that the difference between disjunction and an impossible figure is that the former represents an explicit incoherence, and the latter an implicit incoherence. Or maybe my thinking around the concept is wrong because the concept is too subjective: what for one reader is impossible is for another just a peculiar expression.

5.1.6 Maps can still be made

Maps cannot be made based on information from a text without significant loss of meaning. If we accept such loss of meaning, how can we proceed to make maps? How can the loss of meaning be minimised? In this section I will summarise some solutions awaiting a longer discussion in Chapter 7 connected to digital mapping and the consequences of fuzzy, dynamic, and interactive maps.

In the case of underspecification, we saw that maps can easily be made once the choices are made. In order to express more than one set of choices, multiple maps can be made. In regard to disjunction and negation, the situation is more complex.

There are ways to make maps in situations with disjunction. One can make two or more map images, one for each alternative, to be seen as parts

[20]This may, however, be different in some types of fiction. To take one example: it may be the case that the strange spaces in Ishiguro's novel *The Unconsoled* (1995) can be understood as impossible figures. Such observations can add to an understanding of how the text creates its sense of strangeness.

of the whole. Such use of multiple maps is different from the case of underspecification. In this case, different maps are made which in sum tell a complete story, whereas in the case of underspecification, each map tells a complete story, but only one of the possible ones.

Negation may be expressed for a limited number of categories on one specific map, but only if a definition exists under which completeness is feasible. For an area with very little building activity, one can have complete coverage of houses on a large-scale map for a period of time, giving the user an option to read out negative information: no symbol on the map means no house. This is impossible for a small-scale static maps.

A general solution to all these problems is to include on the map a text explaining the situation to the map user. This solution will work for all cases, but it will turn the part of the map in question into a document where the geometry of the landscape is no longer expressed fully by spatial similarity with the map. It turns, so to speak, the map into a text—at least at certain points. It creates a geocommunication system which gives more than maps and texts alone at the expense of the geometrical clarity of the map.

5.2 The question of context

The question of context has been raised several times before in this book and has been discussed at different levels. I will here analyse it anew based on evidence from the experiments. I will focus on the narrow and visible context rather than the wider context discussed by Hirst (2000). The aim is to clarify how the context in which references to spatial features are given influence how they work, and how this plays out differently in maps as opposed to texts. But first I will digress by telling a story about pre-digital map making based on landscape surveying. It is based on personal experience from the mid-1980s, and the resulting map is Eide et al. (1986).

When a group of which I was a member set out to make a new orienteering map for an area in Eastern Norway in 1986, the task included extensive field surveying. We recorded our results as pencil corrections to a base map, which was our main tool in the field. Base maps were made on the basis of double sets of aerial photographs. Using a stereoscope, the base map constructor would see a three-dimensional image of the landscape. He or she would draw all relevant information that could be detected from the aerial photo onto the base map; what he or she could not see was obviously not drawn.

One example is that the crossing of a creek by a road would be recorded accurately, whereas the stretches of the creek between such crossings often would not be, because of vegetation.

Creeks in the landscape types in which we were working are often covered by thick bushes of a certain size, so that the constructor sees the bushes, knows the creek is there, but does not know the details of the creek. When mapping out the creek during a survey, the technique we used was to start from one of the fixed points, to try to define straight stretches, and then to measure the angle using a compass and the length by counting footsteps. This is difficult to do accurately in thick vegetation, of course, so once I reached the next fixed point, there would be a discrepancy in the map sketch. This was corrected with pencil and eraser by stretching and moving, keeping the relative relations between the angles and lengths.[21]

This example shows two things. First, context is always needed, and can be very narrow; it can be the spatially known places around the spatially interpolated places. Second, establishing a map based on landscape is fundamentally different from establishing a text based on landscape. Similar processes would not have been necessary, or even possible, if I had been writing a text. A text will mention the fixed points, the general direction and degree of straightness of the creek, but not every turn, and the stretching process would be meaningless. On the map, more choices have to be made. The places have to be located in spatial relationship to each other.

This difference is clearly connected to how each map symbol relates to the other symbols around it, as opposed to how a clause in a text relates to other clauses around it. It is connected to the narrow context. Internal context operates differently in texts and maps. Links between specific places described in the two media will be links between different internal contexts. A place name in the text has a textual context, whereas a place name on the map has a spatial context.[22] Through my modelling and the creation of maps based on the model, either is also included in the explicit context of the other; contextual links are stored in GeoModelText.

How is this done? Each part of the primary model established in the

[21] Today much of this process is automated, especially the measurement of the whereabouts of the surveyor. This does not remove inaccuracy per se, but it may be reduced to a level where it can be neglected at the scale of the resulting map, which means that the inaccuracy no longer exists in the context of the map.

[22] As we will see in Chapter 6: also a text has spatial context. But in the text studied here, this is not connected to the meaning in any way similar to what it is for maps.

experiments is connected to the source text at the word or paragraph level. There are links from the primary model through the stepwise formalisation all the way to the vector data and to the maps. These series of links can be followed back from a map to the source text on which it is based. So there is a close connection between each detail of the model and the source text. This gives text-based evidence for the conclusions, but not only that. It also gives the internal context of each textual feature linked to the model. As the model is linked to the tags in the text, the context is always already there.

But can such a context be used? It can be reconstructed, but it cannot be included on the map. The map creates its own system of context, based on spatial proximity and similarity between symbols. So the contextual link through the model to the source text is a link out of the map, different from links to other place representations within the map.

Each utterance in **S1**, as in any text, exists in a context. The context operates at several levels and cannot be fully specified. Context can be divided into two prototypical groups, existing internally and externally to the text, respectively.[23] In my experiments I have not eliminated the context, but I have gone to significant lengths to reduce as much as possible the text-external context I take into consideration.

In section 5.1 the categories *fully specified textual descriptions*, *underspecification*, *disjunction*, *negation* and *impossible figures* were presented. How would these categories look if we formulated them in the context of a pre-existing map—that is, if we put the information *onto* a pre-existing map rather than expressing it *as* a new map? The typology was based on the pretence that I knew nothing about the landscape described in **S1**, except for the descriptions in the text itself. I pretended not to have seen any map and not to know the area, or even general features of Scandinavian landscapes. I pretended not to know most of the context.

What if I move back to a more common way of reading a text such as **S1**? Different strategies would then be followed, in which necessary and relevant contextual information is included. In such readings, the text can be mapped, even if the task may be difficult and quite time-consuming. This is routinely done for fiction as well as nonfiction.[24] One creates a new map representing a reasonable understanding of the text by adding information

[23]This distinction will not, I suspect, stand up to detailed scrutinising. But is serves my purpose as a general rule of the thumb.

[24]Digital mapping of texts will be discussed further in Chapter 7.

from the text onto a pre-existing map. Some places will not be identified at all, and some only by interpolation from other places mentioned in the text, whereas many will be found on the maps used. In this process, much information which is external to the text—that is, which is included from the external context—is taken for granted.

I assume this to work according to Ryan's principle of minimal departure. In order for this principle to apply, the reader must be able to make some association with a previously known world when he or she reads the text. Once a text and the reader's knowledge of a landscape are connected, the principle explains how we read our way into the landscape—or rather, into our knowledge of the landscape:

> [T]he 'principle of minimal departure' ... states that we reconstrue the world of a fiction and of a counterfactual as being the closest possible to the reality we know. This means that we will project upon the world of the statement everything we know about the real world, and that we will make only those adjustments which we cannot avoid (Ryan 1980, 406).

In order to understand better how context works, another typology is included here as a contrast to the one we saw in section 5.1. This new typology describes the normal way of seeing the relationship between text and map, intended not to create a new map based on a reading of a text alone, but rather to express information read from the text onto a pre-existing map.[25] The latter process involves adding a significant amount of contextual knowledge to the process through what is learned from the pre-existing map.

1′. **The match.** *The text fits the map without ambiguity.*

This should be the case for travel guides; at least one would hope so. Many descriptions in realistic novels will also fall into this category, taking the principle of minimal departure into consideration. Most parts of **S1** will end up here.

2′. **The unspecified map.** *The text includes too little information to enable the reader to relate the described places unambiguously to the map.*

[25]Normal in the modern Western culture, that is. We have no indications that this would be normal for a Sami reindeer herder in the eighteenth century or for other people in other times and places.

This may happen if too many of the place names are not found on the map. A text describing an unnamed landscape may also fit here. In the case of **S1**, unidentified place names may push fragments of the text into this category.

3′. **Disjunction.** *I assume this category will work similarly here as in the 'as map' situation.*

4′. **Negation.** *I assume this category will work similarly here as in the 'as map' situation.*

5′. **Impossible figures.** *Impossible figures could be the result of using the wrong map.*

What if the text does not fit the map, that is, if we are not able to put the places on the map because something does not fit? This could mean that we have the wrong map. To try to map onto a normal map of England a description in which someone travels to the south from London and reaches York would be an example of this situation.

There is a difference here based on the number and severity of issues: the more problems faced, and the more severe they are, the more likely it is that the map is not the right one; the fewer and less severe the problems, the more likely it is that the problem is one of inaccuracy.

The problem of underspecification is not really solved even if we have a map to start from; rather, it is hidden. The same choices are made when one starts from a pre-existing map; however, they are made based on and in accordance with the map.[26] So the map will define a spatial reading of the text. Another map could lead to a different reading. The problems are highlighted when we are faced with places we cannot identify. If there are no spatial relationships to identified places to be found in the text we have no way to put those places on the map. They will then rest in their own map layers, similar to what we saw in the 'as map' situation.

The choice of one set of interpretations of the text is made when the base map is chosen. As one map based on a text can be significantly different from another map based on the same text, readings of texts can also be pinned to significantly different pre-existing maps. A text cannot be interpreted as

[26]Being in accordance with a good map tends to be seen as being in accordance with truth (Monmonier 1996).

representing information in conformity with any map, but the maps can be quite different.[27]

Further differences between texts and maps are linked to specific types of spatial features. Mountains are difficult objects to pin down to geographical ontologies.[28] They are, however, easy to discuss in texts; they do not seem to be problematic at all in **S1**. This may be related to the fact that a text needs no explicit borders, whereas on a map the potential for borders is always already there.

The most detailed topographical map data covering all of Norway are held by the Norwegian Mapping Authority.[29] In the digital vector data on which the maps are based, there are identifiers of spatial objects for some types of places. For roads and municipalities, to take two examples, the vector data connect the lines or polygons representing spatial objects to data specifying road type and number and municipality number and name.

Similar information is not included for objects such as rivers and mountains. There is no link between a set of water polygons and a river name or identifier, and there is no connection between a mountain and any polygon at all.[30] A mountain is recognisable to a map reader by the contour lines or the shading in the vicinity of the name of the mountain on the map image constructed on basis of the vector data. Place names are not connected to river or mountain objects in the same way they are for municipalities or roads. They are connected to spots on the map—not the location of each letter, but a point close to which the name as a whole should be located.[31]

[27] In map based orienteering I have often experienced a moment of revealing truth. I have thought I have been following the map for a while, but then, suddenly, I understand that I have been on the wrong track. Unknowingly I have been stretching and interpreting the map to fit the landscape, and my view of the landscape has been adjusted to fit the map. Then everything falls into place and I realise I am not where I thought I were; that is, my location in the terrain is referenced by a different spot on the map from the one I thought it was, and my recent journey followed a different line on the map from the one I thought it had.

[28] In their discussion of the ontological status of mountains, Smith & Mark (2003) opens the possibility of seeing mountains as affordances in Gibson's sense.

[29] Kartverket, webpage: http://kartverket.no/ (checked 2015-04-04).

[30] This is related to the distinction between fiat and bona fide objects (Smith & Varzi 2000). The latter have physical borders, the former do not. Mountains and most lakes are fiat objects, but lakes are to a large extent delimited by bona fide borders, except where they border to other water objects such as rivers.

[31] Placing names on maps in an aesthetic and functional way is a complex matter I will not discuss in this book.

This is partly a consequence of lack of investment by the mapping agency, but only partly. While there may be ways to identify the polygonal outline of a river, this is not possible for mountains. Few mountains have definite borders. This is not a question of uncertainty, because 'exactly' measured data such as the borders of lakes and the height above sea level are also based on partly arbitrary choices; for instance, where the limits of a lake are depends on what water level is taken as the baseline situation.

Rather than uncertainty, what I am aiming at is a difference between situations where the average map user expects to find an explicit border, such as for a lake, and when not, as for a mountain. It is socially accepted to claim that a lake ends somewhere, even if it does not end exactly there much of the time because of varying water level. It is socially accepted to put a line delimiting the lake on the map, at least when the other side of the line is dry land. It may be more difficult to specify where the lake ends and the river begins, and it is normally not socially acceptable at all to define exactly where a mountain ends.

Similar problems just do not arise for textual descriptions, because textual context is not spatial in the same way. Texts may mention places which cannot be not identified, but once a place is identified and put on the map, spatial relations to other places as they are expressed in the text are no longer relevant. No geometry will be impossible once the information is mapped, because at that stage, the data fit the map per definition.

Part III

Chapter 6

Texts and maps as media expressions

In the previous chapter it was shown how the hypothesis was supported and a typology of media differences was established based on the results from the experiments. I also discussed what the consequences may be if one proceeds to create maps based on textual information, and I outlined some general ideas about the relationships between maps and texts. In order to develop this further, I will now turn to broader theoretical landscapes.

Chapter 4 showed that maps cannot be made based on fragments from **S1**—short texts—without significant loss of meaning. What implications can we draw from that result, beyond what we saw in Chapter 5? **S1** contains many descriptions of landscapes, based on many different people's views. If any text gives evidence that can be generalised, this one is a good candidate.

But no matter how good one text is, in order to discuss general characteristics one must go beyond the single text. In order to do so, I will show that similar differences between media are well known, even if they have not been studied much for the relationship between texts and maps. My claim is that there are texts from which all geographical information can be expressed as one single static map, and there are texts from which it cannot. But there are no texts in natural languages based on which a map can be made without making choices with significant consequences; thus, it is impossible to make a map from a text without adding and removing information.

In order to evaluate this claim we need to get to the details of how the two media relate to their objects of reference. So the claim will be investigated through a theory based comparison between the two media. I will connect

to a long tradition of comparisons: that between painting and poetry, known as *Ut pictura poesis*. This will give some basic understanding of how the two art forms are experienced in different ways. I will focus on a seminal work written just after Schnitler died, Lessing's *Laokoon* from 1766. From that I extract two oppositions which are useful also for understanding the relationship between texts and maps.

Lessing's *Laokoon* grew out of the same intellectual landscape as Schnitler lived and acted in. It allows us to approach a theory of the relation between texts and maps that makes explicit how Schnitler is likely to have thought about such matters. Lessing's rules still work, as is demonstrated not only by performances from then to now, but also by the scholarly discussion in the twentieth century. *Laokoon* is far from undisputed, but the positions we base on it are clearly defensible.

Then I will briefly mention ekphrasis, the tradition of describing a visual work of art in text, and use it to understand better the differences between reading a text and reading a map. Ekphrasis can also be understood in the light of *Laokoon*. After that, I will classify maps and text in a system recently developed in Elleström (2010) and show how his system can be used to generalise the distinctions I established based on Lessing; Elleström's system can be seen as a generalisation of central oppositions found in Lessing's study. It can explain what goes on in **S1**, and I will use it to systematise the relationship between oral texts, written texts, and maps. In this we can see a scholarly line from Schnitler's intellectual environment through Lessing to some of the central arguments in Elleström (2010). This will be used as a basis for a renewed discussion of the relationship between texts and maps.[1]

This chapter will focus on Western written culture, the culture Schnitler came from and also the culture behind the written education of the lower classes in Northern Scandinavia. An inquiry into the applicability for other cultures is most desirable, but is beyond the scope of this book.

6.1 Comparing the arts

Comparison between text and image was traditionally a comparison between the arts, specifically between poetry and painting. The tradition is often

[1] A shorter version of this discussion with a focus on antiquity was published in Eide (Forthcoming 2015*b*).

called *Ut Pictura Poesis*, after the passage from Horace.[2] I will focus on two groups of distinctions between painting and poetry discussed in *Laokoon*, which I refer to as *Bodies in space vs. actions in time* and *The question of coverage*. Lessing clarified these distinctions in the form of aesthetic rules. I will demonstrate their usefulness for understanding the relationship between texts and maps before I show how Elleström generalises them and offers a stricter system for comparison.

When I show that the conclusions from Chapter 4 of this book are in line with distinctions made in *Laokoon*, I have also shown that the thinking existed in the culture in which Schnitler lived; it must have in order to be available for Lessing to formalise it in the 1760s. Lessing systematised ideas in the culture in which he grew up, the same culture that Schnitler was part of. My argument is that these rules have a general impact on the relationship between maps and texts within that culture, and they were ideas known at Schnitler's time, so *Laokoon* can serve as a plausible theory for Schnitler's work. I have no direct evidence that Schnitler discussed them specifically, or theorised at all about such matters; the link is rather at the level of ideas common to European culture of the eighteenth century.

Gotthold Ephraim Lessing was born in 1729 and died in 1781. He was an active participant in the development of German literature in the enlightenment era, as a dramatist as well as an art critic and philosopher. Lessing saw the language of poetry misused by people who believed that what was beautiful in a painting would be wonderful as a poem. Based on this observation, he took it upon himself to describe how poetry should be written—which techniques were suitable to the medium, as opposed to painting. He published the most important part of this discussion in *Laokoon* (Lessing 1893).[3] The main importance of his work lies in clarifying and systematising ideas about the difference between painting and poetry that were already expressed separately in the works of other authors.

For Lessing, a totality exists which can be called 'The Arts'. The forms of art are variants of this totality. Among the forms are painting and poetry, and he is trying to find the borders between these different forms. Each of them has its special characteristics, and he claims that each of the art forms must be true to these characteristics (Bale 2009, 141).

[2]For the links back to antiquity, see Eide (Forthcoming 2015*b*).

[3]*Laokoon* was first published in 1766. Lessing also discussed similar ideas in *Hamburgische Dramaturgie* (1767–69), in notes for the second and third parts of *Laokoon* that were never finished, and in letters. I use the published *Laokoon* in this discussion.

