Yvonne Eriksson

Tactile Pictures

Pictorial representations for the blind
1784–1940

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For Judit

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ABSTRACT
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The purpose of this thesis has been to investigate the relationships between the philosophical, psychological and pedagogical theories on tactile perception and the design of relief pictures and maps for the visually impaired from 1784 to 1940. One of the results presented is that the pictures and maps produced for the teaching of the blind were from an early date based on explicite theories of tactile perception. Consequently the thesis also considers problems related to visual communication, since visual representations were used as the basis of tactile representation. Many of the pedagogues who laid the foundations of teaching of the blind developed comprehensive theories and methods which had their origins in the theory and methodology of teaching by object-lesson. The object-lesson as a teaching method played an important role in the teaching of the blind during the 19th century and well into the 20th century. In order to illustrate concepts and phenomena, teachers of the blind used relief pictures and maps and models. The present study is the first comprehensive investigation of the representation of pictures for the visually impaired from the perspective of history and the theory of pictures.

A variety of relief printing techniques were employed in the production of tactile maps and pictures. This thesis proves that the production of tactile pictures and maps have a longer tradition than has been recognized, and that the teachers of the blind were following the general development of the expanding printing industry of the 18th and the 19th centuries. The thesis documents and analyses a considerable number of the practically inaccessible pictures and maps which are today kept in a number of widely scattered collections of the production of the pioneers and experimenters Alston, Guldberg, Moons, Kunz, Vogel and Thilander. Individual picture books produced by other printers using a variety of techniques are also included (*Ektypographischer Bilderwörtenbuch*, *A Picture-Book for the Blind*, *A Toy Book with Imitation of the Verses* and *A Picture Book in color for the Blind*) are also considered.

Key words: relief pictures, relief maps, tactile pictures, tactile perception, visual communication, relief printing, object-lesson.

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Preface

This dissertation was made possible by the fact that I was able to combine my work at the Swedish Library of Talking Books and Braille (TPB) with my doctoral studies, first in the Department of Communication, Linköping University, and later at the department of History of Art at Gothenburg University.

At an early stage, I came into contact with Prof Lena Johannesson's research in *Den massproducerade bilden* (1978). The encounter with Lena Johannesson's extension of the history of art to include pictures (empirical and theoretical) together with the the psychology of pictures which formed part of my graduate studies in the history of art in the 1970s were decisive factors in my later interest in the tactile picture. I was later privileged to have Lena Johannesson as my advisor, and discovered many more points in common with her research than I had expected to find when I began my studies. These common points of interest led to many long and interesting conversations over the years, during which Lena Johannesson gave me very valuable help and advice. I would like to express my most sincere gratitude to Prof. Lena Johannesson for these inspiring and instructive talks as well as for her constructive criticism of my work during the planning stage and later in the writing of my thesis.

My interest in the reproduction of pictures for the visually impaired was awakened in the mid-80s when I became editor of talking books at TPB. I was first introduced to pictures for the visually impaired by Polly Edman of RPH Syn (now SIH Läromedel, Solna) and her successor Monica Srucel. I then made contact with Lena Löwenhielm, pictorial teacher at Tomteboda-skolan Resource Centre, and assistant professor Gunnar Jansson of the Department of Psychology at Uppsala University. Very early in my doctoral studies, I had the privilege of collaborating with Prof John M. Kennedy of the University of Toronto. I greatly appreciated this co-operation, which I found both instructive and stimulating.

In my work at TPB, I was given great freedom to dedicate myself to historical and contemporary research into the development of pictures for

the visually impaired. I would like to express my most sincere gratitude to the director of TPB, Ingar Beckman Hirschfeldt, for her faith in me and for so generously allowing me access to their research resources. I also wish to thank my colleagues at TPB for their support, encouragement and fruitful co-operation. Over the years, Beatrice Christensen-Skiöld has generously shared all her national and international contacts and her knowledge with me and helped me in many practical aspects, for all of which I am extremely grateful.

During the first years of my doctoral studies (1992–96), I was matriculated in the Department of Communication studies, Linköping University. When my advisor, Lena Johannesson, was appointed professor of history of art at Gothenburg University, I chose to continue my studies there. I wish to thank all my former colleagues for many interesting and productive discussions in doctoral seminars and meetings during my years at Linköping, especially the members of my doctoral study group Henrik Artman, Jonny Karlsson, Mikael Peolsson and Natacha Korolija and the members of the seminar *Kultur & Medierad Kommunikation*, and Christina Brage and Rosemari Malmgård at the Tema library.

Many archives and museums of the history of the blind opened their doors to me and freely offered their generous collaboration. Among these were the Perkins School for the Blind, the American Foundation for the Blind, the Lighthouse for the Blind in New York, the School for the blind in Budapest, Bundes-Blindenerziehungsinstitut in Vienna, Schweizerische Bibliothek für Blinde in Zurich, Blinden-Museum in Steglitz/Berlin, Deutsche Zentralbücherei für Blinde in Leipzig, the Musée de Valentin Haüy (Association Valentin Haüy pour le bien des aveugles) and Institut des Aveugles in Paris, the Royal National Institute for the Blind in London, Danmarks Blindehistoriske Museum in Copenhagen, synskadades Museum in Enskede (Stockholm) and the Tomtebodaskolans Blindmuseum School Solna (Stockholm). At these institutions, I met a number of people whom I particularly want to thank: Kenneth Stucky, librarian at Samuel Hay's Research Library, Perkins School for the Blind; Birger Wiggen, Sven-Gustav Andersson and Göte Linghed at the Synskadades Museum; Thorsten Andersson of the Tomtebodaskolans Blindmuseum; Mogens Bang and Jeanne Christensen of Danmarks Blindhistoriske Museum; Christian Glenstrup at Danmarks Pedagogiska Samlingar and Communale Culturdienste Süd (CoCus) in Berlin.

At the final seminar where this thesis was considered, Solfrid Söderlind, Ph.D., acted as my opponent. I would like to thank her for accepting this task and for her valuable comments. I also wish to thank the higher seminar at the Department of History of Art, as well as Anna Tellgren, Ph.D., and Anette Göthlund, Ph.D., for their very much appreciated opinions. I thank Ulla Hamberg for giving me access to the portrait of prof. Hamberg.

My faithful friend and colleague, Monica Strucel, proof-read for me. For that and for her stimulating collaboration over the years I am very grateful.

Ridderstads Stiftelse's generous contribution made it possible for me to take leave from my work at TPB to complete my thesis. The translation into English was made possible by support from Vetenskaps- och vitterhets-samhället in Gothenburg and TPB.

My closest friends and family have been very supportive during my work on this thesis. Lena Sandgren and Peter Götzlinger's kind hospitality enabled me to take part in the activities at the Department of History of Art in Gothenburg, in spite of the fact that my home is in Stockholm.

My closest family, Judit Benedek, patiently followed the development of my thesis and made many constructive comments. This thesis is dedicated to her.

Yvonne Eriksson, Koppartorp, July 1998

I

Introduction

Pictures for touching—tactile pictures—are pictures made in relief. For the relief to be perceived and interpreted by touch, the peculiar capacities of the sense of touch and the skin must be borne in mind when the relief picture is being produced. In *Tactile Pictures. Pictorial representations for the blind 1784–1940,* I intend to reconstruct a history the greatest part of which has been forgotten. It is the history of tactile pictures and therefore the history of pictures made for the blind. By making a study of the philosophical, psychological and pedagogical ideas which had a bearing on the teaching of the blind during the period in question, I have tried to show how these theories influenced the design of pictures and maps for the blind.

Pictures for tactile reading have mainly been made for use in the teaching of blind school children and adults. The pedagogues who used tactile maps and pictures employed the object-lesson method in their teaching. I have therefore chosen to relate the history of tactile pictures to the philosophical and pedagogical theories on which object-lessons were based.

During the period I investigated, the object-lesson was common practice in ordinary schools, where the wall-chart appeared towards the middle of the 19th century. Surprisingly little has been written about the material employed in object-lessons (wall-charts, maps and models). *Vor Ungdom* (Our Youth), 1907, featured a long article on the first pictures made for use in object-lessons in the primary school ("Nogle Dövstumme billeders Historie"). Lena Johannesson introduced this complex research problem to the Swedish public in *Den Massproducerade bilden* (1978), while Christian Glenstrup has written about early German wall-charts for the teaching of deaf pupils in "På jagt i en billedskat" (1991).[1] The model as a teaching aid is the subject of *Habitat Dioramas. Illusions of Wilderness in Museums of Natural History* (1993) by Karen Wonders, and *Naturaliesamlingar och naturhistorisk undervisning vid läroverken* (1974) by Yngve Löwengren.

Starting point and suppositions

During my everyday professional activities at the Swedish Library of Talking Books and Braille (TPB), I regularly meet the people who use tactile pictures and maps, as well as the people who design them. During the 1990s, I have participated in and succeeded in exerting an influence on the production of tactile picture books, different types of reference books and textbooks for schoolchildren and students in Sweden. I have done this, of course, in close collaboration with designers, draughtsmen and users, that is, people with severe visual impairments.[2] In addition, I have also worked on the transfer of art pictures.[3] The design of tactile pictures is determined by our actual knowledge of tactile perception and by the designer or draughtsman's capacity to avail himself or herself of this knowledge and make practical use of it. Our knowledge of how pictures for tactile reading ought to be designed is continuously being augmented by close contact with the users, who can tell us what is required to make a tactile picture or map as distinct as possible.

The development work which I am involved in at TPB, in the reproduction of pictures for the visually handicapped readers of talking books and braille, has made me aware of the problems related to the design of tactile pictures. I therefore have had to study the type of information which can be extracted from a tactile picture or map. This experience has been an important factor in my assessment of the historical source material used in my thesis.

Distribution and use of relief pictures and maps today

Today relief pictures and maps are mainly produced as educational material or textbooks. In Sweden, it is common to transfer whole books to braille or talking books. It very exceptionally occurs that only parts of a book's text or adaptations of texts are transferred to braille or talking books. On the other hand, it is very rare to find all of the pictures in a book transferred to relief. This is chiefly because of the complicated and time-consuming process involved in the translation of a visual picture to a tactile picture. Apart from the problems involved in production, there are also problems for the user. Many of today's readers are not used to tactile pictures, and in the schools there is no staff with the qualifications necessary for teaching visually handicapped pupils to read tactile pictures.

Relief pictures and maps are found in braille books, as appendixes to talking books and in exhibitions. In talking books and braille books, the illustrations have verbal descriptions. Yet another form of verbal description takes place when films are viewed audiovisually, that is, when a voice describes what is happening on the screen in the pauses between the dialogue. During audiovisual interpretation of theatre performances, the scenes are described by a voice which can be listened to with ear-phones.

Different types of pictorial representation for visually handicapped people have been employed since at least the 17th century. Today's relief picture and map design thus continues a long tradition. The first successful technical solutions were introduced during the first decades of the 19th century, something that many of today's producers and users are seldom aware of. Even audiovisual film-viewing has a relatively long history. The first attempts at audiovisual viewing were made in the 1920s by soldiers who had been blinded during the First World War.[4] In the 1950s, the Library for the Blind produced several of Ingmar Bergman's films as talking books, which in practice was the same thing as audiovisual viewing.

Sources and collection of material

My thesis will deal mainly with a hitherto little-known or unknown type of educational material, that is, relief pictures and maps executed in a variety of techniques and teaching models. A large part of the material which I have unearthed relief pictures and maps, is unique. There are only two or three surviving copies of some of the relief picture-books, either because no other copies were made or because the copies which were made have been lost. Many of the relief maps were made by hand and existed in one copy only.

I found and studied the material on which I have based my thesis at the following institutions: the Perkins School for the Blind, the American Foundation for the Blind, the Light-house for the Blind in New York, the School for the blind in Budapest, Bundes-Blindenerziehungsinstitut in Vienna, Schweizerische Bibliothek für Blinde in Zürich, Blinden-Museum in Steglitz/Berlin, Deutsche Zentralbücherei für Blinde in Leipzig, the Musée de Valentin Haüy (Association Valentin Haüy pour le bien des aveugles) and Institute des Aveugles in Paris, the Royal National Institute for the Blind in (RNIB) London, Danmarks Blindehistoriske Museum in Copenhagen, Synskadades Museum at Enskede (Stockholm) and the Tomtebodaskolans Blindmuseum in Solna (Stockholm). A great deal of the information in my thesis has been reconstructed with the help of the material I found in these institutes in the form of collections and oral traditions.

The institutes I have mentioned possess collections which are difficult to access, since only about half of them are catalogued, which means that in certain cases only part of the collection of relief pictures, maps and models is available, together with a great deal of disorganised potential source material such as letters, notes and other literature. Magazines and reviews connected with the movement in favour of the handicapped, its organisation, education of the handicapped, congress reports and annual reports are more readily available.

An extremely valuable and necessary part of my search for source material has been the creation of a vast network of contacts with people who in one capacity or another have had some relation with the institutes which I have investigated. The majority of the literature in relief print or braille with relief pictures, such as congress reports and books on the subject is uncatalogued. I discovered a great deal of this material, whose content was unknown, in boxes and cup-boards. Many of the relief pictures have been identified by talking to people who have had a long professional relationship with the institutes in question, or who have had the good fortune to share older colleagues' memories and experiences. I had to work slowly on this inventory, as the people I was in contact with gradually remembered other people or material which might be of interest for my thesis. Vital literature pertaining to Swedish relief material is only to be found in private collections, and is therefore not catalogued in any archive or library.

In the material I consulted, I found a great number of models for object-lessons in natural history, geometry, geography, botany, zoology and anthropology. A remarkably large number of these models came from Germany. Most of them, however, were not made specifically for the teaching of the blind, but were produced by manufacturers and publishers of general teaching material for ordinary schools.

Another source to which I have had access are photographs, several of which, at the Blinden-Museum in Steglitz/Berlin, show classrooms with pupils surrounded by an impressive collection of zoological specimens. I found similar photographs in Denmark, but there the collection of animal models was less extensive. In photographs of the early museum in Vienna, there are animal models among the exhibits. This, of course, is related to the general development of natural history museums in Europe and the increasing importance of models in the history of European education.[5]

Research tradition and the state of the art

My thesis touches on fields of research which to some extent coincide and which, on the other hand, partly belong to traditionally divergent forms of research. In the case of my research into pictures, I have moved in that area of the history of art which deals with mass-produced pictures, including instrumental pictures and educational pictures. The design of tactile pictures and maps has been influenced by this pictorial tradition, but has also depended to a large extent on a knowledge of tactile perception. The problem of how pictures can best be presented verbally to the visually impaired reader has also been a prominent issue in the debate on the perception of tactile pictures. The result is that it is not possible to refere to one particular research discipline in studies of tactile pictures for the visually impaired.

Modern research into visual handicaps has principally been carried out by psychologists and pedagogues. Previous to that, this was the task of philosophers. Any research which has to some extent focused on pictorial representation for the visually handicapped has generally been undertaken by psychologists involved with the psychology of perception, who have either studied the capacity of the blind to understand pictures or artistic creations produced by the blind themselves (drawings or clay models).

There exists older and more recent research into the development of writing for the blind, from relief writing to the modern braille system developed by Louis Braille. Historical surveys mention some examples of relief pictures and maps, but so far no-one has focused specifically on tactile pictures and maps.

During the last few decades, an important part of the research on tactile perception related to visual handicaps has been involved with visual perception as opposed to tactile perception, that is, investigation into which of the two senses is the dominant one. Both the visual picture and the tactile picture consist of lines, surfaces and dots. Although we use the same symbols, the visual and the tactile picture look different, and what is more, their perception is different, depending on whether vision or touch is involved. When D. H. Warren and M. J. Rossano discussed these problems in their paper, "Intermodality Relations: Vision and Touch", they divided visual and tactile perception into perception of texture and figures (inclination, size and length,) and spatial perception.[6] In studies of the blind´s reception of tactile pictures, however, it is difficult to distinguish any particular part of preception. Many factors are involved, not least the quality of the relief picture itself.

Warren and Rossano's results are directly related to the development of robotic technology, where it is important to know the dominant mechanisms in a given situation and to be able to adjust them to the situation. In the case of a hypothetical conflict between vision and touch, Warren and Rossano maintain that vision will always predominate. This is possibly one of the reasons why so many unsatisfactory relief pictures are produced—the manufacturer relies on vision instead of touch. A relief picture, whether for visual or tactile use, is often perceived as being much clearer visually than tactually, because light effectively accentuates its different levels.[7]

During most of the 20th century, studies have been carried out on the capacity to distinguish between different textures—line, surfaces and dots. This applies equally to the tactile capacity of those with severe visual impairment. Studies have also been carried out on the factors which govern and facilitate haptic identification and recognition, partly concentrated on relief pictures and maps. There are, moreover, a great many studies of pictures made by persons with severe visual impairment, images which have been the starting-point for an estimation of their tactile capacity, that is, what they can be expected to perceive of a tactile picture or map.

Mass-produced pictures, the history of engraving and printing techniques

The increased availability and distribution of tactile pictures during the period covered by my study was a repercussion of the increased production of pictures in general, and of different types of printed material such as newspapers and periodicals. These visual pictures had a great influence on the iconography and design of tactile pictures. Furthermore, the design of wall-charts became the model for educational tactile pictures, especially the type of wall-chart which was based on the encyclopaedic picture tradition. Lena Johannesson introduced the study of massproduced pictures as an independent line of research in 1978, with *Den massproducerade bilden*, and has since published a number of titles and papers on this subject.

The general increase in the distribution of pictorial material also affected interest in the adaptation of visual pictures for tactile reading. The development of printing techniques facilitated the illustration of books and other printed matter, and this increasing skill in the application of printing techniques was carried over into relief printing, particularly into relief printing for the blind. In the preparation of my thesis, a vital source of information on the development of printing has been Lena Johannesson's comprehensive study, *Xylografi och pressbild* (*Wood-Engraving and Newspaper Illustration,* 1982), in which she describes, amongst other things, those printing firms which had become well-established by the end of the 19th century or the beginning of the 20th century. Johannesson's study was of particular interest to me, as in it she describes several printing firms which also printed embossed text, and the contemporary artistic debate on relief prints as a form of sculptural expression. There is a direct link between Johannesson's thesis on the history of engraving and my thesis, as relief prints are typical products of their time, the lively, experimental Romantic period.

Interest in vision and forms of visualization

All pictures are to some extent representations of visual ideas and of how we understand and experience visual perception. The consequences are that the history of art, that is, of pictures, offers us a rich variety of pictorial representation of objects, scenes and environments, contemporary and historical. The spatial organisation of the picture surface in these representations depended not only on the artist's skill, but also on the period in history in which they were executed and its concept of what the human eye saw. This has been described by Ernest Gombrich in *Art and Illusion*, Rudolf Arnheim in *Art and Visual Perception*, Martin Kemp in *The Art of Science*, and also by Svetlana Alpers in *The Art of Describing*. These researchers have made me aware of the variations which occur in visual representation, and therefore also of the differences and similarities between visual and tactile representation.

In *Technique of the Observer* (1990), Jonathan Crary maintained that the separation of the senses increased as the science of optics developed during the 19th century. That is, interest became focused on the visual sense, to the detriment of the other senses. This is not quite true, since during the later part of the 19th century there was great interest in the question of the cooperation which took place between vision and touch. It is obvious that the philosophers and psychologists who developed theories on tactile perception and thus directly or indirectly influenced the development of pictures for the blind were themselves influenced by the contemporary debate on spatiality and form. In *Empathy, Form and Space. Problems in German Aesthetics 1873–1893* (1994), Harry Francis Mallgrave and Eleftherios Ikonomou collected and analysed texts by Robert Vischer, Conrad Fiedler, Heinrich Wölfflin, Adolf Göller, Adolf Hildebrand and August Schmarsow. In their comprehensive introduction, the editors mention the debate which evolved around psychological and physiological aesthetics during the period in question. The debate took form in *Kritik der reinen Vernunft* by Immanuel Kant (1781), was continued and developed by philosophers such as Johann Friedrich Herbart (1776–1841), Herman Helmholz (1821–1892), Gustav Fechner (1801–1887) and Herman Lotze (1817–1881), and culminated in a more experimental form with the work of Wilhelm Wund (1832–1920).

One of the questions which aroused philosophical interest in the 18th century was the so-called "Molyneux question," which was concerned with the differences between visual and tactile perception and what is learned or what is innate. In *Shadows and Enlightenment* (1995), Michel Baxandall discusses how scientific knowledge and the interest in vision and light affected art, leading to a greater importance being given to light and shadow.

Tactile perception

How and where vision occurs in the human organism has been the subject of a lively debate throughout history, which in turn has given rise to a great many different interpretations of the concept. This complex mechanism has been discussed by philosophers in more recent times and forms the basis of philosophical and psychological theories of tactile perception. Knowing how, where and when vision occurs is vital to our understanding of visual perception, as is the question of whether the capacity to interpret pictures is innate or acquired.

Some important research work has been done on tactile perception, but very little of it on relief pictures. In 1925, David Katz, a German psychologist who later practised in Uppsala, published *Der Aufbau der Tastwelt*, which aroused great interest in the 1990s, after it had been translated into English in 1987. Katz wished to eliminate the hierarchic division of the senses by showing that much of what is regarded as visual perception might also be classed as tactile perception.[8] Amongst other things, Katz investigated the information which could be extracted by touch. While he approached his research from the psychological phenomenology standpoint, he carried out his experiments according to Gestalt psychological theory. When the French philosopher Merleau-Ponty discusses tactile experience in *Phénoménologie de la Perception* (1962), he bases his argument on Katz's *Der Aufbau der Tastwelt*. Merleau-Ponty stresses that there is an important physical element in visual perception. When an object is located, it is always in relation to the individual's body. This is what distinguishes touch from vision, according to Merleau-Ponty, and what makes it possible to perceive similarities between the two senses. When we see an object in a room, it is not actually located on the retina, but is situated in the room itself, and what we see depends on our position in the room. The size of the object is perceived differently, depending on where we are standing in relation to the object.[9] Merleau-Ponty points out that movement and time are not simply objective conditions for tactile recognition, but perceptible components of tactile data. Just as light enables us to see a pattern in what we are looking at, so movement gives us tactile information about its shape and surface.[10]

Studies on tactile perception

In *Der Aufbau der Tastwelt*, one might say that Katz started what John M. Kennedy is now continuing, that is, the investigation into whether visual perception and tactile perception are in fact closely related. Katz's research into the creation of pictures by the blind, however, was of greater importance to Kennedy. Katz's study of drawings by blind children is presented in "Hur tecknar blinda?" (How the blind draw) which appeared in *Nya Psykologiska strövtåg* (1945). John M. Kennedy, for his part, has presented his research into pictures drawn by the blind in several articles and in *Drawings & the Blind* (1993), where he describes in detail the ability of persons with severe visual impairment to express themselves in pictures, and of their ability to understand tactile pictures which represent both concrete objects and abstract ideas. Kennedy's point of departure is that the understanding of pictures is an innate capacity. By allowing people who were born blind to draw on a drawing-cushion[11] without any previous instruction, Kennedy found that they used in their drawings the very same forms of expression as can be observed in cave paintings, that is, simple line drawings.

Kennedy considers that the capacity to reproduce a shape in outline is universal. He bases his hypothesis on J. J. Gibson's theory according to which all objects are formed of different combinations of plane and curved surfaces. Gibson refers only to surfaces, while John M. Kennedy includes lines and contours. Using lines and contours, it is possible to show how these surfaces meet and form edges and corners. These contours and edges are tangible; they can be felt and held. Kennedy maintains, in agreement with Katz and Gibson, that man's surroundings are everything that surrounds him both physically and psychologically, and that our ability to interpret these surroundings is innate. Kennedy and Gibson, however, differ, in that Gibson holds that a picture is merely an optical phenomenon, while Kennedy sees the lines of a drawing as axes with a definite direction in space. He maintains that this is how people with severe visual impairment are able to perceive tactile pictures.[12]

Kennedy starts with the hypothesis of our innate capacity for interpreting pictures, and systematically investigates whether what is true of visual perception is also true of tactile perception. His research involves perspective as well as foreshortening, and the importance of the direction of an object on the picture surface. Experiments on perspective and foreshortening have been made with pictures drawn by the blind as well as with tactile reading of pictures. In both cases, the participants were able to perceive and understand perspective and foreshortening.

Kennedy, in his studies of pictures drawn by people with severe visual impairment and their ability to read and understand tactile pictures, focuses on their perceptive capacity. This is also the case of the research carried out by Susanna Millar, which touches on and to some extent coincides with Kennedy's. Like Kennedy, Millar has investigated both the reading capacity of the blind and pictures drawn by them. In *Understanding and Representing Space* (1994), Millar includes information on blind children's spatial perception in the interpretation of pictures. Millar's studies of the haptic memory have a bearing on other studies of the "usefulness" of relief pictures. She has come to the conclusion that it is easier for the blind reader to recognise a relief picture if he rereads it in exactly the same way as he did the first time.[13]

During the last few decades, research on tactile perception in people with severe visual impairment has been based on a long tradition which stems from a number of epistemological questions. Present day research is not connected with the teaching of the blind, as it was during the 19th century, but resembles in some ways the philosophical interest which existed in the 18th century.

The history of institutes for the blind

The creation of the first educational institutes for the blind is described in detail in both primary and secondary sources. Several of the founders of these institutes themselves published pamphlets or articles in specialised reviews on the development of their institutes. Their correspondence also contains information, but publications connected with the celebration of anniversaries and annual reports in particular are excellent sources. Furthermore, over the past 70 years or so, a number of more comprehensive articles and theses have been published on the subject. Otto Wanecke discussed some of the most important theories on pedagogy for the blind in *Geschichte der Blindenpädagogik* (1969). The development of the German educational institutions and pedagogical concepts on which their teaching method were based is presented in *Begründung des deutschen Blindenbildungswesens* (1986) by Marianne Schuber. At the time of the final preparation of this thesis, the doctoral thesis *La cécité et les aveugles dans la société française; représentation et institution du Moyen Age aux premières années du XIXe siècle* by Zina Weygand was discussed at the Université de Paris whose subject was the historical development of French institutes for the blind.