Lessing discusses the viewing of paintings and reading of poetry. His work has strong implications for the creation of poetry and painting as well, leading some critics to see *Laokoon* as a manual of poetics. When I talk about rules in regard to Lessing, this is based on the strongly prescriptive tone that runs through *Laokoon*. Although Schnitler could neither obey nor break rules that Lessing wrote after his death, the culture from which *Laokoon* arose was also the one in which Schnitler was educated: the first part of the eighteenth century, seen from a German-speaking perspective.

Based on examples taken from different works of poetry and plastic arts, Lessing established several distinctions with variable clarity. I will discuss two major distinctions, or groups of distinctions, which I will refer to as *Bodies in space vs. actions in time* and *The question of coverage*.

According to Lessing, the real object for painting is bodies in space, and the real object for poetry is acts in time. Painting uses figures and colours in space, while poetry articulates sound in time. The signs used need to have a comfortable relationship to the signified. Things beside one another are bodies. Things after other things are acts. Poets must make their characters act, and thus characterise themselves through acting (Lessing 1893, ch. X, XVI).

The speed with which we are able to get an overview of an image is very different from the speed with which we get an overview of a text. The text has to be read and understood, while the image just has to be glanced at. Even a complex statue or painting can be seen at a superfluous level quickly, whereas a complex textual description has to be read before the main structure can be understood. When we look at a clear expression of things in space on a painting, we rapidly study the parts, then their connection, and then we combine them into a whole. When a poet tries to copy this process, it is not fast enough, because reading will take too much time. When reaching the end, we have forgotten the beginning (Lessing 1893, ch. XVII).

This difference leaves room for different rules for how the two art forms should be used. In narration, an object should not be described so that a painter could follow the description. Rather, a story about how it is created should be told. The reader will then see the making of the object as a process.

This is connected to how Lessing sees complexity handled by art. The way he sees art as reducing complexity can be compared to the simplification and abstraction inherent in modelling (Arnheim 1997). The infinite, unmasterable complexity of reality interferes with the intelligibility of the painting or sculpture. In poetry, this complexity is reduced by abstraction;

through the segmentation of the world which language has accomplished, essence has been isolated from accidental features, has been abstracted from the particularities of individual occasions. The perceived world has already been segmented and conceptualised for the poet by language, using discrete expression tokens (Wellbery 1984, 154–5).

This brings us over to the second area, namely the question of coverage. Clothes on a statue will often cover what is beneath. The plastic artist must choose, whereas the poet can describe the body as well as the clothes covering it (Lessing 1893, ch. V). In poetry, the author can describe the naked body underneath the clothes of a character, whereas in plastic arts, the clothes will more or less cover the body.

So plastic arts do not aid imagination; even worse, they lead the imagination astray, placing the image in time and thus transforming it into temporal content, an unwritten narrative. In the plastic arts, selection determines content substance. In poetry, selection yields discrete content units (Wellbery 1984, 169–72). What is abstract and only hinted in poetry has to become concrete in painting.[4] In the plastic arts, the signs are arranged spatially. The fact that clothes are actually covering something in the plastic arts is an example of the syntax of the plastic arts restricting its semantics.

> 'For the poet, a cloak is not a cloak.' For the sculptor it is; not entirely, but insofar as the expression token / cloak / is material and occupies space. *The syntax of the plastic arts is the set of spatial relations between real things* (Wellbery 1984, 127, italics in original).[5]

Based on Lessing's work in the area of comparison between poetry and painting, we have established two oppositions:

1. Actions in time should be applied in poetry, and bodies in space in painting.

[4] An example of such undetermined units taken from modern media is the fact that in a novel, the skin colour of the characters may be undetermined. In a film version of such a book, actors will have to be chosen for the roles, taking their skin colour with them. This can be overcome by a creative film maker in various ways but the point here is that in a film it has to be overcome, in a novel it can just be omitted. This is in line with underspecification as it was defined in Chapter 4.

[5] What is here called 'syntax' is called 'syntactics' by MacEachren (2004) in his discussion of maps.

2. What is hidden is not seen in painting, while things hidden can still be seen in poetry.[6]

These are the two oppositions I refer to as Lessing's rules, and they will be used later to understand better the problems systematised in previous chapters. The arguments in *Laokoon* are based on the idea that limitation is necessary to follow the laws of aesthetics. Given the historical context, Lessing proposes a new approach to aesthetic form rather than a new set of norms, an approach in which nature replaces traditional rules as the main principle. This is also a relevant conflict for Schnitler's work. His education was scholastic, whereas his work was based on people's actual understanding of the landscape as much as it was based on traditional rules.

But why call these two oppositions 'rules'? What kind of rules are they? Lessing's rules are prescriptive, not descriptive. They do not describe what can and cannot be done in poetry and painting, but rather how poetry and painting should and should not be made in order to fulfil their artistic potential. Still, Lessing's rules are connected to actual limitations in the different art forms, giving them an added descriptiveness. Lessing did state his argument in rather big letters, but I will still argue that the limitations he described are indeed there; that they can be overcome only confirms their existence. As we saw in the film example above, the text had no limitations in the specific area addressed, and thus nothing to overcome.

How exactly the limitations can be overcome has been shown by Frank (1963) in his discussion of spatial form in literature. While Lessing saw poetry and painting muddled together, the one influenced by the other, where each of them should follow its own separate way, Frank described how modernism blends them, using time for space and space for time, with plastic art losing spatial depth and poetry losing historical depth. While Lessing claimed that the border should not be crossed, Frank saw value in such border crossings; neither of them denied that the border can be crossed.

Lessing's laws are not natural laws; they are rather to be seen as social rules. They can be broken. Such breaches may cost you, but you may also gain from breaking them. The balance between loss and gain is dependent on many things, including the society in which you live and act.

Indeed, the border between space and time is always crossed in reading. When we look at a text, we see space. In order to turn that space into

[6]These oppositions were first published in Eide (2012*b*).

something to understand, we divide the space into lines of characters, and the characters are separately or, more commonly, in groups forming one or several words, read one chunk at a time.[7] The process of reading happens in time, chunk by chunk, in a more or less sequential fashion; at least, the ideal is sequential. Then, based on the understanding in our mind developed through this reading, a second kind of space may be formed, where we can 'see' things like a table or a mountain, or even a page full of words described in the text.

The space we comprehend when we read a text is indeed reconstructed. But it is reconstructed through a very different route from the one followed when we see a figurative painting or a photograph of a table, a mountain or a page inscribed with words. The table we see in the image has a colour and a style. The table we read about does not need to have either.

Lessing knew very well that spatial and temporal features can be mixed, in poetry as well as in plastic arts. This is the whole point! They *can* be mixed but they *should* not, because of Lessing's insistence that the basic level of reading or viewing should be connected to the form of the artwork. The argument is based on his fundamental poetics, but he also clarifies, as it were, how the two art forms actually work. Plastic art is of course enjoyed in time. But the time in which we enjoy it is not connected to one specific route through the space of the artwork, as it is the case when we read a text.

There is another important relationship at stake here which goes to the core of my project. How do we express our experience of one artwork in the language of another art form? Specifically, how do we move from image to text? Ekphrasis refers to verbal textual descriptions of visual works of art. Scholz (2007) aims at a more precise encircling of the concept. Of special interest to us is a shift of focus he connects to Spitzer's 1955 article on Keats's *Ode on a Grecian Urn*. Scholz argues that Spitzer shifts the focus of ekphrasis from the textual properties of the descriptions to the relations between described work and the description itself.

> It spells out explicitly that the *transposition d'art* of ekphrasis involves a gaze, a conscious encounter of a perceiving subject ('seeing', 'choosing', 'showing') with a work of art. The ekphrastic text thus comes to us, its readers, as the record of that gaze (Scholz 2007, 290, italics in original).

[7] Lancashire reminds us that from the perspective of the text-creator, language is a succession of chunks, even if it feels like a stream (Lancashire 2010, 49–50).

The opposition on which the genre of ekphrasis rests is not the one between verbal and non-verbal, 'but that of "being verbally accessible" vs. "being sensuously accessible" ' (Scholz 2007, 301). The same opposition prompted Lessing to claim that a description of a work of art should, like a description of nature, describe the real artefact (*wirklicher Gegenstand*), and not the thing seen as a sign.

Ekphrasis pinpoints what happens not only when objects of art are described, but also in the description of maps or landscapes. What was an infinite number of possible route through the visible space is replaced by the one chosen. All other possible descriptive routes are left behind. The map as a document, with its potential for an indefinite number of different reading orders, thus gains all possible views of a certain kind by the radical sacrifice of the richness of any one view, whereas the text gains the richness of a particular view at a particular time by the radical sacrifice of all other possible views.[8]

The process of crossing the boundary from text to map represents a transformation from one medium to another, and in this respect it is comparable to extracting the moment of potential from a narrative in order to present it in a painting. Comparable, but quite different. Claiming that both processes represent a movement from a time base to a space based medium is too simple because the so-called space based media also interact deeply with time. Maps and paintings (taken as general categories) have quite different relationships to time. The map is a graphical diagram which tends to express timelessness in its rhetoric, whereas paintings have a long tradition for fixing the moment.[9]

However, both these processes, along with ekphrasis, are similar at a more abstract level. Elleström (2014) distinguishes between two types of media transformation: transmediation and media representation. These two categories are entangled, but they express a useful theoretical distinction. Transmediation is what happens to a work when it is translated from one type of technical medium, from one kind of sensory configuration, to another. An example is the transfer of the vital characteristics of a poem from book page to sound by reading it out loud.

[8]This opposition can be seen as an analogue to the opposition between the scientific and the poetic trajectory, as it is discussed in the context of social science texts about geography by Sayer (1989).

[9]This is related to the distinction between intrasignification and extrasignification in maps we saw in Chapter 2.

Media representation, on the other hand, operates at the semiotic level. One medium represents another medium, for instance, a photography depicting a dance. Media representation will often work in conjunction with transmediation. That is, vital characteristics of the original media product are transferred to the target media product along with the representation. If this is not the case it is a pure media representation.

Elleström's categories are analytical and will necessarily present a simplified model of a more complex reality. Due to the complexity of the matter I will not make general claims about how ekphrasis and the creation of paintings based on narratives fit into his model.

As for the theme of this book, creating a map based on a text is a process in which the meaning expressed in the textual medium is re-presented as a new map expression. The map is not depicting the text as such, but the understand of a landscape we can read out of it. In that sense it is a transfer of media characteristics, that is, a transmediation. Creating a map based on a text can also include aspects of media representation, when parts of the text, for example place names, are reproduced on the map. They are changed in the process due to the change of context, but they still remain the same strings of characters. The media transformation process will always include a transmediation so if it is a media representation it is never a pure one.

We will come back to the relationship between semiotics and the spatiotemporal aspects of media below. Here we will focus on the relationship between time and space.[10] We saw in Chapter 2 how Gibson (1986) claimed that they are fundamentally different. We will later see that Elleström agrees. However, this is highly disputed. One of the most influential claims for their unity in narrative texts is found in Bakhtin's concept of 'chronotope'. In Chapter 3 above we saw that the event in CIDOC-CRM is defined as people and ideas meeting in space-time. Bakhtin goes further, claiming that time and space are two different aspects of a larger, common whole.

Bakhtin defines the concept of a chronotope as 'the intrinsic connectedness of temporal and spatial relationships that are artistically expressed in literature' (Bakhtin 1981*b*, 84). In this concept, time and space are inseparable; time is seen as the fourth dimension in addition to the spatial three. We saw above how a written text is not only time-bound, but also spatial, at the basic level of reading. An oral text, on the other hand, is not spatial at this

[10]It goes without saying that this question will not be covered in any depth here. Only a few points will be made, based on the specific topics of this book.

level. Everything which can both be said and spoken exemplifies the time-space difference. When a mathematical calculation is spoken, '2 + 2 = 4' is organised in time, but in writing it is organised spatially (Linell 2009, 284). At a more abstract level authors have always expressed themselves about space as well as time, and at this level oral texts are equally spatial as written texts.

It is extremely important to keep these two levels distinct, while also seeing the relationships between them. In order to understand Lessing, we must distinguish between how language works at a basic level, the level in which the reading follows one route through the space of the text, and the level of understanding, at which all sorts of metaphorical spaces are created, in texts and images alike.[11] As we will see shortly, one of Elleström's main strengths is that his system includes a way to clarify this distinction.

The text is localised in space, but we read it in time. The text is never dead, but it is imprisoned in dead material, such as books. The textual work is categorically divided from the represented world; the author is always outside the world he or she represents, outside the time and space of the events, moving freely in time and space (Bakhtin 1981*b*, 254–7). This is important to remember not least for nonfiction with autobiographical tendencies such as **S1**, because the author is never the same as the person referred to by 'Peter Schnitler' in the text; they are categorically different creatures.

Bakhtin claims that space and time are interrelated in literature. Yet, texts describe the time and space of the real world we all live in; or rather, based on the principle of minimal departure discussed in Chapter 5 above, we will encompass the world we know as the place for narratives. So we should consider whether it is actually correct to see time as the fourth dimension of space in the world as we perceive it when we move around in it, as well as in the worlds we meet as representations in texts and images.

Gibson claims that in the real world we move around in, it is not. In his ecological thinking, he argues that events should be seen as the primary realities and time as an abstraction from them. Events are perceived by humans and other animals, but time is not. His thoughts about space are along the same lines: objects do not *fill* space because there was no such thing as empty space to begin with. The environment is always already full

[11] Thus, I contest the denial of the essential temporal nature of literature put forward by Mitchell (1980, 544–5). In my opinion, he underplays the differences between the media at the basic level of perception.

of things; the space we call empty is defined by the objects around it, so it is full by their presence.

> Time is not another dimension of space, a fourth dimension, as modern physics assumes for reasons of mathematical convenience. The reality underlying the dimension of time is the sequential order of events, and the reality underlying the dimensions of space is the adjacent order of objects or surface parts. Sequential order is not comparable to adjacent order, it is not even *analogous* to adjacent order. For the order of events cannot be permuted, whereas the order of parts can. You can reshuffle the parts but not the events, as you can arrange the furniture in a room but not the happenings that occur in it (Gibson 1986, 101, italics in original).

This, for what it is worth, is in line with Lessing's rule number 1. If what I claimed in Chapter 2 is true—that is, if the people Schnitler interrogated saw the landscape in line with what is described by Gibson and Ingold—then Schnitler, with his feet on the same ground as Lessing, actually had corresponding influences from both sides: from the people he interviewed as well as from his intellectual background. If this is so, then it also follows that the chronotope, with its deep integration of time and space, is less than useful in this context.[12]

What Gibson says in the passage quoted above is that events happening in time are frozen. To that I would add: as is the route we have followed once a journey is over, and the static line we follow when we read through a text. He claims further that the objects in space are movable. I again would add: as the track of observing an image may be different each time we view it, or the travel route as we move through the landscape can be different from the one followed on our previous journey.

So it actually seems to be the case that our perception of an environment and our reading of a text or viewing of an image are quite in line. The witnesses perceived the environment as objects in the world. Then they expressed this to Schnitler during speech events in time, in the form of a linearised oral text. Finally, after considering all the facts, Schnitler created

[12]This should be investigated deeper than this short discussion. The last word is clearly not said about the relationship between or indeed the existence of time and space, neither in media expressions nor beyond.

new spaces: those of maps. These were different from, but indirectly based on and with some geometrical similarity to, the spaces experienced by the witnesses.

There is another distinction which comes to play here: the one between past and future time. In CIDOC-CRM these are modelled differently, based on an ontological analysis of the museum and cultural heritage context, which is linked to long term issues in the humanities at large. The difference penetrates all our categories: past travels as opposed to choices for a travel just starting, the stable nature of a written text as opposed to the openness of the text not yet written are but two examples. This is closely connected to the modelling method used and how problems of time is handled, a question to which we will return below.

We now have a starting point from which to study the media differences in more detail. How does this discussion relate to the actual differences found in Chapter 4? In order to find that out, we must break into each of the types of media expression. This is where the technical analysis made by Elleström comes in. He takes the media apart and dissects the differences between them. A study of his analysis will conclude this attempt to use interart and intermedia studies to understand the differences between texts and maps.

6.2 Media modalities

The existence of certain art forms has been taken as the starting point throughout the tradition of interart studies. A medium is a subcategory of all human forms of expression, as a form of art is a subdivision of the general category of the arts, ontologically speaking. The different media or art forms, whatever they are named and however they are defined, are ways to group entire expressions. Once a classification system is chosen, one can clarify how mixed a specific work is, and which media are the most important ones for this specific work.[13]

In a recent paper, Elleström (2010) starts from four media modalities we find in each and every media product: the material, sensorial, spatiotemporal, and semiotic modalities. This is a more bottom up approach compared to previous studies. The differences between texts and maps fall mainly in the latter two categories, whereas the main differences between oral and written

[13] All media are mixed media, that is, no medium is unintermedial (Arvidson et al. 2007, 13–14).

texts are found in the former two modalities. In the following, I will show why.

In Elleström's system, any expression will include all four modalities, each in a form specific for the expression, but classifiable according to general rules. An expression cannot be divided into its modalities, as the distinctions between them are based on our analysis alone.

Elleström defines mode as 'a way to be or to do things' (Elleström 2010, 14), which is in line with OED (2012*b*, sense I.4.a). He stresses the need to be clear about modes, and about how they are distinct from media, defining a media-based approach as different from his own, and based on an epistemologically difficult concept. He does not state this, but the media-based approach is clearly a top-down approach, which is also problematic because it treats the media forms as separate entities. The lack of distinction between the materiality and the perception of media, the distinction between documents and the reading of documents, is a second problem.[14] Although the modalities cannot be separated in practice, Elleström sees it as crucial to discriminate between them theoretically. 'Every medium has the capacity of mediating only certain aspects of the total reality' (Elleström 2010, 24).[15] Which aspects apply is based on the specific form of the modalities in each work.

In order to specify a medium, a type of mix between modalities representative for this specific medium has to be found. This could point towards a possible definition of media based on modalities, but this is not done by Elleström and will not be expanded upon here.

6.2.1 Material modality

The material modality is the most basic of the four and is described thus: 'The latent corporeal interface of the medium; where the senses meet the material impact' (Elleström 2010, 36). This is not the physical substance of the medium, but rather the potential in need of something to be expressed, that which is capable of being manifested in it. This something may be an image on a piece of paper or a computer screen, or a sound produced

[14]This is in line with Bakhtin's distinction we saw above between the live text and its imprisonment in dead material. It is also in line with the distinction between a map as a document and navigation using a map.

[15]We see already here how this is in line with the results from the experiments, where we saw that maps and texts can specify different aspects of the environment.

by a larynx or a loudspeaker. The actual manifestation through which this potential is realised is called a technical medium. Elleström suggests that the material modality is connected to content, whereas the technical medium is connected to form (Elleström 2010, 30). The dichotomy form/content is problematic, however, and will not be pursued further here.

Elleström singles out three modes as the most important ones of this modality:

1. human bodies
2. other demarcated materiality
3. less clearly demarcated materiality[16]

Neither maps nor texts use mode 1. Mode 2 is used by maps and written texts alike. Texts are generally expressed in two dimensions on paper or other surfaces and on computer screens; if a third spatial dimension is present, it typically has no other meaning than making the actual letters visible, such as writing chiselled in stone. Maps, although usually in two dimensions, are sometimes made with a landscape contour, in what is called $2\frac{1}{2}$ dimensions.[17] Maps on computer screens are two-dimensional at the level of the material modality. The third dimension, which is presented by use of perspective on the screen, belongs to another modality: the interpretation giving three dimensions is created as a virtual space in the spatiotemporal modality described below.

The third mode comprises things like sound waves and laser and light projections. Oral text uses this mode. Performance cartography in the form of performances made by humans using drums and chanting uses all three modalities: the human bodies dancing, the drum skin as a two-dimensional object, or the whole drum as a three-dimensional object with inscriptions, and the sound of the human voice, the drum, and possibly other instruments.

[16]Demarcated means that they have clear boundaries, as opposed to for example sound waves. The distinction is not the same as the one between fiat and bone fide spatial objects in geographical ontologies. Sound waves are not spatial objects at all in the sense used in geographical ontologies.

[17]The concept of $2\frac{1}{2}$ dimensions was explained in footnote 9 in section 2.1.

6.2.2 Sensorial modality

In this modality the human brain and body system meets the extra-human material through our senses.[18] Elleström's description of this modality is 'The physical and mental acts of perceiving the interface of the medium through the sense faculties' (Elleström 2010, 36). The five modes of the modality are the five senses: seeing, hearing, feeling, tasting and smelling. Seeing is the main mode for maps and written texts, whereas hearing is the mode for oral texts. In addition, a physical $2\frac{1}{2}$-dimensional map may be felt, as are Braille letters and Braille map features when read with the fingers.

Because sensorial stimulus and recollecting are so closely related, all modes may be triggered by any medium. A famous example is the madeleines in Proust's *A la recherche du temps perdu*, where taste triggers memories in the form of many different sense impressions. This is linked to how spatial form in literature works (Frank 1963). One may think that textual descriptions in general will trigger more feel, taste, and smell memories than maps do. Maps tend to be read in a more 'objective' way, but is this always the case? Maps in historical atlases may trigger strong feelings among people who took part in the events being mapped, and the process of creating map biographies by first nation people is known to trigger strong feelings of grief in some informants (Tobias 2009, 311). But is this based on the map or the story? Probably more on the story, of which the map is a servant only. So yes, texts are 'warmer' than maps for most people.

6.2.3 Spatiotemporal modality

This next modality is described by Elleström as 'The structuring of the sensorial perception of the material interface into experiences and conceptions of space and time' (Elleström 2010, 36). This process is of special interest to my work, with its close connections to space and time. Through and with the experience of the media expressions, concepts are formed. The modality also includes the translation process in which we establish a feeling of space and time from what our senses sense. We do not know in full detail how the process happens, but we know the result: we experience time and space.

The experience of time and space given by a media expression is similar

[18] Elleström comments on some of the brain research going on in this area. A more thorough comparison with neuroscience and also with Ingold's views would be most interesting.

to the experience we would have if we lived through the same situations as the ones we are reading about. The experience is also similar to dreams, in sleep as well as daydreaming. How similar are they? The similarity can be felt as very strong. But evidence presented in Chapter 2 suggests that a landscape is learned in an inferior way when seen or heard about compared to a travel through it. This will not be studied further here.

There are four dimensions of our spatiotemporal perception: width, height, depth and time. The first three define space. Time works fundamentally differently from space. They are not seen as integrated in line with Bakhtin's chronotope; the view here is more in line with Gibson's. The sequentiality of time can be represented as fixed, partially fixed or non-fixed. A two-dimensional computer-based map with a time slider which can be moved back and forth, changing the map to represent the situation at different points in time, would represent time with a less fixed sequentiality than a movie theatre film or live music. We will return to the sequentiality of time when we discuss time in maps in Chapter 7.

The modes

The following modes are the most important ones for this modality. The first tree concern space, while the latter three deal with time.

1. (a) space manifested in the material interface
   (b) cognitive space (always present)
   (c) virtual space
2. (a) time manifested in the material interface
   (b) perceptual time (always present)
   (c) virtual time

1(a) space manifested in the material interface The material interface of a map clearly manifests space. This is central to the way maps refer to the terrain, and is not dependent on the map's containing a set of correct references, or indeed on whether the referent (that is, the terrain) even exists. It is equally clear that speech, being connected to a voice, does not manifest space. As for written texts, they do manifest space. Written texts are expressed in a two-dimensional space, but in most cases the spatiality

of the text does not directly refer to the meaning of the text. The material interface is spatial in reading, but the perception incorporates temporality and sequentiality based on the conventional semiotic aspects of language.

The use of space for non-linguistic reference to meaning in written texts is visible in poetry, and can also be experienced in historical sources. One example of the use of a weak spatiality is Schmidt (1983), where he exploits the spatial order in which place names are listed in historical source documents to resolve possible identities of the places they refer to, based on the assumption that the order in the text to a certain degree reflects the order in the landscape.[19]

The spatiality of maps works differently from that of texts. A map symbol can be a single black dot whose location in the space of the map refers to the location of a boulder in the physical world. Another black dot can be up, down, or in any other direction from the first one. These two basic symbols have no order. Any of them can be read before any other. They have a spatial relationship without order.

However, when texts are put on a map, two different levels emerge. At the level of the internal structure of one textual expression, it is still ordered. Even when put on a map, 'New York' is not readable as 'York New' or 'eNw rkoY'. At this basic level there is a difference between meaning expressed on a map and meaning expressed in a text. Letters must always be put in the right order. If the order is broken, the letters become either another text or just illustrative objects, not letters of a language expression.

At the level of relationships between several textual expressions on the map, on the other hand, the governing spatial system is that of the map. At this level, two place names are located relative to each other based on similar rules as other map symbols; their spatial relationship is without order.

1(b) cognitive space Spatiality is more than the three physical dimensions. Our cognition works, to a large extent, in terms of spatiality (Arnheim 1997). Abstract concepts and experiences of time also have spatial characteristics, and interpretations of narratives and music may also be conceived

[19]More exceptions exist, also in other genres. An interesting case is so-called magic squares. For a discussion in the context of the 'Tabulae Illiacae', see Squire (2011, 197–246). It seems to be the case that the stronger the spatial reference function gets in such examples, the more map-like the text document gets. This will not be pursued further in this book but represents an interesting area for further research.

as spatial relations and patterns. So cognitive space is a fundamental aspect of all cognition, and is present for all three media types.

1(c) virtual space Oral texts have no space at all, only sounds in time, so in oral texts, all space is virtual. Although this virtuality is usually established based on the lexical meaning of the words, other forms are also available, especially when music is involved. Sounds can resonate with space, as in Sami joik, where mountain peaks can be represented by aspects of the tonality of the joik (Tirén 1942, 123).

The decoding of a written text usually does not extract spatially referential meaning from the spatial organisation of the text when it is read as a sequential string of character and/or words, taking the exceptions mentioned above into consideration. But there is still a space to be found. Through interpretation of abstract concepts in the text, a virtual space is formed in the mind of the reader.

The fundamental two-dimensional space shown on a map is not virtual, but there are also some tendencies towards virtual space in maps. For example, this is true for heights, which are often represented in the form of colour shades or contour lines. The process of creating a virtual space through viewing a map is different from the process of reading texts, as it is based on reading another space, or rather another surface—the map.

2(a) time manifested in the material interface The corporeal interfaces of maps and written texts are non-temporal, whereas for oral texts they are temporal. Only when we read a written text does it become sequential , as the order of the text as a string of characters and words is connected to grasping the meaning of the text. The intention of meaning creation through sequential reading is there in the text, and the intention is fulfilled through an act of reading. We can study the beauty of calligraphy without even knowing where the lines go, but in order to read the text built up by the letters, we need to find the lines. For maps, the order is more or less arbitrary; it will change from reader to reader, and from reading to reading.

Time is not manifested in the material interface of written texts; the temporality is secondary, which may be the reason for the ease with which maps integrate their texts. No comparable ease of integration between maps and spoken texts exists; they are still, after centuries of coexistence, felt as a mixed system.

2(b) perceptual time All media are realised in time. Even media that are not basically temporal become situated in time once they catch our attention. Even if there is no fixed temporal direction on a map, each map reading happens in time. So perceptual time is a fundamental aspect of all cognition, and is present for all three media types.

2(c) virtual time In static maps, all time is virtual. Interpretations of moving objects, which are seen thus from iconic grounds, always include the idea of states before and after the frozen time of the image.[20] In some types of maps, such as military history maps showing troop movements, virtual time is active. As we will see in Chapter 7: with digital maps such movement can be represented by movement on the screen, either with fixed sequentiality, as a movie, or with less fixed sequentiality, for example with a time slider.

A normal reading of a map will include an interpretation that the map is stating the situation at a specific time. This time is clearly represented on some maps, such as statistical maps and maps in historical atlases. Google has copyright date on their map images, but no date of creation is explicitly given. Some maps go far in the direction of expressing a timeless truth in their rhetoric, such as many topographical world maps. The knowledgeable reader will know, however, that the landscape is not stable—at least not on a geological time-scale—and that the projection distorts size, directions, or both.

Time is connected to narrative time in speech, the words are spoken in an order. But there will be secondary times as well, functioning as virtual time. The event order of a story may be different from the order in which it is told.[21]

Tension

There are certain symmetries between the space-related modes, **1 a**–**c** above, and the time-related ones, **2 a**–**c**. For the (a) modes, the differences are quite clear between the media we discuss: maps and written texts have manifested space, and oral texts have manifested time. As for the (b) modes, they are always present, but they work in different ways in maps and texts. The (c)

[20] This is similar to Lessing's concept of the moment of potential (*der fruchtbare Augenblick*).

[21] This difference is well established in narratology, for example as 'story' vs. 'discourse' in Chatman (1978).

modes are potentially present for maps, oral texts, and written texts, but whether they are necessary differs. An oral text can represent space only as virtual space.

Virtual space and time are necessary when the represented spatiotemporal state is different from the spatiotemporal state of the representing material modality. Tension is raised when a medium lacks certain qualities in the interface, but still invokes these qualities in its perception and interpretations.[22] Maps can create virtual time only through tension. For written texts without the manifested space connected referentially to the described world, I find it reasonable to see a lack of ability to represent space, leading to tension in this case as well. So these texts too can create virtual space only through tension.

6.2.4 Semiotic modality

The last of the four modalities is the semiotic. At this level, the understanding of the medium based on the meaning of the signs used in it is considered, or, in Elleström's description, 'The creation of meaning in the spatiotemporally conceived medium by way of different sorts of thinking and sign interpretation' (Elleström 2010, 36). Following Peirce, he groups the signs into three categories:

1. convention (symbolic signs)
2. resemblance (iconic signs)
3. contiguity (indexical signs)

As long as we discuss the basic sign system and not complex signs used in literature such as metaphors, the two types of texts use almost exclusively symbolic signs.[23] As for maps, the semiotic system was outlined in Chapter 2.[24] Maps are images, and as such, they foster iconic sign functions, but not as many indexical ones as certain other images do. However, the map grid

[22]Tension is related to Lessing's rules, but raising tension is not the same as breaking his rules. The relationship is more complex; however, I will not work it out here.

[23]Exceptions include icons such as † and imitations of sounds in oral texts.

[24]Both MacEachren (2004) and Brodersen (2005) base their studies of cartography on Peirce's semiotics. A deeper integration between Elleström's model and cartographic theory would be most wanted, but is beyond the scope of this book.

lines in themselves turn the map image into an indexical space. Map images are meaningful in a pictorial way and will induce pictorial representations in the mind of the reader. At the same time, the abundance of symbolic signs on the map induces in the reader a primarily symbolic kind of thinking as well. The mind conceives a map as both spatiotemporal and propositional structures simultaneously.[25] This, I assume, is what lies behind the comparison between a map and a library put forward by Jacob & Dahl (2006, xix; 254–6): the map is a space with a number of propositional statements spread out on it.

6.2.5 The model as a whole

The discussion of Elleström's model can be summarised as seen in Table 6.1. When we study the plus and minus signs in the table, noting especially the places where the three media types differ, we see that the differences in the modality between media carried by sound and media carried by physical documents appear in the areas of the material and the sensorial modalities, whereas no differences between texts and maps are found there. Like writing and pictures in general: both are kinds of ' "scratching"—that is, marking on and in surfaces' (Elkins 1999). This is in line with naïve observation: A document is a document, no matter whether it carries a map or a text. Listening to talk is different from seeing a document.

In the area of the semiotic modality there are no differences between oral and written texts. We are now in the process of interpreting the meaning of what is conveyed to us. The differences between texts in different forms, such as a text seen as an image, heard as a sound, or the contours felt in Braille reading, are not present at this level. Conversely, the flat physical surface of the document is no longer something making the text similar to the map. In order to understand what we see or hear we must decode what is carried to us through the media product. As the semiotic systems are different this decoding will take different forms for texts and maps.

The differences between the three media are most complex in the area of the spatiotemporal modality. The many parentheses in the table indicate this. Maps and written texts are both documents with space manifested in the material interface. But the creation of meaning from the spaces works

[25]This is well known from cartography. One example is Wood et al. (2010, 53–6), showing how the map creates a link between a place and a proposition.

Elleström			**Eide**		
Modality	*What the modality is*	*The most important modes of the modality*	*Map*	*Oral* text	*Written* text
Material modality	The latent corporeal interface of the medium; where the senses meet the material impact	1. human bodies	–	–	–
		2. other demarcated materiality	+	–	+
		3. not demarcated materiality	–	+	–
Sensorial modality	The physical and mental acts of perceiving the interface of the medium through the sense faculties	1. seeing	+	–	+
		2. hearing	–	+	–
		3. feeling	(+)	–	(+)
		4. tasting	–	–	–
		5. smelling	–	–	–
Spatio-temporal modality	The structuring of the sensorial perception of the material interface into experiences and conceptions of space and time	1(a) space manifested in the material interface	+	–	(+)
		1(b) cognitive space ...	+	+	+
		1(c) virtual space	(–)	+	+
		2(a) time manifested in the material interface	–	+	–
		2(b) perceptual time ...	+	+	+
		2(c) virtual time	(+)	(–)	(–)
Semiotic modality	The creation of meaning in the spatiotemporally conceived medium by way of different sorts of thinking and sign interpretation	1. convention (symbolic signs)	+	+	+
		2. resemblance (iconic signs)	+	–	–
		3. contiguity (indexical signs)	+	–	–

Table 6.1: Elleström's modalities (Elleström 2010, 36), with my interpretation for maps and texts. Numbering in the third column of 'Elleström's part' is added by me.

differently. The same can be said for time: neither has time manifest, but the two media still operate differently in time when we interact with them.

Maps and texts alike have space manifested in the material interface, but the way in which a cognitive space is established based on the material interface differs. Because the spatiality of texts is less directly connected to the spatiality of the described landscape, the landscape spatiality established in the mind of the reader is a reconstructed virtual space. As for maps, the

space manifested in the material interface has a spatial similarity to the landscape depicted. Modern people are trained map users and will usually see this similarity. This will be different for people who are not trained map users and whose systems for communication and reflection are not map based. The decoding of a map is a considerable cognitive task. The abundance of maps in Western cultures may have made this task invisible, but we cannot assume it is automatic under other cultural circumstances.

This study of interart and intermedia theory has shown two things. First, there are two rules established by Lessing which are in line with the thinking behind the stronger claim presented in the introduction to this chapter. And second, Elleström's work shows that there are clear differences between texts and maps—not in the material and sensorial modalities, but rather in the spatiotemporal and semiotic. Lessing showed that poetry and painting can easily represent some parts of reality, while each of them will struggle with representing other parts. Elleström shows the same in a more abstract way, generalised over all media.

6.3 Texts and maps

A theoretically informed comparison between texts and maps will follow. First, however, I wish to include a few words from some of the more knowledgeable amateur practitioners in map use: orienteerers.[26] The following quotation is taken from the introduction to a book about 'Tiomila', a 10-man relay race which includes both night and daytime legs:

> **Maps as memory archives**
>
> To orienteer, and to write, would be less than interesting if there were clear borders between open lines of sight and reduced visibility. I move forward through interpreting and understanding how someone drew. Having written a text one has also drawn a map, which must be used in order for the printed book to be anything else than ink on paper. The reader does half of the work. Maps and texts exist only when used, when they are read.
>
> And what is printed can be read quietly on the couch. Yet one travels. And maps, as texts, can be memory archives, can help us imagine, prepare us for voyages, help us reaching the unexpected.

[26] Amateurs as orienteers, that is. Some of them also have a career in cartography.