In the historical surveys which have appeared in the last two decades, I have observed a more critical attitude towards the ideology behind the older educational institutes and the means for educating children and adults with visual impairments. It is neither surprising nor particularly remarkable, when one considers that the predominant policy in the western world is no longer to segregate these social groups in specialised institutions, but to integrate them in normal educational environments.

As my thesis is not concerned with institutes as such nor with pedagagy or educational methods in general, but focuses on object-lessons and their significance for the visually handicapped, I will not be discussing the ideological question of the need for or the validity of special schools for the blind. Instead, my purpose has been to discover the philosophical, pedagogical and psychological thinking and theories on which the teaching of the blind is based, especially teaching by object-lesson. My basic aim was to demonstrate beyond doubt that in most of the institutes, at least when they were founded and during the decades immediately afterwards, there existed a very conscious vision of how teaching ought to be carried out in order to give the visually impaired the best education possible.

The history of the relief picture and the relief map

My investigation deals with the representation of pictures for the visually impaired during the period between 1784 and 1940. 1784 was the year in which Valentin Haüy laid the foundations in Paris of what was to become the first institute for the education of blind pupils. The pedagogical ideas which developed during the Age of Enlightenment and on into the 19th century, continued to a large extent into the 20th century. The principles by which relief pictures and maps were produced remained more or less the same, although printing techniques progressed during this period.

It is not possible to give an exact answer to the question of *when* the production of pictures for people with severe visual handicaps began. Neither do we know when relief pictures and models were first used to introduce to or clarify concepts and phenomena for the visually handicapped. Different forms of writing for the blind (relief or engraved letters), particularly individual solutions, were in existence since approximately the 16th century. The Museum for the History of the Blind in Bucharest conserves a Japanese relief print with writing for the blind which dates back to the 9th century.[14]

The teachers who first organized the teaching of blind pupils and who later founded educational institutes for the blind were influenced by the intellectual currents and philosophical discussions which were taking place in society at the time. Much of the literature I have consulted testifies to this. As a result, they introduced contemporary pedagogical ideas into their teaching. According to the theories in vogue at that time, knowledge must be developed through the senses, not only through cognitive processes. For the pupil to form an overall picture of a world which was becoming increasingly complex, illustrative pictures and models were needed. The map and the globe were given a central place in this new pedagogy. Geography lessons changed during the 19th century to include the teaching of climate, vegetation and anthropology. The detailed drawings and paintings of contemporary explorers and the novel zoological and botanical gardens played an important role in this spreading of knowledge. In the material I have consulted, I found that the new pedagogical currents and the change in character of school subjects also had repercussions in the schools for the blind.

"From Vives to Haüy"

The organized education of the blind began at a time when there was a great deal of philosophical and political interest in pedagogical experimentation. The pioneers of the pedagogy which developed in the teaching of the blind were forceful personalities with well-established international contacts, which meant that pedagogical and psychological theories on the teaching of the blind and on the development of teaching aids such as relief pictures and maps and models rapidly spread throughout Europe. There were, in fact, no geographical limits to the transmission of this knowledge, as several of those countries which occupied leading positions in the teaching of the blind possessed colonies in Africa and Asia, and so the pedagogical innovations spread to these areas, too.

There were important personal contributions to the development of the teaching of the blind, and the interchange of knowledge and pedagogical theories was obviously built in many cases on personal contacts at international level. Nevertheless, we must not forget the common philanthropic foundation on which these people based their work, that is, a tradition which traced its roots back to the 16th century Valencian philosopher Joan Luis Vives (1492–1540) and his *De anima et vita libri tres*, published in 1538. Vives advocated the practical use of knowledge, defended women's right to education, the right of the poor to protection, while he advocated the use of an international scientific language other than Latin. In *De anima et vita libri tres*, Vives anticipated a number of basic ideas on the teaching of the blind which were put into practice during the 18th and 19th centuries. He believed, for example, that the blind should be taught music and crafts.[15]

Although the teaching of the blind principally meant the teaching of handicrafts, reading and writing were also included. In one of Albert Engström's stories in "Smålandsberättelser" (Stories from Småland), the author describes the village characters. When he comes to the local blind man, we are told that he was the only one in the village who could read, as he had been sent to the school at Tomteboda.[16] Engström's story is not unique; there are several examples of blind boys and girls from the lower social classes who received an education precisely on account of their handicap. The comparison between the use of modern teaching material in the education of the blind during the 19th century and the use of modern techniques with the visually or otherwise handicapped pupils of today is relevant. Modern technology, especially computers with synthetic speech and braille displays, are commonly used by handicapped pupils, university students, postgraduate students and professional people.

J. A. Comenius—the father of object-lesson

Teaching by object-lesson played a decisive role from the very beginning of the education of the blind. The principal pedagogues who laid the foundation of the object-lesson as a teaching method were Johann Amos Comenius (1592–1670), Johann Basedow (1721–1790), Hermann Pestalozzi (1746–1827) and Friedrich Fröbel (1782–1852). They had, therefore, a considerable influence on the educational principles which developed from the 19th century onwards, in ordinary and special education alike, and not least in the teaching of children with severe handicaps.

Johann Amos Comenius, a priest, established, in *Didactica Magna*, a pedagogy which became a basic point of reference in Central European educational philosophy. Comenius basically believed that the content of teaching should be adapted to the pupil's perceptive capacity. It should start by giving the pupil a general picture, and proceed to a more thorough consideration of details. It was also important to begin with the simple and progress to the more complex. Comenius was of the opinion that all teaching should be concrete and that human beings could only arrive at logical knowledge through sensorial experience.

To the reasonable soul inside us are added external organs, which are like messengers, and knowledge, which helps man to maintain contact with everything that is without: vision, hearing, smell, taste and touch. Thanks to our senses, nothing that belongs to the outer world is hidden from man. Now, as there is nothing in the visual world which cannot be seen, heard, smelled, tasted or touched, and whose character and nature therefore can be perceived, it follows that the world does not contain anything that the man gifted with senses and reason cannot grasp.[17]

Comenius regarded the soul as a blank page and therefore considered education necessary, if man was to be more than a beast without reason. Education should start in childhood, as children learn more easily and are more adaptable than adults. Comenius believed that education should be imparted in schools, rather than on an individual basis. In addition to the historical arguments in support of his claim, he adduces five reasons why collective education is superior to individual or home education. Firstly, it saves time if everyone dedicates himself to the occupation he is best at. Secondly, parents very rarely have the type of knowledge required to educate their children adequately. Thirdly, even when the parents are able teachers of their children, it is useful and stimulating for the children to be with their peers. Fourthly, they emulate and compete with their companions and thus their desire to succeed increases. His fifth reason was that: "The larger the orchard, the better the trees normally like it; the larger the fishpond, the bigger the fish. Just as ponds are made for fish and orchards for fruit trees, schools should be built for children."[18]

Comenius advocated that women and the "weak" should also be educated. He writes the following on women:

> Because women are also created in God's image, and therefore share in his mercy and the kingdom to come, they also have a soul which is alive and open to wisdom (yes, often more open than the souls of men). The highest positions are also available to them; they have often ruled states, given sensible advice to kings and emperors, practised medicine and other professions useful to mankind. Yes, women have even been prophetesses and punished priests and bishops. And all through the Lord's doing. Why, then, should they be allowed to learn their letters, but later be kept from studies? Are we perhaps afraid of their thoughtlessness? But the more use we make of our capacity to

reflect, the fewer occasions will there be for thoughtlessness, which normally is the result of inner emptiness.[19]

These lines are interesting, and education for the blind eventually became the norm for girls as well as boys, as we shall see.

When Comenius talks about the "weak," he means those who initially may appear to be slow to learn and sluggish, but this sluggishness can be overcome by hard work. The contrary may occur, and the strong and courageous person can become weak and exhausted. Therefore it was important that noone should be excluded from education, "if God himself had not denied him senses and reason."

In *Pampaedia*, Comenius stated that the blind and the deaf should not be excluded from education either:

> Only non-human creatures should be excluded from collective education for the masses, and as all are part of the human race, they should have a share in all the services. Especially where nature cannot remedy an inner lack, is external help necessary.[20]

Comenius also had ideas on the most suitable type of education and professions for the blind and the deaf:

> Precisely for this reason, education should not be abandoned, since if Nature is prevented from developing in a particular direction, all the more will develop strengths in other areas—if given some assistance. In such cases, history clearly shows how persons blind from birth, by developing their hearing, have become important musicians, lawyers, speakers, etc., just as persons born deaf have by their efforts become outstanding artists, sculptures and craftsmen. /.../ There is always an entrance to the reasonable soul through which light can and must find its way.[21]

Comenius's reasoned thoughts on the importance of the senses in learning clearly have great bearing on the later development of teaching by object-lesson.

> So must hearing still be linked with vision, language with the hand. What is to be learned must not only be told, must not only enter through the ears; it must also be presented in the form of pictures which will engrave themselves on the fantasy through the eyes. The pupils will only learn to express what they know with their mouths and their hands, once ears, eyes, reason and memory have satisfactorily assimilated it. And to

> this end, it is advisable that all that is taught should be reproduced in pictures and writing on the classroom walls, be it theories and rules or charts and pictures illustrating the subject taught at a given moment. If this procedure is followed, learning becomes unbelievably much easier.[22]

For Comenius, knowledge was synonymous with knowing something by its causes. By understanding things with the help of the senses, knowledge would become permanent. He writes that if a person has been to Rome and has paid attention to what he saw, his perception of the city will be retained by the memory; the person who has tasted sugar knows the meaning of sweetness; the person who has seen a camel conserves that image in his mind. Where it is not possible to study living creatures or particular objects, these can be replaced by copies or educational pictures. I will later be dwelling on similar thinking in the teaching of the blind.

Comenius gives concrete instructions on how illustrations should be used in teaching and in textbooks.

> Therefore, authors of books on botany, zoology, geometry, surveying and geography make great use of illustrations. This ought to be the case with books on physics and other subjects. The human spine, for example, should in my opinionbe studied visually and in depth, if a human skeleton is available—such skeletons are normally to be found in the universities—or a wooden skeleton could be used. It should be equipped with muscles, tendons, nerves, veins and arteries, and be made of leather stuffed with wool. Then the intestines, lungs, heart, diaphragm and stomach, all in their natural positions and proper proportions, should be added. Each organ should be inscribed with its name and function. On such a model, pupils studying biology could, nearly as if it were a game, understand everything about the body and its construction, if detailed explanations and descriptions were also given. Material of this sort for object-lessons (that is, copies of things which are not available in the original) should be made for all subjects and should always be at hand in the classroom. And even if the production of this material occasioned expense and difficulty, the results would amply justify the trouble involved.[23]

This type of practical instructions also applies to the object-lesson in schools for the blind.

II

The development of teaching of the blind

The methods employed in the teaching of pupils with visual impairment developed basically from practical experiences, but also through contacts between colleagues and knowledge of philosophic theories. In early pedagogic literature, the authors often argued in favour of teaching by object-lesson as the most appropriate method for pupils with serious visual impairment. In these texts we frequently come across indirect references to teachers' opinions and experiences of tactile perception. The writers' experiences of practical work with pupils with severe visual impairment occurred either in their teaching or as directors of educational institutions. It was not unusual for these authors to have themselves founded the institutions, which they directed. From the very first, the teaching of visually impaired pupils was based on what we, in modern terminology, would call participative observation.[1]

The foremost directors of such institutions were regular speakers at the many congresses for teachers of the blind which were held in Europe from 1873 onwards. They were also frequent contributors to the various reviews which specialized in the handicapped and particularly in the visually impaired.[2] What chiefly interested the directors of institutions for the blind and their teachers were the practical aspects of teaching, since their main aim was to prepare visually impaired children to become as independent as possible of family and society, in practical, social and economic terms. It was thought that a vocational training which would enable them to become self-supporting was the only road to an independent life. Three types of educational institutions developed: institutions which taught the most common school subjects, including handicrafts; craft schools for men and women; and, from 1862, pre-schools.[3] In 1784, Valentin Haüy (1745–1822) laid the foundation of the first educational institute for the blind at which most of the normal school subjects were taught.

My purpose here is not to give an account of the creation and development of these institutions. Instead, I will be focusing on those areas of their pedagogy which involved teaching by object-lesson and on the materials employed in these lessons (i.e. relief pictures and models). The pedagogues and institutions I will be concentrating on are those whose ideas and methods have been published, and who played an important role in the development and design of relief pictures and maps. The history of the teaching of the blind is, furthermore, a living oral and practical tradition which has been handed down to us, consciously or unconsciously, by many of these pedagogues.

The teaching of the blind before Valentin Haüy

The creation and development of educational institutions for the blind must, of course, be seen as a step in the right direction towards a juster society. Today, in many countries, disable pupils, including those with visual handicaps, are integrated, as far as possible, into ordinary schools. This is a major step, but there is still much to be done before prejudices and discrimination against the discapacitated are eradicated from our society.

Historical literature, contemporary as well as later, testifies to the direct and indirect role of the visually impaired themselves in the promotion, planning and creation of the first organized education for the blind. As early as the beginning of the 19th century, biographies were compiled of the lives of outstanding blind personalities who, in spite of severe visual impairment, achieved positions in the face of an acquired visual impediment.[4] When arguments were sought in defence of the intellectual capacity of the blind in spite of visual handicaps, it was probably useful and effective to be able to refer to these successful personalities.[5]

Early historical surveys of the growth of special institutions for the blind all conform to a similar pattern.[6] The Age of Enlightenment, with its humanism and its efforts to turn individuals into useful citizens, has been said to be the moving force behind the creation of institutions for the blind. However, it would be more reasonable to relate this phenomenon to the general change in attitudes towards marginalized groups which developed in society at this period. The change in the general perception of the physically and intellectually handicapped, of the unemployed and the poor, etc., was in part a consequence of the phenomenon of urban growth. In the expanding towns, the unemployed, the poor and other marginalised sectors of society became more visible than they had ever been before, when they were dispersed around the countryside. Leading forces in society wanted to put a stop to begging, for example. There were, on the other hand, philanthropists and enthusiastic educators who struggled to offer these marginal sectors of society solutions other than a place in asylums or poorhouses, which were in reality detention centres.[7]

Before the creation of institutions for the blind, begging was the only form of subsistence for the visually handicapped, unless they belonged to well-to-do families. Much earlier, there had been institutions for the discapacitated which has direct links with the Church and the monasteries. In an article entitled "The Blind and the French Revolution", Dora B. Weiner comments on the ecclesiastic institutions and the blind, and comes to the conclusion that blindness seems traditionally to have inspired fear, rather than pity, which may explain why the blind were on the whole treated generously, and at times even achieved social status as seers.[8]

It is perhaps that fear that Kretschmer wanted to reduce when he writes:

> Widespread, planned education for the blind came into existence only towards the end of the 18th century. With the passage of time, education for the blind has been introduced in most countries, until now the concept of the "civilised State" implies that its visually impaired citizens receive an education which will enable them to become self-supporting. In order for the blind themselves, as well as the general public to appreciate fully the blessings of today's care for the blind, we must remember the days when the blind were believed to be ineducable and incapable of looking after themselves, when there was no known method of releasing their spiritual and physical energy.[9]

The purpose of Kretschmer's historical survey was to make people appreciate more fully modern care for the blind.[10] His survey is a study of the social conditions in which the visually impaired have had to struggle, beginning with the right to life itself in the earliest times and the change brought about by the expansion of Christianity, and culminating in the present-day when, in certain countries, they enjoy full legal rights. His history is almost exclusively occidental, as any other parts of the world mentioned were effectively European colonies.

As Christianity spread, the blind were looked upon as unfortunates who had been given a heavy cross to bear in life. In the first Christian congregations, the blind came under the protection of the deacon and received charity from the congregation itself. Wealthy Christians even took visually impaired members of the congregation into their homes.[11] The growth of the Christian church and the massive influx to it of the poor and needy, led to the creation of a new form of poor relief. This was the "Xenodochias" or hospital. These institutions were intended to serve all kinds of people in need, but particularly those who required permanent help.

In Scandinavia, we find poor relief of a public nature at the beginning of the 12th century. The "Grågås" table of laws, which consisted of written Islandic laws from the early 12th century, bears witness to this, as does "Jonsboken", dating from 1280.[12] Charles the Great, wishing to institute a suitable form of poor relief in his kingdom, ordered not only that the Church should set aside one tenth of its revenues for charity, but also that landowners and their tenants should donate land to its cause. Charles employed special supervisors to ensure that his orders were carried out. The treasury decrees issued during the reformation period were aimed at making organized poor relief a matter not only for the Church but also for the middle classes.[13]

There are several instances of hospitals and monasteries i Europe dedicated to poor relief. The blind were probably not housed in any special section of the hospitals, but lived together with other handicapped or needy people. However, there is already evidence in the 15th century of associations formed by the blind inmates of these hospitals. The most important of these guilds during the Middle Ages was the "Congrégation et maison des trois cents" in Paris. The hospital was called Quinze-Vingts and was built by Louis IX (St. Louis) in 1254.[14]

Quinze-Vingts was, as its name suggests, designed to house exactly 300 blind persons. The inmates of the hospice were a lay congregation of "brothers and sisters". On becoming a member of this fraternity, the blind had to promise to obey the rules of the hospice, to say prescribed prayers every day, to hear mass and receive holy communion, and to show obedience to their superiors.[15] Men and women alike wore long, blue tunics with a lily on the front. Both sexes were permitted to marry and have children; the children remained with their parents until they reached a certain age.[16]
It is said that blind inmates of Quinze-Vingts were taken, in the mid 18th century, to what is now the Place de la Concorde, to play at the many cafes which existed at that time. The blind "musicians" could not play; the purpose of the entertainment was doubtless to ridicule their efforts.[17]

In *Folie et d´raison. Historie de la folie à l´âge classique* (1961), Michel Foucault has demonstrated how begging and poverty were dealt with differently during the various economic crises from the 18th century onwards. By means of a variety of forms of internment, the streets were cleared of beggars, who, when the economy recovered, served as a source of labour. During periods of prosperity, these detention centres provided cheap labour. There existed a definite correlation between the geographical location of these institutions and the industrialized areas, and there was a clear intentionality behind the rules which stipulated how the detainees should work. Foucault writes:

> In 1622, its rules were published; they were very exact. (F. is writing about the Zuchthaus house of correction in Hamburg, founded in 1620.) The inmates must all work. Their work value is very carefully calculated and they are paid a quarter of that sum. The work is not simply occupational therapy; it must be productive. The eight directors of the asylum draw up a

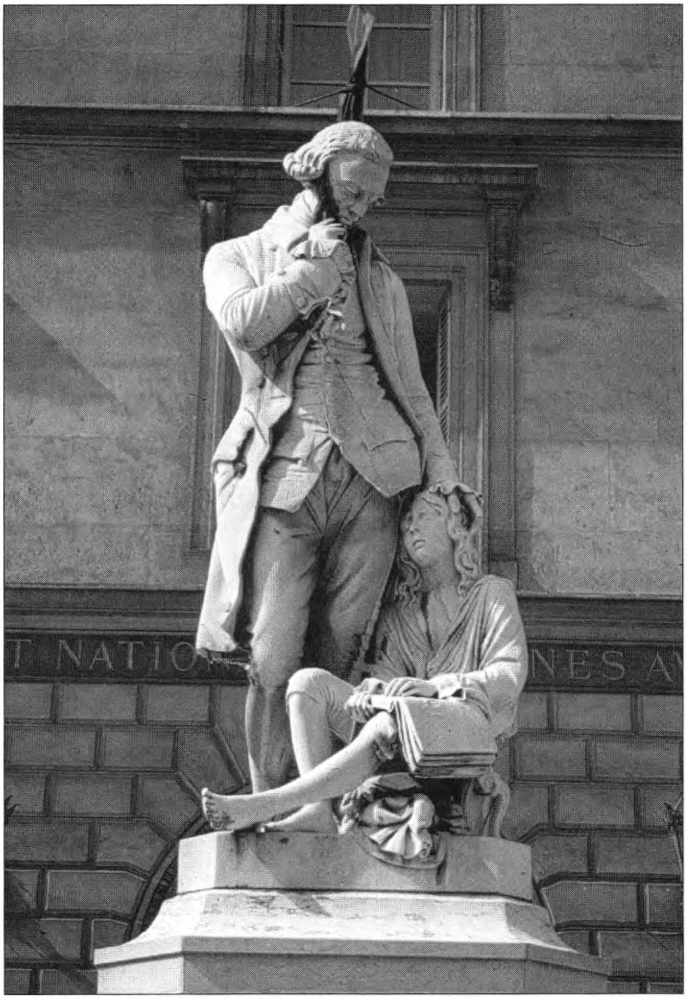
> general plan. "Der Werkmeister" (the supervisor) allots everyone his task and at the end of the week he will judge whether it has been properly carried out. These rules remained in force until the end of the 18th century, as Howard notes that they spin, make stockings, weave linen and horsehair and dress flax; wood is scraped for the production of lye, as are deer antlers. One workman scraping wood should produce at least 5 pounds per day.[18]

According to an edict of the Hôpital générale, begging and idleness were to be prevented, as they were the root of all evil. "What is then wrong with an idle life? It is, says St. Ambrose, in reality a second rebellion against God's creation".[19] Foucault's historical accounts of such institutions have a bearing on the development of institutions for the blind.

If we analyse where, how and why many of the asylums for the blind were established, it is impossible to discard Foucault's analysis of the creation of such institutions as centres of cheap, forced labour. Nevertheless, one can, and probably ought to see these early asylums as primitive attempts to create a better life for marginalized groups, at a time when there was an upsurge of social interest in cleaning up urban streets and squares of undesirables. That this was not perceived as positive by those who were taken into care is demonstrated in part by the difficulties that J.W. Klein, director of the first institutions in Vienna, encountered in his attempts to stop his pupils begging.[20] Our difficulty in judging the impact of these institutions on the individual inmate is due to the fact that there are very few contemporary testimonies by the inmates themselves. What we do have are well-formulated declarations of their programmes, written by the founders of the institutions, their directors and teachers.

Valentin Haüy and the first organized education for the blind

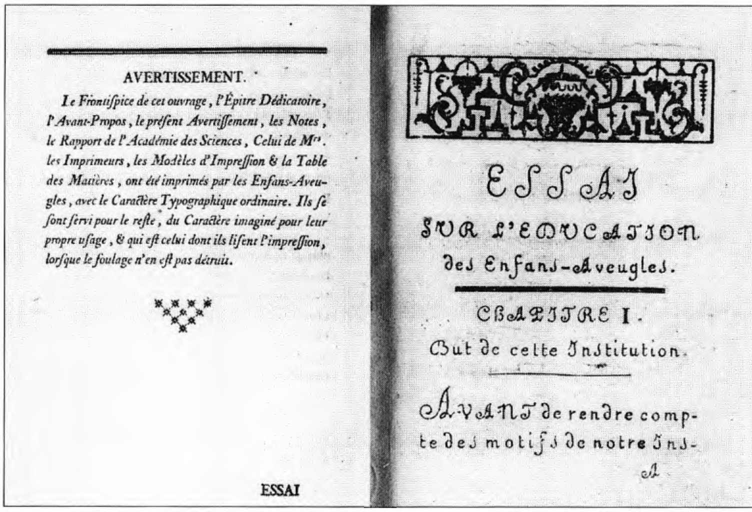
1784 is generally taken to be the year when organized education for the blind came into existence, with the founding of Valentin Haüy's school, when he began the instruction of his first student, the blind, 16-year old beggar, François le Sueur.[21] Like his successors, Haüy commenced his activities on a small scale, with only one pupil. Haüy was granted funds by the Philanthropic Society for the teaching of 12 blind pupils, after he had demonstrated the success of his teaching methods to the Academic Society. When Haüy took on his first pupil, the education of deaf-mutes had already been in existence for several years. The deaf-mute, Michel de l'Epée, well-



Valentin Haüy, Paris (Photo: author).

established as a pedagogue, published his teaching methods in 1776 in *L'Instruction des sourds et muets par la voie des signes méthodiques.*[22]

According to Haüy, his motives for becoming a teacher of the blind had their roots in some very personal experiences, one of which occurred during a concert at a café near what is now the Place de la Concorde in Paris. The members of the orchestra were blind and came from Quinze-Vingts. The musically incompetent orchestra "played" only to amuse the audience and to be ridiculed by them. It was precisely the coarseness of the



AVERTISSEMENT.

Le Frontiſpice de cet ouvrage, l'Épitre Dédicatoire, l'Avant-Propos, le préſent Avertiſſement, les Notes, le Rapport de l'Académie des Sciences, Celui de Mrs. les Imprimeurs, les Modèles d'Impreſſion & la Table des Matières, ont été imprimés par les Enfans-Aveugles, avec le Caractère Typographique ordinaire. Ils ſe ſont ſervi pour le reſte, du Caractère imaginé pour leur propre uſage, & qui eſt celui dont ils liſent l'impreſſion, lorſque le foulage n'en eſt pas détruit.

ESSAI

ESSAI

SUR L'ÉDUCATION

des Enfans-Aveugles.

CHAPITRE I.

But de cette Institution.