> The wonderful thing is that this can even happen when we totally misunderstood the book's or the map's signs![27]

Hearing and understanding the geographical aspects of a narrative include contemplating the spatial organisation of a landscape. This spatiality is expressed in words, in the linearised form of speaking and listening. Even if landscape understanding is partly individual, it is also something we can communicate about. Orienteerers tell each other stories which are understood, and they share maps with a common, although not identical, understanding. What happens when we 'read' a map that is different from reading or hearing a text? The characteristics of a map can be seen as constraints, but also as enablers. What is the trade-off when a narrative about movement through space is visualised? What is gained, and what is taken away? Conversely, what happens when we describe landscapes in a text?

There is a strong relationship between narrative and text. Lessing claimed that poetry should be used for events in time, not for descriptions of space, even if texts *can* be used for stories and descriptions alike. The amount of spatial detail one can reconstruct from a text seems to be limited, which is in line with Lessing's claim that describing an object in poetry takes too much time, so that the reader loses track of it. This may be one reason why textual descriptions that are quite limited in what they actually convey nevertheless seem to be very detailed, as we saw in Chapter 4. Lessing's argument implies that a reader can cope with more detail in a story than in a description.

Detailed descriptions seem to be harder to understand than detailed stories. While a text, with its more abstract signification, is freer to convey underspecified information than a map, there is still a limit to this freedom if the reader is to comprehend what he or she reads, which may be too difficult if a landscape description is too complex. Then communication may break down; or rather, the only way really to grasp the spatial meaning may be to make a drawing based on it—a map. The text becomes a drawing

[27] '**Kartor som minnesarkiv** Att orientera och skriva vore ointressant om det fanns absoluta gränser mellan vad som är öppen fri sikt och vad som är sämre sikt. Det är i tolkningen, förståelsen och aningen om hur någon ritat, som jag når fram. Den som har skrivit en text har ritat en karta som måste brukas för att vara något annat än tryck på papper. Läsaren gör halva arbetet. Kartor och texter existerar först när de tas i anspråk, blir avlästa. Och det tryckta kan avläsas i stilla soffposition. Ändå färdas man. Och kartor kan som texter vara minnesarkiv, ge oss fantasi, förbereda oss på färd, hjälpa oss att nå fram också till något alldeles oväntat. Det underbara är att detta också kan ske när vi alldeles missuppfattat bokens eller kartans tecken!' (Hyttfors & Tirén 2011, 5).

instruction. But the drawing is only necessary if one really needs, or wants, to comprehend the detailed spatial description. This is often unnecessary in order to read and understand a text, as a description may serve numerous other purposes.[28]

While texts are freer, maps seem to be easier to understand. Scaled maps tend to be understandable to anyone with basic ability to read such graphical representation, an ability that seems to be either present or quickly developed by people of all cultures. Numerous examples of this can be found in Woodward & Lewis (1998), as well as in Landau & Lakusta (2009). It is easier for most people to understand space by studying Schnitler's maps than by reading his texts. The language issue is an obvious part of this—less than 1 per cent of the population of the world can read Danish—but only a part. The difference goes deeper. It seems to represent a general tendency of all maps and texts; however, it may be dependent on culture, and the abundance of maps in modern Western societies may have given us a bias.

Although maps are much quicker to take up than linear script, they are hard to analyse. Always ambiguous, the language of maps is never completely translatable. We may think we understand a map immediately, and in a sense we do, because it says such simple things which we are trained to know. But for historians, maps offer a slippery witness to the past, no less imprecise than written language (Harley & Woodward 1987, 2–3). In my opinion, the difficulty of analysing maps is connected to the fact that the analysis takes place in verbal text. Texts cannot be translated to maps without loss of meaning, and it is likely that translating maps to texts is equally difficult.[29]

Still, even if hard to analyse, maps do give us easier access to a spatial overview, and this clarity comes at a price. Using a map, we give away some of the freedom textual communication offers us,

> we sacrifice the ability to deal explicitly with those principles of fuzziness, indeterminacy and evolving relations which seem inherent in all human action (Olsson 1974, 53).

[28] Again, the example of Ishiguro's novel *The Unconsoled* (1995) is relevant. The landscape described in the novel is not comprehensible in any direct sense. The reader does not need to comprehend it in any detail either, as long as the strangeness of it is understood. Many more examples exist in fiction.

[29] This could be the topic of a study in line with the present, with the modelling method adjusted appropriately. I will come back to this suggestion in Chapter 8.

What is lost in indeterminacy is gained in oversight and clarity of expression. Maps can describe a landscape in great detail without losing the overview, as long as the map is large enough. In digital mapping, intended to be used on smaller computer screens, the lack of size is compensated for by zooming. Zooming, which is used extensively in digital maps, seems to have no direct parallel in texts. The closest we get may be keywords and summaries, and the metaphorical zooming out we find in macroanalysis.

Maps and texts can be classified according to two distinct modes of perception discussed in Certeau (1984, 119): *seeing* and *going*. On a very practical level, maps and other images are connected to seeing, to the tableau, whereas verbal text is connected to going, to movement in a particular direction. A map can be *seen* as a whole, at once, whereas a verbal text, maybe apart from the very shortest utterance, has to be *gone* through, or listened through, in order to be understood.

Maps primarily describe. But even if they do not tell stories, they can be used for storytelling, connected to eye, finger, or pen movements over their surfaces. A trace of telling a story, or an instruction for retelling the story, can be put on the map document by lines, arrows, and small texts. But only a verbal message in the form of writing, speech, or song will turn the lines and arrows on the map into a narrative. Some discourses about space, such as route directions, have natural linearisations. In other cases, spatial structures have no natural linear arrangement. A common strategy in the latter case is to project an event structure onto the domain of discourse (Levelt 1981), for instance by taking a mental tour through space—either a body tour or a gaze tour.

This points back to the the walk as a memory system known from antiquity, and also to Lessing's rule number 1, which claims that poetry is for events in time and painting for objects in space. Reading a map comprises a tour, removing all the non-followed routes through the space and retaining only the followed one.

In situations of communication, maps are used quite differently from texts. Silent reading is different from reading out loud. The difference may be minimal for text. If the listener does not make any comments, reading out loud is quite like a monologue. But when one is reading a map, the difference is fundamental. The moment someone starts reading, or talking over, the map, lines and trajectories start to appear, the sounds of the words mix with the image of the map, and the map turns into a background image for potential or past travels. When a story is told using a map, the process of

telling—of going through the story—will create lines across, or through, the map. This line may be written, for instance with a pencil on a paper map or by a GPS system as a series of measure points defined to be interconnected by lines, or it may only exist in the moment of telling each part of the story as well as in the memories of the participants (Wood 1993*a*).

As was shown for texts and images in general above, reading a text is to *follow* an order, whereas reading a map is to *create* an order.[30] One route through the described object is chosen, and all other routes are unchosen. Because reading a map includes the creation of a route through the map, reading it out loud to other people is a creative process in a different way from reading a text. In the latter case, the creative process lies mostly in *how* the words are spoken, not *which* words are spoken. Changing the order of the words will soon change the act of reading into something else. Reading a map in a social setting, on the other hand, is to define an order in which map symbols are called to the audience's attention.

One may argue that a text one has read several times will be well known and randomly accessible from memory. While it is well known from narratology that the first reading is different from later readings, the claim that the whole text is randomly accessible in the mind of the reader is wrong in principle. For even if I may remember everything I read from a text, I will not remember it *as a text*. The text I read and remember have to be translated into knowledge in order to be randomly accessible. If I remember the text as text I will have to 'play it through', that is, listen to my internal voice in order to get to it—and in that case it is only available in sequential form, not randomly.

The relationships between map symbols work differently from the relationships between words, clauses, and sentences during reading. These differences are linked to how we travel through a landscape. A journey through a real landscape can be represented by a continuous line on a map. A travel narrative—that is, a text—cannot create such a line in the same way. It will need to base itself on pre-existing lines such as 'going along the eastern side of the lake.'

Travel narratives can, however, easily be represented as a series of place names. In a later mapping of the narrative, what was a route becomes a constructed line between the places on the map representing the places in the landscape denoted by each of the place names. In this mapping process

[30]Cf. the 'reading' of geometrical diagrams in Elkins (1999, 85)

the temporal aspects of the travel is replaced by a spatial sequence of points, making it reversible (Certeau 1984, 35). This new line is created by the reader, rather than being a reconstruction of the original line. The original line was not expressed in the text. We know that there has to have been a line of travel, but we do not know from the text where it was. In the textual narrative the places are mentioned; the rest, the stages between them, may or may not be totally unspoken, but they are rarely fully specified. The text is silent about parts of the route.[31]

We are free to be silent about the connections between the place names in a text, whereas we cannot put anything on a map without locating it, without deciding on what is between it and other map symbols. We cannot be silent, because a blank area is a statement of blankness, and not a nothing. The semiotic system of a map endows a space on a map with a special relation to the spatial system in the world referred to. This is in line with Lessing's rule number 2, which refers to the differences in syntax and level of abstraction between poetry and painting.

The difference between points and lines goes to the core of cartography and has consequences for the semiotic status of maps. In a set of geographical vector data it is common that what was recorded when the data were collected was just a series of points, even for lines and polygons. If you look at, say, a road as it is presented on a modern digitally based map, what you see as a line is really a set of interpolations, usually straight lines drawn between measured points, even if the actual measurement points are rarely visible on the map. Such interpolations were common on maps produced through an analogue process as well. But in other cases we created curves based on aerial photographs or on what we saw when surveying the landscape. We drew curved lines which were not interpolations between points, but rather representations of what we saw. These lines were copied through several steps, keeping their indexical qualities, semiotically speaking, all the way to the map.

[31]Meister describes how underspecification is well known in narratology. The information is always selective and partial, it is 'characterized not only by the material it explicitly includes, but even more importantly by patchy descriptions, schematizations, and omissions' (Meister 2003, 18). The full truth about the character is never told; we must extrapolate based on world knowledge. The clever poet does not postulate the existence of the non-existent, he or she imitates an event, knowing that the recipient will complement it with images of agent and patient (Meister 2003, 73). This points straight back to Lessing's rule number 1.

A digital raster map, which is a scan of an analogue paper map, is digital, but still, the bits are used to represent lines as lines. Thus, a sort of pseudo-indexicality is present.[32] When the map is vectorised, on the other hand, the curve is reduced to a set of measurement points, each recorded by storing numbers for the X and Y axes. The drawing of the map will then be based on interpolation. The resulting map is better in many ways than the raster map, but the indexicality of the line is lost. No similar semiotic difference between lines and points exists in texts.

The differences outlined on the last few pages are fundamental. They steer what can be expressed in each of the two media. While they can to some degree be overcome, it is not necessary to do so in most situations of ordinary communication. Each medium can be seen as a tool, and when we build something, we use a combination of tools suited to the task. Combining maps and texts in practical work comprises an example of geocommunication, a mixed medium which may include maps, texts, gesture, and other dynamic elements. Performance cartography is a type of geocommunication.

Examples of geocommunication systems include car-mounted GPS systems, in which the two constituent media forms are a map and a computer-generated voice giving textual directions. Another example is the route-finding systems made available by many providers on the web, including Google maps, in which maps, textual directions and images are combined. A third example is a researcher with open books and atlases on his or her desk. Some of the contemporary users of Schnitler's material may very well have been in such a situation. His dataset could have been part of geocommunication systems already in his own time.

Historically, this concept is known considerably earlier. Purves makes a similar point about Anaximander's cartography and prose:[33] 'it is possible ... to see the map and prose narrative as two mutually reciprocating halves of a single, complete 'text' ' (Purves 2010, 109). The fact that maps and texts are both needed for many communication purposes was also known in medieval Europe, at least in the fourteenth century (Schulz 1978, 452). The understanding is expressed in China at least as early as the 10th century (Harley & Woodward 1994, 99–101).[34]

[32]This type of indexicality is claimed for digital photographs, but the claim is not undisputed. See Lister (2007) for a discussion of the complexities of the indexicality when it is seen in light of social practice.

[33]Anaximander (c. 610–c. 546 BCE) was a Pre-Socratic philosopher.

[34]It would be very interesting to track this idea though history with a global perspective,

In combined map-text systems, the map is the static part, whereas the text is the active part establishing a movement in time through the static, timeless space of the map. As a static map is frozen, it can be said to be outside time. The claim that maps are outside time may be true when it describes map use, but it is never essentially true. The information on a map is collected in time, that is, at different times (Jacob & Dahl 2006, 325–7).

According to Lessing, and to my argument in this book, texts are more abstract than the plastic arts, because the plastic arts have to present actual people and things, taking many properties with them, whereas texts have abstracted away many of the accidental features, such as the skin colour or the clothes of a person. But in the discussion of the relationship between texts and maps, for example in Jacob & Dahl (2006), a text is seen as a more concrete expression situated in time and place, whereas the map tends to locate itself in a more abstract timeless truth. How can these two claims both be true? How can a text be both more and less abstract than a map?

The former opposition is based on how the intrasignificant sign system of maps works. It is concerned with the relationships between map symbols, between the symbols and the depicted landscape, and between symbols and concepts. Seen intrasignificantly, the map symbols are more concrete than textual expressions. The latter opposition is in the area of extrasignification where each map is seen as one cultural sign working in a society, with the tendencies towards myth pointed out by Wood & Fels (1986). Seen extrasignificantly the map is more abstract, its binding to place and time is less concrete than the one we find in geographical texts.

Whether or not a map is outside time is also a question of level. Some maps are produced to be used once, such as the physical copy given to an orienteering runner for a competition. After the competition the map, folded many times, damaged by water and dirt, may be used as a memorial object to retell the tale of the competition (Hyttfors & Tirén 2011), but the map is never used again for navigation. This is, however, only one copy. Behind the copy there is a printer and all the other copies, used many times before, at the same time, and after the copy of our example. And behind that again we have the updating of the map, making a new print production a decade or two into the future, reflecting changes in the terrain as well as cultural changes in how the map presents the landscape. For the map is but one possible way of visualising the landscape, one in infinitely many potential

but that is beyond the scope of this book.

ones; it, too, is underspecified.

Even if maps are selective and underspecified, they still connote truth. Furthermore, as political tools they also establish truth, as when a coloniser's map renames places. A map can lie by being denotatively wrong—for instance, by moving a border for political reasons. But even 'correct' maps may lie. In such cases the map lies in the area of connotation, not denotation. Maps use space to denote space, but the space of maps is a manipulated and transformed world space, based on general and specific map schemata. People have to learn that maps lie (Monmonier 1996), whereas texts are known from the outset to have a complex relationship to truth.

Maps and texts are different media which may work together in geocommunication. But even as separate expressions, there are links between them, created by place names.[35] They are used in almost all geographical texts and on most maps. They are the same in both cases: strings of characters to be read in the correct internal order. The definition of 'place name' is the same whether they are used on maps or in texts.[36]

Yet the relationships to their contexts are different. The main difference between the ways in which maps and texts use place names is related to local context. In a text, either oral or written, place names are connected to words around them by syntactic rules. On a map, the rules are geometrical.

The place names in a text follow the same rules as the words around them; they are made from the same substance—from letters. On a map, the spatiality is broken by the introduction of a place name, because it is not connected as a spatial object to the landscape: it is not indexical. Instead, it works symbolically, as does the cross symbol for a church. One arm of the cross has no spatial meaning, unlike the meaning a section of a road symbol has. Neither has the 'L' in 'London'; it has meaning only as part of the word. The name as a whole is connected to a point or area on the map. Each letter in a text on the map is located in the space of the map, so reading can be seen as moving across space (Jacob & Dahl 2006, 202–3). But it is not; not really. The letters are outside the spatial system of the map, so a claim that the 'o' in 'London' is east of the 'L' is seen as silly by a competent map user.

A proper noun provides a name for an instance of a general type when

[35]This fact is fundamental for text mapping in digital humanities. It sometimes leads to problems because the specific function of each occurrence of a place name is overlooked (Southall 2003).

[36]I use Olsen's definition from Section 4.3.4, in which the social function of toponyms is expressed clearly.

the instance is unique within an implicit context. This is the same for maps and texts, but when a toponym is added to a map, it is often connected to a symbol. The symbol is known from the legend or otherwise to represent a class. A symbol becomes particularised when it is located on the map; it becomes a representative of the class located at a specific place (Wood et al. 2010, 58). This particularisation is supported by the place name. It may also lead to a subdivision of space, for example by separating out a wide part of a river by naming it as a lake, or by adding different names to different parts of a river system (Jacob & Dahl 2006, 203–4).

How the names on a map are chosen is a political, cultural and juridical question with potentially strong implications (Helander 2009), connected to place name use in other settings, and to the general power play in map making. Here, too, not only the current power but also the marginalised can use the map as a tool (Mathisen 1991). Even in cases where names existing in oral use were excluded from official maps for a long time, the situation can be changed.

As we saw above, there are two main areas in which we find differences between texts and maps. First, we have the spatiotemporal modality, where time and space are manifested differently in the material interface. We also have a difference in virtual space and time. There is a tendency towards symmetry here: what is true for space for one is true for time for the other. This is in line with Lessing's insistence on time and space as key concepts, presented as his rule number 1 above.

Second, there is a difference in the semiotic modality, namely the usage of iconic and indexical signs in maps, in addition to the mainly symbolic signs we see in both texts and maps. This is also in line with Lessing's views, especially in the interpretation of the differences between what he called conventional and natural signs,[37] also seen in his rule number 2. Spatial indexicality is something most verbal texts lack, even in written form, while it is of utmost importance to maps. The interaction between spatial location and non-spatial attributes is specific for maps (MacEachren 2004, 164–5). In Chapter 2, the distinction between navigation and wayfinding was discussed. In the context of Lessing's rules, navigation is more like an image, in space, whereas wayfinding is more like poetry, in time.

According to Jacob & Dahl (2006, 23–4), the drawing of maps appears

[37] *Willkührliches Zeichen* and *natürliches Zeichen*. I will not go into Lessing's semiotic system here; see Wellbery (1984) and chapter 5 of Todorov (1982).

when verbal language reaches its limits. In such a situation mapping is not used to replace verbal text, but to address communication needs not met by it. This is parallel to the way in which a map user in a communication situation adds verbal text and gestures to the map, and it is in line with Elleström's view as we saw it above: 'Every medium has the capacity of mediating only certain aspects of the total reality' (Elleström 2010, 24).