AVANT de rendre compte des motifs de notre Ins-

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latter, their scorn and derision, which aroused Haüy. The musicians wore glasses and there was music on the music stands. This the audience found hilarious. Haüy describes the incident as an isolated case, but we may assume that he attended these concerts on more than one occasion.[23]

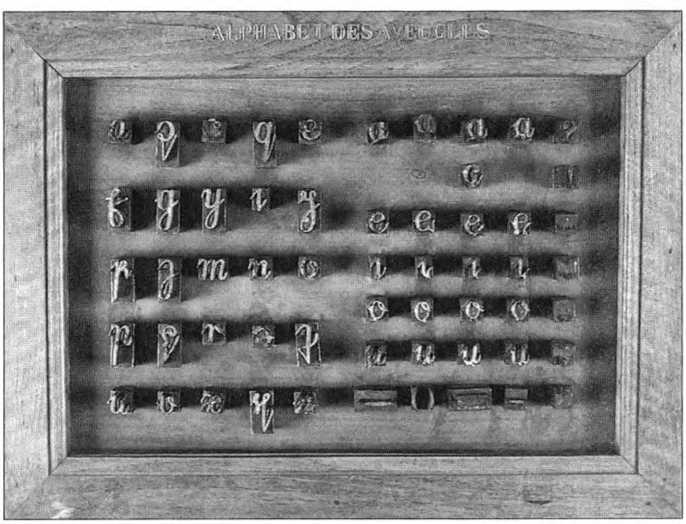
It would be well to keep an open mind about this anecdotal presentation of history, and the facts indicate that Haüy would in any case have graduated towards the philosophical and pedagogic debates and theories concerning tactile perception and the capacity of the blind. However, another incident to which Haüy and later historians assign an important role in the creation of his institute was his meeting with a blind boy who was listening with interest to his sighted brother's reading. When the sighted boy made a mistake in his reading, he was corrected by the blind brother. When the latter asked his sighted brother to read his own school books aloud, he refused. This incident caused Haüy to consider the use of aids to make the blind less dependent on the sighted around them, and he started to collect already existing teaching aids, particularly those invented by the blind themselves.[24]

A meeting which came to be of great importance to Haüy took place at a time when he was in need of stimulus and encouragement. He met the blind singer and composer, Maria Theresia von Paradis from Vienna. Miss Paradis and her blind teacher, Weissenburg, had heard about Haüy's attempts to develop aids for the blind.[25] Haüy was already acquainted with the aids developed by the singer and her teacher, and at the time of this meeting, had found a variety of potential aids (apart from the material which he himself had collected), and had drawn up a teaching programme.

Miss Paradis had been accepted in the highest circles of Paris because of her piano playing and vocal talent. For Haüy, his meeting with von Paradis was yet further proof that the blind could aspire to a superior education.[26]

When Haüy began to take an interest in the blind and envisaged the possibility of making a positive contribution to their lives, he was employed at the Ministry of Foreign Affairs as a translator.[27] It has been said that Haüy's intimate knowledge of translations from foreign languages and of old texts had made him sensitive to the problems involved in the transfer from one language to another. Haüy made use of this sensitivity and understanding when he started his experimentation with tactile reading.[28] We must return to the problem of translation in chapter IV, since a large part of the transfer of pictures for the blind is in fact a problem of translation.

Two years later, in 1786, Haüy published *Essai sur l'éducation des aveugles*, which is the first pedagogic text of its kind.[29] The purpose of Haüy's educational programme was to teach the blind to read with the aid of books in some type of relief print, but also to teach them printing, writing, arithmetic, language, history, geography, mathematics and music. Apart from the theoretical subjects, Haüy also planned for subjects of a more practical nature to be included in the curriculum, such as knitting, spinning, bookbinding, etc. His aim was to provide people with severe visual handicaps



An Essay on the Education of the Blind by Valentin Haüy, 1786 (Danmarks Blindehistoriske Museum, Copenhagen. Photo: Jørgen Schytte).

with skills which would enable them to aspire to a dignified role in society.

Haüy believed that the only true method of learning and remembering what one had learned was by reading. Through the written text, we have access to and assimilate knowledge in all its facets. Therefore the teaching of reading must be given priority.[30] Haüy describes the printing system he "invented" as follows[31] :

> We had observed that a printed leaf issuing from the press presented to the eye on its contrarary side, the letters higher than its surface, but reversed both in their position and in their order. /.../ We ordered typographical characters to be cast in of the form in which their impression strikes our eyes, and by applying to these a paper wet, as the printers do, we produced the first exemplar which had till then appeared of letters whose elevation renders them obvious to the touch without the intervention of sight.[32]

To complement the printed text, hand-written letters were also used in the teaching of the blind. These letters were written mirrorwise on good-quality paper with a steel nib. In this way, the visually impaired could carry on their own correspondence with the sighted, as well as with the blind.

Haüy trained his visually handicapped students to manage the printing workshop at the institute. We can assume that Haüy succeeded in his educational ambitions, both theoretical and practical, since history bears witness to a much-appreciated performance given, on Boxing Day, 1786, before the court at Versaille, by his 24 students. The school, however, survived only until 1791, when it was decided that it should be merged with the asylum for the deaf-mutes. The State took over the institute, and the Philanthropic Society, which had previously financed it, was dissolved. The new institution soon found itself in financial straits, and Haüy set up a printing workshop for the sighted, in order to raise funds. In 1794, the blind students and the deaf-mutes were once more separated, and in 1795, a law was introduced which re-organized the institute. It was now directed towards the training of blind workers, which more or less completely cancelled out the principles on which the school was originally founded.[33]

It has been said that the French Revolution had a positive influence on the debate concerning the poor and the handicapped in society: voices were raised in defence of the right of the needy to support from society; of the right of the mentally sick to care; and of the handicapped to an education. History shows, however, that these ideas were not born as a consequence of the revolution. The temporary deterioration which occurred when the State took over the existing institutions, seems to indicate that something which was under construction was destroyed, but it is doubtful whether the asylums for the education of the blind would have developed much more than they did if they had continued their activities with only the support of private funds.

In 1802, Haüy lost the direction of the asylum when he was pensioned off by Napoleon Bonaparte, who did not sympathize with the pedagogue's philanthropic ideas. Haüy immediately founded a private institute, which he called the Musée des Aveugles. Through this institution, he wished to complement the State-owned National Institute in two ways: by providing education for blind children from 4 to 7 years of age; and for those over the age of 16. Tradition has it that Haüy was forbidden to enter the institute once Dr. Guillié had taken over as supervisor. Guillié is said to have been disliked, but towards the end of Haüy's life, Guillié could no longer prevent Haüy from entering the institute.[34] The conflict between Haüy and Guillié is today a tale told by the staff at the Institut des Aveugles, where the latter is described as an almost sadistic man and teacher, in contrast to the good-hearted Haüy. Guillié, however, was a progressive pedagogue whose theories are set out in his *Essai sur l'Instruction des Aveugles*, published in 1817. In spite of the rumours, we must assume that Guillié was a capable successor to Haüy.

Haüy was next called to St. Petersburg by Alexander I to set up an institute for the blind there. This, however, was never carried out, although Haüy worked in Russia for eleven years.[35] On his journey to Russia, Haüy had halted in Berlin, where he inspired the creation of the first Prussian institute for the blind. Fredrick William III commissioned Haüy to name a director for the institute; he chose Professor Zeune.[36] At Blinden-Museum in Berlin/Steglitz, there is still evidence to be found of Haüy's visit, in the form of a model of his writing board, which he made himself.

Valentin Haüy's predecessors

We must now return to Maria Theresia von Paradis, and take a closer look at the significance of this woman and of others like her, in Valentin Haüy's development as a pedagogue of students with severe visual handicaps. These women probably had an indirect, if not direct influence on the pedagogy for the blind which developed during the 19th century. Historical literature, contemporary, as well as later, shows the direct and indirect influence of the visually handicapped themselves in the planning and development of the first organized education. There are several cases of private teaching from the end of the 17th century until 1784. Descriptions of these cases of individuals who, in spite of their visual impairment, received an education, often stress their privileged background and very rarely their importance in the development of education for the blind. In early historical literature, it is easier to accept this polarization between individual education and institutionalized education of the handicapped. The policy of these institutions was, after all, based on the right of each individual to education. It is more surprising to find that this simplified vision is still in vogue amongst modern historians. In his article "Educating the Blind in the Age of Enlightenment. Growing Point of a Social Service", published in *Medical History* (1979), Robert Heller underlines the fact that the condition of those with severe visual handicaps during this period had not changed since the Renaissance, meaning that the visually impaired, with few exceptions, were still second-class citizens. The exceptions were, according to Heller, members of the privileged classes, like Elisabeth Waldkirsch, who was given a certain degree of theoretical schooling.[37] Heller does not, however, stress the importance of that schooling, as Pierre Dufau did. Dufau was the director of the Institut des Aveugles from 1840, and the author of several theses on blindness. He described Elisabeth Waldkirsch's teacher, the mathematician, Jacob Benoulli, as the earliest representative of the fraternity of teachers of the blind. Dufau considered these primitive educational experiments to be of great importance for later developments.[38]

Elizabeth Waldkirsch

Elisabeth Waldkirsch was born in 1660, the daughter of a merchant in Schaffhausen. She lost her sight at a very early age, and later the family moved to Geneva. It is said that her father was very insistent that she should have a good education, and that by the age of 15 she spoke Latin, French and German, and knew almost all of the Bible by heart. She was probably also well-versed in philosophy and could play several musical instruments, such as the violin, the flute and the organ.[39] This young woman is of interest not only because of her own achievements in different areas, but also because of her teacher, Jacob Benoulli. The English theologist, Glittret Brunett, mentions this fact in *Some Letters Containing What Seemed Most Remarkable in Travelling Through Switzerland, Italy, Some Parts of Germany etc.*[40] When he visited Elisabeth Waldkirsch, he was shown the alphabet board on which the letters had been carved so that the young girl could feel the grooves with her finger or follow them with a pencil. In this way she became familiar with the letters of the alphabet and knew what they looked like. A writing-frame for normal writing had also been made for her. This held the paper while she wrote. Jacoub Benoulli, her teacher, experimented with these techniques in 1676.[41]

Mélanie de Salignac

Mélanie de Salignac (1741–1763) has become known to posterity through Diderot, who wrote about her in his *Addition to Lettre sur les aveugles*. Here is another case of early education which influenced later pedagogy for the blind. She was taught mainly by her mother, and special equipment was produced for her use. She had, for example, maps embroidered on an ordinary map in silk or wool; the stitching marked the borders of each country and their provinces. Rivers and mountains were indicated by rows of pin-heads, and the towns were marked with drops of wax of different sizes, according to their population. The maps were very similar to those made for Maria Theresia von Paradis, which are dealt with in chapter V.

Mélanie de Salignac could read and write. She wrote with a lead and used a ruler as a guide. In addition, she could also write in relief. With the aid of a needle, she punctured thick paper and formed the letters from right to left, just as the reglet is used today.[42] Her writing apparatus had a frame with two parallel, moveable metal rulers. Apart from this handmade relief writing, she had access to a book printed in relief. The printer, Prault, made this reading book for her, with relief type cast in lead. It seems the same method was used by the Parisian linguist, Peter Moreau, when printing for the blind in 1640.[43]

In *Encyklopädisches Handbuch des Blindenwesen*, Alexander Mell describes how de Salignac played cards with cards marked with pinpricks which enabled her to tell one card from another. After every game, she changed the marks so that no-one would know what cards she held. According to Mell, Mélanie de Salignac was very skilled at sewing and was an extremely graceful dancer.[44]

Maria Theresia von Paradis and R. Weissenburg

R. Weissenburg and Maria Theresia von Paradis (1733–1808) are both directly linked with what has been called the birth of education for the blind. Both were in contact with Haüy and met him during his stay in Paris. Weissenburg was born in 1756. When he was seven years of age, his eyes were affected by smallpox and eventually he went completely blind. However, with his father's help, he engaged a private teacher by the name of Niesen, a native of Mannheim.[45] In the teaching of geometry, Niesen used figures made from wire on pasteboard. Particular points on a figure were indicated by wire letters. Weissenburg also learned to read with the aid of these wire letters. For arithmetic lessons, Niesen improved on the calculation board invented by the professor of mathematics, Nicolaus Sunderson (1682–1739). Weissenburg had, too, a writing board similar to Elisabeth Waldkirsch's, as well as maps.[46]

In her article, "Das Leben der Maria Theresia Paradis und seine Bedeutung für die Blindenbildung", Marlene Janisch points out the importance of von Paradis and the scant interest that she has been shown in the past.[47] On several occasions in the late 19th century, articles about von Paradis appeared in *Zeitschrift für das österrreichische Blindenwesen*, and she is also included in biographical studies. Maria Theresia von Paradis was a pianist and composer. Born in Vienna, the daughter of an Austrian justice of the Supreme Court, she was given a very thorough musical education. She went blind between the ages of 3 and 4, for reasons which are not clear. It is speculated that she may have lost her sight because of a disease, incorrect treatment of some kind of skin disease or because of paralysis of the optic nerve. In the article on Maria von Paradis, Marlene Janisch touches not only upon the cause of their visual deficiency, but also on the attempts made to cure it by the German doctor and originator of the theory of animal magnetism, Franz Anton Mesmer (1734–1815), who met the then 17-year old blind girl. Stefan Zweig gives a more detailed account of her treatment in *Die Heilung durch den Geist*. The young girl had already been treated to no avail by the well-known surgeon, Professor Barth, who carried out cataract operations, and by Barth's personal physician, Stoerk. There was, however, reason to believe that von Paradis's blindness was not caused by any deterioration of the optic nerve, and Mesmer diagnosed nervous disturbances, which made him believe that he could cure her with the help of his methods. Stefan Zweig narrates vividly and dramatically Mesmer's treatment of the young girl.[48]

In 1785, von Paradis made an extended tour of Europe and played before the courts of Paris, London, Brussels, Hannover, Berlin and in other cities. Before the tour, Mozart composed a concert for piano and orchestra for Maria Theresia von Paradis. In addition to her concert tours, Miss von Paradis ran a school of music in Vienna, where she gave singing and piano lessons. She also composed, where she used a transcription system specially invented for her. She wrote a lyrical drama, a melodrama, the opera *Rinaldo und Alcina*, as well as songs and piano sonatas.

Before her tours, von Paradis had maps made in relief. These maps were made from ordinary, printed maps on which the borders and rivers were embroidered in satin stitch. The stitching for the rivers was narrower than that representing national borders, and towns and cities were marked with buttons of different sizes. Von Paradis also had a printing press made for her by Wolfgang Ritter von Kempelen, which she used to make her own relief texts.[49]

Von Paradis used practically the same maps as Weissenburg, a fact known to us from letters they wrote to each other. Maria Theresia von Paradis also used the arithmetic board invented by Sunderson. The notes for music teaching were made by von Paradis in two ways: she cut the notes out in thick paper and stuck them on a board (We must assume that they were a variation of the notes which can be seen in the Blinden-Museum in Berlin);

when composing, she used a wooden board with raised lines which had a large number of holes into which small plugs could be fitted. The plugs had small heads representing notes, which could be felt and recognised by the blind composer.[50]

She met Valentin Haüy during her grand concert tour in 1784. The meeting was to be of decisive importance to Haüy, as it gave him the encouragement and inspiration he needed to commence his teaching of the blind and to put his pedagogic ideas into practice. Von Paradis was not only living proof of the possibility of education in spite of visual impairment. She also had experience of and had herself contributed to the development of many of the pedagogic aids which Haüy was to make use of in his teaching.[51]

As in many other areas of historical achievement, the female protagonists were forced to remain in the background during the 19th century, to come to the fore once again in the 20th century. For this reason, many of their achievements were forgotten.[52] In the last few decades, during which earlier historical literature has been revised, the presence of these women in different activities has often been interpreted as the embryonic beginnings of the modern woman's much more active role in society, an interpretation which is not always relevant. Anna-Lena Lindberg notes in her paper, "Ulrica Fredrica Pasch och konstakademien", that Pasch's art was not the beginning of all female art, but came in fact at the end of a period during which female artists were more common than during the following century.[53] Marilyn Yalom comes to similar conclusions in *The French Revolution in Women's Memory*, in which she selects and discusses the memoirs of women who lived during that period. Yalom notes that it would be approximately one hundred and fifty years before women were to write as many memoirs as they did in the 18th century (she refers to the memoirs of women who had lived through the Second World War).[54] It is noteworthy that there were a number of outstanding women in the various institutions for the blind throughout the 19th century. In the developing institutions for the blind, there are many examples of enterprising and influential women.

Haüy's successors

The changing political situation, increased medical knowledge and the increasing interest in pedagogy as a means to shaping the modern man, all combined, towards the end of the 18th century, to create the conditions in which the organized education of the blind could develop. What was new and sensational was the idea of educating the blind to take their place in society as independent citizens. To make this possible, the various types of education for the blind which existed were oriented towards the integration into the curriculum of object lessons and subjects such as handicrafts, modelling and training of the senses, in addition to the traditional school subjects, which included reading, writing, arithmetic, geography and religion.[55]

Traditionally, the blind were employed in crafts such as basketry, brushmaking, knitting, rope-making, shoemaking, and as masseurs and physiotherapists. The professional options available today are obviously much more varied. The blind were also employed in the printing trade, particularly in relief printing (which today is almost exclusively carried out by the sighted), but by the time the first institute was created in Paris, blind teachers were being trained. In 1789, Haüy opened a section for sighted children of both sexes at the blind asylum. Blind teachers taught reading, arithmetic, grammar, geography and history. Writing and drawing lessons, however, were given by sighted teachers. The craft school for blind women founded by Anna Wikström (1854–1919) in Uppsala in 1884, is another example of a school staffed by teachers with severe visual handicaps. Anna Wikström was blind herself, and had been educated from an early age. Her school was intended for women who had become blind as adults. During its 35 years of existence, four of its total of nine teachers were blind.[56]

I have found that those pedagogues responsible for the blind, in their attempts to provide the best education possible for their students, systematically developed their own knowledge and understanding of the perceptive capacities of the blind. A large part of the pedagogic and philosophical ideas used in the education of the blind bears witness to this. They studied how the visually impaired perceived their surroundings and how they effectively were able to understand abstract concepts. This knowledge of the capacities and abilities of the blind formed the pedagogic foundation of the many institutes which were created in the latter part of the 19th century and during the first decades of the present century.

When we examine their statements of objectives and annual reports for this period, we find a conscious effort to integrate theoretical and practical education. The practical aspect was entirely oriented towards crafts which the visually impaired could learn, including cookery. When the students completed their education, they moved on to industrial work, and the institutes often ran their own industrial enterprises.

Great Britain

In Great Britain, a number of asylums were founded in the years following the opening of Haüy's institute in Paris. Initially, teaching was focused on crafts rather than on general school subjects. Pudsey Dawson opened an asylum in Liverpool in 1789, where children with severe visual handicaps were given instruction in crafts and music. Three years later, Dr Johnson, a priest, contacted Haüy, after which he began teaching in Edinburgh. In

November 1774, ten years before Haüy opened his institute in Paris, an article entitled "A letter on Education of the Blind" appeared in *The Edinburgh Magazine and Review.* This article expressed views on how parents and teachers should treat the blind child. They should let the child dress and feed itself and investigate its surroundings, as far as possible. The writer stresses the importance of activating the child at an early age, so that it may later receive instruction in a craft or profession which would provide it with a living. Through the *Lettres sur les aveugles* by Denis Diderot, the writer was acquainted with Saunderson's arithmetic board. This board inspired him to write:

> Suppose, for instance, a table were formed, four feet broad and eight in length; for the figures, that they may be more sensible to the touch, ought to be larger than ordinary. Suppose this table had brims, or a moulding round it, rising half an inch above the surface. Let the whole expanse then be filled with wax, and the surface above pressed extremely even with a polished board, formed exactly to fit the space within the mouldings. This board will always be necessary to efface the figures employed in former propositions, and prepare the surface for new ones. /…/ I can see no reason why general ideas of geography or topography might not be conveyed to him in the same manner, by spheres, composed of, or covered with the same impressible matter. The knowledge of astronomy might likewise be of infinite use, both enlarging his ideas of the universe, and by giving him higher and more confirmed impressions of that energy by which the stares are moved, and of that design by which theirs motion are regulated. But these objects are too vast; their distances, their magnitudes, their periods of revolution, are too complex to be comprehended in the mind, or impressed in the memory, without sensible mediums. For this purpose an orrery or some machine of a similar construction, will be indispensably requisite.[57]

Well-developed pedagogic ideas had thus existed for more than a decade in Edinburgh, when Dr Johnston contacted Haüy.

In the years that followed, institutions were established in several cities (e.g. Bristol, 1793, and London, 1799). To begin with, instruction was oral, and only covered what was considered essential, that is, religion. At the beginning of the following century, other institutes were set up. In 1805, a school for the blind was opened in Norwich, through the initiative of the blind nobleman, Tawelw. The Richmond National Institute was established for blind craftsmen, and in 1815, the Molyneux Asylum for the blind women.[58]

In 1839, the fifth edition was published of *Statements of the education, employments, and internal arrangements, adopted at the asylum for the blind, Glasgow*, by John Alston, director of the asylum.[59] The asylum had been founded at the turn of the 18th century and is an example of an institution with a clearly defined policy of moral education and work. Alston argued that it was vital to start the moral education of blind children very early in life, as it was with sighted children, or perhaps even more so. By beginning the preparation of children for education and work at an early age, one could prevent them from being drawn in later life towards begging. He also stressed the importance of giving children with severe visual impairment access to literature, which they could read for themselves.[60]

There was no clear connection between the ideas that education and offered work should keep the students from a freer life of beggary once they left school. Alston describes how a workshop was set up next to the school. The craft production at the asylum was carried out entirely by blind men and women. The men worked mainly at the weaving of sacks, spinning, twining, rope-making and the production of different types of carpets. The women sewed, knitted, crocheted and dedicated themselves to "the winding of pirns for the weavers". Each worker could perform several of these activities, which allowed the institute to adjust its production to the demand.[61]

In the enlarged edition of Statements of the education, employments, and internal arrangements, adopted at the asylum for the blind, published in Glasgow in 1846, Alston, in his introduction, includes what could be described as a recommendation of tactile training for the blind. One wonders whether it may have been the experience garnered by Alston, which caused him to add this introduction, or if it reflected a contemporary debate in which he participated. There are certain similarities with the reasoning of Haüy's successor, Guillié, as to blind children's need of external help if they are to take their place in society. As Alston's statement is important, I have chosen to include a lengthy quotation from the text:

> Hence it is that we at first consider the blind as an unfortunate race, whose conceptions are confined to that narrow sphere in which they live and move, and, as far as knowledge of external objects is concerned, must be limited consequently to that imperfect acquaintance which is obtained by the sense of feeling. On the other hand, though labouring under disadvantages, at first appearance insurmountable, we find that the sense of hearing is very acute in Blind persons, which enables them, from oral information, to analyse, and compare, and arrive at conclusions more or less correct; while their retentive memory and other powers of the mind all contribute to their stores of knowledge; so that by these united means, they become well informed on subjects of general interest. /.../ With these facts

> before us, we would most earnestly call the attention of Parents and others having charge of the Blind, that the self-education of a child born Blind commences as soon afters its birth as that of one who sees; and if Parents in such cases would give themselves this trouble in its instruction, instead of looking, as is too often the case, upon theirs as one of despair, they would find little difficulty in communicating to them the names, habit of cleanliness, the putting on his clothes, in place of doing all these for him. That, and many other particular objects, with the exception of some classes of words, denoting colour or other qualities, which can only be known by means of sight, might be perfectly conveyed to him. /…/ Parents could give correct ideas of numbers to a large amount, by means of tangible objects.[62] They could also give ideas of time, space, distance, so as to impress him with correct notions of the earth, its size, in habitants, productions, climates &c.—all this knowledge, of a useful and pleasurable kind, could be imparted until the children arrive at age and sense to be sent to Institutions to be taught these mechanical arts, so as to make their bread by their own industry, as it has been proved that blindness is no insurmountable obstacle to the acquisition of knowledge, either as respects education, or science, or art.[63]

In this lengthy quotation, we can follow Alston's well-informed thoughts on how blind children develop their understanding of the world around them. Later pedagogues express more or less the same ideas concerning the relationships between language, objects and understanding.

Alston has also developed a pedagogic theory on the teaching of reading. He describes how this should be done:

> The mode of instructing them is the following: —After the pupils have acquired a knowledge of the shape of each letter of the alphabet, they are taught orthography; they next proceed to the study of etymology; derivation of words and their relation to each other, are particularly explained. After they have attained this, words of two or three letters may be submitted to their touch. They should then be made to feel the words with two or three of their fingers, placing a finger on each of the letters; by this means they will be able to decipher two or three letters at once, which by practice will give a dexterity and fluency to their reading; their finger nails to be kept short to prevent them from injuring the surface of the letter.[64]

He also stresses that during reading practice, it is important to describe the shape of individual letters.

Samuel Gridley Howe

Samuel Gridley Howe (1801–1876) is perhaps best known for his work as the teacher of the deaf-blind girl, Laura Bridgman, who came to his institute when she was eight years old, on October 4th, 1837. When Howe took on Laura Bridgeman's education, he developed his theories on the education of so-called "three-sensed" pupils (i.e. deaf-blind children). Howe had had a varied past when he became director of the institute in Boston. After a difficult upbringing, during which he had shown no particular inclination towards study, he turned over a new leaf and began studying medicine at Harvard Medical School.[65] On graduating, he travelled to Greece to join the people's struggle for independence.[66] Howe worked there as a doctor, then returned to the USA to raise money in support of Greek independence. On his return to the USA in 1829, after having spent a number of years in Greece, he was offered the post of director of the New England Asylum for the Blind.[67]

This offer was made to him by Dr John D. Fisher, who was a member of the committee which had founded the asylum that same year. John D. Fisher had studied medicine in Paris and had been in contact with the institute for the blind there. After Fisher's return to Boston, he got in touch with the asylum in Edinburgh. These contacts formed the basis of the committee he later created. In time, Howe came to exert considerable influence as a reformer of school policy in Massachusetts, and he formed a close relationship with another school reformer, Horace Mann.[68] In "Education of the Blind" (1833) Howe begins his article by discussing the situation of ethnic minorities and their fight to be recognized as citizens in American society. He went on to compare their situation with that of the blind and their future possibilities.[69] This was radical thinking, which it is interesting to follow, and, not the least, to compare with today's debate on these questions. Howe spoke in favour of the need for visual experiences in the process of acquiring knowledge and understanding of one's environment. He pointed out that many authors describe phenomena and environments they have never seen or visited, but have learned about from books. Therefore, he wrote, it should be possible for the blind to acquire knowledge and understanding of places and objects which they had never seen or visited, but had heard of or read about in books in relief print.[70] Howe also pointed out that many sighted people are completely "blind" to book-learning and can barely write their own names when forced to do so, which does not necessarily mean that they lack intelligence.[71]

Like many other directors, Howe widened his knowledge of pedagogic practice by visiting other institutes for the blind. In 1832, he toured Europe for this purpose. In "Education of the Blind", published in *North American Review* 1833, he expressed his impressions of the institutes he had visited in Europe. His observations are of interest, partly because they give a picture of how the various institutes were managed in the 1830s. He argues, in his article, in defence of his own ideas as to how an institute for the blind should be run. The article was published only one year before Howe's first book of relief maps was printed. Howe had a keen interest in the art of printing and described the relief print of the different institutes he had visited, as well as individual, handmade relief maps.

Howe had heard rumours that the institute in Paris was the best school for the blind in the world, but he was, however, not particularly impressed by what he saw, and thought that he could see no development since Valentin Haüy's days.[72] He found the teaching too academically based, in contrast to the schools in London and Edinburgh, which were oriented towards crafts, and where all intellectual education was neglected.[73] Howe's intention was to find a balance between these two extremes at the Perkins Institute for the Blind, to provide the students with opportunities of studying whatever they were most gifted at. Those students with no talent for book-learning would learn a craft. In reality, the majority of the pupils eventually was instructed mainly in crafts and was only given a very elementary academic preparation.[74] Crafts predominated because that was the area in which there were most work opportunities for the blind.[75] When Howe returned from Europe, he did, nevertheless, bring with him a teacher from the Paris institute, and a handicraft teacher from the asylum in Edinburgh.[76]

In his first annual report in 1833, Howe presented his plans for publishing books for the blind as cheaply as ordinary books, and for building a library for the blind, just as there were libraries for the sighted. He would start with the four books of the apostles and continue with the rest of the New Testament.[77]

The basic condition for successful education of blind children was, proclaimed Howe, that they should develop self-confidence. An important impediment to the development of self-confidence was to be found in the home, where children were often overprotected and understimulated. Howe changed his mind about the importance of self-confidence when he became depressed by the results achieved at the Perkin's Institute for the Blind. It was said that, around 1860, he began to believe that the blind were born with low intellectual capacity.[78] It is interesting to note that Howe had reached a stage of resignation at about the same time as his European colleagues had once more begun to develop a pedagogy for the blind. This was a pedagogy which to a large extent coincided with Howe's earlier ideas, that is, it was oriented towards object-lessons.

Howe participated in the first congress for teachers of the blind in 1783, but I have not been able to find any documentation showing that he appeared or spoke in an official capacity. He died three years later.

The German-speaking area

At the beginning of the 19th century, a new centre of development and expansion of pedagogic ideas emerged. The Institute for the Blind in Vienna came to be of great importance because of its founder, Johan Wilhelm Klein, whose ideas became widely known. Klein belonged, together with the Abbé de l'Épée, Valentin Haüy, Johann Heinrich Pestalozzi and Per Aron Borg, to a generation of pedagogic pioneers. When the British institutes for the blind were created at the end of the 18th century, they were, above all, oriented towards giving their pupils a training in certain crafts. In this there was an important difference between Britain and the continent. Haüy in Paris, Klein in Vienna, Zeune in Berlin and Borg in Stockholm developed an educational model for schools for the blind which included practically the same subjects and orientation as ordinary schools.[79] Klein took on his first pupil in 1804 and in 1808 started his institute with eight pupils. His school aimed principally at providing an elementary education, since his pupils were poor. Klein wrote *Lehrbuch zum Unterrichte der Blinden*.[80]

A large number of schools for the blind in the German-speaking area were founded in the early years of the 19th century. Several of these institutes had prominent teachers and directors who often appeared as speakers at congresses for teachers of the blind. These teachers followed the traditional methods used by pedagogues in the 17th and 18th centuries, although they continued to develop them, both in theory and in practice.

The importance of the pupil's own creativity during the learning process was emphasised, amongst others by Simon Heller, in his pamphlet *Modellieren und Zeichnen in der Blindenschule* (1891) and August Büttner in *Das Formen und Zeichnen im Blinden-Unterrichte* (1890). Heller directed and taught at the Israeli institute for the blind in Vienna, and Büttner at the Saxony institutes in Dresden. Both texts became standard references not only in the German-speaking area but also had a great influence further afield (e.g. in Scandinavia). That so many German pedagogues exerted such an influence on the teaching of the blind is no doubt because of their pioneering of pedagogic ideas, but most of all because their ideas were generally founded on a thorough knowledge of tactile perception.

Det Kongelige Blindeinstitut in Copenhagen

The first school for the blind in Denmark was founded privately by the "Selskabet Kaeden" in 1811.[81] Selskabet Kaeden then ran the institute until 1858, when the State took over its management, and it became known as the Kongelige Blindeinstitut. With the intervention of the State, Johannes Moldenhawer was appointed director and head-teacher of the school. He had, however, already been teaching Danish and geography when the school was still being run by the Selskabet Kaeden. Moldenhawer had also made a study tour of different institutes for the blind in other countries.[82] Like his colleagues, Moldenhawer was well aware of the importance of the senses in learning, especially for the blind. In a guide for parents of young blind children, he talks about the importance for parents of starting tactile training with their children as yearly as possible.[83]

Moldenhawer proposed a conscious educational strategy, and a methodology based on the object-lesson was developed at the institute. These object lessons were put into practice in such subjects as geometry, physics and natural history. One of the teachers at the institute, Ludvig F. Guldberg, built a geometric drawing-machine which was of great importance.[84] The appartus consisted of an ordinary pair of compasses with an adjusting bow. One of the legs of the compass had a fine cogwheel with which a punctured line could be traced on thick paper. It also had a cogwheel corresponding to a draw spring and a crossbar for support of the fingers.[85]

Guldberg also invented a method for the production and reproduction of relief maps. These maps were exhibited at the international congresses for blind teachers. The idea was later adapted by Martin Kunz, who improved on the method and became one of the most prominent mapmakers in Europe. (Kunz and his work are dealt with in chapters IV–V).[86] Carl Edvard Guldberg, Ludvig's brother, also taught at the institute, and together they constructed teaching models.

Several of the teachers at the institute during the second half of the 19th century and at the beginning of the present century were well-known figures in the international debate on education for the blind, particularly Moldenhawer himself, E. T. Wildau and A. F. Wiberg. They fought to improve the social conditions of their blind pupils and were dedicated to a pedagogic ideal.

Sweden

It was Per Aron Borg who laid the foundations of organized education of the deaf and the blind in Sweden. He became aware of the need for such education when, at the Royal Theatre in Stockholm, he watched a play called *"De l'Épée"* or *Den Döfve och Dumbe*.[87] In 1807, Borg accepted his first pupil; a blind girl called Charlotte Seijerling. He taught her for four years, thus giving her an education which was unusual for a person of her class at that time.[88] Seijerling was invited by the Russian imperial family, and once in Russia, she taught at the institute for the blind, thus enabling her to keep herself and her sick mother. When she returned to Sweden, she was given a life pension from Russia, paid annually.[89]

In 1810, the first statutes of the Blindes och Döfstummes Institut were drawn up, with Queen Hedvig Elisabeth Charlotte as patron. In the beginning, the institute had serious problems, not least financial, which they tried to overcome by publicizing its pedagogic work. It expanded, was more efficiently organized and larger premises became necessary.[90] In 1812, Borg bought Öfre Manilla, on Djurgården, with his own money, and teachers were employed to provide adequate education for the growing number of pupils.[91] After a conflict with the school board, Borg left the Manilla Institute in 1816 and founded his own school at Manhem, also on Djurgården. The break was a temporary one, however, and both schools were united in 1819 at Manhem, under Borg's direction. Borg was not at Manhem for long.[92] In 1823 he was asked to found an institute in Portugal, on the same lines as the Swedish model, and there he remained until 1826.[93]

Not until 1878 was it decided that a special institute for the blind should be created, but it was another year before the Tomtebodaschool, which is identified with Swedish education for the blind, was inaugurated at Solna, outside Stockholm.[94] Before the inauguration, teaching had been carried out for a long time in premises in the centre of Stockholm. At the Tomtebodaschool, pedagogical methods were based on the ideas which were current at this period in Germany and Denmark. The subjects taught were religion, Swedish, geography, arithmetic, history, grammar and nature study, but also object-lesson training[95], modelling and handicrafts.[96]

The interest in the blind included school education, professional training and the care of blind adults. Up till now, I have mainly concentrated on educational institutions and above all on those centres which laid the foundations of the object-lesson in schools for the blind. It is chiefly within the pedagogy which is based on learning through the senses that there has been a demand for educational materials for object-lessons (pictures, maps and models, etc.). Those teachers who advocated the use of teaching aids in the teaching of blind children usually were aware of the possibilities and limitations of tactile perceptions.

III

Tactile perception

Vision has been considered from three different perspectives: philosophical, physiological and psychological. Over the last few decades, vision has been related amongst other things to the concepts of modernity and gender, and has also been discussed from the points of view of cinema, photography and art theory. Psychological research, for example, has focused on aspects of our perception or on questions of Gestalt psychology. In my thesis I will mainly be concentrating on those aspects of vision which have some relationship with the possible causes of interest in tactile perception and, as a consequence, interest in tactile pictures for persons with severe visual handicaps.

Philosophical interest in perception has to a large extent been related to epistemological questions, but also to problems concerning differences and similarities between different forms of perception. The relationship between vision and touch has not only been the subject of debate in the case of the visually impaired. Philosophical discussion on the subject was well established long before there was any organized teaching of the blind. If we wish to make a serious study of early relief material, we must first study early research and interest in tactile perception, particularly that which took place towards the end of the 19th century and during the first decades of the 20th century. The philosophic tradition I have chosen to discuss in my thesis concerns the capacity of tactile perception. Research and speculations on tactile perception formed part of the philosophic discourse which had its origins in the discussions on sensory data of René Descartes (1596–1650), George Berkeley (1685–1753) and John Locke (1632–1704). It was also influenced by Denis Diderot (1713–1784), Etienne Bonnot Condillac (1715–1780), Thomas Reid (1710–1796) and Immanuel Kant (1724–1802) and their theories on perception. In addition, research into tactile perception formed part of the developing experimental psychology, and several pedagogues showed great interest in the phenomenon.

In the 18th century, there was considerable philosophic interest in France and England in blindness. This interest was mainly concerned with tactile perception and with the differences between visual and tactile perception. The theories which developed in the 18th century influenced psychological research in the latter part of the century, both directly and indirectly. They also influenced the developing pedagogy of a number of educational institutions which were founded around the turn of the century. Many present-day researchers have maintained that there was no altruistic interest in the blind as such, and that the questions really moved on a philosophical and metaphorical level.[1] Even if that were the case, we should not disregard the importance of the practical use which was made of those theories.

During the 16th and 17th centuries, a science based on observation, experimentation and mathematical calculation began to develop. During both centuries, scientific measuring instruments such as the barometer, the microscope and the telescope were invented, astronomical observations led to a revised concept of the world, while important progress was made in medical science, especially in surgery. There was an enormous interest in literally "getting under the skin" of the human body. As a result of this increased interest and knowledge of the human body, attempts were made to map out the senses.[2] Several of the philosophers who influenced the development of ideas on tactile perception also took part in discussions on the deaf and on sign language. The French encyclopaedist and philosopher, Denis Diderot, wrote *Lettre sur les Sourds et sur muets* which was published in 1755, only six years after the publication of his *Lettre sur les aveugles*.[3] Yet another Frenchman, Etienne de Condillac took part in the debate on the so-called "Molyneux question", which will be considered later in this chapter. In *Essai sur l'"origine des connaissances humaines*, Condillac investigated sign language. He maintained that the first form of language was the gesture, which was then abandoned in favour of verbal language, and was of the opinion that sign language could only function in basic communication.[4] We need hardly mention that Condillac was sadly mistaken in this. In *Silent Poetry. Deafness, Sign, and visual culture in Modern France,* Nicholas Mirzoeff points out not only the development of sign language but also the development and significance of gesture and sign language in the theatre and pictorial art. The latter was, to a large extent, due to an influential colony of deaf artists.[5]

Theories and myths related to vision

The importance of vision had already been emphasized by Plato, who distinguished between the creation of vision, which he considered contemporary with the creation of intelligence and man's social attributes, and that of the other senses, which he classified as part of man's material aspect. The fact that the human eye can perceive light depends, according to Plato, on its possessing the same qualities as our chief source of light, that is, the sun.[6] Plato believed that light radiates from our eyes just as it does from the sun. The external light joins the light radiating from the eyes, reinforces it and enables us to create the colours of the visual object.[7] In his translation of *Timaeus* (4th century A. D.), Chalcidius comments on Plato's theory of the threefold causes of vision:

> Therefore when these three [conditions] concur, sight occurs, and the cause of sight is threefold: the light of the innate heat passing through the eyes, which is the principal cause, the exterior light kindred to our own light, which both acts and assists, and the light that flows from the visible bodies, flame or colour; without these [three causal factors] the proposed effect cannot occur.[8]

Plato's praise of vision included an interest in the Greek ocular centrism. In the philosophy of Plato the concept of vision symbolises the inner eye of the soul. This becomes clear when he expresses his reservations on the credibility of the normal perception of the eye. We see through our eyes and not with them. In *Timaeus*, Plato declared that vision is mankind's greatest gift, while warning against the illusions which our imperfect eyes may give us. True philosophers do not "see with their eyes", they see with their hearts.[9] Hans Blumenberg discusses the meaning attached to light and thereby to indirect vision. Light gives us spatial perception and enables us to judge distances. It is through light that we define our position in the room and identify others. Light becomes a source of knowledge in a figurative as well as in a direct sense. In articles and literature on the blind, we often meet with the concept "lichtloosen," that is "without light". The objective of the education of the blind was to "free them from darkness", i.e. to enlighten them with knowledge.[10] The mythology of the blind and the concept of blindness is the central issue of Jacques Derrida's *Mémoires d'aveugle: L´autoportrait et ruines*.[11] Mythology deals to a large extent with taboos related to vision and not with problems involving blindness as such. It is vision, as a sexual power, which leads us into temptation.[12]

The loss of worldly vision in exchange for inner vision is something that is told in a number of revelations; 'the wordly eyes will be opened in the next world'.[13] In *My Religion*, Helen Keller speculates on the metaphor of vision; she regards her eyes as worldly, and believes that she has eyes inside them, which will open when she dies.[14] It is interesting that Helen Keller, who is blind, chooses this metaphor. Was she at the same time expressing a hope, or did she see it only as a symbolic expression?

On several occasions, Derrida returns to the question of insight and understanding as a consequence of lost sight.

> Each time a divine punishment is cast down upon sight in order to signify the mistery of election, the blind become witness to

> the faith. An inner conversion at first seems to transfigure light itself. Conversion of the inside, conversion on the inside: in order to enlighten the spiritual sky on the inside, the divine light creates darkness in the earthly sky on the outside.[15]

A blind *man* may frequently become a seer or a visionary.[16]

> Like all blind men, they must *advance*, advance or commit themselves, that is, expose themselves, run through space as if running a risk. They are apprehensive about space, they apprehend it with their groping, wandering hands; they draw in this space in a way that is at once cautious and bold; they calculate, they count on the invisible. It would seem that most of these blind men do not lose themselves in absolute wandering. These blind men notice, since the illustrious blind of our culture are almost always men, the "great blind men", as if women perhaps saw to it never to risk their sight. Indeed, the absence of "great blind women" will not be without consequence for our hypotheses.[17]

There is a conflict between the romantic idea of inner vision and the acceptance of tactile vision. The blind seer does not use his hands to feel his way or to create an image of the situation or his surroundings. Instead, his inner vision is created completely without exterior, palpable impulses. The historian Martin Jay points out that even when vision was, as it often still is, considered the noblest of all senses, its position was ambiguous. Vision could be considered as a pure, perfect, static form, the eye of the soul; or as the impure but immediate visual impression of the eye.[18] This ambiguity also characterized the relationships of occidental culture to light for a long period in history. Light could be understood as a model composed of geometric rays; this idea had been developed in Greek optics through catoptrics, that is, the science of reflection or diotroptics, the science of the refraction of light. This implied that perfect, linear forms existed ideally, regardless of whether they could be perceived by the human eye or not, and were superior to what the imperfect eye perceives. An alternative to this form of light was lux, which instead stressed human experience of vision. Here, colours, shadows and movements played an important role, as did form and contours. In the history of art, as in optics, these two models of light are seen as in competition with each other.[19] The theory of light and colour has been of great importance in art, particularly during the last few centuries.

Martin Jay summarizes the medieval and modern discussion on vision and its role in the modern ocular centristic culture. He places the medieval, metaphysical concept of light in the foreground. It can be said to be a religious interpretation of Plato's idea and was kept alive by the assumption that vision was the noblest of the senses because of its capacity of illusion and creation of lecherous thoughts. Secondly, the lengthy dispute on the metaphysics and the idolarity and the visual praxis of the church, led to a new awareness of the difference between representation and fetishism. Thomas Aquinas made a distinction between venerating iconolatry and a worshiping idolatry. Thirdly, a separation took place between the profane and the religious. Neither must we disregard the effect of political pictures at a later date.[20]

Vision includes representation, with which I started this chapter. In earlier research, modern vision was described as a product of the central perspective of the renaissance. Later research has shown that our modern vision has a more complex and disparate history. The first theoretic interpretation of the central perspective was written by Alberti in *De Pittura*, in the early 15th century. Perspective has been considered by many researchers from a technical, aesthetic, psychological, and religious point of view, as well as from economic and political standpoints.[21] In spite of much debate, there is agreement on the fact the linear perspective developed from the Middle Ages fascination with metaphysical light; light in the divine sense of *lux*, rather than as perception or *lumen*. It came to symbolize harmony between the mathematical laws of optics and the will of God.[22]

In order for us to perceive our surroundings visually, there must be light. Light is a condition for vision. During our first hours outside our mother's womb, we slowly become accustomed to light. Each new minute brings with it new visual impressions that we learn to interpret and understand. Not all human beings, however, are born with vision. What happens when a person born blind becomes sighted later in life? Is it at all possible to use the expression become sighted? This question has been discussed for at least three hundred years, but there is still no definite answer. As the question initially was of central importance to the interest in tactile perception of persons with severe visual handicaps, I have chosen to include the main features of the discussion.

"Molyneux's Question" and John Locke

A question that has influenced the philosophic and psychological discourse on tactile perception, directly and indirectly, was posed by the Irish barrister, William Molyneux.

Molyneux posed the following question to Locke in a letter dated 2nd March, 1693:

> *Suppose a man born blind, and now adult, and taught by his touch to distinguish between a cube and a sphere of the same metal, and nighly of the same bigness, so as to tell, when he felt*

one and the other, which is the cube, which the sphere. Suppose then the cube and the sphere placed on a table, and the blind man to be made to see; quaere, whether by his sight, before he touched them, he could now distinguish and tell which is the globe, which is the cube. To which the acute and judicious proposer answers: *Not. For, though he has obtained the experience of how a globe, how a cube affects his touch, yet he has not yet obtained the experience that what affects his touch so or so must affect his sight so or so; or that a protuberant angle in the cube, that pressed his hand unequally, shall appear to his eye as it does in the cube.* I agree with this thinking gentleman, whom I am proud to call my friend, in his answer to this problem, and am of opinion that the blind man, at first sight, would not be able with certainty to say which was the globe, which the cube, whilst he only saw them, though he could unerringly name them by touch, and certainly distinguish them by the differences of their figure felt.[23]

The reason why Molyneux took such an interest in this matter at all may have to do with the fact that his wife had lost her eyesight. The question was also one that ought to have suited the empiricists of those days down to the ground. The importance of the senses in perception and interpretation of the perceived was central to the philosophers who dedicated themselves to differences and similarities between tactile and visual perception. The British philosopher, psychologist, pedagogue and doctor of medicine, John Locke, was among those mainly responsible for the empirical tradition in the British theory of knowledge in *An Essay Concerning Human Understanding*, in which he deals with epistemological, psychological and semantic theories. (The first edition appeared in 1690. From his collected letters, diaries and manuscripts, we know that the text had by then been rewritten many times. Research has shown that the thesis was already in preparation in 1671.)[24]

Locke regarded the mind as an unwritten page. The mind receives its ideas through the perception of external sensory objects, or its own internal activities. Locke believed that experience had two sources: (1) sensation, (2) perception of operation of our own mind, wich may be called "internal sense". According to Locke, the sense holds no ideas whatsoever which have not originated from either of these two sources. External sensible objects provide the mind with ideas through sensorial qualities, that is, all the different perceptions they produce in us. The mind, in turn, provides the mind with ideas on its own activities.[25] In due course, the mind begins to generate its own ideas which Locke called *reflecting ideas*. But we must not forget that the origins of all ideas are the sensation that external objects make on our senses and the reflection the mind makes over these. Everything that a person touches is perceived through the senses; the sensation in itself is invisible.

In the following section, the ninth, Locke continues expressing his thoughts and ideas on vision:

> But this is not, I think, usual, in any of our *ideas*, but those received by *sight*. Because sight, the most comprehensive of all our senses, conveying to our minds the *ideas* of light and colours, which are peculiar not only to that sense; and also the far different *ideas* of space, figure, and motion, the several varieties whereof changes the appearances of its proper objects, viz. light and colours: we bring ourselves by use to judge of the one by the other..."[26]

For Molyneux and Locke, the question was not whether the blind man, once he became sighted, could see the sphere and the cube or not. The question was whether he could name the objects; the problem was, in other words, one of semantics.[27] Locke, like Descartes, was quite satisfied with the idea that sensations such as pain or colour exist within us, placed there by God.[28]

The way in which this debate on the Molyneux's problem has been expressed is of some relevance, as are those new problems and questions it has generated. Molyneux's question created discussion on the relation between perception and language, sensation and perception and visual versus tactile.[29] All the philosophers who took part in the discussion agreed on the existence of differences between the visual and the tactile sensation of an object. No agreement could be reached, however, on the connection between the visual and the tactile sensation of a particular object. Some philosophers thought that the relation between the two was arbitrary and caused by experience alone, while others decidedly stated a necessary connection between the two sensations. Yet others believed that an object could be immediately perceived as being the same, independently of whether it was seen or experienced through touch, and some held that experience was necessary. Molyneux believed that the connection between the tactile and the visual perception of the shape of an object was not immediately created, but something that developed with experience, that is, something which was learned.[30]

Locke did not believe that a person who had recently become sighted would be able to distinguish the sphere from the cube. He was then referring to the person's capacity of naming the objects. In other words, Locke held that the person was unable to name the sphere and the cube with any certainty. Furthermore, Locke stressed that a person who had just become sighted would interpret the sphere as a circle and the cube as a square or hexagon, depending on the angle from which the cube was observed. Perhaps he was expecting to find a connection between the square or hexagon and the cube, and between the circle to the sphere, but he could not be sure. Before he was able to name the cube and the sphere correctly, he must first learn how two-dimensional projections of an object which he is looking at correspond to the palpable, three-dimensional object.[31] According to Locke, we are born without the capacity to interpret the shaded circle as a sphere. That knowledge is related to our experience of how light acts when reflecting from different kinds of surfaces. Through experience we learn to interpret the meaning of the variations of forms that are created through light reflections.[32]

The analogy between sight and touch

Not only the analogy between sight and touch in relation to the problem of identification was of interest. Molyneux's question also led to interest in the origins of the understanding of the distance of an object and of its size. George Berkeley, the successor of Locke, was one of those who showed such interest. Berkeley is also counted amongst the classical representatives of the English empiricism. In 1709, Berkeley published his *Essay towards New Theory of Vision* and in the thesis he continues the discussion of differences and similarities between tactile and visual perception.

It is often said that presence is a condition for tactile perception, as it is impossible without direct or indirect touch. This means that distance is impossible to estimate through tactile perception, as it will be out of tactile reach. Where longer distances are concerned, the estimate builds on an intellectual process, meaning that the distance is known from experience. One possibility is to use memory to sum, for example, the number of steps walked. Berkeley believed that distance in itself could not be seen, but through the experience of the size of an object, we can estimate the distance between that object and ourselves; that is, understanding based on experience.