So maps and texts are different media, able to articulate different aspects of the world they refer to. They can be used together in geocommunication, and there are connections between places on a map and places in a text represented by place names. However, the claim that maps cannot be made based on any text without making choices asks for a wide variety of evidence from texts and maps to supplement the theoretical discussion in this chapter. That would, however, be beyond the scope of this book.

What happens at the border between texts and maps? One key question which was hinted at in the very beginning of the book is why people use either texts, maps, or both when they communicate about wayfinding and navigation. This question is connected to how the word 'map' is used. In this book the word is used for documents and not for the fuctional aspects of navigation and wayfinding. The practice of map use in conjunction with other media is covered by the word 'geocommunication'.

Lessing claimed a fundamental difference between painting and poetry. I will argue for a similar fundamental difference between text and map, but also that the two can be united in geocommunication. Indeed, the *Ut pictura poesis* tradition, and the end of it in the eighteenth century, can be used to understand better the relationship between maps and texts. The idea of the sister arts, the understanding of 'poetry as speaking painting, painting as silent poetry', this idea that Lessing argued was wrong, was seen as true by many people because it was a reasonable view. It was usable, and it permitted a good understanding of the relationship between the two art forms. The history of scholarly discussion since the enlightenment has shown that Lessing's view can be attacked from many angles; one example is Mitchell (1984).

The same goes for *ut mappa scribens*, the idea that a drawn map is like a written text. Indeed, expressions like 'a geographical text will be like a map' or 'a geographical text is a speaking map, a geographical map is a silent text'[38] are a bit awkward, but their meaning is quite clear and would

[38]These are examples made up by me based on statements about the sister arts, as is

presumably be accepted by many people.

But they should not be. As Lessing did for poetry and painting, we must go beyond the 'sister media' of text and map in order to see how they are *truly* different. This is where Jacob & Dahl (2006) fail in the otherwise solid book *The Sovereign Map*. They see that a map is something more and better than a text, but the text is not respected as something more and better than a map. To them, the map can do everything a text can do, and usually better. The text is just a servant, or a poor cousin, of the map.

The problem with this view is that one of the two media becomes the norm for the other. What happens is exactly what Lessing warned against. What Brown says about Lessing's accomplishment must be said for the relationship between geographical narrative and maps as well: 'each art is assigned an independent sphere in accord with its nature' (Brown 1971, 87). The two arts are indeed sister arts, but at an abstract level, not in the way they use signs at the concrete level. Landau & Lakusta (2009, 17) understand this fully: maps and texts are truly different, and combining them produces in sum a very useful set of tools. They are independent in the sense that one should not mime the other, but they can still be combined in geocommunication.

In the early twentieth century, the idea of images as an economically efficient way of communication was established in advertising in the USA. Mieder has traced a small part of this history, the part connected to the slogan 'A picture is worth a thousand words', which began with an advertisement for tram advertising in 1921, using the slogan 'One Look Is Worth a Thousand Words' (Mieder 1990, 209–10). It was claimed to be a quotation from a Japanese philosopher, and later it was attributed to traditional sayings from other East Asian countries, but Mieder found no evidence for this, arguing that the saying was created in 1921. It quickly caught on, however, and is now proverbial in many parts of the world.

A similar claim for efficiency can be seen for maps. In the area of geographical information, there is a general view that maps are better than texts for storing and communicating information about geography, and this is true in many cases. But in which cases? Are there cases in which the opposite is true? Lessing argued for the different qualities, the different areas where painting and poetry could work at their best. The image may have many good qualities, not least with modern capturing and dissemination techniques, but still, poetry is far from dead. I claim that the same is true for the sisterhood

the expression *ut mappa scribens*.

of geographical maps and geographical texts. The efficiency, clarity, and definitiveness of the map may appeal to our time, but the lack of specificity and the abstract openness we find in text are still important, in fiction and beyond.

This is in line with the claim in Sayer (1989): regional geography needs the narrative. But this is not just about using texts to express geographical knowledge. Such texts show no sign of disappearing. The real threat is rather in the way we use texts to express knowledge about landscapes, and the weight we assign to the accompanying map expressions we use in geocommunication systems. This is in line with the point made by Lessing about using one medium as the norm for the other. The danger is not a world with only maps and no texts; the danger is rather a world where texts become more and more like maps, less and less open, losing one of the main strengths of textual expressions about landscape. This danger has been seen for a long time, for example by Olsson (1974). It needs to be kept visible, not as a prohibition against maps but rather as a word of warning, in line with the warning issued in Monmonier (1996).

If I claim that texts are better than maps in some cases, what does that mean? Quality cannot be assessed without reference to what we try to convey, and what the limitations are to our means, intellectually as well as technically. We have seen that texts can convey types of information that maps cannot express. I claim, on that basis, that knowledge can be expressed in a text that cannot be expressed on a map. But what does that imply? Can we not just change the way we say things so that we can express them in any of the media?

We cannot do that because the medium is not isolated from the message.[39] It is not just that we cannot say things in the same ways in texts and maps; we cannot even say the same things. If we take the message of Lessing seriously, which I think we should do at this specific point, maps should not be like texts and texts should not be like maps. This implies, for instance, what many people know well already: the navigation systems based on hybrid cartographic-textual interactive documents available on the Web and in the form of GPS based hand-held or car-mounted systems may be more useful than either a map or a text. One may say that the solution is hybrid. Or, at least, a partial solution; GPS systems can be dangerous if trusted blindly.

[39]This idea was famously expressed by McLuhan in his 1964 article *The Medium Is the Message* (McLuhan 2001, 7–23)

But are not maps in themselves representatives of a fundamentally hybrid form, in that their graphical representations are connected to a set of texts written beside the image, a legend, the title, and so on, as well as within the image, in the form of place names? The form is hybrid in one sense, but the space of the map image is still governed by spatial rules. Even if texts on the map image help to particularise map symbols, they are not necessary, and the texts play the game according to the rules of the map.

In order to create a more hybrid form, the map would need some sort of temporal aspect. That comes with map *use*. Map use operates in time as well as space and possesses this higher level of hybridity. Maps in themselves do not. Many systems for digital maps, for example those used to implement deep maps, possess that level of hybridity, but then they are geocommunication systems: they are not maps, but rather they include maps. In this sense, one can say that geocommunication is the result of adding time to the map.

In geocommunication, such as in a GPS system, a multimedia story is told with maps and narrative texts combined. They are mixed, but still mixed as separate parts—they are not hybridised. The key to the workings of a map is the indexicality of the statements made by the map surface, not the question of correctness or even existence of the referred landscape. The map does not need to be based on a Cartesian geometry, and the referenced landscape may not exist, as for a map of Tolkien's Middle Earth.

What makes the map a map different from a text is the semiotic claim inherent in the spatial reference system. Can we create different forms of documents where maps and texts are integrated in novel ways? What are the role of time in digital maps? These are among the questions to be raised in the next chapter.

Chapter 7

GIS and digital mapping

The possibilities for integrating texts and maps and for creating map based narratives are important in the spatial humanities, and those questions deserve both theoretical and practical studies. The results from the research described in this book is important for the application of computer based methods for spatial information implemented in GIS and deep map systems in the humanities.[1] Such applications are usually connected to textual information, and the spatial data are often drawn from textual sources. The consequences the current work may have on the way in which we conceive digital maps and texts in academia and beyond will be discussed in this chapter. In Chapter 8 similar questions will be asked about modelling in general and critical stepwise formalisation specifically.

This chapter will show some practical consequences the results from the case study may have for digital communication of geographical information, covering digital tools of various types such as dynamic, fuzzy, and deep maps, as well as 'route-finding systems' and Google maps. The cultural capital that Google maps has acquired, and the implications for digital humanities in particular, will be discussed with an eye towards similar trends in other mapping systems, digital as well as analog. Examples will be shown of how current digital mapping practices in the humanities, such as the mapping of texts and deep mapping, struggle with some of the same fundamental

[1]No general introduction to tools and systems for digital humanities mapping and time visualisations will be given. Neither will I explain GIS beyond the brief introduction given in Chapter 3. A number of introductions to digital mapping are freely available online. There are also several books about the spatial humanities available, see for example Bodenhamer et al. (2010).

media differences as the ones documented through the stepwise formalisation process.

The main purpose of this chapter is to clarify the extent to which digital mapping can change the situation described thus far in this book. Tally (2013, 42–6) calls for new forms of representations of space, new types of textual cartography. How does this relate to maps? How far can the borders between the media be pushed by digital mapping? Are there still inherent limitations in each of the two media? Finding out to what extent the limitations we still see can be overcome by better technology and further conceptual development is an important area of speculation.

This will include a discussion of the possibilities for the visual representation of disjunction and negation, and also a critical assessment of the concept of underspecification. No expression is underspecified per se, it can only be underspecified relative to something else: another expression, a human experience of something, or a corner of the world as we may conceive it (Eide 2014*a*, 216). Rather than further developments of mapping technology and map schemata I will suggest that geocommunication systems, that is, dynamically integrated map-text systems, are the closest we can get to overcoming the media differences between texts and maps.

Rather than arguing that mapping textual information is impossible or wrong, this chapter will be a call for awareness of what types of knowledge we cannot express with each of the two media. Texts and maps alike should be used consciously, and various types of combined systems will often be the best choice. Such geocommunication systems enable the telling of stories that would be hard to tell by either maps or texts alone.

7.1 The mapping problem

Before going on to digital mapping specifically I will pinpoint some of the problems raised in Part II. As we remember from Chapter 4, a topological map is a depiction of spatial features where scale is not represented and directions are altered in order to make a clear visual image; an example was presented as Figure 4.9. While a topographical map follows the map definition from Section 2.1, topological maps are not maps according to such a definition.

The fact that the hypothesis is supported is also based on this definition; it is clear that a wider definition of 'map' could have given a different result.

As we saw in Chapter 4, topological maps are spatially vaguer than topographical maps and can represent more 'text-like' information—for example, when networks are described in a text. Static topological maps are stable representation of a visual form representing relationships between places.

As for scaled maps there is no way of saying explicitly that something does not exist with topological maps. The geometry does not have the concept of explicit negation in its vocabulary. The same is the case for disjunction. An object or a link on a topological map either exists or not. A spatially incoherent text is hard to translate to a topological map, as the network will be incoherent, for example by two nodes both being connected and disconnected at the same time. Dotted lines or node symbols may represent uncertainty and thus underspecification may be shown, but it is hard to establish the choice aspect of disjunction without falling back on a textual description.

The route description example above showed a situation where topological maps are closer to texts than topographical maps are. Apart from that the use of topological maps has not been studied in the experiments. Topological maps, with their special relationship to networks, can be envisaged as a possible middle layer between texts and maps. They express explicitly something that can also be expressed explicitly in texts, namely networks of relationships between places, but they do so in a graphical form.

The importance of networks also seems to be in line with the cell systems found in neuroscience, where cells representing locations in the environment form networks in the brain, and with Gibson's claim for a networks of places in a region. I am not able to bridge the disciplinary gulf between wayfinding and networks as I found them in my experiments on the one hand, and on the other how these topics are understood in anthropology, psychology, and neuroscience. Interdisciplinary work in, for instance, neurospatial-anthropology would be most wanted to investigate further into this, in line with what was suggested by Dobbs in Knierim (2007, 49).

In the graphical presentations made in section 4.3.2, one map was created for each set of choices of the underspecified values. What if no such choices were made? What if the model's openness was translated into a geometry? A figure based on such a geometry is not a map. Can it still be useful? The thinking presented here is based on a system developed for the purpose of modelling time, called *Holmen/Ore calculus* (Holmen & Ore 2010).[2] Space

[2]Holmen/Ore calculus is based on time modelling mechanisms in CIDOC-CRM, with strong links to Allen operators (Allen 1983).

is more complex to model in this way than time is, and I have not tested any implementation of what is speculated upon here.[3]

My original, naïve plan for creating a map based on the text, in which I exchanged each direction with a number (for example east becoming 90°), represented only one possible reading of the text, and thus, it did not capture the openness of the text correctly. A more correct reading lets each direction represent a span of possibilities.[4] Given a text stating that B is 1 mile east of A, a figure could be made where B would be represented by the curved line which is the $22\frac{1}{2}^{\circ}$ sector of the circle with A as the centre and 1 mile scaled down to for example 10 centimetres as radius. But a curved line is not enough. The length of the mile is not known. 'Mile' may have different meanings, and no measurements at the time and place were accurate. If we say we know it to be no less than six and no more than ten kilometres in this specific example, we get a sector of possibility for place B. This is illustrated in Figure 7.1.

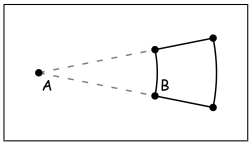

Figure 7.1: Underspecification 1: From point A, the connected point B can be anywhere in the sector.

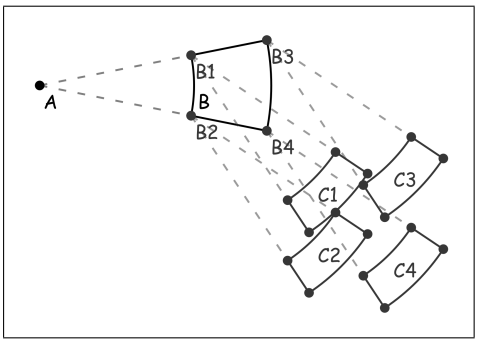

Figure 7.2: Underspecification 2: From point B, the next point C can be anywhere in the area made up by the set of sectors created from $B_1, B_2, \ldots, B_n$. Four examples are shown.

[3]The example described here is also dicussed in my blog post 'Text to Map: Rooms of Possibilities,' URL: http://modmebo.hypotheses.org/date/2014/09 (checked 2015-03-01).

[4]This may reflect what Gibson (1986, 68) calls 'visual angles' in reference to people's wayfinding, that is, it is based on how an observer sees the world. While the angles change with movement, the components of the earth (mountains, lakes, trees) do not change in size. Of course, everybody involved in the border work knew this; probably not explicitly, at least not in similar words as the ones used by Gibson; still, they 'knew' it as part of their practice.

If we have a new point C 2 miles to the south-east of B, new sectors would have to be made from each point on the sector representing the possible location of B, as shown in Figure 7.2. Such geometrical models would soon become quite complicated. It is possible to create them mathematically, and also to express them as figures, but such figures would not be maps. The use of an area to represent a possible location of a place is contrary to how maps usually work. Areas of possibilities are mostly used to represent fuzziness in thematic mapping, not for mapping topographical features. We will return to fuzzy mapping below.

We saw in Chapter 4 that the maps made from GeoModelText are quite limited in the amount of data they can express. The possibility of making maps covering larger chunks of texts would be an interesting further development of the tool. However, as the discussion above shows, such maps may be hard to present to users. While better algorithms for establishing geometrical data based on larger parts of the text would be most useful, the visualisations of such data sets should also be more advanced than what is shown in this book. They should include techniques as the ones described above complemented with time based and fuzzy methods as we will see them later in this chapter. In order to be fully understood, visualisations of such geometrical data sets need more complex visualisation systems than what static maps can offer.

The evidence from Holmen & Ore (2010) shows that when new facts are added, uncertainty is reduced in the system.[5] One could assume something similar happening for space. As new data are added to these geometrical rooms of possibility, it is quite likely that added place references will link back to places mentioned earlier. This will increase the complexity of the geometrical model, but it may simultaneously reduce the possible area in which a place can be located, thus reducing uncertainty. This method implemented dynamically in software would allow the historian to explore multiple possibilities of how and where a landscape described in historical sources may have been located.

[5]The reduction of uncertainty is depending on if and how the new facts relate to the previous state of the system.

7.2 Geographical ontologies

There has been a movement in the direction of cognitive models of geographical space in the last 20 years. The geographical information theory behind this cognitive modelling has developed independently of GIS systems. A major difference between the traditional GIS based data standards and geographical ontologies has been that GIS based standards for geographical information have been developed to express and transfer data in professional geographical and cartographical environments, whereas geographical ontologies have taken the perspective of ordinary people (Mark et al. 1999).

Geographical ontologies as they are described in Smith (1996) and Galton (2005) go beyond the tradition of cartography. Simply speaking, the quantitative cartographical tradition is different from the qualitative view of geography used in ordinary human thinking and communication:

> In contrast to the ontologies underlying most geographic information systems, which rest on discretized metric world models, such an ontology must have the resources to represent the *qualitative* conceptual categories conveyed by natural language (Mark et al. 1999, 287; italics in original).

So the ideal of geographical ontologies is to cover geographical information expressed in verbal text as well as in maps—that is, to cover both sides of my comparison. This is also in line with Smith's hope for a generalisation from cognitive linguistics to general ontology, including not only conceptualisation and categorisation imposed via language use, but also based on, among other things, 'the map-making activities of the geographer' (Smith 1996, 299). An example is Galton's concept of 'neighbourhood', which has both field-like and object-like characteristics:

> The determinants of a neighbourhood include such things as house prices, average income, social class, ethnic identity, and accessibility, all of which can be modelled as fields. But they also include the presence or proximity of such things as shopping centres, canals, railways, recreation facilities, places of worship, and so on, all of which are best modelled as objects (Galton 2005, 49).

In Chapter 3 above, I argued that political institutions connected to places such as municipalities have a similar double nature. A similar distinction,

or lack thereof, was also to be found in relationship to events, especially type events. It is hard to make a distinction between discrete events and a seamless texture of continuous variation. This is discussed further by Grenon & Smith (2004). This also points towards the general problem of relationships between space and time.

Ontologically based modelling of text is the method of my experiments. Because geographical ontologies are intended to cover both of the media I compare, they can function as bridges. The bridge metaphor is misleading in one respect, though. This process is not about crossing over from the text side to the map side with all the goods intact. The process will include losing as well as adding information. But modelling based on the thinking behind ontology development seems to be a good way to clarify what is lost and what is added. That is another reason why CIDOC-CRM is so useful in this work.

7.3 Time in maps

Digital media may be causing us to think in new ways about mapping spatial ideas. With interactive digital maps, time is injected not only into the reading of a map but also into the map itself, making it unstable and mutable. Paper based maps are static and movement can only be alluded to through the use of arrows and series of maps in comics like panels. The digital map itself becomes an interactive dynamic object, changing its surface with time or based on user input. Still, there is a tension here, connected to the inability for maps to fully represent the world expressed in the text.