As we cannot see the lines and angles on which the mathematicians base their calculations of distance, the mind cannot read the distance to the object. Furthermore, those lines and angles do not exist, they are merely hypotheses. Even if the optic angles and lines were to exist, they would not suffice to allow us to use them for judging the distance. A person who is born blind and becomes sighted does not have the capacity to understand distance through vision, if he has not had the necessary experience. Berkeley stressed that judgements of distance through hearing and vision are very similar. The closer the sound, the louder it is, just as an object becomes more and more visible, the nearer it gets.[33]

It is, then, through experience that we are aware that an object has a permanent size independent of how far away from it we are.[34] It is only the distance between the observer and the object which increases. A person who listens to, sees and touches an object, perceives it differently through each of the three senses involved, but as all three co-operate, the overall impression is one object. When an object is perceived through vision as well as touch, we still interpret it as the same object, even if it looks different to what it feels like.[35] Berkeley believed that there is a great difference between perception through vision and perception through touch:

> *The extension, figures, and motions perceived by sight are specifically distinct from the ideas of touch, called by the same names, nor is there any such thing as one idea or kind of idea common to both senses.*[36]

Berkeley was of the opinion that it takes a lot of experience to learn how to link the tactile sense to the visual sense. It is only through long experience that we learn to infer, instantly and automatically, the tactile ideas which are the consequences of visual ideas.[37] Berkeley believed that although a person who is born blind and who later becomes sighted, already possesses names for objects which he recognizes by touch, will be unable to relate these names to the objects when he only sees them. Visual forms are symbols of tactile forms and can hardly be considered autonomous. It would, however, be superfluous to use denominations for tactile and visual forms. A tangible square and a visual square are as different as a tangible square and the six-letter word "square".[38]

> Cube, sphere, table are words he has known applied to things perceivable by touch, but to things perfectly intangible he never knew them applied. /.../ the ideas of sight are all new perceptions, to which there be no names annexed in his mind: he cannot therefore understand what is said to him concerning them: and to ask of the two bodies he saw placed on the table, which was the sphere, which the cube, were to him a question downright bantering and unintelligible.[39]

Berkeley also distinguished between the object and the sensation experienced through the senses. From Berkeley's writing, it is, however, clear that he did not consider sight more important than touch, but emphasized the co-operation between the two senses. Berkeley asked how we are able to recognize an object as a square, when the impressions received through vision and touch are different. He continues by saying that there are certain basic features which are common and tangible in spite of the differences in perception. The square has four sides which can be perceived through vision as well as through touch, although the experience is arbitrary to a certain degree.[40] If an object is perceived through vision and touch, and although it looks different from what it feels like, we still experience it as one and the same object.

Berkeley stated that it was not possible to make an analogy between visual and tactile figures. The proof lies in the fact that if we take an object which appears to be round and soft to touch when we look at it, and study it under a microscope, it takes on quite a different aspect.[41]

Sensation and perception

In *An Inquiry into the Human Mind* (1764), Thomas Reid discussed the difference between sensation and perception.[42] Read believed that sensation is something which exists only in the mind and which has nothing in common with external objects. A perception always involves an activity through which we become aware of it. Reid, in contrast to Berkeley, was of the opinion that an object can exist whether it is perceived or not. He distinguished between two types of perception: some are neutral and original, while others are acquired through experience.[43]

Like Locke and Berkeley before him, Reid made a comparison between perception and language. Our original perception is, said Reid, similar to natural language, while the acquired perception can then be compared to artificial language. Natural perception is the result of observation. In natural language, we use facial expressions, physical gestures and vocal modulations. These signs are universal and the capacity to interpret them is natural and not learned. Acquired perceptions, on the other hand, are neither sensations nor things that we perceive through sensations. Artificial language manifests itself through articulated sounds. In acquired perception as well as in our understanding of artificial language, experience teaches us to identify the connections between these articulated sounds. Simply expressed, a child is born with the capacity to communicate by means of natural language, whereas he must learn or be taught artificial language.[44]

Reid thought that besides distinguishing between perception and sensation, it was also necessary to distinguish between what is perceived and what at that moment we already know about an object.[45] Reid was in agreement with Diderot that vision was the noblest of our senses. He believed that the person who was born blind could acquire only an infinite part of the knowledge acquired by the sighted.[46]

Reid stated that objects assume different aspects, depending on the distance and the position from which they are observed. But through touch, we learn how to perceive the objects as identical, regardless of their distance from us or their position.[47] Reid also believed that the visual form of an object was merely a symbol of the real figure.

> When I use my original powers of sight to look at a globe standing before me, I perceive only something of a circular form, variously coloured. The visible figure has no distance from the eye, no convexity, nor is it three-dimensional. But once I have *learnt* to perceive the distance of every part of this object from the eye, this perception gives it convexity and adds a third dimension.[48]

Reid answered Molyneux's question in the following way:

> To a man newly made to see, the visible appearance of objects would be the same as to us; but he would see nothing at all of their real dimensions, as we do. He could form no conjecture, by means of his sight only, how many inches or feet they were in length, breadth or thickness. He could perceive little or nothing of their real figure; nor could he discern that this was a cube, that a sphere; that this was a cone, and a cylinder. His eye could not inform him, that this object was near, and that more remote /.../ In a word, his eyes, though ever so perfect, would at first give him almost no information of things without him.[49]

There were, however, those who answered Molyneux's question in the affirmative. One such answer came from Edward Synge (1659–1741). Synge, bishop of Raphoe (1714), later became Archbishop of Tuam (1716) and was the author of *Gentleman's Religion* (1693).[50] Marjolein Degenaar *(Molyneux´s problem. Three centuries of discussion on the perception of forms)* tells how Synge came in contact with the problem set by Molyneux and became obsessed by it. Synge first learned of it during a visit to a friend, Francis Quayle, prebendary of Brigown. The day after the visit, Synge wrote to Quayle who sent the letter on to Molyneux and Locke.[51] According to Degenaar, Synge believed that a person who was born blind might have a tactile idea of a sphere and a cube and of what distinguishes one from the other, but he could not form a visually structured image of either. His idea or knowledge of the sphere was that it is an object that feels the same wherever you touch it. His idea of the cube is that it is an object which does not feel the same all over. Some surfaces are flat to the touch, others have sharp, right-angled corners and long edges stretching between these corners.[52] With these ideas of the object, the person could distinguish between them. The "unknown" Synge's idea of how the once blind man could distinguish between the objects, resembles the ideas presented by the philosopher Gottfried Wilhelm Leibniz (1646–1716). Leibniz believed there was a hidden condition in Molyneux's question: the blind person had been given the task of distinguishing only between the two objects. No other objects were there: only the cube and the sphere. The man would know that he was to be shown a sphere and a cube. He would therefore, beyond any doubt, be capable of distinguishing between the objects. He had a fifty per cent chance of making the right choice. This led to the conclusion that the sphere has no distinguishing features anywhere on its surface, which is smooth and without angles, while the cube has a number of very different distinguishing features.[53]

Leibniz believed that there existed a relationship between what we perceive tactually and what we perceive visually. If this were not so, the blind would be unable to comprehend geometrical concepts.[54] He did not agree with Berkeley on the idea that a person deprived of the use of his hands would be unable to understand geometrical concepts with the eyes alone. Berkeley was of the opinion that geometrical concepts are not formed through vision but through tactile extension and shape. A person who is for some reason incapable of tactile perception could not, according to Berkeley, perceive solid bodies or flat shapes.[55] Contrary to Berkeley, Leibniz believed that geometry was something which to a large extent is learned through vision alone. If we were to compare the geometrical concepts formed by a blind person with those of the tactually incapacitated person, we would come to the conclusion that both had formed the same idea, even if the diagrams they drew were not absolutely identical. Leibniz thus distinguishes between the idea and the pictorial representation of the idea.[56] This is directly related to the manner in which relief pictures for the blind differ from pictures for the sighted.

"Das sieht hell aus"

Since 1728, Molyneux's problem has become linked to the Cheselden report. Those who on theoretical grounds held that a person born blind would be unable to distinguish the sphere from the cube, saw the report as support for their ideas, while those of the opposite opinion commented favourably on it.[57] William Cheselden (1688–1752) was a famous surgeon, famous not only for his cataract operations but also because he could remove kidney stones surgically.[58] In an article published in *Philosophical Transactions* (Royal Society, 1728), he reported the results of one of his operations in detail: "An Account of some Observations made by a young Gentleman, who was born blind, or lost his Sight so early, that he had no Remembrance of ever having seen and was couch'd between 13 and 14 Years of Age."

Later testimonies have appeared and in *Der Blindefreund* (25th January 1884), in an article by Professor Dr Th. Saemisch in Bonn, the story of Caroline Huhn was told. She had gone blind when she was two years old, because of cataracts in both eyes. A year later, in 1881, her left eye was operated on, to no avail, and she was admitted to the Provinzial-Blindenanstalt in Düren, where she remained until September 1883. As there were hopes of greater success with her right eye, she was operated on in Bonn on September 22nd 1883. Before the operation, the girl could distinguish between light and darkness, but could only orient herself if there was a strong source of light. The day after the operation, Caroline did not recognize any of all the objects she had previously been familiar with through touch. Her doctor held out his hand with three fingers extended. When he asked the little girl what he was showing her, she answered: "Das sieht hell aus" (It's bright). The procedure was repeated the following day, this time with an apple. Caroline answered that she did not know what he was showing her. Then the doctor placed the apple in the child's hand, when she immediately identified it: "Das ist ein Apfel" (It's an apple.). Three days later, professor Saemisch again showed her an apple, but she still could not say what it was. Then he asked her what colour the object was, and she gave the correct answer. A few days later she could also identify the apple. Several weeks later, Caroline Huhn still had great difficulty in distinguishing small objects. She was then subjected to the following experiment:

> A large, round apple and a small, thin pear were shown to the child, who was already wearing cataract glasses. When asked what she was shown, she answered "That is an apple and that is an apple, too". When she only used touch, she immediately distinguished the apple from the pear.[59]

The girl was also very uncertain in her estimates of distance, when she only looked at an object. This uncertainty was no less when she picked up the object. On the other hand, she very rapidly learned to recognize colours. It took the girl about a year before her tactile and visual worlds were brought to coincide and she could trust her eyesight.[60]

A discussion of certain importance, of a more practical character, concerned how much of the cataract could be cured and what the results of the operation actually were. Furthermore, the fact that the patient was forced to wear glasses after the operation became yet another aspect to consider. What could a recently operated person see, and what could he not see? Two types of cataract operations were carried out: reclination (the tissue is pushed to the side through an incision) and extraction (the tissue is removed). After an operation, vision can never be perfect as the lens has been removed, and with it, part of the eye's capacity to refract light. A cataract operation makes the patient long-sighted and glasses are necessary if he is to see satisfactorily.[61] This, of course, affects his possibility of seeing anything at all.

Condillac played an important role in the discussion aroused by Molyneux's problem. He criticised Cheselden's report and his first rejoinder appeared in *Essai sur l'origine des connaissances humaines* (1746). Condillac, who was an admirer of Locke for his observations on the human mind which laid the foundations of new analyses, accused Locke of inconsistency in his empirical reflections on inborn capacity.[62] According to Condillac's philosophy, a capacity of which we are unaware but of which we can become aware, cannot be termed instinctive or unconscious. He criticised Locke and Berkeley for having taken for granted that unconscious conditions can explain particular perceptual phenomena. According to Condillac, Locke introduced Molyneux's problem in order to illustrate his own theories. However, according to Condillac, he should have been as consistent in his argumentation on his theories on distance, position, size and extension, as he was on shape.[63] Locke stressed that the sphere and the cube which had been the original cause of dissension were of the same size and therefore it was to be supposed that vision could distinguish size without the help of touch. Condillac believed that Locke contradicted himself when he assumed that it was possible to perceive size but not shape.[64]

Condillac believed that a person who had been blind since birth and who later became sighted would automatically be able to see light and colour. Only later would that person be able to distinguish between the sphere and the cube. He makes a comparison with a sighted person who looks at a painting which is full of detail; it takes us a while to distinguish the different elements of the picture and to analyze them.[65]

Lettre sur les aveugles

Another influential person who participated in the argument was Diderot. In *Lettre sur les aveugles* (1749), Diderot set forth two questions concerning Molyneux's problem: Can a blind man see immediately after a cataract operation? If so, is his vision good enough to enable him to name as accurately, without hesitation, the objects he sees, as he would have done if he had touched them?

In *Lettre sur les aveugles*, Diderot presented his own general ideas and notions on the blind and their capacities, as well as the individual blind person's performance and conceptions of the world around him. His thesis consisted of three main themes: first a conversation with the blind man from Puiseau, then the case of Saunderson, the blind professor of mathematics at the university of Cambridge, and, finally, the Molyneux problem.

Diderot asked how a person, blind from birth, could understand figures:

> I believe that the motions of his body, the successive existence of his hands in several places, the continuous feeling of a body passing between his fingers, give him the notion of direction. In sliding them along a thread tightly stretched, he has the idea of a straight line; in following the bending of a slack thread, he gets that of a curve line: he has, by repeated experiments of the touch, a remembrance of sensations felt in different points. These sensations, or points, he is able to combine, and form figures by them. A straight line is to a blind man, who is no geometrician, only the remembrance of a series of sensations placed in the direction of a tight thread, a curve line the remembrance of a series of tactile sensations referred to the surface of some solid body, concave and convex. Studies rectifies the geometricians notion of these lines by the

properties he discovers in them; but he who was born blind, whether he understands geometry, or not, refers all to his fingers' ends. We combine coloured points, he combines only palpable points; or, to speak more precisely, only such tactile sensations which he remembers. The operations in his head have little analogy with ours; he cannot imagine, as imagination implies a coloured ground and points detached from that ground, by supposing them differing in colour from that ground: make those points of the same colour as the ground, and they are instantly lost in it, and the figure disappears: at least, that is the case in my imagination; and I suppose imaginations are alike. Thus, when I purpose to perceive in my head a straight line otherwise than by its properties, my first step is to spread in it a white canvas, detaching from the ground a continuous series of black points in the like direction. The stronger the colours of the ground and the points, the clearer my perception of the points. To view in my imagination a figure of a colour very nearly bordering on that of the ground, puts me to no less trouble than if out of myself and on a canvas.[66]

In this lengthy quotation, we recognize parts of Synge's comment on how the blind man could separate the sphere from the cube by studying their respective characteristics.

According to Diderot, Molyneux, Locke and Condillac did not distinguish between the idea which a blind person forms by touching an object from what a blind person who becomes sighted forms by looking at the same object. Diderot distinguishes between the sensory experience of an object and the understanding of it.[67]

While education for the visually handicapped was developing, ideas came forth on how this education was to be carried out. Psychological and physiological investigations were undertaken to understand "the nature of the blind", as it was phrased. The director and pedagogue of the Institut des aveugles in Paris, Pierre-Armand Dufau (successor to Guillié), who taught there in the middle of the 19th century, was one of the first to study the blind from a psychological perspective.

Early psychological research on tactile perception

A large part of the psychological research deals with the spatiality of tactile perception. Most of the psychologists that I have studied are in agreement that the skin is very sensitive to pressure, differences in temperature and movements. This sensitivity varies in different parts of the skin and reaches its maximum in the nerve-ends at the tips of our fingers, in our lips and on the soles of our feet, which are vital for tactile interpretation and spatial understanding.

Research on tactile perception started to develop within what is called experimental psychology during the first half of the 19th century, and the questions considered were, for example, what differentiated sensory nerves from motor nerves. Galen (129–199 AD) had already distinguished between the two, but had not been able to explain why they were different. In 1811, Sir Charles Bell published his discoveries on the sensory fibres in the spinal cord. Johannes Müller (1801–58) was the first to use a microscope to investigate tissue samples from sick organs. He later classified the energies of the nerves into several species and in 1826 he formulated a law according to which there are five different energies in the nerves, one for each of the senses, regardless of what causes the stimulus.[68]

During the first part of the 19th century, an important part of psychological research was dedicated to the phenomenology of sensations and then mainly to vision. E. H. Weber, however, was an exception whose investigations into sensations (*Der Tastsinn und das Gemeingefühl*, published in 1846) were of great importance.[69] Weber's results had a great influence on many of his contemporaries as well as on later researchers into tactile perception. Weber believed that touch was too vague a concept, as the whole of the skin and large parts of the inside of the body are made up of sensory fibres leading to nerves in the spinal cord.[70] This sensitivity is very general, the concept of *Gemeingefühl* was practically synonymous with *touch* and the sense of touch belongs to the skin.[71] The tactile sense can perceive three kinds of sensations, according to Weber: pressure, temperature and location.

In 1886, Alexander Bain published *The Senses and the Intellect*. In his survey, *A History of Experimental Psychology*, Boring states that Bain was of no importance; he was not to be compared with Descartes, Locke, Hume or Johannes Müller. Bain's place in history is not that of a creator of a theory, according to Boring, he was rather one of those who worked to integrate physiology and psychology.[72] The book *The senses and the intellect* is, how-ever, an excellent representative of the interest in tactile perception which existed in psychology towards the end of the 19th century. This interest is reflected in the argumentation of the pedagogues who participated in the public debate on teaching by object-lesson. According to Bain, touch is an intellectual sense of greater value than the other senses.[73] As far as I can understand, he placed touch above vision, which is interesting. Bain defines touch not merely as a "knowledge-giving" sense, like the others, but as a source of ideas and imaginings rooted in the intellect and capable of comprehending the external world. The notion of size, shape, direction, distance and the localization of a body can be acquired through touch. Touch alone, however, is not enough, as it is the combination of touch and movement which enables us to perceive size, shape, direction, distance and location. It is thus a combination of the tactile sense and the sensitivity of the muscles which is decisive in tactile perception. The same applies to vision.[74] If we touch the surface of an object with our fingertips, it is force, resistance and sensations which create the perceptual effects. Our interpretation of the object we have under our fingertips, depends on how we move our hands and on the sensations we feel as we do so. To be able to understand an object by touch, we must move our fingers and for that we need muscular force. By following the contour of the object we form an idea of its shape, size and location.

The superiority of touch is based, according to Bain, on the fact that it can create a wide range of intellectual forms and impressions, as tactile sensitivity varies in different parts of the body. The sensation created by touch is interpreted differently in different parts of the body. Even the smallest part of our skin has its own nerves with their own, independent line of communication with nerve centres. This enables us to localize each sensation at the point where contact takes place.[75] Like most other researchers into tactile perception at that time, Bain refers to Weber and especially to Weber's research into barely measurable differences in the way we perceive tactile exposures, depending on where they occur on the skin. The distance between two points on an object which is being perceived by a more sensitive part of our skin is, for example, perceived as half as long as when perceived by a less sensitive part.[76] Just as the distance between two points is distinguished differently by different parts of the body, we also discriminate weights differently, if no muscular force is involved. A weight placed on different parts of the skin is perceived differently depending on the sensitivity of the different areas.[77]

Although our skin is extremely sensitive and although it is possible to appreciate very small distances between two points, this does not mean that we can judge the exact distance. In *Some Observations of the Mental State of the Blind, Deaf and Dumb*, published in 1860, R. Fowler makes a survey of his own writings, most of which were originally published in the 1840s and 1850s.[78] In one, Fowler refers to a lecture on "the Philosophy of the Mind", by a Dr Brown, which deals with the relationship between distance and time.

> If the fingers be alternately passed quickly and slowly over the same surfaces, while our eyes are closed, we shall estimate the distance of the edge of a book or table to be longer when the finger has moved slowly, than when it has moved quickly. This is an easy and satisfactory confirmation of the fact, that time is an element in our measure of space (extent), as the watch and sundial are proofs of the converge of this, that time is measurable by extension.[79]

In other words, it is a question of the perception of a distance rather than o f an actual, measurable length. That time is an important part of understanding and knowledge of distance is a fact that we all make use of to a greater or lesser degree in getting about from one place to another. Time, particularly for the visually impaired, is an important factor in the perception of, for example, the size of a room. The time it takes to walk from one point to another in a room is an excellent way of grasping the actual length of the room. Berkeley pointed out that vision requires the assistance of other senses (e.g. touch) to perceive something at a distance. The only thing we can perceive through vision, without any help whatsoever from the other senses, are colours and shadows.[80] Descartes held the opinion that it is not through vision alone that we discover the position of an object in the room. Instead, we note the direction in which we move our eyes to look at the object, and the angle formed between the eyes when they focus on the object. According to Descartes, touch can contribute nothing to the understanding of location as it can only appreciate qualities such as hardness, weight, warmth and moisture by the sensations experienced. It is the awareness of the relationship of the object to the body which is reached through rational calculation; in other words, it is an intellectual process.[81]

It is obvious that Fowler, in the above-mentioned publication, is very familiar with the debate and the research which I have described so far. Fowler mentions persons such as Charles Bell, Dr Brown, Thomas Reid, Charles Darwin and Sir David Brewster, amongst others, while he himself possessed his own empirical research material in the form of case studies of deaf, blind or deaf-blind children. Fowler's work is only one example of psychological research directly aimed at the target group under consideration in this thesis. It is also clear that Fowler had studied earlier philosophic and physio-psychological research, which he then applied in his own observations.

Theodor Heller: synthetic and analytical reading

When Wilhelm Wund published his *Philosophische Studien* in 1895, it included the comprehensive article by Theodor Heller, 'Studien zur Blinden-Psychologie", which dealt mainly with tactile perception and its importance in the perception of spatiality. Heller was one of the first to attempt to analyze the methods used by the blind in tactile reading. He distinguished between *synthetic* reading and *analytical* reading. In synthetic reading, the object is covered by the hands. A complete picture is achieved through perception of pressure, tension and movement. In analytical reading, the object is felt with the hands, part by part. Heller seems not to have been as important for later research as David Katz was, probably because Katz's research was more comprehensive. Katz's thesis, *Der Aufbau der Tastwelt* (1925), was not translated into English until 1989, a fact which may be indicative of the renewed interest in tactile perception, especially in persons with serious visual handicaps, which has developed over the last twenty-five years. In *Der Aufbau der Tastwelt*, Katz systematically analyzed those elements of visual perception which can be transferred to tactile perception (such as, shape, volume and distance).

It is, however, remarkable that Theodor Heller is not mentioned in Mell's encyclopaedia, when both Mell and Heller were active within the same linguistic sphere, German. Alexander Mell was senior executive officer and director of Des K. K. Blinden-Erziehungs-institut in Vienna. In 1900 he published a comprehensive handbook entitled *Encyclopädisches Handbuch des Blindenwesens*. We can only speculate as to why Heller is not mentioned in the encyclopaedia, by name or in the article on the tactile sense. Mell may not have heard of Heller, or may have considered him irrelevant to the subject, which would seem somewhat odd. Heller's theories were later discussed by A. F. Wiberg, who taught at the Blindeinstitut of Copenhagen from 1920 to 1935. Wiberg is actually the only author I have come across who refers to Heller.[82] There may also have been some conflict between their different points of view. On the other hand, if Heller was unknown to contemporary pedagogues at the institutes for the blind, he himself was not unaware of the debate on this type of education.

"Tastsinn"

By consulting the term "Tastsinn"[83] (i.e. the tactile sense) in Alexander Mell's encyclopaedia, we can, to some extent, become familiar with the ideas and the knowledge which were in general circulation at the time, in the German-speaking countries at least. We also are able to form an idea of the notions and the knowledge which existed concerning the possibility and capacity of a person with a serious visual impediment to perceive the world around him through touch. In addition, we also learn something of the theories on tactile perception which were prevalent towards the end of last century.

"Tastsinn" is divided into "Tastsinn, anatomisch" (anatomical sense of touch) and "Tastsinn, physiologisch" (physiological sense of touch). Under the latter heading there are two subheadings, "A. Drucksinn" (sense of pressure) and "B. Ortssinn" (sense of location). Under section "B. Ortssinn," five main points are presented, followed by a theory on the capacity for spatial orientation. Those five points are:

> 1. Webers Zirkelversuch, 2. Aesthesiometer, 3. Doppelnadeln,
> 4. Localisationsversuch, 5. Fechner's "Methode der Aequivalente".[84]

The identification of shape and character of an object depends on the pressure created when we feel with our tactile sense (which consists of a number of points on the skin) the edges, corners, depressions, elevations, etc. of an object. In touch, the fingertips, the whole hand, the tongue and the lips are normally used.[85]

The following quotation from Mell's encyclopaedia illustrates that there were, to a large extent, few divergent opinions on the tactile function:

> The skin's spatial capacity is made possible by the existence of certain nerve-endings which, when stimulated, indicate with accuracy the origin of stimuli on the epidermis. This spatial awareness is also generated by pressure, heat or other general sensations (e.g. pain, itching). This is undoubtedly true when the sense of touch is involved, but less so in the case of general sensations (see above).When a particular set of nerve-endings receives several similar or different stimuli from an extraneous object, or when we feel an object on one particular part of the skin, a series of sensory impressions is created in a given order. On the basis of these impressions, we perceive the shape and surface of the object, almost without the intervention of sight. In fact, even in sighted persons, this capacity plays an important role in their perception of an object /.../ [86]
> The philosophical question as to whether spatial perception is innate (the nativistic point of view) or acquired through experience (the empirical point of view) therefore remains unsettled.[87]

In "Studien zur Blinden-Psychologie", Theodor Heller begins by saying that there had recently been an obvious need for basic psychological studies within the pedagogy of the blind.[88]

Heller's systematic search of knowledge

Heller wished to open new roads to knowledge, roads which would lead the reader away from the vague and fruitless wanderings which had been customary in the psychology of the blind.[89]

To begin with, Heller emphasized that blind persons' ability to perceive and understand shape improved considerably if they had been sighted at some time in their lives. While he points out that the visual memory tends to disappear quite soon after the loss of vision, Heller stresses that perception through vision develops well from the second to the fourth year of a child's life. Should the child lose his vision after that, it will conserve the consciousness of visual impressions for some time. Not until later will the visual representation (i.e. the perception made through vision) fade away completely.[90]

In order to achieve relevant results and to ensure reliable answers from blind persons to questions on idea and understanding of the environment, investigation must be carefully and adequately carried out. An investigation of the visually impaired must be such that the sighted person can control the relevancy of the answers, writes Heller. He mentions work by Weber and Diderot as examples of methods for investigation of the blind.[91]

For the person who is born blind, touch is the only source of spatial perception, while the sighted, physiologically, have two senses, touch and vision, which work in collaboration. Hearing is a more intense sense and not unimportant in spatial conception, but it is less reliable than touch.[92] The most useful organ of touch for the blind is the hand[93]. In this, Heller seems to agree with Weber's theory on the importance of pressure for the sensitivity of the fingertips.[94] It is possible to perceive the texture of a surface by simply allowing the fingertips to glide very gently across it.

Spatial perception depends on two factors:

> ... first the spatial perception of the sensitive zone which systematically organizes the elementary perceptions of the object; secondly, the mobility of the sensory organ which accurately locates the object in relation to the world around.[95]

Heller commented on the limitation inherent in tactile perception: that it is only possible to perceive a small part of a surface at a time, in contrast to the optical capacity of the eye. Therefore, it is important to be told how one should "read" the surroundings. Heller emphasizes the difference between the movements of the eyes, when we orient ourselves through vision, and the movements of the hand, when we do the same thing through touch.

> Neither touching movements nor the system of signs of location are capable of producing by themselves a spatial perception. Both are mere conditions for the development of the blind person's sense of direction. /.../ Whenever a blind person acquires a precise perception of a space, these two factors operate in close collaboration. Their mutual relationship can be described as one of synthesis and analysis.[96]

Heller distinguished between synthetic and analytical tactile reading. In the former, the object is held and enclosed by the hands, and a schematic, general picture of the object is achieved through pressure, tension and movement. Analytical tactile reading, on the other hand, is limited to that part of the hand which successively touches the contours of the object.

Synthetic touch

Heller bases his theory of synthetic touch on Weber, who in turn had elaborated on the consequences of Johannes Müller's theory, which stated that every part of the skin with nerve ends is endowed with a degree of sensitivity which capacitates it to perceive touch. This builds on the teaching of the German philosopher Immanuel Kant (1724–1804) on "a priori" knowledge. Kant distinguished between two types of knowledge: empirical knowledge built on sensation (Sinnlichkeit) and a priori knowledge which is acquired regardless of the capacity of sensation. Heller refers to Weber who calls those parts of the skin which cannot distinguish impressions an "observation circle" (Empfindungskreise).[97] When Kant refers to intuition (Anschauung) he distinguishes between empirical and pure intuition. Empirical intuiton presupposes an input of sense-datas (Empfindungen), created by the two forms of intuiton (Formen der Anscahuung): time and space. The number of sense-data in itself does not cause us to perceive an object or knowledge. To do that, we need the outer form, which intention provides. The forms of observation can be perceived (in pure intention) independently of concrete perception material. Because of the pure intention of time and space, it is, according to Kant, possible to construe pure mathematics and geometry applicable to all types of intention, the pure as well as the empirical. What was Heller's opinion on this, even when filtered through Weber's theories?

Heller quotes Weber's first theory where he states that each observation circle has a nerve-ending in which a spatial component must exist. Heller continues with a description of research which has shown that the blind have a more developed capacity of tactile reading than the sighted. Heller, however, emphasises that it is not possible to explain this capacity in terms of physiological differences, that it develops through practice and concentration.[98]

The importance of the movement in perception

Heller's interest in tactile perception is experimental; his physiological and psychological models are based on empirical or experimental investigation. He wished to determine the factors involved in tactile perception. An essential factor in the function of the skin's "Raumsinn" (spatial sense) is the point of pressure, its size and the degree of force. These so-called pressure points must not too close to one another as they then become difficult to distinguish. Movement is of great importance in the conversion of these individual pressure points into a single, meaningful unit.

"When I make this touching movement," said Oscar Sch., the subject of the experiment," I always imagine that my index finger moves from one point to another." When arbitrary touching movements are made, associations are always produced while the former are being analysed. The fact that the greater the number of pressure points, the more difficult the simulta-neous interpretation of these by the skin's sensory perception becomes, makes touch even more remarkable. If touch is expressly forbidden/or prevented/eliminated, it still occurs as a spontaneous side-effect of the subjective analysis of the impression. These spontaneous reflex movements are in fact none other than involuntary touching movements.[99]

The pressure point, its size, the force applied and movement are of great importance in braille reading. Only a limited number of points can be perceived simultaneously with the fingertip, while the pressure exerted plays a decisive role in braille reading. If the pressure is too strong, the fingertips soon become numb. In order to perceive whole words in braille, the fingers must move along the braille line, and each word is read letter by letter. Heller mentions braille reading but says nothing about relief pictures and maps.[100]

Heller also stressed how important it was to use the whole surface of both hands, as they moved over the object, so that an overall picture was perceived.[101] The importance of movement in tactile perception had already been discussed by John Locke in *Ideas of Space, Figure and Motion*. Heller emphasized the importance of the combination of muscle force and movement which enabled the blind to perceive and identify three-dimensional objects. Movement and practice are closely related; a fact which was dwelt on by A. F. Wiberg *Den blindes følemetoder*.

Heller insists on the importance of practice.[102] By making a series of uniform movements, the finger provides a first impression of the fixed point.[103] When an object is identified by synthetic touch, the procedure is the following:

In order to be able to grasp an object, the hand must abandon its resting position, all of the articulations must execute a contracting movement which is completed when as much of the object's surface as possible is in contact with the hand. At this stage, the sense of movement is of vital importance.[104]

Heller believed that although it is impossible to achieve a full understanding of an object, the following could, nonetheless, be understood:

> 1) ... if he is holding an angular or round object in his hand. In the second case, there is generally a sensation of pressure, and in the first case, an uneven distribution of this pressure, as the feeling of the edges and corners of an object differs in quality and intensity from the feeling of its plane surfaces.
> 2) If the object is regular or irregular. When the objects are round, perception is mainly based on the impulses of the hand muscles. When the objects are angular, perception is also based on the impression of the distance of the edges and corners.[105]

Synthetic touch can, however, never provide more than a schematic picture of an object.[106]

To arrive at a complete picture of the object, it must be of limited size:

> If the blind person wishes to visualise the actual size of an object, his visualisation reduces the succession of touching movements which are required in the measuring of it. If his attention is focused on its shape, he must make a reduction of the object in the way described above; an immediate, simultaneous impression is only possible when small areas are touched.[107]

There is a clear notion of the difference between what is understood through touch and through vision. Through touch, something is perceived in successive stages, while through vision the impression is simultaneous. From Heller's reasoning, it is clear that the differences between the tactile and visual senses should not be exaggerated:

> We try in vain to form a total picture of a large object situated directly in front of us. We have as it were to compose a picture of the object from its separate parts. If we wish to form a simultaneous impression of the object, we must imagine it removed from ourselves. In doing so, we necessarily reduce our mental picture of it.[108]

F. H. Lange's *Från mörker till ljus. En skrift om blindheten i det praktiska lifvet* (From darkness into light. A pamphlet on blindness in everyday life.), published in 1916, expresses the "user's perspective" of what can be perceived through touch. The author, who himself was visually impaired, writes:

> The sense of touch may give the blind the perception of twelve-thirteenth parts of all things existing in the world. He may observe the six sides of each object and, in addition, their weight, sound, temperature, the texture of the surface, smell and taste, but not their colour. Besides, each object has its special features and the world of forms is immensely rich. In this

> richness the blind moves about, only colours do not impress him at all. When the blind person handles a coin, he always does it by touching the edges of the coin. The embossing is rarely used for identification, but the other characteristics of the coin such as thickness, size and sound are.[109]

And he continues:

> The blind person moves around differently from the sighted. He is forced to come into close contact with the objects he encounters, in order to be able to orient himself.[110]

The interest in the senses, which arose in the 17th century, and the debate caused by the problem posed by Molyneux became part of the experimental psychology which developed during the 18th and 19th centuries; a psychology which included research directly related to persons with serious visual impairment and particularly to their ability to perceive and understand the world around them. The most prominent pedagogues in special pedagogy not only participated in this type of research, but also contributed directly to its creation and development.

The pedagogue's interest in and knowledge of tactile perception

Early literature (1800–1900) on tactile perception in blind children often dealt with a variety of teaching methods closely related to the object-lesson method. The authors expressed their opinions in the form of descriptions of existing teaching methods or advice and instructions on how the teaching of the visually impaired child ought to be carried out. A great number of these texts lack all references and it is difficult to determine if they are at all related to the philosophic discourse on this subject, or if they were simply based on the authors' personal experiences, as we must believe Haüy's opinions were to a large extent.

By the last two decades of the 18th century, philosophic theories on tactile perception were well developed, especially in England and in France. It is worth noting that the English and French pedagougues at an early stage had already developed theories on tactile perception which appeared in various publications. Pedagogues in Denmark, Germany and Austria did not develop theories until some time later. This seems to prove that the English and French philosophic theories on perception and the importance of the senses influenced pedagogues in other parts of Europe, and that their publis-hed texts where available in their respective languages.

The pedagogues who formed and published their theories were often founders of institutions for the blind, and in their writing we find that their ideas and teaching programmes are closely interlinked. This permits us to study how knowledge and notions of tactile perception were put into practice.

The most prominent directors of institutes were frequent lecturers at the congresses of teachers of the blind, and often wrote articles which were published in specialised reviews on the handicapped and the visually impaired in particular. The questions which most interested the directors and teachers at the different institutes were of a practical nature. Their aim was to make visually impaired children as independent of others as possible. That is, to educate them and train them for a profession or trade by which they could later earn a living. Studies were therefore made on how the visually impaired perceived their surroundings and how they could understand what is not directly palpable in a more effective way.

Guillié in France

In 1817, doctor Guillié's book *Essai sur l'instruction des aveugles* was published. It was translated into English the following year.[111] It is illustrated with etchings showing work and teaching situations involving blind people. In his writing, Guillié deals with the blind geniuses and the character of the blind. The book is partly biographical, and recounts the lives of a number of blind personalities who rose to positions of importance in the arts and sciences. Finally, there is a part dealing with the manner in which the blind should be taught.

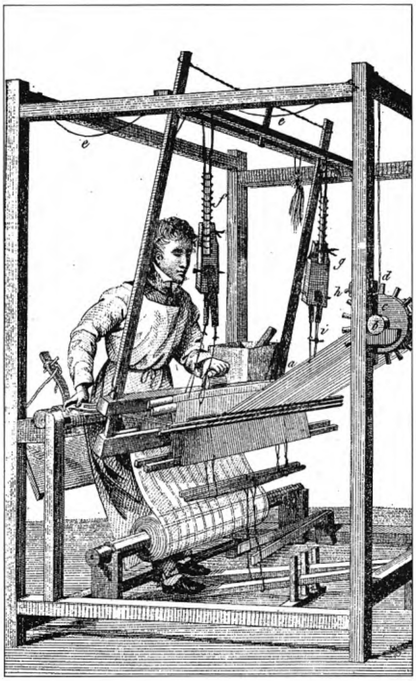
Guillié initially discussed the fact that blind children do not, as sighted children, learn by imitating the adults they observe daily. Therefore, many blind children become silent and timid during their first years, something which marks them for the rest of their lives.[112] This problem was not considered until the end of the 19th century, when kindergartens were opened for children with severe visual impairment.

Guillié pointed out the importance of touch, and affirmed that language without sight cannot shape an object and that there is no correlation between sound and colour. It is therefore necessary to set blind children concrete tasks in which touch is the basic tool. Touch is the only possible link between the sighted and the blind. Guillié stressed, however, that the eyes of the deaf can never *hear*, and the fingers of the blind can never *see*.[113] This should be read as meaning that we must make the best use possible of the senses we possess, in order to compensate for what we lack, but that one sense can never replace another. By "replacing" we mean literally what Guillié says; that fingers can never see, or perceive optical phenomena, and that eyes never can perceive acoustic phenomena. It therefore follows that material for the visually impaired, literature, relief maps and relief pictures and models, must all be adapted to touch.

Guillié was, like many others, of the opinion that all man's knowledge and understanding is dependent on sensory impressions. If one or several of the senses were missing, the teacher must look for new ways of compensating for their absence. Guillié calls this "artificial compensation".[114]

There is a memory of sensations and another of intelligence; the first perceives the memory through physical feelings and the second through reflection, causes, speculations, etc. The blind are richly endowed mainly with the latter, namely, the memory of intelligence. Guillié assumed that the blind have an inner method, the result of their great capacity for analysis.[115]

Guillié presented a historic review of unique relief literature and the art of relief prints for the blind. In this context he also describes the difficulties involved in tactile reading and that the letters employed must be very easy to



Engravery from Essay on the Instruction and Amusements of the Blind by Dr. Guillié, 1819 (Courtsey Danmarks Blindehistoriske Museum, Copenhagen).

distinguish.[116] This had already been commented on by Haüy. Guillié, however, penetrates deeper in his analysis of tactile perception:

> As people cry very loud to make the deaf hear, they think it is necessary to present to the blind objects of very great dimension, that they may be more easily felt, which has given rise to the great letters I have already mentioned. We do not sufficiently consider that the blind, who can only have successive ideas of the objects which he touches, must necessarily at first form different opinions of things, which, though identical in their form, differ in size. He must perform a secondary operation in order to bring together his first ideas, and finally to judge by comparison, after having run through the whole series of intermediary ideas. Do not we do the same thing when we see a drawing in miniature? We do not recognise it always immediately, and we should not even be carried too far: *because the cessation of a colour is to the eye what the cessation or resistance is to the touch.*[117]

Martin Kunz in Germany

Martin Kunz's (1847–1923), theories on tactile perception had a great practical influence in the teaching of the blind. His relief pictures and maps were distributed throughout the entire western world, which is demonstrated by the fact that I have found his products in all the institutes I have visited. (For more on Kunz's production of pictures and maps, see chapters IV and V.) In 1908, Kunz presented his prolonged research into tactile perception, in *Zeitschrift für Experimentelle Pädagogik* in the article "Neue Versuche über das Orientierungsvermögen und das Ferngefühl Blinder, Taubblinder und Sehende". There, Kunz rejected the idea that the blind had some kind of sixth sense which enabled them to orient themselves without vision. He stated that it is true that people who have damaged vision do use their hearing to orient themselves, but stressed the importance of touch, and reminded his readers that the deafblind are perfectly capable of orientating themselves, which demonstrates the importance of touch. For "Ferngefühl" we have five means of orientation, according to Kunz: hearing (if this has not been not lost), the touch of the feet, smell, the sense of direction, where it exists, and spatial memory.[118]

Kunz is an exception to what I initially called "participatory observations". In his own words, and he refers to earlier research he had carried out, he based his views on 8000 to 9000 experimental cases.[119] He explained the conditions for Ferngefühl in the following points:

1. Not all blind persons have a sense of distance. This sense does not develop when one becomes blind; neither does it depend on when the person became blind. However, the causes of blindness very clearly play an important role. It is thus impossible to learn a sense of distance, although practice may sharpen the attention.
2. The sense of distance is not the same as the sense of location, which we must consider as simply an aid.[120]
3. The sense of distance is not a special or sixth sense. It is merely a question of the blind and deaf-blind person making careful use of the senses which he or she conserves. Smell and taste are not involved.[121]

For the blind person with full hearing, it is the sense of touch in the feet and in the muscles and the sense of direction which are vital to "Ferngefühl" (sense of distance). Kunz believed that reflecting, inaudible waves cannot create any "Ferngefühl."[122] For the blind as well as for the deaf-blind, the capacity of orientation depends on the co-operation between the senses they possess, the intelligence and the memory.[123]

As most pedagogues relate their theories on tactile perception to direct pedagogic methods, I have chosen to deal with them in the following chapter, which is on object-lessons. In the present chapter, my purpose has been to present, with some illustrative examples, the relationships between the philosophic ideas and theories on tactile perception, and psychological and pedagogical research. Against this background, it is possible to see how teaching by object-lesson was very much a conscious innovation in the institutes which were founded towards the end of the 18th century and at the beginning of the 19th century. Object-lessons brought with them an early production of relief pictures and maps for the teaching of the blind, as well as models were.

Reproductions for visual and tactile use

Lena Johannesson has discussed how we naturally look at and believe that we understand a picture, but, like Bengt Fausing, she points out the elusiveness of the picture. We normally see and immediate meaning in a picture; our understanding of it is immediate. At the same time, this understanding includes a non-coded message which cannot be verbalized. In using language, we accentuate what is non-verbal, and while searching for meaning, we also accentuate a field of meaning which cannot (or only with difficulty) be subjected to a meaningful analysis. We talk about a picture and express our thoughts about it in a species of translation of the picture into words. This translation is not without its complications, however, as pictures are multi-dimensional and language is linear.[125]

Realistic representations are conceptually and historically based on the adoption of a model which allows both the creator of the picture and the observer to determine and find a systematic relation between the object and what is represented. The pictures are not the objects, but represent the way in which we see them, or rather, how we use our eyesight. One might say that the pictures are an expression of how we define vision.[126] For a reproduction to be considered realistic, it is necessary to adopt a model for seeing which in itself is "pictorial". As soon as we characterise seeing as pictorial, we can understand how visual images are transformed, translated or copied. A photo does not have to look exactly like what it is meant to represent to be understood as realistic. We are trained to perceive and understand certain similarities.[127] An analogy is often assumed to exist between the object we observe and the representation of it. At the same time, there is a built-in scepticism which accepts, in the same way, that there is an analogy between the object as perceived through touch and the representation of it in the form of a tactile picture.

In the attempt to reproduce the surroundings as accurately as possible, different types of illusionist art have developed ever since the Renaissance. In this, I include the various forms of representation of perspective as well as the attempts by the impressionists and the pointillists to find a way of creating a picture which reflects what we actually see. But perhaps the main ambition has been to reproduce spatiality. Spatiality has often been invoked as an explanation of why a person with severe visual impairment is unable to perceive pictures, as it has been stated that tactile perception cannot visualize a three-dimensional representation on a two-dimensional surface. It is, of course, necessary to define what we mean by representation of spatiality and of three-dimensionality. The picture of a map and a plan-drawing are examples of two-dimensional representations of the three-dimensional surroundings. All spatial representation is not an illusion, however, just as all perspective representations are not spatial.

When the first, fumbling attempts were made to create pictures and maps in relief for tactile reading, the pictures and maps were often based on knowledge and insight into tactile perception. When pictures and models in general became more and more used, this also influenced the pedagogues' production and application of picture material in their teaching of children with serious visual handicaps.

IV

Relief pictures for the visually impaired—a great variety

Relief pictures for the visually impaired are a concept which comprises a variety of pictures, artistic as well as instrumental. They are produced by a number of techniques and may be unique, handmade items, printed or otherwise duplicated, mass-produced articles. Relief pictures have been made as individual copies specifically for classroom teaching, but have also formed part of other kinds of teaching materials and of different types of picture-books. Relief pictures have been made explicitly for tactile reading, but there are also examples of visual pictures which have been converted to tactile pictures. A large number of relief pictures not made after a particular model have, however, been influenced by contemporary pictures, often by educational wall charts. This is hardly astonishing, considering the fact that most relief pictures are used in educational situations.

A discussion of the concept of what represents a picture is unavoidable; we must at least define what is meant by a picture in the present context. The actual and former English denominations are *tactile picture, tactile graphic, relief picture and embossed picture.*[1] Tactile graphics is sometimes charged with subjective judgements, the idea being that a picture made for tactile reading could never be anything but a much simplified outline of the original picture. If you regard a picture as a two-dimensional surface, however, where the lines and surfaces form a pattern, the structure of which represents an object or an idea, then relief representations for tactile reading must necessarily be defined as pictures.

From visual to tactile picture

The transfer of a picture from one medium to another entails certain complications. The differences between visual and tactile perception make obvious changes necessary in the tactile picture. How big the change must be, depends on the form and contents of the original. Various types of diagrams usually do not need major reworking; neither do plan-drawings or very simple maps. Most pictures, however, do demand a good deal of transformation in order to be read tactilely. There have been, and still are, several methods for converting a visual picture into a tactile one most efficiently, based on theories and ideas on tactile perception.

According to the classical theory of communication, you need the following three components to achieve communication: a sender, a message and a receiver. This model has never been accepted by researchers in pictures, since we always have to introduce a fourth factor, i.e. the fact that the physical character of the medium is a message in itself. A picture may be explained and interpreted in many different ways and several different interpretations may be equally relevant. When you transfer a visual picture to a relief picture, an additional interpretation is made before the picture reaches the receiver. The person responsible for the conversion starts with his or her own interpretation of what he or she considers is worth representing in the relief picture. At best, the picture is designed in a way which allows the tactile reader to perceive and understand the picture in a way consistent with the intentions behind the design of the tactile picture. Due to the ambiguity of pictures, there have been discussions on whether transfer is at all possible, and whether the transfer of visual pictures, and particularly of artistic pictures, should be made.

The appearance of the tactile picture

Pictures often contain an illusion of spatial representation, an illusion created by lines and surfaces on a flat surface. It is not always obvious and easy to interpret the lines and surfaces of the picture as meaningful objects and events. Tactile pictures in general are simplified compared even to very simple visual pictures.

In tactile pictures, we can represent more or less whatever we want, with the exception of colours and nuances of light. Whether a visually impaired person can understand perspective or not has long been subject of debate. Pictures meant for tactile reading often exclude perspective. Tactile pictures can, in part, be compared to Ancient Egyptian art. Like the Egyptian pictures, tactile pictures are often descriptive in character; they give an account of the structure and function of an object, rather than of what it looks like. In Egyptian art we find representations in orthogonal, that is, right-angled projection. Orthogonal projection is fairly common today in the representation of pictures for the visually impaired. Such pictures show the same object in right-angled projection from three different sides.[2] In the early 1940s, David Katz carried out a study of the drawing ability of blind pupils and reached the conclusion that many of them chose to represent various objects in orthogonal projection.[3] This caused Katz to wonder if the use of orthogonal projection in the representation of objects in relief pictures would not be the natural choice.[4]

For most people, pictures are something you see. But what do you see, and what information or message does a picture convey? Sven Sandström has stated that the picture in itself does not give new information, but offers us an opportunity to gain access to information.[5] The information which can be obtained from a picture depends partly on the type of picture, and partly on the observer's previous knowledge. If we look at a photograph of an area, certain information can be extracted from it. If we study a map of the same area, another kind of information is given, and when we see an artistic picture of it, a third kind, a topic which Gombrich has discussed.[6]

An object is mainly recognized by its external shape.[7] To create a tactilely identifiable object on a picture surface, the principal characteristics of the real object are exaggerated. The fact that the motif in a tactile picture must have a simple shape seems to have been well known from the very beginning. A great number of the surviving relief pictures I have studied are proof of this. But, of course, to say that a picture is simplified is a relative concept, as the following examination of the material on relief pictures will show.

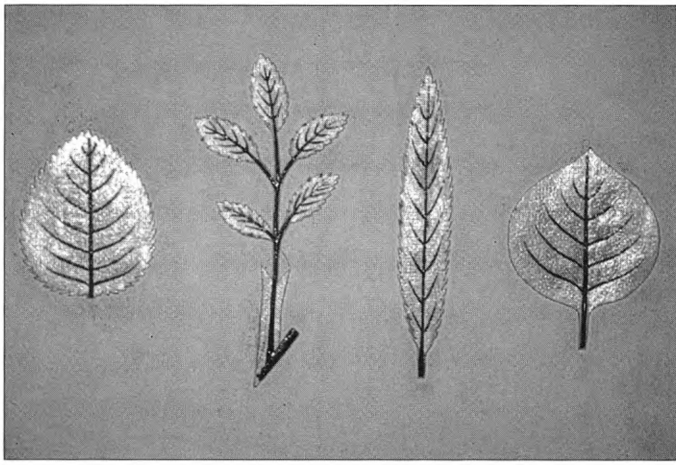
Around 1873, Josef Glötzl at the k.k. Blinden-Erziehungs-Institut in Vienna produced an interesting and remarkable book. It was remarkable in that it expressed and anticipated a discussion which chiefly took place in the 1980s and 1990s. It concerns the question of whether relief pictures can best be perceived tactilely as line drawings or as solid shapes. The first five spreads of the book contain pictures of leaves cut out and stuck on the picture page, three or four different leaves to each page. After this come five spreads with exactly the same leaves, as line drawings.[8] The technique resembles the ectypography (which is explained below), except that the lines are purple instead of black. The book is 280 x 190 mm in size.

The simple, stylized relief pictures of various leaves resemble the pictures created by William Henry Fox Talbot in the technique he called "photogenic drawing". Talbot placed ferns, pieces of cord or flowers on silver nitrate paper which he then exposed to the light. Flat silhouettes of the objects he had used were created by contact copying.

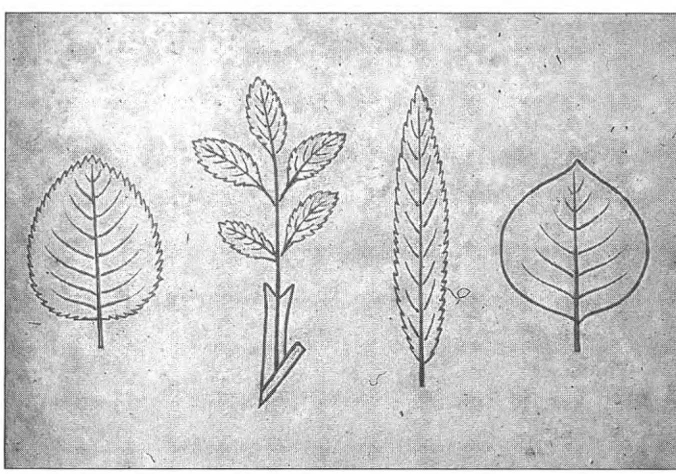
To make a picture simple and distinct it must also have "underlines", i.e. markings created by the exaggeration of relevant details.[9] It is exactly these accentuations or reinforcements which are missing in many of the early relief pictures for the blind. The reason for this could be that the person who made the pictures did not know enough about tactile reading, or that he came from a tradition of making relief pictures for the sighted. Other reasons are probably to be found in the technique as such. So much att ention was paid to solving technical problems, that the quality of the picture was forgotten.