In 1869, Minard published his famous visualisation of Napoleon's 1812–13 Russian campaign (Figure 7.3). The visualisation is based on a map, an indexical spatial grid representing the area from Kaunas in today's Lithuania in the west to Moscow in the east. On the space of the map image there is a thematic layer with a bar stretching over the landscape representing the travel route and the size of the army, which is also shown with numbers next to the bar, from 422,000 in the outset to 10,000 in the end. Further to this, there is a graph at the bottom showing the temperature during the retreat, connecting dates and the temperature to the space over which the retreating army travelled. Thus, the temperature is connected not only to the time of the retreat but also to the areas the troops moved over. There are also some textual descriptions in the document.

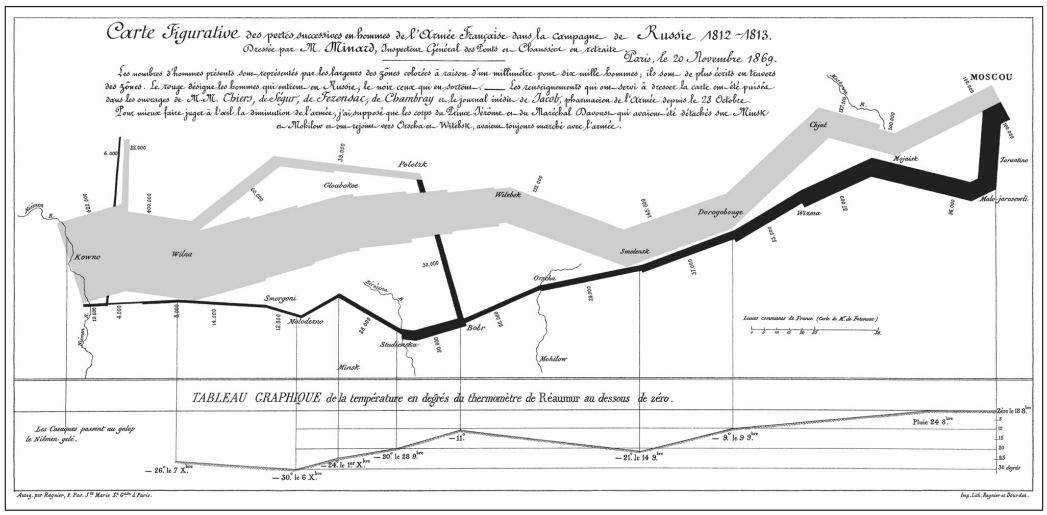

Figure 7.3: A reproduction of Charles Minard's 1869 chart showing the number of men in Napoleon's 1812 Russian campaign army, their movements, as well as the temperature they encountered on the return path. Lithograph, 62 x 30 cm. Wikimedia Commons. URL: http://commons.wikimedia.org/wiki/File:Minard.png (checked 2015-01-16).

This document represents graphically space, time, numbers of soldiers, and temperature. These four aspects, together with the textual descriptions, are presented in the form of an image, a large size lithograph. In this book it is reproduced in smaller format. Time is represented, but not as time; it is virtual only. The technical medium of the lithograph is space based; time is represented as space. The same is the case for the size of the army and the temperature. This is in line with the cartographic tradition where the changing world has been represented with static maps, thus, time remains an attribute of space (Dragicevic et al. 2001, 546).

A spatial document representing the space of a landscape has a similarity between the form of the media object and the referenced landscape, in line with the harmonies in art pointed out by Lessing. A map document has an indexical relationship to the landscape on which it is based, but it also appears iconic to the map user, representing directions and distances based on spatial similarity. This signification will always depend on context. The map is more than geometry, but the map image is organised according to

a geometrical system. Time can be represented too, but then as spatial features in the document. The relationship between medium and message is different for space and time, as the medium of printed maps is static. The sense-data remains the same over time, and thus, the paper map is in this respect outside time (Elleström 2010, 19).

However, this can be different today. We can do things Minard could not. The world of representations have changed. A digital humanities discussion of the twenty-first century must be different from a humanities discussion of the nineteenth. The current book is published in a material medium well known to Minard. In order to represent time graphically I must use time represented as space, as in Figure 7.3. I can also play on the reading time of the book consumption, and I can describe the virtual time in words. But other document types open up for an indexical relationship to historical time because the sense-data of the documents are dynamic.

As we saw in Chapter 6, Elleström (2010, 19) distinguishes between three representations of the sequentiality of time: fixed, partially fixed and non-fixed. He also points out that there are no definite borders between the categories, so I will rather see them as expressing a continuum of fixedness. Minard's map has no such time sequentiality at all, it only has virtual time. Time is quantified, but the quantification is spatial. However, a video version or an interactive version of his map would have time sequentiality. Such versions do exist online. One example is made by Landsteiner. It is an interactive system with a slider for some key dates which can be moved back and forth and represents a less fixed sequential time.[6]

A further development can be seen in systems which integrate text with a time slider and a map window. One such online document is made by Pollock on major battles in the Napoleon war using the tool TimeMapper.[7] Such documents represent geocommunication systems, including texts for

[6] 'Charles Joseph Minard: Napoleon's Retreat From Moscow (The Russian Campaign 1812-1813) : An Interactive Chart' by Norbert Landsteiner, 2013. URL: http://www.masswerk.at/minard/ (checked 2015-01-16). A number of other animated graphical representations can be found at Michael Friendly's webpage 'Re-Visions of Minard.' URL: http://www.datavis.ca/gallery/re-minard.php (checked 2015-01-16). This includes videos with a more fixed sequentiality; yet it is not as fixed as a cinema movie would be, as the user can stop the video at any point and also move backwards.

[7] 'Major Battles in the Napoleonic Wars' by Rufus Pollock. URL: http://timemapper.okfnlabs.org/rufuspollock/major-battles-napoleonic-wars (checked 2015-01-17). TimeMapper is a tool to make such strongly intermedial documents. URL: http://timemapper.okfnlabs.org (checked 2015-01-17).

the narrative and descriptive parts and a time slider. Time is represented as space, but also with a non-fixed sequentiality because the user can change sense-data with the time slider. A map visualising the places where the events took place is also included. The slider is not continuous but rather slot based. Moving it from point to point changes the active symbol on the map as well as the text.

Elleström (2014) points out that the difficulty of media transformations varies between different media. Transferring between media products with similar modes in the media modalities is easier than when the modes are different. That is true for all four modalities. It is easier to transform a painting to another medium with a flat surface material modality and the spatial mode of the spatiotemporal modality, such as a photograph. A transformation from dance to painting is only partially possible, because one distinctive border is between temporal and non-temporal media. However, some space based media have a second order temporality which makes transformation into temporal media easier:

> [S]ome qualified media, such as most printed visual literature, are conventionally decoded in a fixed sequence, which makes them second-order temporal, so to speak, and hence well-suited for transmediation into temporal media such as motion pictures (Elleström 2014, 38).

More generally, texts can be used as a link between temporal and non-temporal media. The narrative/descriptive text on a map adds time to the timeless map image while adhering to the flat material modality and the spatiality of the map. This explains how texts easily blends in with the map images while they also connect easily with time based media such as time sliders and video.

Video maps and interactive maps give opportunities to overcome some of the limitations we find in paper maps. They move beyond the limitations of virtual time to include a manifestation of time in the material interface. What are the consequences of this change for the problematic areas found in the modelling, namely, underspecification, negation, and disjunction?

It is hard to see how a manifestation of time in the material interface could ease the representation of negation on maps. Negation as we saw it in the case studies is an abstract concept disconnected from time in the sense that movement does not help us in grasping it. For underspecification

and disjunction this is different, however. The two are similar in that they claim an openness of the map, they expect the map to tell more than one single story, which is hard to do with a static map. Yet they are different in that disjunction presents a limited number of distinct stories. This or that mountain is a border mountain. Underspecification is more open.

What does it mean that something is expressed on a map? A symbol so small that it is invisible for the ordinary map user would not be part of the map's communication system. If a symbol is only known within a specific community familiar with a certain kind of map schemata then the symbol is only part of the communication system for that community.[8] Given that the readers of a digital map can be brought to understand movement in time as representing choice then disjunction can be shown on such a map to such an audience.

The level of understanding can be enhanced by textual information at the type level, for example by explaining in the perimap that specific kinds of symbols represent disjunction when they move in certain ways. This is different from putting texts on the map in order to explain specific situations because the specific texts will adjust an understanding created by the geometry of the map, whereas the type level information will, if it works, change the way the geometry is read and understood. As new users of orienteering maps are taught that dots represent boulders, new users of such a dynamic map could be taught that fade in–fade out alteration between two map symbols represents disjunction.

Underspecification, on the other hand, is not about presenting a limited number of different spatial situations, it is rather about the openness of textual landscape descriptions. There is an infinite number of possibilities for the location of places based on textual descriptions, as we saw in the experiments in Chapter 4. If one could establish borders for the possible interpretation, as Figures 7.1 and 7.2 indicate, one could use movement within the bordered region to indicate the openness of the underspecified expression. This would be a map schema which could be taught to new users. But it would not adequately express the underspecification of the text.

The openness of textual descriptions such as the ones found in **S1** means that they do not define a specific place or even specific borders for the possible place. There is no way to establish the borders of Figures 7.1 and 7.2 which

[8]The map legend may change this. However, not all maps have legends and legends often include only a subset of the symbols used on a map (Wood 1993*b*, 96–101)

fully represents the openness of the text. When someone says 'east' it could be an expression in a system of 16, leading to sector of $22^1/_2°$. But it could also be an expression in a system of 8, 4, or 2, and the textual context will not always tell us which system is used. Further, even if we know the system being used, as in the case of expressions such as 'north-north-east,' which can only be understood within a system of 16, claiming exact sectors for textual expressions still represents a mis-reading of many texts.

Thus, this is not a way to fully express the underspecification of the text. While dynamic maps can potentially be used to represent textual disjunction, they do not present a satisfactory solution to the problems of representing negation and underspecification. Below we will see that fuzzy maps has similar limitations.

7.4 Fuzzy maps

Maps can represent uncertainty in their graphical appearance, as was lain out more than 20 years ago in the overview over visualisation techniques in MacEachren (1992). Such techniques can be used to represent local and specific uncertainty in specific textual passages. This can solve the problem described in section 5.2 where we have a pre-existing map we use to interpret the text.[9] However, the general underspecification of a text read without such contextualisations cannot be meaningfully modelled and visualised using these techniques. This is not only due to the fact that the visual image would make little sense, but also because there is no basis in the data to decide on borders of the uncertainty, as we saw above.

From the outset paper based maps tend to be more fuzzy than digital maps. The ability to zoom gives digital maps a stronger language of precision.[10] Fuzzy mapping is still closely connected to digital mapping. In that sense it is not primarily about the visual appearance of the maps, but rather a method to present uncertain or fuzzy data on maps.[11] It is about creating spatial data based on uncertainty in the sources, as is exemplified by the

[9] My blog post 'Text to Map: Rooms of Possibilities' gives an example of how this can be used to locate unknown places mentioned in texts. URL: http://modmebo.hypotheses.org/date/2014/09 (checked 2015-01-22).

[10] This is the case for vector maps. Raster maps are more like paper based maps in this respect.

[11] Making maps is not the only use of such data. They can also be used in many other forms of visualisations and also in non-visual analysis.

techniques described in, for instance, Guesgen (2005), Hwang & Thill (2005), and Dragicevic et al. (2001). How can my concept of underspecification be understood in this context?

Fuzziness is common in thematic mapping, in static as well as interactive maps. Areas are often linked to the probability for some feature of on area, for example a species breeding there. The saturation of a colour may show population density. The fuzziness of the borders of such regions of probability is obvious to competent map readers.[12]

Fuzzy forms on maps are less used in historical mapping of topographical features other than for inherently fuzzy objects such as mountains. Maps tend to have a place name attached to a mountain, some marking of height using, for example contour lines, but no borders. In some cases a national park or another area with clear borders coincides with a mountain, but what is then marked on the map is the borders of the administrative area of the national park and strictly speaking not the mountain itself.

Similar fuzziness of unclear borders can be found on historical maps. Some maps representing Northern Scandinavia before 1751 do indeed show a degree of fuzziness. But this is not always the case. It is common in historical atlases to show borders as clear cut lines even when the situation on the ground is undetermined. An example is Barraclough (1986, 188–9) where the border between Sweden and Norway at the time of overlapping tax rights before 1751 is shown as clear cut. This is not consequent, however; other maps in the same book show fuzzy borders, such as maps of early human cultures and of religions influence in historical Europe. What is much less common than fuzzy borders on printed maps is fuzziness in the location of for example cities or lakes. Borders can be fuzzy, but locations rarely are.

Fuzzy mapping, and mapping of fuzzy data, have strong links to the concept of uncertainty. Humanities research is based on data with uncertainty at many levels, as pointed out by Drucker (2011) in her discussion of capta vs. data.[13] One of the reasons for this is the non-self-identity of texts, as pointed out by McGann (2001). There is an inherent uncertainty and potential for instability in the reading of all texts. Even if many things are indeed

[12]There are exceptions to the fuzziness of such borders, for example when the border of the area where a plant species is found coincide with the border between land and water. But the main point still remains.

[13]I am not claiming that data in other areas of scholarship, such as social or natural sciences, are not uncertain or that the concept of capta is not useful there. However, as the main topic of this book is the humanities I limit my claims to that area.

reasonably fixed and stable in our understandings of texts (Hoover 2005), new transformations of old texts, such as novel visualisation techniques, may influence the target at the hermenuetical level (Elleström 2014, 60).

Another level of uncertainty is given by our limited knowledge of historical 'facts' in general. Quantitative historical data presented on maps are always uncertain. Even if we have reasonably good data we cannot know exactly how many people migrated from Norway to the USA in the nineteenth century or how many people lived in Northern Norway in 1741. Even today we do not know exactly how many people live in Norway; there are always some who evade registration and counting.

Some ways of representing the complexity of human experience on maps were suggested by Drucker (2011), with references back to a long tradition of alternative mapping. One example is maps where the indexical grid does not represent space measured in distance, but rather in travel time. Such maps do not automatically become more fuzzy in a geometrical sense, but they will induce a feeling of unfamiliarity in most readers and, as a consequence of that, question the stability of the representational system of the map. Fuzziness is not a feature of digital maps only, and there is no direct link between fuzziness and interactivity. However, the means to present fuzziness is much enhanced by digital media, and can be used in combination with video maps or maps with less fixed temporality, that is, with maps representing indexical time.

Will one be able to express underspecification, negation, and disjunction better with the use of fuzzy mapping? As we saw it in the case studies in Chapter 4: there is really nothing fuzzy about negation, so there is no reason why fuzzy maps would help to express it. As for disjunction, one could possibly express disjunction using fuzzy symbols, as an alternative to the time based approach described above. After all, disjunction is close to the type of spatial uncertainty that has often been modelled with methods based on fuzzy logic. When uncertainty is being mapped in the humanities it is usually uncertainty of historical facts rather than uncertainties based on the inherent underspecification of texts. Disjunction falls well into this category. We try to make fuzzy marks on the map because we do not have precise data. The capta problem, that our datasets are constructed and categories are not as neat as they may seem to be, is connected to this.

Disjunction can be seen as a known specific uncertainty, that is, a choice between two or more known alternatives. Underspecification, on the other hand, is an unknown open uncertainty. When for example Guesgen (2005)

discusses fuzzy reasoning in geography it is in order to handle problems of the former type. Thus, his models are well fit for expressing disjunction, but not really for textual underspecification. While some fuzziness, such as the boundaries of fiat objects such as mountains and counties, represent a form for underspecification, it is the underspecification of fiat objects themselves rather than that of textual expressions. The fact that the underspecification is often recognised when place names are used is not an aspect of the language expression as much as it is an aspect of the geographical object itself.

If a map is specifically and explicitly made as a media transformation of a text then fuzziness can be used to express the underspecification of the text. This is not about fuzzy expressions as such, but rather about what is seen by the map reader as the source of the mapped information. A map presenting a combined knowledge of the past drawn from many different sources is different from a map of the world view expressed in one specific text. This distinction, and the degree to which it is communicated to the map user, is central to understand whether maps are read as representations of textual underspecification.

But even if a map is read as a fuzzy expression of textual underspecification, the full openness of a textual description can never be conveyed. Even fuzzy map objects have visible limits. Creating such limits is exactly what expression such as 'east' refuse to do. And the explicit relationships between places, the link between A and B when A is said to be east of B, can only be put on the map as a map symbol which will then be read as a claim for a feature in the landscape. But 'east' in such expressions is not a feature of the landscape. It is a feature of language.

For what is mapped is not the text as such. The written text is always already lain out spatially, on the space of the document page. This is not what we call mapping here. What is mapped is the existing or non-exisiting spatial world expressed in the text, readable for those who can decode it. The mapping is based on the mapper's understanding of the text. The map may partly be created by a computer but always on behalf of a human, expressing in algorithmic form rules created by humans.[14]

No map is based on data that are perfectly accurate. There is always a fuzziness in our data about spatial objects or features, however accurate they may be. One solution to the problem of imprecise data is to use minimal

[14]The role of the computer in mapmaking is dicussed in my blog post 'The head of the cartographer,' URL: http://modmebo.hypotheses.org/date/2014/08 (checked 2015-03-08).

bounding boxes, as proposed by Hiebel (Forthcoming 2015). A minimal bounding box is the smallest area a place known from one or more historical sources is certain to fall. This removes the distinction between fuzzy and non-fuzzy data. It is also in line with my approach visualised in Figure 7.2 above. The problem remains, however, that this establishes maximum areas of uncertainty which may work for many types of historical data but do not really represent textual openness.