Throughout the centuries, a number of inventors and relief printers have been of great importance because of the widespread distribution of their pictures. To give the clearest possible picture of the work of these producers of relief pictures, each one of them will be dealt with below. A relatively large amount of the surviving material is anonymous, that is, the institution which published it is known, but not the person or persons by whom it was designed.

a.



b.



Pictures by Josef Glötzl, 1873 (Bundes-Blindenerziehungsinstitut, Wienna. Photo: author).
a. Pictures of leaves cut out and stuck on the picture page. b. Line drawing.

Relief pictures in teaching—individual examples

Picture series and picture books from the early 19th century have been preserved. My research shows, however, that throughout that century, relief pictures were intended for educational purposes, although they were widely distributed in other circles. It is not until after the First World War that we find tactile picture books on different subjects for a new target group, people who had been blinded during the war.

Different printing techniques

Relief pictures have been made in a variety of techniques. An early method was the Ectypography, which gives a low and rather indistinct relief, especially if the picture is somewhat complex. This is in part due to the fact that the lines are not sharp enough. The low black relief line resembles the rubber prints you find on modern T-shirts. The method employed in ectypography is the following:

> The lines which are to be embossed are written, drawn or printed in latex, and before the writing has dried, it is sprinkled with powdered resin of approximately the same composition as sealing wax, after which the surplus powder is removed. When the fine coating of latex is heated to a suitable temperature with the appropriate instruments, the resulting lines become slightly raised and easy to read.[10]

Relief prints for tactile reading, however, have most often consisted of an uncoloured relief produced by various kinds of im-printing. The tactile pictures were printed on heavy, good quality paper. Moulds of various shapes were used; one early mould was carved out of wood. Later this method was developed so that different materials could be used for the mould and so a more distinct relief was achieved. These moulds gave a relief picture with several levels and unbroken surfaces. Other producers of relief pictures only made contour drawings. The moulds for the line reliefs were often made from a thin brass plate. A variety of techniques have been used in the reproduction of tactile pictures, some of them related to different kinds of relief printing. Printing techniques to a certain extent determined the design of tactile pictures. The embossed pictures and print in books and on writing-paper for the sighted recreate a sculptural form where the effect of light and shadow plays a decisive role in how the relief is perceived. The almost indiscernible transition from one surface or line to another makes this relief pictures or print unsuitable for tactile reading. Nevertheless, this type of relief is found in literature for tactile reading.

Martin Kunz, one of the leading producers of tactile pictures in the 1890s, made pictures for the teaching of natural history which partly resemble the reliefs made for the sighted during the 19th century. Kunz's reliefs were duplicated by means of a mould in relatively high relief which had surfaces of various textures on different levels. The mould was made basically of plaster, and the printing technique involved form-pressing damp paper between a positive and a negative mould.

Valentin Haüy's *Essai sur l'éducation des aveugles* proves that he was continuing a typographical tradition when he developed embossed print for the blind. In all probability, many of the printing techniques used in the production of relief maps and pictures for the blind were identical to those used in normal printing at that time. To judge by Kunz's description of how he made printing blocks for his tactile pictures and maps (page 107–108, this chapter and 175 in chapter V)—from wood-cuts and wood-engravings to a mixture of plaster, wax and metal—there were obvious similarities between his method and the stereotype moulds.

As Lena Johannesson has noticed in her studies on how modern printing processes were established in the end of the 18th century:

> Stereotyping starting with a positive version of a form as a plaster cast inverted by type metal of the plaster cast, was not a method specific for the printing of pictures but belonged to the elementary routine of modern typography, and picture moulds were made in the same way as printing moulds. For the printing of pictures, however, a somewhat softer mixture of the type metal was used in which bismuth was added to the lead and pewter alloy.[11]

As the printing of tactile pictures has the same graphical structure as other techniques for relief printing, close parallels can be found between the technological development of tactile printing and the most successful technique for relief printing in the 19th century, the wood engraving. The technique of stereotype printing is an example of a function which has been improved within the techniques for relief print (i.e. type metal engraving, wood-cuts and particularly wood-engraving) and which it has been possible to use for printing tactile pictures.

The machinery used for embossing relief pictures and maps in all probability worked on the same principles as the equipment in general use at the time. The puncher or guilloching machines, a mechanical aid for engraving, was developed in the 1860s. It was used to facilitate the engraving of smooth, parallel or concentric lines on surfaces.[12]

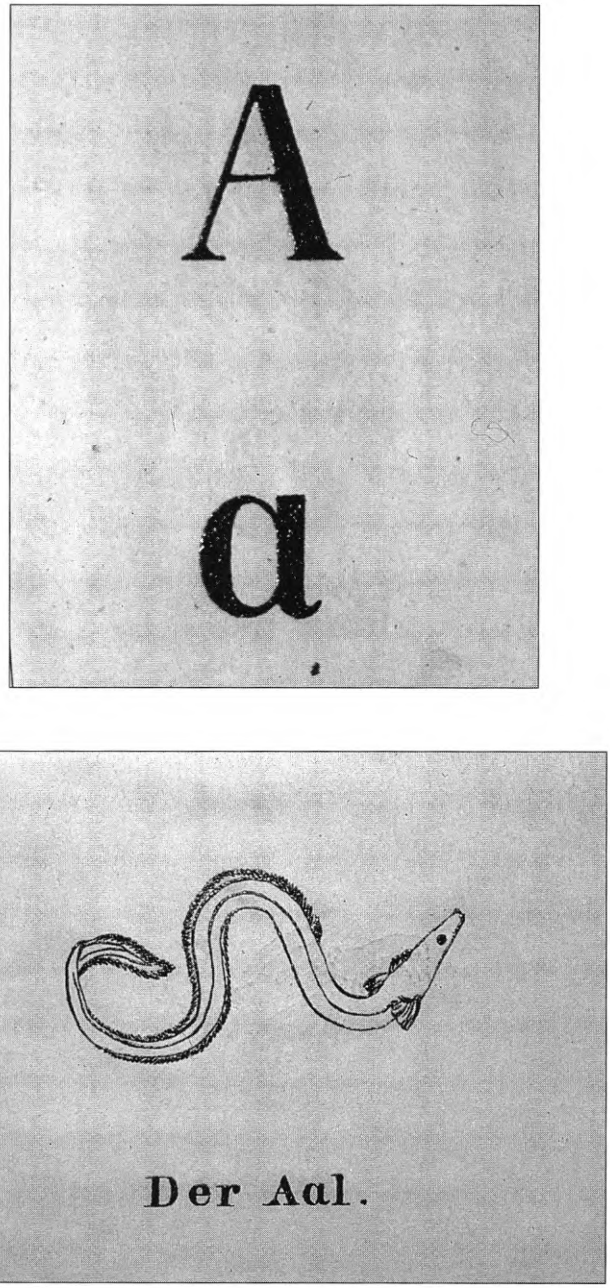
The surviving printing blocks of *Aide-Mémoire pour Masseurs Aveugles* (page 119, this chapter) are made of a soft metal, probably an alloy of pewter and lead. The relief pictures were produced by form-pressing on damp paper. In *Xylografi och pressbild*, Lena Johannesson describes how printing-shops made metal stereotypes from wood-cuts. According to Johannesson, this older casting method has never been mentioned by authors who have made a study of industrilised wood-engraving. The reason for this silence may be that the method employed was purely manual.[13] The casts for *Aide-Mémoire pour les aveugles* are mounted on thin wooden plates in the same way as electro-shells and casts "were stabilised by the addition of metal from behind and mounted on wooden plates adapted to the height of the types."[14]

During the 1910s and 1920s, a type of picture was developed in which the relief was created by means of dots of different sizes forming surfaces and lines. A figure was drawn on paper which was then mounted on a metal plate. Using a manual printing-press and a variety of tools for the production of relief dots of various sizes, the drawing was transferred to the metal plate. There were also cases where the picture was hammered onto the metal plate by hand. To print the relief on paper, a negative mould was required. The relief picture was a development of an earlier method whereby the figure was drawn mirrorwise on the back of a sheet of card. The contour of the figure was then closely perforated at regular intervals. In this way, a positive relief figure appeared on the front of the card. If several pieces of card were placed together, several copies could be made simultaneously. This translation of a drawing on paper into a series of lines and surfaces made up of different sized dots on a metal plate does imply a certain rigidity in the picture. This rigidity is not a requirement of tactile perception, but a result of the technique employed. It is doubtless not easy to create smooth, graceful lines when punching dots on a sheet of metal, even if the metal is soft.

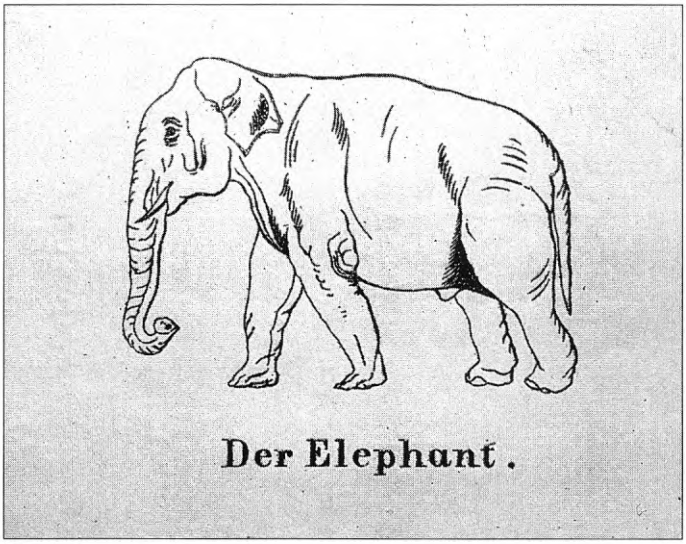
Ektypograhisches Bilderwörtenbuch für Blinde

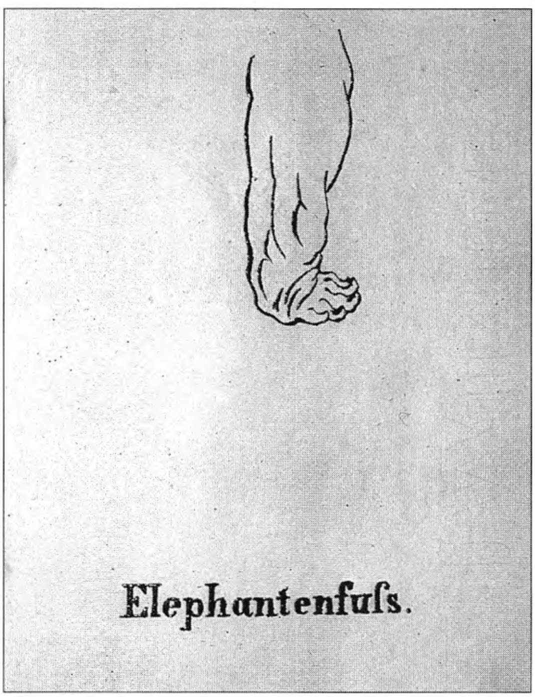
Ektypographisches Bilderwörtenbuch für Blinde[15] is one of the early relief picture books produced especially for the blind. It was made by Felix Freisauff and issued in 1839. It was this retired army officer who, in 1837, invented and published ectypographic pictures.[16] His book is alphabetical ordered. The first volume goes from A to L and has more than 180 illustrations.[17] It is 210 x 260 mm in size. For each new letter there is a page with a capital as well as a lower-case letter, followed by illustrations, one on each page. Each illustration has a heading which tells us what the picture represents.

The pictures are complicated and difficult to distinguish tactilely even though they are in simplified line relief. One reason for the indistinct relief is

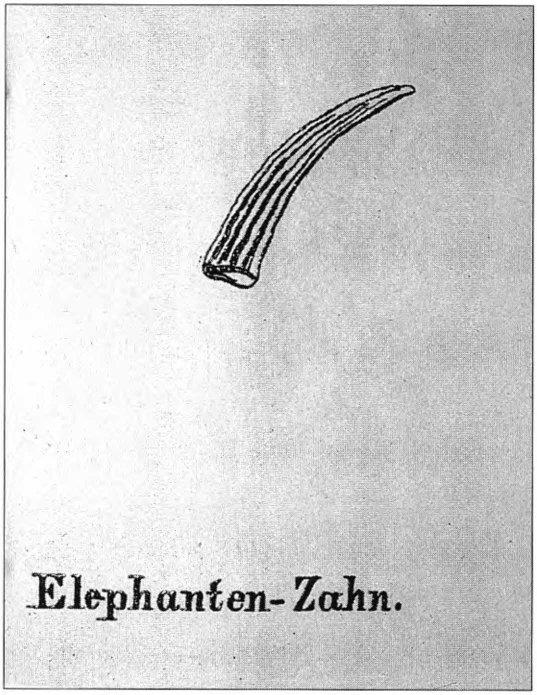


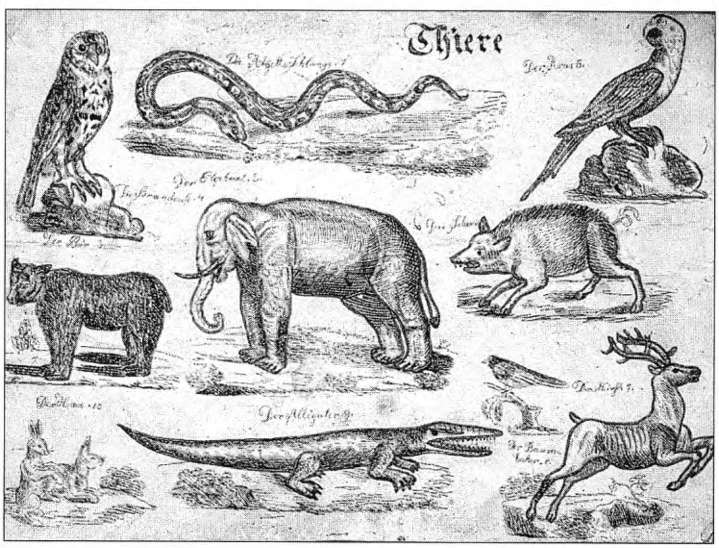
Ektypographishes Bilderwörtenbuch, 1839 (Bundes-Blindenerziehungsinstitut, Wienna. Photo: author).





Ektypographishes Bilderwörtenbuch, 1839 (Bundes-Blindenerziehungsinstitut, Vienna. Photo: author).





Engraving (Bundes-Blindenerziehungsinstitut, Vienna. Photo: author).

the technique employed, but also the fact that accentuation and enlargement of relevant details are missing. Moreover, many of the pictures are far too small and contain unnecessary details. Enlargements of one or several details, on the other hand, accompany some relief pictures. The presentation of these pictures is done in such a way that you first see the whole object and on the following pages the enlarged details. One example is the relief picture of a monkey, followed by an enlarged picture of the monkey's foot. Another example of the same kind is the relief picture of an elephant. Here, the author has chosen to enlarge two parts of the elephant's body: a foot and a tusk.

The elephant is not particularly well executed. Its ears are small and the feet look more like a bear's paws than an elephant's feet. The relief picture is suspiciously similar to that of an elephant which, with several other animals, appears on an engraving (approx. 30 x 21 cm in size) now in the Bundes-Blindenerziehungsinstitut in Vienna. By filling the contour lines with something that seems to be viscous ink, the animals on the engraving have been adapted to tactile reading.[18] This type of reproduction error are not uncommon in relief pictures. They are probably caused by erroneous originals or by uncertainty as to the interpretation of the original, on the part of the person who did the relief version.[19]

Ektypograhisches Bilderwörtenbuch für Blinde also contains different stages in the development of plants. "Aestchen mit einem Auge zum oculiren" and "Aestchen mit einem Fruchtauge" are two example of this. The author gives the following most informative explanation of the history of the book. The text is written exclusively in ink print. I will use a long quotation to render the purpose of the book:

> ... Making pictures which can be perceived by touch is there–fore considered to be a particularly difficult task in the teaching of the blind. Only by observation through the senses can their perceptive capacity be controlled and protected from the possibility of degeneration and error. Much in a text which is vague and unclear becomes obvious through object-lessons which are backed by good pictorial presentation. Such lessons also help the memory to learn, conserve and recall the associated concepts. /.../ So as not to make tactile reading more difficult for the blind, the objects were drawn on a fairly large scale. An octavo-sized sheet was adopted as the limit of individual illustration; no consideration was given, though, to the relative sizes of the various illustration. For the same reason, only one object was depicted on each page. /.../ According to the original draft, this picture dictionary was intended to consist of those words related to all the branches of science and the arts crafts which could most easily be reproduced

a.

b.

Ektypographische Vorlegeblaetter für Blinde. (Bundes-Blindenerziehungsinstitut, Vienna. Photo: author). a. Ferdinand I. b. The Bengal tiger.

pictorially, mainly in German, Latin, French and English, accompanied by the corresponding illustration (reduced to the size of an octavo) and a short text, as in an encyclopaedia. /.../ This was the origin of the present work which contains only illustrations of natural objects. Although it is less extensive, I hope it will nevertheless prove useful. /.../ For the rest, the greatest care was taken to make the contours distinct and accurate. If we have not achieved the desired degree of perfection, the difficulties inherent in the task are to blame, and I deserve at least recognition for the zeal with which I have tried to succeed in my ambition, which was to make the teaching of the blind easier and to enable it to take place outside the institute for the blind. Vienna, 30 January 1839/The Author.[20]

The picture folder *Ektypograhische Vorlegeblaetter für Blinde* (Ectypographic matrices for the blind), 1837, was made in the same technique and its contents were varied:[21]

1. Ferdinand der Erste, Kaiser von Oesterreich; 2 u. 3. Oesterreichische Volkshymne; 4. Das grosse alphabet; 5. Stenographische Alphabet. 6. Stenograpische Shriftmuster; 7 u. 8. Blumen-Bouquest; 9. Der Königs Tiger.

Ferdinand I is seen in profile. The portrait is a line drawing although rather rich in details, especially if we consider that the pictures were made for tactile reading. Flower motifs were popular in the 18th and 19th centuries and their inclusion in the folder was probably a natural choice. The picture of the bunch of flowers is also a line drawing, with overlapping parts and perspective, which complicates tactile reading. The Bengal tiger is shown at an angle, with his head turned towards the observer and the left front leg resting, unnaturally bent, on a rock. You get the impression that the tiger was drawn from a model or perhaps even copied from another picture, and that the artist did not really know what a tiger looked like.

Alston and Asylum Press of Glasgow

The development of relief writing and of braille (which developed later) is relatively well-documented in historical studies. It is not possible, however, to find similar research dedicated specifically to relief pictures and maps. The interest in relief pictures has been practically nil. In a historical review dated 1837, however, we can find some information on the production of relief pictures.[22] Apart from telling us how the early relief pictures were made, the text also reveals the knowledge of tactile perception which existed at that time, and the intentions behind the design of relief pictures.

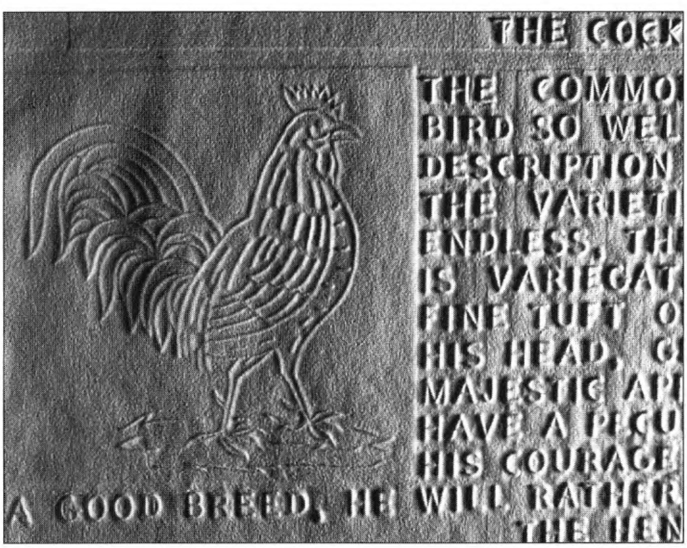
> The Blind can feel the shape of any image which they can handle; but not having any idea of perspective, it is only an outline which can be understood. They readily perceive the resemblance between the outline of Italy and a boot, and they can also perceive the resemblance of any outer outline which is full and well defined. We are, therefore, able to give the Blind many illustrations of different objects by means of the printing press, or the pin-cushion, or another method which is now about to be described.[23]

The "pin-stamp" method meant that the paper was punctured with a pin. Not only letters but also pictures and diagrams could be reproduced in this way. As the relief appears on the other side of the paper you are working on, the motif was first drawn on the side what was to be the reverse of the relief. Then it was easy to follow the lines and make regular holes with a pin or a needle. It was possible to make two or three pictures at the same time, depending on the thickness of the paper. This type of relief picture were used in literature where the text was printed with a stamp and where diagrams and pictures were pierced with a pin.[24]

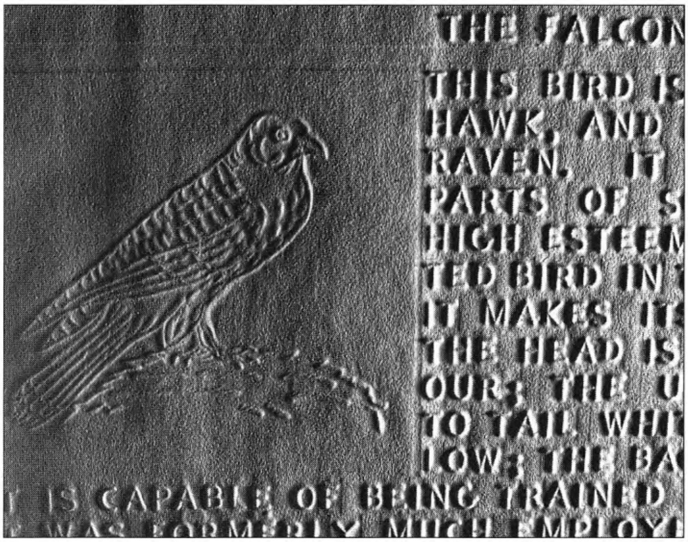
The oldest, still surviving relief picture books in paper are those published by John Alston. Alston was an accountant at the Asylum for the Blind in Glasgow. He devoted his time to the development of relief writing for the blind and to the publication of books in relief print. Alston printed illustrated books in embossed print in Glasgow at about the same time as the retired army officer Freisauff published ectypographic books in Vienna. Alston's books contain tactile pictures made of form-pressed paper on which text and pictures appear very clearly. To my knowledge, none of the literature on John Alston's publication of books at the Asylum for the Blind in Glasgow goes deeper into the matter of the relief pictures.

From the start, the first relief print books from Glasgow contained illustrations. An early example of this is *A Peep into the Menagerie of Birds*.[25] The book has six pages and both the relatively small format and the layout remind you of the small books on natural history which were published from the beginning of the 19th century. In the book you find a note in relief print on a separate page, stating the following: GLASGOW 17 DEC 1841, SPECIMEN OF MR ALSTON'S IMPROVED METHOD OF WRITING FOR THE BLIND. Alston's alphabet was based on Fry's prize-winning system which was used in several schools in England and Scotland for the printing of a large number of books in English.[26]

The format of *A Peep into the Menagerie of Birds* has a horizontal layout, with a picture in the upper left-hand corner of the text page. On each page two birds are described, but only one of them is illustrated. The book ends with a poem written in vertical format, which means that you have to turn the book round to read it.[26] The birds represented in the pictures are also described in more detail. The book starts with the cock. It is interesting to compare the picture with the one illustrating "The Cock and Precious Stone", in *A selection of Fables with Woodcuts*, also published by Alston.[28] The design of the two books are practically the same: a small relief picture on the left-hand side of the page and the rest of the same page covered by text. For both books the same printing technique was employed.[29] The relief picture of the cock in *A Peep into the Menagerie of Birds* consists of various kinds of lines: a solid contour line for the body and head of the cock; a series of short, horizontal lines for the chest; the back and the sides are filled in with faint lines which follow the shape of the bird's body; the tail feathers are made to look bushy with curving lines; the comb and the wattle are drawn in solid lines. It is difficult to judge the quality of the relief, as the copy of the book I have had access to is in very bad condition.[30] It was probably once possible to discern the outline of the cock against the lower background. Today it is only with great difficulty that one can distinguish the relief cock.[31] The picture of the cock in *A Selection of Fables with Woodcuts* shows the head and body as a solid contour line; the tail is a series of curving lines forming a feathery plume; the comb resembles



The Cock, A Peep into the Menagerie of Birds, 1841 (Royal National Institute for the Blind, London. Photo: Mark Crick).



"The Falcon. This bird is nearly allied to the hawk, and is about the size of a raven. It inhabits the north parts of Scotland, and was in high esteem as a bold and spirited bird in the days of falconry. It makes its nest in the rocks. The head of a light rust colour; the under side from chin to tail white, tinged with yellow; the back of a brown colour It is capable of being trained for sport, in which it was formerly much employed".
A Peep into the Menagerie of Birds, 1841 (Royal National Institute for the Blind, London, Photo: Mark Crick).

a small, stylized crown. The cock and the ground he stands on (a dunghill) are a series of lines drawn closely together. On the dunghill, where the cock stands, the precious stone is shown as a diamond shape. Today the picture cannot be appreciated tactually, as it is in extremely low relief, and I doubt if the picture ever was of a particularly good tactile quality. The almost completely filled in surfaces produce an indistinct relief, as they are really too small to be filled in.[32]

The purpose of *A Peep into the Menagerie of Birds* was probably to convey information about a variety of birds. The accompanying text is, however, a combination of fact and subjective judgements.[33]

> The Cock
>
> The common domestic cock is a bird so well known that a minute description of him is unnecessary. The varieties of the

> species are endless. The plumage of the cock is variegated and beautiful; the fine tuft or comb at the top of his head gives him an elegant & majestic appearance; and his eyes have a peculiar fire & brilliancy. His courage is so great, that if of a good breed, he will rather die than yield.