So the problems are partly solvable in a local, practical way but not fully solvable at the general level. We cannot build a bridge between the two media, nothing can be taken over from text to map fully intact. Visual and verbal media are each inexhaustible in terms/images of the other. They do not match. Images do not enshrine the same verbal logic as texts (Squire 2011, 144–5). We cannot transfer the openness of texts to maps, not even to dynamic fuzzy maps. It seems to be the case that some textual features are unrepresentable in the sense used in Elkins (1999, 40–4). The only system which can include such an openness is a system including the text itself. If such a system also includes maps then it is a geocommunication system.

This is not to say that maps cannot include complex structures. But the way these structures are merged together operates differently from textual expressions. 'Every map is a palimpsest, a many-layered imagination of another place and another time' merged into one spatial expression (Olsson 2007, 135).

This implies that the practical problems faced by projects trying to put textual data on maps can often be solved. Compromises can be made which work in practice. What remains is the theoretical constrainer of media differences.

7.5 Deep mapping

A well known example of a traditional deep map is Heat Moon (1991). This deep 'map' is a book in which most of the pages are filled with prose texts. Some illustrations, including maps, only confirm that the main medium of communication is written English. The book triggers a number of habits in its readers. It is a narrative with descriptions. Even if the book can be browsed, read a bit here and there, or even read back to front, a competent reader understands the intention of reading it through in the right order, either fully or in parts.

With the development of new tools the concept of deep mapping has changed. Such tools include TimeMapper and Neatline. The latter will be discussed here as an interesting tool for geocommunication. It differs from a GIS system in a number of ways. It is mainly designed for making hand crafted maps, not to put large quantities of data on maps in a rule based fashion. It also integrates a manipulatable time line and puts an emphasis on the integration of textual material, both extrasignificantly connected to the map as a whole and intrasignificantly connected to single symbols on the map. These texts can also include images and other media, as well as hyperlinks. It basically works as any web page would.

The features of Neatline are not fundamentally different from what is known in GIS systems. The main difference is the way in which it nudges the user towards some courses of action rather than others in the creation of map exhibitions. It points the user toward the narrative and textual aspects of spatial understanding. A large number of online examples show how this is taken up by the community.[15]

I will breifly describe one example here. It is the Neatline version of Sterne's *A Sentimental Journey*, created by Kurt Jensen, an undergraduate student at the University of Virginia.[16] It includes a map of Yorick's travels as they are described in the book with a number of events marked and linked to text boxes. These text boxes include quotations from the novel as well as Jensen's comments to the text. The exhibition also includes a text describing the purpose of the work, which is to examine the complex relationship to time and description in the Sterne's book, working with the significant inconsistencies in the level of detail of what is conveyed about time, space, and events.

So the Neatline document is a mapping of a text. But the mapping is deep: in addition to a map image representing the space described in the

[15]I want to thank a number of students in Passau for their hard work in solving mapping problems and their many interesting and difficult questions, which have taught me important lessons about mapping in general and the use of Neatline specifically. I also want to thank the Neatline group in general and Bethany Novwiskie and Ronda Grizzle specifically for their help in understanding the tool, its limitations, and most importantly, the meaning and intention behind some of the limitations. See Nowvisie's blog post 'Neatline & Visualization as Interpretation' for an explanation of the rationale behind the tool. URL: http://nowviskie.org/2014/neatline-and-visualization-as-interpretation/ (checked 2015-03-08).

[16]URL: http://enec3120.neatline-uva.org/neatline/show/a-sentimental-journey (checked 2015-03-08).

text it also represents time. Time is represented in the spatial mode of a visible timeline, but also interactively; by operating the timeline the map image and the textual information presented is made to change. This gives a time function with a less fixed temporal mode. The exhibition also includes a significant amount of text. The texts are partly taken from the mapped book and partly written as part of the Neatline project. It was shown in Chapter 6 that seen through the lenses of intermedia studies, all media are mixed media. But some media are more mixed than others. Geocommunication systems are more mixed than texts and maps alone.

This gives the user a narrative represented as a map. It contains the different levels of underspecification of maps and texts. It is a geocommunication system where choices are made in the establishment of the maps while keeping the textual openness in the system. To the best of my knowledge this is the closest we get today to express the full potential of a text in a mapping system, a closeness caused by the system integrating media with different modes in their modalities. This geocommunication system shows how far we can get in digital mapping if the goal is to include the full complexity of human culture as it has been expressed in texts.

But even more important: it also makes the interactivity of creating deep map systems available to any scholar in the humanities. It opens up the black box of map creation. It fulfills the basic homo ludens principle of the digital humanities. As for modelling, so in mapping: it should rather be seen as a dynamic process of imaginative experimentation than the production of a definitive and true record. The aim of producing maps from texts and texts from maps is not to create the end product, as in modelling for production, but rather to study the process, as in modelling for understanding (Eide 2015*a*).

Maybe this will create new map schemata. But that is not the main point. More importantly, it de-stabilises map schemata and maps used to express textual information. It indicates how every map is one reading of the text among countless others. It shows how the narrative one reads out of a map is one out of many possible ones. It does the same for digital mapping as Monmonier (1996) did for analogue and TV maps: it shows though practical examples how we must always questions the truth in maps. Maps can be truthful but never exact and complete.

7.6 Cultural capital

The text based maps available on the web present maps that are underspecified relative to the texts they are based on. But the texts themselves are also underspecified relative to what they describe, being it physical landscapes, human fantasy, or other media products (Eide 2014*a*, 196). In a geocommunication system including texts, maps, and other graphical forms such as timelines the interaction between the elements is used to create a more complete storytelling system. While still being underspecified the whole multimodal system provides its users with richer, more complex stories.

A possible problem arises, however, when a map, or another graphical form such as a graph, is used to represent the totality of a complex phenomenon such as a text. It is not wrong to make simplifications. All models, including all maps, represent simplifications of some phenomena. But some expressions have stronger inherent truth claims than others, and some are linked to stronger cultural capital than others. This is known from the seminal book 'How to lie with maps' (Monmonier 1996). There are also books about how to lie with statistics (Huff 1954), how to lie with charts (Jones 2000), and even on how to lie with methodology (Scharnberg 1984). There is no book on how to lie with texts. Maybe it is too obvious to write books about, or it is too complex to explain all the ways you can lie with a text.

In the current media situation with strong complementary cultural capital residing with digital mapping systems such as Google Maps, Open Streetmap, as well as with map systems developed by national mapping agencies, Monmonier's main points are even more important than in the age of static maps.[17] The elegance, simplicity. and ubiquity of the medium makes it easy to present simple stories. But these simple stories, map versions of narratives and description, lose or reduce key elements in the complexity of how humans express their understanding of the world, including negation, disjunction, and underspecification. We can move in the direction of expressing such complexity using fuzzy and dynamic maps—but only partially, and only if we develop and strengthen new map schemata. The differences between texts and maps are there and the question still remains to what extent new ways of understanding maps can bridge the gap between the two semiotic

[17]The map seems to be changing from general purpose to personalised tools with the recent wide spread availability of digital mapping. However, the topographical data shown on the maps are still to a large extent created by large organisations, either in the form of professional companies and agencies or crowdsourcing enterprises.

systems.

These new map schemata are not yet here, not as widespread understandings of how visualisations work. In this situation we must find ways to keep the complexity visible. Geocommunication systems integrating maps, other visualisations, pictures, sound, video, and more with texts into strongly multimodal systems are key elements in presenting this complexity in an understandable way. This is why tools such as Neatline and TimeMapper are so important. They can be used for simplified stories, surely—as texts can be used for simplification and propaganda. But at least they give the map makers, or map story tellers, the toolsets they need to make more complex stories, stories that can only be told in strongly mixed media.[18]

[18] And it gives the creator-users the toys they need in order to play the game that might give them a deeper understanding of what media transformations mean. A student asked me after working for hours with Neatline trying to represent her sources on the map: 'But how can I express the vagueness of the text here? This does not work!'

Exactly. It does not work. That is the message. It does not work and when we attempt to do it anyway we create not only new producs but also new knowledge. Such new knowledge is the intended outcome of all modelling in the digital humanities, as we will see in the last chapter.

Chapter 8

Critical stepwise formalisation reloaded

In Chapter 7 the research presented in this book was discussed in the light of digital mapping. This chapter will discuss critical stepwise formalisation in the context of modelling in digital humanities more generally. It will be shown that critical stepwise formalisation is not incompatible with text encoding—the case study used a TEI encoded text as a starting point—but that it goes beyond text encoding by freeing the modelling practice from the limitations of the currently used XML formalism. Critical stepwise formalisation will also be seen in the light of contemporary work in intermedia studies, with a focus on media transformations.

In Part II, critical stepwise formalisation was used for text analysis; specifically, for studying the relationship between one historical text and maps as a medium. In this chapter the applicability of the method for research involving other qualified media will be outlined. It will also be discussed whether the method may be applicable to analysis not only of texts, but also to experiments where other qualified media are used as the starting point.

8.1 Modelling and intermediality

What I call critical stepwise formalisation is a modelling practice which involves creating expressions in one medium based on a source in another medium. Thus, it can also be studied as a media transformation process, using theory from intermedia studies. While theories and models play differ-

ent roles,[1] they share a common goal in structuring and abstracting from a diverse and complex reality.

The tension between the humanities and computer science is a real one. But so is the tension created by any expression trying to push the borders of its medium. The computer is not necessarily the rigorous part, as paper is not in itself soft. There is no inherent tension between the computer screen and paper. From the perspective of a reader, a text stored in a computer and read from a computer display is more similar to a text on paper than it is to a map on a computer display. Indeed, an image of a scanned book page on a computer screen is close to identical in all media modalities with the original book page.

The rigorousness of the computer is connected to certain types of use. Computer based modelling introduces a rule based way of working with information read from a text. The computer in itself does not automatically provide rigerous models, but can be used to establish signs that act as models due to the theoretical context we put them in. The model is a sign that becomes a model through our use of it (Kralemann & Lattmann 2013). So the tension is not as much between the text in the book and the text in the computer as it is between the text in any medium and the model.

The tension is similar to the one found in the study of text-map differences in Part II above. Specifically, such tension was raised when attempts were made to make maps based on textual expressions. If a computer model is an expression in the medium of computer models then the differences between text, computer model, and map becomes differences between three different qualified media. Critical stepwise formalisation always includes a transformation from one medium to another through the intermediate medium of computer based conceptual model. In our case the transformation is the one in sentence 8.1. This shows how the conceptual model is both a model of the text and a model for the maps (Mahr 2009).

$$\text{text} \rightarrow \text{computer based conceptual model} \rightarrow \text{maps} \tag{8.1}$$

Critical stepwise formalisation involves media transformation processes,

[1] In studies of modelling in the experimental sciences, computational models are seen as mediators between theory and the modelled objects, cf. Marras & Ciula (Forthcoming 2015) with further references. This is comparable to the view in MacEachren (2004, 246) that sign-vehicles function as mediators between denotational and connotational qualities, as discussed in Chapter 2 above.

but it operates at a different level from research into media transformation, such as adaptation studies. Studying an adaptation is to study a media product and its relationship to another media product, for example a film and the book on which it was based. In the case of critical stepwise formalisation, no pre-existing media transformation is the object of study. Rather than doing research based on media transformation theory this book uses a research method which can in itself be seen in the light of such theory. So rather than *studying* media transformations, critical stepwise formalisation is *doing* them.

Modelling in the form of critical stepwise formalisation is a type of media transformation operating at multiple levels. Not only from source to target medium, in our case from text to map, but also from source medium to model, from each modelling stage to the next, and from model to target medium. This fits well with Elleström's model of media transformations. He acknowledges that there are intermediate stages between source and target medium which are important but hard to pinpoint (Elleström 2014, 59). While this book offers no general way of detecting these stages, it shows how they can be formalised in one type of media transformation, namely, critical stepwise formalisation.

In Elleström's study of media transformations, the distinction between the presemiotic and semiotic levels is central:

> Whereas the material, sensorial, and spatiotemporal modalities form the framework for explaining presemiotic processes of mediation, the semiotic modality is the frame for understanding representation (Elleström 2014, 39).

This has a parallel in modelling. In a recent article, Kralemann & Lattmann (2013) proposed an understanding of models as signs in the sense of Peirce. Specifically, models are icons. This has been connected to digital humanities modelling in Marras & Ciula (Forthcoming 2015).

We saw above how networks are seen as a middle layer between texts and topographical maps. We have also seen how the map is a complex semiotic system with both symbolic, iconic, and indexical aspects. In Ciula & Eide (2015) it was pointed out that network models can be seen as icons based on a metaphorical similarity between the model and the object being modelled. It is beyond the scope of this book to compare media transformations to the presemiotic and semiotic levels of modelling. But such comparisons will

be an important part of the further development of a theoretical platform for transformative digital intermedia studies, building the theoretical basis for critical stepwise formalisation specifically and improving the theoretical framework for modelling in the digital humanities more generally.

This should be seen in light of the long tradition of non-digital models in the humanities and social sciences, also in order to understand better the limitations of modelling. Seeing models as icons may help us towards a deeper understanding both of how modelling fits in with other forms of inquiry and of the role of semiotics in mind models and theory development. As Elleström points out, semiotics cannot answer all questions:

> The strength of semiotic analysis is its capacity to pinpoint vital mechanisms that produce basic meaning. The weakness is its limited capacity to go into hermeneutical depths (Elleström 2013, 115).

A central point in this book is that mapping and modelling alike are learning processes. The main purpose of critical stepwise formalisation is not to create models and maps, but to learn from iterative processes of (re-)modelling and (re-)mapping; that is, learning by doing. This aspect of the digital humanities has a potential for making deep and lasting changes in how we see models, theories, semiotics, and knowledge in the humanities at large.

8.2 Text encoding, mapping, and borders

As a study in the digital humanities, this book addresses one of the central challenges of the field, namely, the tension between the formal systems in which knowledge must be expressed in order to do computational work, and the ambiguity characteristic of expressive media in the humanities and arts. This tension is implicit but very much alive in my comparison of algorithmically generated maps to the texts on which they are based. I also investigate it explicitly by examining critically the standard text-encoding method I used as the input format for rendering my eighteenth century text tractable to computational modelling.

Text encoding as a way of modelling what we know about a text is by now a familiar trope in digital humanities. It is not without its problems and limitations, however, which are in some ways similar to problems I faced

in text mapping. The main experimental focus of this book is to show how modelling a text can help us clarify what maps can and cannot convey in comparison. It also reflects extensively on the nature of texts themselves. And it does so by exposing the formal encoding of the text.

Can the idea of a text as an ordered hierarchy—so successful as a publishing technique but also so troublesome when segments of texts overlap—be aligned with the claim that a text that talks about landscape is fundamentally mappable? Does an expression forming part of two overlapping markup structures have similarities with a contested area in a landscape described in the text?[2]

One of the main problems in creating maps found in the case studies is connected to disjunction, that is, something claimed in the text to be located at either one place or another. This represents a form of ambiguity, but it is more limited in its options than the open uncertainty of underspecification. While a text can clearly say that one or the other of two mountains constitutes the border landmark, a map cannot present the same information with the boolean 'or' still intact. Instead, one has to make separate decisions whether the border crosses each of the two mountains.

I will compare this problem to the problem of overlap in text encoding. When your medium requires you to resolve ambiguity, where do you find the evidence to make an assertion?[3] We saw how the textual evidence both includes disjunction and is underspecified. In many cases no argument for how to choose in ambiguous situations can be built on it, the choice has to be based on what was explicitly excluded in the experiments described in Part II above: context, including the pre-knowledge of the researcher.[4]

In some cases such choices should be made. In much scholarly work ambiguity should be resolved based on the best understanding of the researcher. There are other cases where such openness in our sources should not be resolved. Without stretching the similarity too far, both the basic principle behind TEI based text encoding, that elements nest, and the mapping of

[2]On the handling of overlap in TEI, see TEI Consortium (2013, ch. 20).

[3]The overlap problem in text encoding is not necessarily about ambiguity but more generally about conflicting structures. Two or more structures exist but one has to be given prominence. Nevertheless, such co-existing structures are comparable to the situation of the two possible border mountains.

[4]This is well known from text encoding: encoding is based on choices made by the encoder based on his or her pre-knowledge. For a recent discussion, see Pierazzo (2011) with further references.

texts into topographical maps suits some purposes for textual studies better than others. This argument goes beyond mapping and text encoding. It can come into play whenever research activities involve media transformations into a qualified medium with a different level of formality from that of the source medium.

A similar point can be made for negation, another problem identified in my experiments. To say that something is not there does not mean that nothing is there, and to say that something is missing, such as a hole in a manuscript, does not allow you to say what is missing. The frame of the map image controls the area for which the spatial coordinate system is in function. A blank area within the frame will say that nothing of interest is to be found there, but it is not explicit about what is not there. A hole in the surface of a paper map will escape the frame of the map. The area missing because of the hole does not allow one to say that there is nothing of interest there. It only says something is missing; the intention of the cartographer of saying 'nothing of interest here' we see in a blank area cannot be read out of a hole.

Similar frames do not exist in texts. In natural languages there are explicit ways of expressing specific negation. But even if texts can negate, they often do not. There are many areas for which there is no claim about farms at all, neither negative nor positive. Then we cannot know.

Texts tend to operate out of an open world assumption for most classes; that is, a class cannot be defined by the totality of its instances. There are exceptions: The class of witnesses in **S1** is known in full. All members are listed in the document, creating a closed world for this specific class. Geographical classes such as farms are not known by the totalities of their instances and represent open worlds. In general this is how modelling of historical facts has to be done. As historical knowledge is always limited one cannot define a class by the totality of its instances. CIDOC-CRM is based on an open world assumption (CIDOC 2013, viii).

Thus, approaching the past through different types of documents will provide absences with different meanings. For certain classes there will be claims in the documents that they are specified in totality, like the witnesses in **S1**. A text can do that in a straightforward way, explicitly or implicitly. A map can also do it, through a text in the perimap making the same sort of statement. Then, in our modelling systems, how we can specify this knowledge is dependent on the limitations of the systems. In CIDOC-CRM there is no way of conveying statements about non-existence; its scope is not

the knowledge one reads from one document but general historical understanding. For central historical entities such as persons, farms, and events we cannot use closed world systems. We can never know all instances.

Resolving disjunction, ambiguity, and negation is about making choices about the interpretation of texts. How does this compare to the establishment of borders? What is a border, and how is it similar to, or expressible by, an XML tag? Is there a border between parts of a text? Is there a border between my land and your land? That will all depend on the purpose of the work at hand. In a study of metrics it may make sense to see verse lines in a dramatic text as unbreakable entities, whereas in the study of speeches the verse lines may have to be broken. Trying to encode both views in XML leads to overlap problems (Sperberg-McQueen & Huitfeldt 2004, 142–3). In an attempt to make peace between states the border between farms in different countries may be established firmly and for good reason, whereas in the spirit of good neighbourhood it may be wise of me to let you pick the berries my land is so abundant of, and for you to let me fish in the lake on your farmland.

The discussion hereby penetrates not only text and maps as records, but also texts and maps as political tools and power statements. In the 1751 border treaty between Denmark-Norway and Sweden, the Sami reindeer herders' right to cross the border was established in agreement between the two governments. However, in the negotiations following the 1905 dissolution of the Swedish-Norwegian union established in 1814, the Norwegian government made an effort to reduce such border crossing to a minimum (Lae 1977). Further, in Northern Scandinavia it is a long tradition of custodial reindeer, that is for example farmers owning a few reindeer that was taken care of by semi-nomadic reindeer herders. From the late nineteenth century onwards the Norwegian government introduced regulations with the goal of discontinuing the system (Evjen 2007).

Both developments can be seen as examples of a divide and conqueror policy by the Norwegian government aiming at breaking the reindeer herders loose from each other and from the farmers. It can also be seen as a cold bureaucratic policy of keeping separate things separated, a policy which may not have had explicit political goals but caused political consequences. While it can be discussed how explicitly anti-Sami they were, they are clear signs of a growing hostility against the Sami culture, quite different from the mid eighteenth century when both the political and the ideological climate were more positive towards the Sami (Eide 2012*a*, 50–4). Schnitler was a powerful

King's man establishing records as texts and maps true to his understanding and world view, but the space of Northern Scandinavia was still a sphere of co-existence.[5] By using the space the local populations also took part in producing it, practically and ideologically, and they gave important input to the process leading up the the establishment of the border in 1751.

The meaning of a political border will always depend on cultural and political ideology. The same can be said of the encoding of a map or a text, or indeed if one should encode or map at all. I am positive to all sorts of computer assisted work on texts, experimental as well as steered towards production. I do not claim we can do without some sort of political borders either. I ask, however, for consciousness of the consequences of establishing firm borders.

In the digital humanities, especially in scholarly editing and literary analysis, the most used system for the treatments of texts is created by the Text Encoding Initiative. TEI was introduced in Chapter 3, where some problems with the hierarchical structure were outlined.[6] Text encoding is a large and complex area of research, development, and practical work that I will not go into in any detail here.[7] I will, however, make some points about ways of representing texts, following up on the discussion of text modelling in Chapter 3.[8]

To insert a tag into a text is to create a border, in some ways similar to putting a border on a map. They are both acts of making and marking a difference (Olsson 2007, 409). But text encoding, like vector data, is different from the presentation layer. This was discussed already at the time of the establishment of the TEI. Coombs et al. (1987, 938) distinguished between four types of markup visibility: 'Exposed, Disguised, Concealed, and Displayed Markup.' Similar distinctions are made in map production when vector data are presented in different ways. A line can be fully hidden, it can be represented by a graded change of colour, it can be a dotted or broken line, or it can be a thick black line. The level of 'borderness' will vary; our

[5] On space as a sphere of coexistence of trajectories, see Massey (2005, 63).

[6] Claims have been put forward that the whole text encoding paradigm should be left behind, partly based on similar arguments to the ones posted here, and other formalisms should be used for working with texts. A recent example is Schloen & Schloen (2014).

[7] Good starting points for current and past discussion is the TEI-L mailing list available from the URL: http://www.tei-c.org/Support (checked 2015-03-10) and the *Journal of the TEI*, URL: http://journal.tei-c.org (checked 2015-03-10).

[8] The following is partly based on Eide (2014*b*).

interpretation of what we see on maps is steered by symbology (Bertin 1979).

TEI uses descriptive markup in the form of tags. A tag can be hidden in a presentation, or it can be shown in various ways, for example as a shift in typeset, colour, or a line break. But what is more, many tags need end tags.[9] They encapsulate something. Tagging can, in this sense, be aligned to adding polygons to vector data. They may have holes, but their outer borders cannot be broken.

Such encapsulation, creating nesting hierarchies, can represent many aspects of texts. But they cannot represent well all the structures of semantic understanding. They tend to overlap. TEI have developed a number of methods for coping with this (TEI Consortium 2013, ch. 20). However, these methods are developed as work-arounds to cope with the inherent nesting structure on XML, which TEI is based on. This results in sequential and the hierarchical structures being easily manipulable, whereas structures better represented by networks, such as many overlapping features, become cumbersome to work with.

We saw in Chapter 7 that the ease with which humanities students and scholars can create and manipulate maps through Neatline plays an important part in the development of critical mapping. Creating is different from seeing. A similar point was made in Chapter 2 where we saw how a place is learned better when it is explored and not only visually inspected. In computer based work on textual material the sequential structure of the text is easily available. The same can be said of the tree based structure, which is manipulatable in XML editors. There are also many tools for the visualisation of networks available. What is missing is systems for interactive manipulation of the networked structures of text based models.

Being a programmer I can manipulate any fragment of the text and establish links to any other entity represented in the modelling tool I develop. There were limitations to my work too, but they were different from the ones users of XML editors face, and that difference is signifiant; my research could not have been performed with such tools. My work happens in a context, connected to a specific research question. Problems and limitations—or affordances—of a computer based tool exist in the context of the work at hand. This is in line with underspecification: it is always relative to something: another expression, or a task (Eide 2014*a*, 197).

[9] The exception is empty elements. They can never have end tags and work as milestones in the text.

So when Schloen & Schloen (2014) claims that a database approach, exemplified by the system they advocate, should replace text encoding, I believe they are right in that such a transfer would give more freedom, richer possibilities, better tools. For some users. The problem is to find out when a tool is better than another, when it affords the user with the best solution for the task at hand (Lavagnino 2006), or when combinations of different tools and methodologies can be more useful (Buzzetti 2009).

8.3 The role of the programmer

In the research described in this book, software development was used as a research strategy, not just as a research tool. The software embodies the rules of the formalism, foregrounding the epistemological decisions embodied in, and subsequently imposed by, that software. Can such research ever be made without programming as an integral part? Can it be done through tool use only, without tool development? It boils down to an old question in digital humanites: can we ever make tools which will let users escape the prison of not being able to create their own tools, of being unable to change the workings of the system?

The question of whether the researcher in the humanities also needs to be a computer programmer was raised at least as early as 1962 (Dearing 1969). In the case of this project the answer is obviously yes, and this is not only because I need tools that did not previously exist. Meløe was a philosopher who based much of his work on the study of fishermen and reindeer herders in Northern Norway. He showed how the world one sees is based on the skills with which one meets it. The physical stones, sand and water making up a natural harbour is there to see for us all, but the natural harbour is not something I would see. A fisherman using a boat too big to be dragged ashore but small enough to need natural harbours would see it (Meløe 1988).

A similar kind of insight came from my training and experience in developing computer systems. I, too, see things based on the skills I use when I act in my environment. Interestingly, Dearing made a similar point in his 1962 speech: 'No greater device for ensuring logical thought has ever been developed than the modern electronic computer.' (Dearing 1969, p. 97)

However, being a programmer is not about creating everything from scratch. To a large extent it is about putting bits and pieces together. I exported data to be used with other tools, such as network visualisation and

analysis tools and GIS software. I also used libraries connected to the programming language for my work on for example XML and RDF structures in Java. For many tasks the building blocks are there. The programmers job is to put them together. To return to Meløe's example: the stones, sand and water is there. Our job is to see the potential harbour and to link the modules together in order to make it.

I believe the lesson to be learned is that we need researchers with a variety of skills in addition to the basic knowledge for each discipline. Some researchers should be programmers. That gives us the mind to think about certain problems in our peculiar ways, and the skills to play the computer to produce whatever outcome our theme and methodology leads us to request. As future research problems are unknown in principle, the tools needed for certain types of research will never be available beforehand. We must continue to make tools as the needs rise, and tailoring will still be needed in tool development. Some humanities researchers still need to be programmers so that we can take active part in that process.

8.4 Formalising other expressions

As for modelling, so in mapping: both should rather be seen as dynamic processes of experimenting than the production of one end result, the definitive and true record. The aim of producing maps from texts is the process, not the product. This principle can be extended to the use of other qualified media than texts as input, and other qualified media than maps as output.

Even between different text types there will be significant variation. One will always have to decide on the purpose of the modelling. The purpose will render some texts more interesting to work on than others. Many poetic texts do not really describe external landscapes. To use critical stepwise formalisation to create maps from such texts might make little sense. However, whether it makes sense or not will not always be knowable beforehand. Close reading is often needed to find hidden layers in texts, and critical stepwise formalisation may also detect layers and patterns in texts we could not see beforehand.

Other visualisations than maps can be also be output. We have already seen the use of timelines in Chapter 7. We saw in Chapter 4 how topological maps represent networks of places. Networks of persons may also be created as output, to be visualised as networks of nodes and also to be further

analysed with network analysis tools. One research question in this type of analysis would be to pinpoint if relational information is lost in the process from text to network, and, in that case, what is lost. This could be used to develop an evidence based theoretical underpinning of text based network analysis.

I foresee the method to be applicable also to visual forms as input. One example is maps. It would be interesting to see how the modelling process would work for orienteering maps, especially when they have the routes of past runs marked. In line with that, visualisations such as Minard's 1869 chart showing Napoleon's 1812 Russian campaign reproduced as Figure 7.3 are well worth studying. It would be interesting to see in detail how stories can be read out of such maps. What must be added for that to happen, and what is lost along the way?

Aztec maps from areas in what is now Mexico present fascinating examples of trying to overcome the space-time border.[10] In the Aztec tradition, the relationship between writing and mapmaking was played out differently from how it is done in other parts of the world. Such documents would be very interesting as a starting point for critical stepwise formalisation. The same could be the case of other documents that are called maps but historically served other purposes than showing a physical world, such as Sami ritual drums and Medieval European mappamundi. It may also be possible to look at historical text-map connections found, for example in archives from mapping agencies and commercial map publishers.

Other spatial forms could also be used as input to the method. The applicability would have to be tested for specific qualified media. Using time based media such as sound or living images, either as input or output, would be another interesting area of research. In principle, any pair of qualified media where a media transformation is possible should be applicable to the method, but the research questions would have to be relevant for the parts of the media characteristics which are transferrable.

In his study of media transformations, Elleström (2014) distinguishes between specific media products and qualified media as both source and target in the transformations. In critical stepwise formalisation the source is evidently a specific media product. But the target is a bit more complicated. The end result is not there to be studied before the research is initiated; it

[10]See for example Smith (1973), Woodward & Lewis (1998, ch. 5), and Massey (2005, 107–8) for further details and dicsussions on these maps.

is created along the way. In that sense the output is defined by its qualified medium rather than by being one or several specific media products. However, once the research is concluded the end products are there as specific media products, and then they only represent the qualified media as any media product would. This is also the case in media transformations as creative processes, but in most scholarly studies of such transformations the end products already exist.

Any use of critical stepwise formalisation that I can foresee will be based on the assumption that there may be significant alterations of information in a modelling experiment. Such assumptions should be expressed in the form of hypotheses. One will expect the level and type of information change to vary between different qualified media and also between the input media products chosen, and that the changes will depend on identifiable and classifiable criteria of input expressions. If applied correctly, the method ensures that the results from the modelling of each expression will be documented bottom up so that the information changes found through each of the modelling exercises can be clearly shown. Classifications of the information alteration can then be attempted, in order to look for general patterns as foreseen in the hypothesis made beforehand.

In the philosophy of science, there has been a discussion whether models are fictions.[11] I will not take sides in the dispute whether scientific models express a fictional truth or not, or the role of subjectivity in scientific observation. In the area of document based studies the objects being modelled are products of human creativity and they cannot be understood without interpretation on the side of the researcher. Subjectivity is inherent, and the question whether the models of such objects are fictional or not is not really interesting. More interesting is the question of consistency. While models in the humanities will rarely be models in a mathematical sense they still need a degree of consistency.

At one level the consistency may be implemented as structural restrictions in the computer system. By being stored in some sort of formal structure the model can be forced into consistency. But structure is not enough. Semantic consistency is also needed, and that can rarely be fully enforced by computational methods. Some intervention from human modellers understanding the object being modelled will usually be needed.[12] Semantic consistency

[11] See for example Suarez (2009), Godfrey-Smith (2009), and Frigg (2010).

[12] In text encoding the structure of an XML document may be validated by formal

in the model must be based on the meaning of the objects being modelled, enforcing that similar things are modelled in a similar ways. Even if this goal is not reachable in full, given the unstable nature of human expressions, it must remain a goal we strive to accomplish, noting difficulties along the way as potential research findings. Human input will in most cases get us closer to semantic consistency than computational methods alone.

Critical stepwise formalisation is a general method where detecting differences between expressions is an inherent part of the modelling process. The differences are not found through comparing two media products, but through establishing a path from one to the other, and then studying what happens along that path, using both computational methods, such as recording fall-off, and active engagement from the researcher, where observations along the way can lead to new understanding. The latter should be documented in lab notes.

The usability of the method can only be explored through practical work. Hopefully, that will be of interest both to digital humanists, intermedia researchers, and others in the humanities interested in understanding details of media differences at a technical level. Critical stepwise formalisation may provide evidence which can then be used as part of the background for understanding new things about media in general as well as specific media products.

8.5 On formalisation

The use of TEI and CIDOC-CRM as inspiration rather than as formal specifications may be seen as an abuse of the same standards. If the point of using standards like these is to understand how formalised knowledge representations affect information preservation and transmission, is it not inconsistent to obey only some of their rules?

The use of TEI as inspiration is not the full story. As pointed out in Chapter 3, the starting point of the modelling experiments was a valid TEI document. This valid document is loaded into the system, together with other valid TEI documents containing the registers. At the level of the source

consistency rules. While the consistency of the use of for example place name elements may also be checked by a computer system, there will usually be cases where decisions can only be made based on evaluation by a reader understanding the meaning of the textual expression being marked up.

document, TEI is used as a formal specification. At the other end of the modelling process valid GML documents are created, which are displayed as maps. So there as two formal systems adhered to in this research: TEI and GML.

In the modelling process, on the other hand, formal models are not used for the semantics of the model. No formal models in line with TEI or CIDOC-CRM are created during the intermediate steps in the process. RDF is used, but this is a modelling language with less semantic investment.[13]

The goal of critical stepwise formalisation is to see how much of the information from the source document, in this case a valid TEI document, could be transferred to the target documents, in this case maps. The aim was not to investigate into how the data would fit into pre-defined formalisms during the intermediate steps. For each step in the stepwise formalisation the aim was to move in the direction towards maps and see what was changed in the process, in order to gather a full list of changes as source material for the evaluation.

It could be that a stricter form of critical stepwise formalisation should be developed where each stage, or even each step, is expressed in the formalism of a pre-defined standard language. It may very well be the case that such an added level of formalisation will be needed for other research questions using other source and target media. However, in order to use modelling to investigate into media differences it is not necessarily the case that pre-defined modelling standards are necessary or even useful.

The pre-existing types we must use are the source and target qualified media. However, media are not formalised or even formalisable standards. This basic fact must be acknowledged in research using critical stepwise formalisation, as it is closely connected to what a qualified medium is. As we know from the long research into interart and intermedia studies, and as it is pinpointed in Elleström (2010): to define media in an unambiguous and agreed upon way is not possible. Elleström's model for media modalities represents an alternative to top-down definitions of media.

In this book I used one source text and could do without a precise definition of 'text'. I had to give a definition of 'map' in order to have a frame for the target media expressions and for the comparisons. That led into a difficult landscape of conflicting views on what maps are and in the end it

[13]'RDF is intended for use as a base notation for a variety of extended notations [...] which use a particular vocabulary with a specially defined meaning' (W3C 2014, sec. 3).

proved impossible to make a precise scholarly definition that covered the very different uses of the word.

8.6 The text

One last question remains. In the latter part of this book one word has been used repeatedly, in different contexts: interactivity. The ability to work with material, change it, manipulate it, to play with it has been in focus. Maps, models, and textual data have all been seen in light of the ways in which they can be manipulated.

All this happens in a text. A static, printed text (even if it is available as an e-book too). All the calls for interactivity presented in a stable sequential series of words, as opposed to a world full of interactive possibilities. Why?

Limitations can also be enablers. The inability of texts to pinpoint in a natural way the geometry of a landscape also enables them to express an openness that maps cannot give. In an article about different ways of modelling texts in the context of TEI I concluded: 'So not only can overly strict formalisms prevent communication, overly loose formalisms can have a similar effect. We need our straitjackets to be just tight enough' (Eide 2015*a*). The textual medium is a straightjacket, also for the reader. It pushes towards the development of lengthy arguments, both for readers and for writers. Surely, a book can be browsed and searched and read backwards. But the medium nudges the reader towards certain types of behaviour.

'Every medium has the capacity of mediating only certain aspects of the total reality' (Elleström 2010, 24). This is the third time I quote that sentence. Repetition has a special weight in a printed text. It will often represent importance. 3 or even 120 cities on a map does not give the same effect. It will rather say something about the number of cities in a geographical area. And repeating one and the same city on a map makes no sense. Repetition on a map cannot make a rhetorical point comparable to the repetition of the quote above. The media are different, and training our understanding of such differences is important in order to improve cultural literacy (Segal et al. 2013, 6).

A monograph can give room for a lengthy argument. It is not the only medium with this ability, but in scholarly communication it is the most important one. I needed to express my findings in such an argument. It nudges the reader to follow through to the end. Maybe that limits the number

of readers. But the ones who do read will go through the intended route. What comes out of that is beyond my control. In that sense I am no more powerful as a writer than as a developer of an interactive system. Maybe even less (Aarseth 1997).

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