On the same page the hen is described.

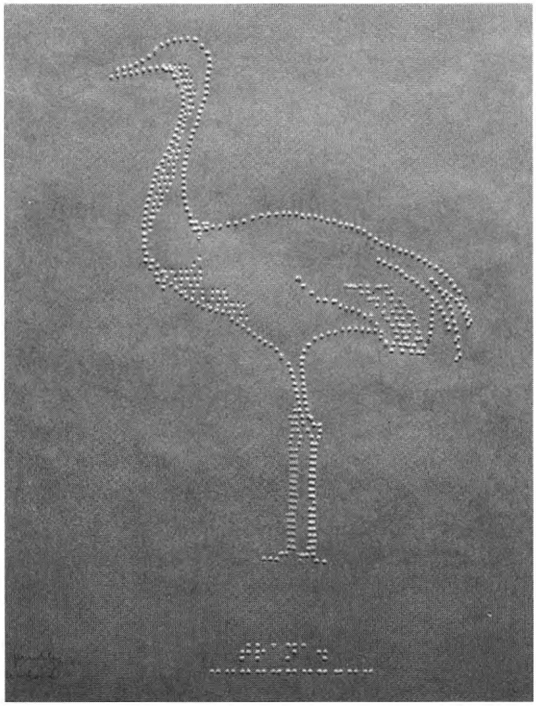
> The Hen
>
> The hen is the female of the cock. She is very inferior to the male in beauty of appearance; but her kind attachment to her offspring hath made her always be regarded as an emblem of maternal affection.

The book on birds contains birds common to Great Britain; the robin, the goldfinch, the falcon, the magpie, the swallow and the blackbird (in addition to the cock and the hen). The book is thus arranged so that two birds are presented on each page; the robin with the goldfinch, the falcon with the magpie, the swallow with the blackbird. A possible pedagogical principle behind this may have been that each page dealt with birds which, in one way or another, are the opposite of each other. The birds are shown in their various natural habitats (with the exception of the cock and the hen which have the same habitat, of course). The robin is a bird of the woods, where it is generally found, while the goldfinch is a seed-eater which normally frequents the meadows. The falcon is a bird of prey, usually found in the countryside, in contrast to the magpie which stays close to human settlements. The swallow normally soars high in the air, while the blackbird prefers to stay near the ground, in gardens and parks.

The descriptions of the other birds in *A Peep into the Menagerie of Birds* are considerably less judgmental than those of the cock and the hen. It is, however, curious that some of the birds are described in terms of their appearance and call or song, while others are not described at all. The appearance and the habitat of the falcon are described, while those of the magpie are not. Like the other birds, the falcon is shown in profile and represented by varying lines. The contour line is solid; a few, irregular horizontal lines cover the back. The tail consists of long vertical lines, as does the wing, which, in addition, is marked by three horizontal lines.

All we learn about the magpie is that it is beautiful and that you can teach it to talk (as folklore had it in those days).

> The Magpie
>
> This very beautiful bird is very common in England, and is likewise found in various parts of the continent. It is crafty and familiar, and may be taught to pronounce words and even short sentences.



The Crane.
(Tomtebodaskolans Blindmuseum, Solna. Photo: Hans Thorwidd).

It is difficult to tell if Alston had any particular model when he published *A Peep into the Menagerie of Birds* but the arrangement and layout of the pictures resemble, for example, Thomas Bewick's *History of British Birds* and *A Natural History of British Birds* (thirty-five wood engravings).[34] The arrangement and the format in both cases are comparable: a small illustration with a brief text. The size of the books, however, is very different, as tactile reading requires a larger format. The tactile book is about 240 x 160 mm in size, and the pictures 75 x 55 mm, while *A Natural History of British Birds* measures 75 x 130 mm. The illustrations in the tactile book are similar to those in *A Natural History of Birds*: small "engravings" of birds in profile with only a hint of the background.[35]

The cock in *A Peep into the Menagerie of Birds* is in shape very like the cock represented on the prospectus advertising the first volume of *History of the British Birds*, published in 1797.[36] There is, however, nothing to say that *A Peep into the Menagerie of Birds* was modelled on any particular book. When representations were copied from an already existing book, the title of that book was normally given.

A large collection of later relief pictures representing birds is still preserved in the Museum of the Blind at the Tomtebodaschool. There are individual pages showing the buzzard, the hawk, the lesser black-backed gull, the wagtail and the chaffinch, the whinchat, the great spotted woodpecker, the lapwing, the sea-gull, the wild duck, and the crane.[37] On the picture of the crane a reference is given to Jägerskiöld, vol. I, p 90. This may mean that the pictures were copied from *Nordens fåglar* (The Birds of the North), by Jägerskiöld and Kolthoff.[38]

Euclid

Alston's *A Peep into the Menagerie of Birds and A selection of Fables with Woodcuts* are, as far as I can find, the first books of their kind. Up until then, the most common illustrations, besides maps, were found in geometry textbooks. When the school at the Perkins institute opened in 1833, there were all together three text-books. One of them was *The Diagrams of Euclid's Elements of Geometry, (arranged according to Simon's edition) in an Embossed or Tangible form, for the use of Blind Persons, who wish to enter upon study of that noble science.*[39] In the preface, the problem of being blind is discussed, along with the fact that the individual resources which the blind possess, in spite of their handicap, were seldom exploited. The author maintains that with adjustment and assistance, the blind person may very well devote himself to science. As examples, he mentions the professor of mathematics, Dr. Saunderson (1682–1739), and the teacher of chemistry and physics, Dr. Moys (1750–1807). An argument in favour of educating the blind is that they can thus become useful citizens in society.

The diagrams are in distinct line relief on paper and still conserve their high quality. The book contains 22 pictorial pages which illustrate Euclid's geometric formulas. The two introductory pages contain definitions of the markings in the explanations of the figures.[40] No effort have been made to adjust the relief text; the letters are capitals and the numbers Arabic. The book is relatively small, 130 x 170 mm, and the picture pages are usually divided by a "dotted line". The "dotted line" stands out from the smooth lines of the figures, making it easier for the reader to distinguish between the figure and the outline. The introduction to the relief pictures shows that the author is aware of how tactile perception functions.

> Directions for using the Diagrams
>
> Cause the pupil to trace, with his finger, all the lines of the diagram he is about to consider, so that he may get the form of it well fixed in his mind. The situations of the different letters,

(which he must endeavour to distinguish readily by their general outline), must also be attended to. Then read to him, (from Simon's Euclid [The diagrams in this work are lettered according to this in Simon's edition.]), the enunciation of the proposition, and when he has got that by heart, and well considered it, he may proceed to the demonstration, which should be gone through step by step, as he can comprehend it; taking care never to begin a new step till he has completely mastered the one before it.

A picture in the Bundes – Blindenerzeitungsinstitut in Vienna is yet another example of geometric figures from the first half of the 19th century. The page is numbered "23" and contains three figures showing the angles a, b and c. The illustration belonged to the following task:

No 23. Task.
What angle can be drawn with the help of two straight lines?
A. Draw an angle with the help of two straight lines.
Solution:
With two straight lines we can make one right angle a,
one acute angle b and one obtuse angle c.

The angles are reproduced in so-called *Masseschrift*, which I assume to be the same as ectypography, as *Masseschrift* resembles ectypography and appears to have the same quality. The interesting aspect of this picture of the angles is that it was still in use as late as 1970, as a mould for a thermoform picture.

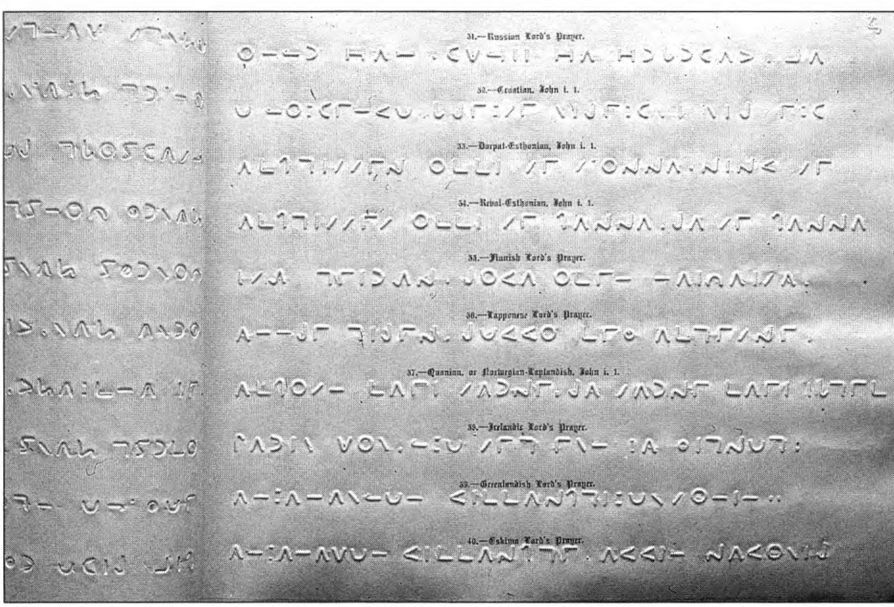
William Moon

William Moon (1818–1894) lost his eyesight as an adult, as a consequence of scarlet fever in his childhood. The illness caused him to be dependent from childhood on relief print (Frere's system). This system was invented by the Englishman James Hatley Frere in the first part of the 19th century. It was initially developed for sighted illiterates and was based on sixteen phonetic symbols. The symbols were read from left to right and from right to left, alternately.[41] Moon developed Frere's writing further and by a combination of signs chosen at random and the old stenographic alphabet, developed by J. Willis (1602), he created what is known as the Moon-alphabet. In 1847, Moon published the New Testament which was the first book to be printed in the Moon-alphabet.[42] Eleven years later, the whole Bible had been transposed and published in the Moon-alphabet, financed by the British and Foreign Bible Society.[43]

In the year 1850, Moon published *Moon's Pocket Atlas for the Blind*, and during the following decades he issued a number of relief pictures and maps.[44] During the second half of the 1880s, or early in the 1890s, Moon published *Embossed Specimens in 250 Languages & Dialects Maps, Diagrams, Music &C*, a folio volume containing written examples of different languages and dialects, astronomical and geographical maps, diagrams, music, portraits, pictures of animals and of public buildings. The book contains relief pictures in various formats which leads us to believe that it was a compilation of parts of Moon's earlier production.

The book begins with the first lines of the *Lord's Prayer*, interspersed with short quotations from the Bible such as St John's gospel 1:1 "In the beginning was the Word and the Word was with God, and the Word was God." This part of the text ends with *the Lord's Prayer* in English, followed by Moon's system of musical notation with instructions in ink print and a melody.

Embossed Specimens in 250 Languages and Dialects Maps, Diagrams,

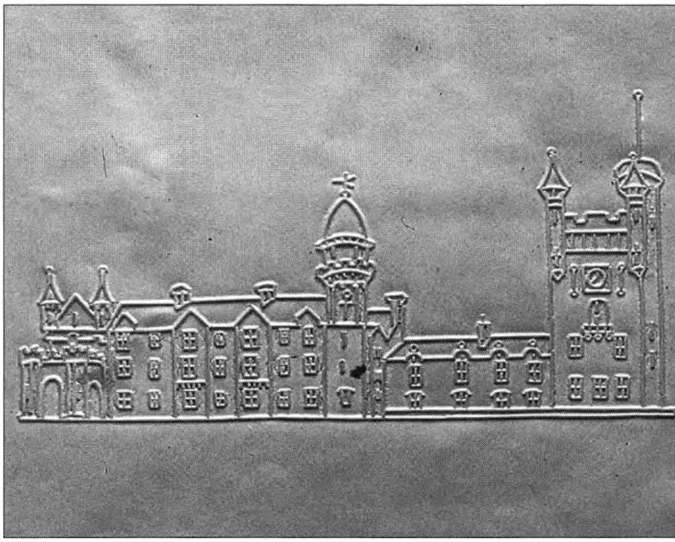


The Lord's Prayer. Embossed Specimens in 250 Languages and Dialects Maps, Diagrams, Music & C, from 1890s (Tomtebodaskolans Blindmuseum, Solna. Photo: Hans Thorwidd).

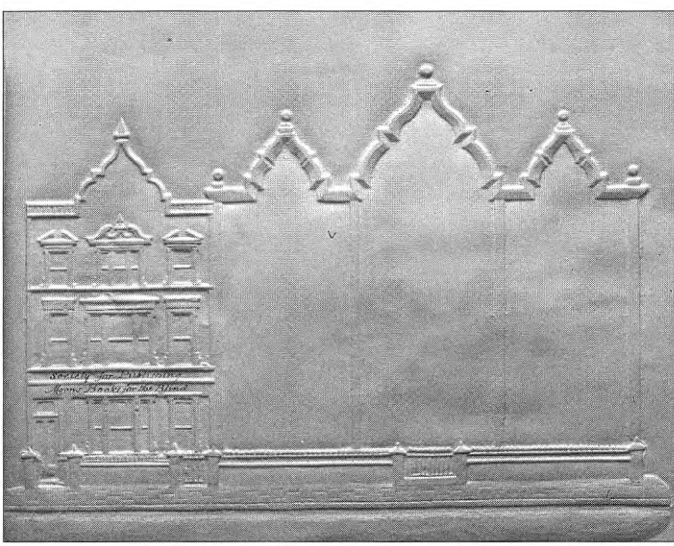
a.

Embossed Specimens in 250 Languages and Dialects Maps, Diagrams, Music & C, from 1890s a. Queen Victoria.

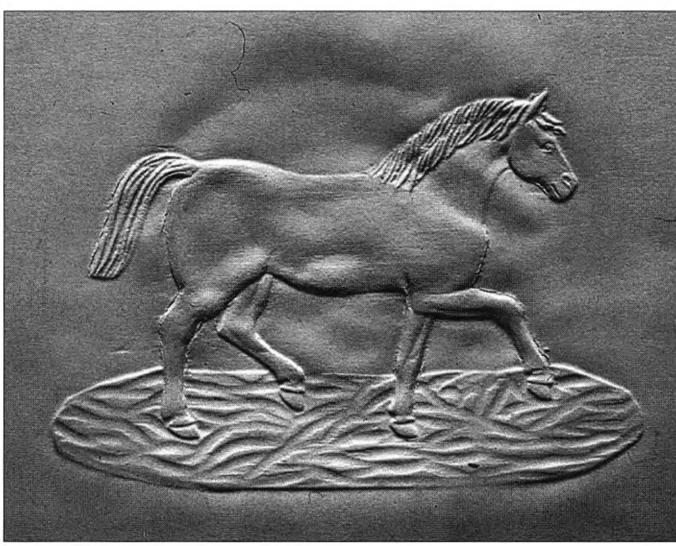
b.



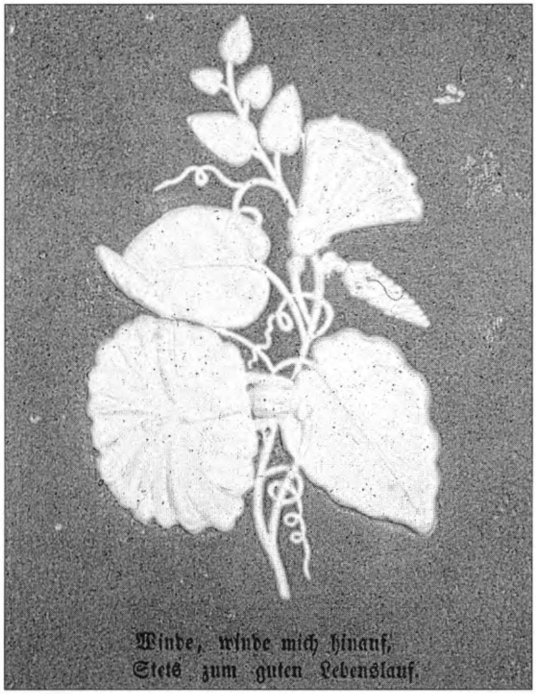
c.



b. Balmore Castle c. The Society for Publishing Moon Books for the Blind building. Embossed Specimens in 250 Languages and Dialects Maps, Diagrams, Music & C, from 1890s. (Tomtebodaskolans Blindmuseum, Solna. Photo: Hans Thorwidd.)



Embossed Specimens in 250 Languages and Dialects Maps, Diagrams, Music & C, from 1890s (Tomtebodaskolans Blindmuseum, Solna. Photo: Hans Thorwidd).



Relief picture-book for the sighted published in Darmstadt, 1846 (Photo: author).

Music & C contains a collection of twenty-eight astronomical maps and pictures representing, amongst other things, the solar system, the firmament, the constellations, various comets, and seasonal charts. A small map of the British Isles, whose size seems to indicate that it was originally in *Moon's Pocket Atlas for the Blind*, precedes the collection. The map shows the islands as embossed surfaces; the rivers are solid relief lines; major towns are dots. The whole text is written in small italics in ink-print. A picture page representing Euclid's diagram follows this map.

The following picture series starts with a small picture page representing Queen Victoria in profile, after which comes Balmoral Castle. The castle was built between 1853–56 and was fairly new when the picture was made. The next picture is a pendant to that of Queen Victoria, representing the late Prince Consort. The selection of the following picture is very natural, and its inclusion speaks for itself. It shows the Society for

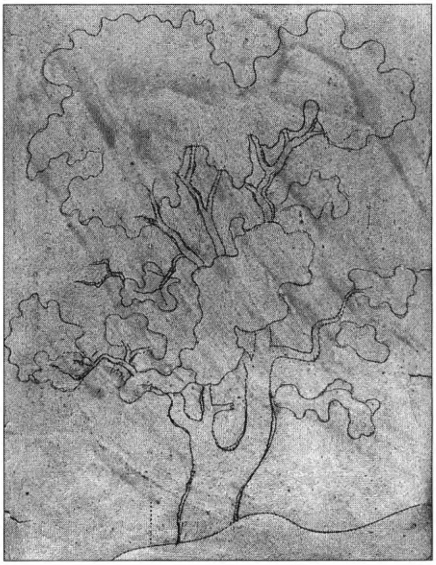
Guldberg's drawing of a bat (Danmarks Blindehistoriske Museum, Copenhagen, Photo: author).

Publishing Moon Books for the Blind building, erected in Brighton in 1856.

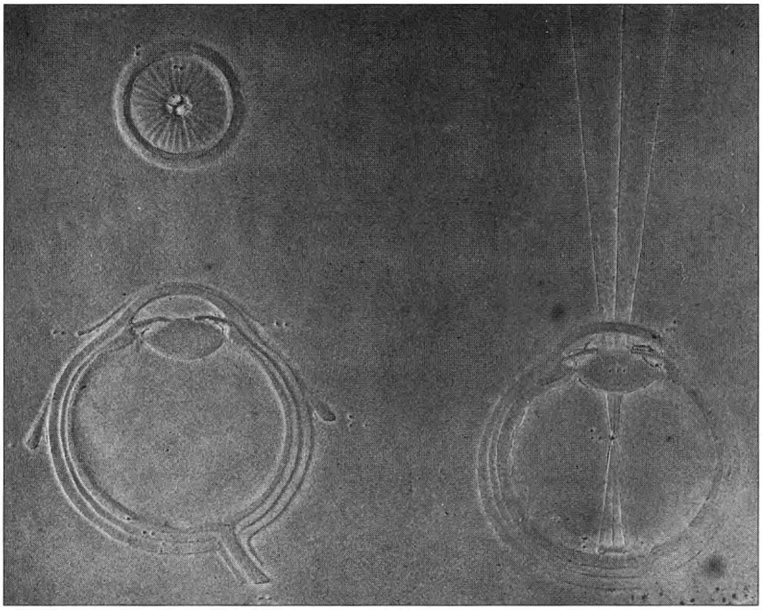
A number of relief pictures of seven buildings is followed by a series of twenty-four pictures. They represent a dog, a cat, a pig, an ox, a tree, a comet, a fish, a watch, a cock, a man in a rowing-boat, etc. None of them is adapted to tactile reading; they are more like the relief pictures produced for the sighted during the same period. An example of this type of relief pictures is a small picture book (153 x 185 mm) published in Darmstadt in 1846.

Guldberg in Copenhagen

Ludvig August Friborg Guldberg taught at the Institute for the Blind in Copenhagen between 1863–1891. He was one of those teachers who themselves produced material for the teaching of blind pupils. In the 1860s he made a relatively large number of relief pictures with motives taken from nature study and physics.[45] One of them is a bat with spread wings, seen from the front. Other relief pictures in the collection show anatomical details such as the heart and physical experiments. The relief pictures were made



Guldberg's drawing of an oak (Danmarks Blindehistoriske Museum, Copenhagen, Photo: Jørgen Schytte).



Guldberg's reliefpicture of the eye (Danmarks Blindehistoriske Museum, Copenhagen, Photo: Jørgen Schytte).

with Guldberg's drawing device. The pictures are executed on yellow or light blue cardboard and the relief is formed by an irregular dotted line.

The exhibits kept today in the Museum of the History of the Blind in Copenhagen are relief pictures representing the circulatory system, the stomach, the intestines, the ear, and the eye. There is also a foot, cut out of cardboard. The relief pictures of plants and animals show a bat, a palm-tree and palm-leaf, a fir-tree, a poplar, an oak and oak leaves, and some other kinds of trees. There are also relief pictures of parts of insects, a cross-section of the earth's crust, the solar system and the earth and its orbit. In all probability, Guldberg used wall charts as models for the reliefs, for example, of the bat and the trees.

Guldberg may also have had a copy of Alston's *Geography and Astronomy* for the Blind (from the 1830s), which contains relief pictures of the Earth's crust, the solar system and the orbits of the planets. This atlas is now kept at the Blindehistoriske museet in Copenhagen, which allows us to assume that it was available at the institute for the blind where Guldberg taught.

Martin Kunz in Illzach

From the 1880s until the turn of the century, Martin Kunz, director of Illzach bei Mülhausen Institute, dominated the market in the production of relief pictures and maps. The pictures and maps he produced were used in German, Danish, Russian and Dutch institutes, in most of the Austrian institutes, and in Swiss, French, Italian and Belgian institutes. Many English and Australian institutes and a large number of North-American institutes also used them.[46] The maps were also distributed in other countries such as Hungary[47] and Sweden.[48] Kunz produced not only relief maps, (these are described together with the other maps, see page 175), but also relief pictures for the teaching of physics, botany and zoology.[49]

Kunz was a trained teacher and had taught at an upper secondary school, before he became director of the institute for the blind in Illzach, where he very soon realized that there was a serious lack of teaching material, especially for geography. While he was teaching at the college, he had persuaded them to purchase teaching models and for geography lessons Kunz made his own relief wall maps.[50] Thus when Kunz came to the Evangelische Blindenwerk in Illzach, he already had an interest in teaching by object-lesson. In his annual report of 1881–82, Kunz stressed the possibility of perceiving minute details with the fingertips and the importance of giving the pupils the means of becoming acquainted with their surroundings through touch.[51] In *Encyclopädischen Handbuch des Blindenwesen*, Mell described Kunz's work:

> In 1877, K. was awarded a prize for the plastic maps which he presented at the Geographic Exhibition in Berlin; he was also awarded prizes in Paris and in many other places. The layered relief sheets produced by the pupils in Genau were later used in the first printing tests in Illzach, which eventually led to the publication of K's three-dimensional repetition atlases for the sighted. This atlas is now in use in many secondary schools in Germany and in other countries. Their creator received one of the few prizes awarded at the Geographic World Congress in Bern in 1891.[52]

According to Johannes Moldenhawer, Kunz appropriated for his own use the method of printing relief pictures on paper which was developed by the Guldberg in Denmark.

> Using a method invented by himself for pressing (cardboard) between en elevated and a depressed mould, he manufactured excellent relief maps of Denmark and Western Europe (Eastern

> Europe was added later). These maps, the first really efficient paper relief maps for use in schools and a copy of which each pupil in the class could be given, aroused great interest in other countries, after being exhibited at the first congress for teachers of the blind. The institute in Copenhagen itself received a number of orders. Mr. Guldberg, however, could not take upon himself a larger production of relief maps on paper and their manufacture was therefore passed on to others, that is, to Dir. Kunz at the institute for the blind in Illzach, Elsass. In England relief maps of this type were also made.[53]

There is nothing in Mell's encyclopaedia to confirm Moldenhawer's information that Kunz appropriated Guldberg's method. I have not been able to find any confirmation in Kunz's own writings, but neither is there any information to the contrary. Guldberg may well have given Kunz the advice and guidance needed to solve the problems related to the printing of maps and pictures in relief. Guldberg was older than Kunz and had long experience of developing teaching material for the blind, pictures and maps as well as models. Perhaps Kunz never mentioned Guldberg's activities in Copenhagen as it would have lessened his own prestige.

Promotional brochures and the large number of pictures which are to be found in the educational institutes for the blind in Europe and in the USA are ample proof of the extent of Kunz's market. Mell points out that Kunz could never have done all this without his wife, Maria Albertina Etter, who kept the accounts, managed the economy and took care of the correspondence.[54]

> For two full years, he made hundreds of attempts at finding a suitable method of reproducing relief print. Thus, slowly but surely, the now widely distributed atlas for schools for the blind came into being. It is probably found in all German and Austrian institutes for the blind, and is also used in Switzerland, Denmark, Russia, etc. K. did all this without hoping for or demanding any share in the profits, as, in order not to increase the expense of the system, he never charged more than cost price. The limited net returns which he managed to make were reinvested in the institute, whose development he tried to promote in every possible way. How else could the maps be sold so cheaply? Today there are 150 moulds which form the basis of the large atlas for the blind, with its 81 maps and zoological, botanical and physical illustrations. On account of his work, K. has earned himself a place in the history of the blind; he did away with the individual teaching of geography which was common at the

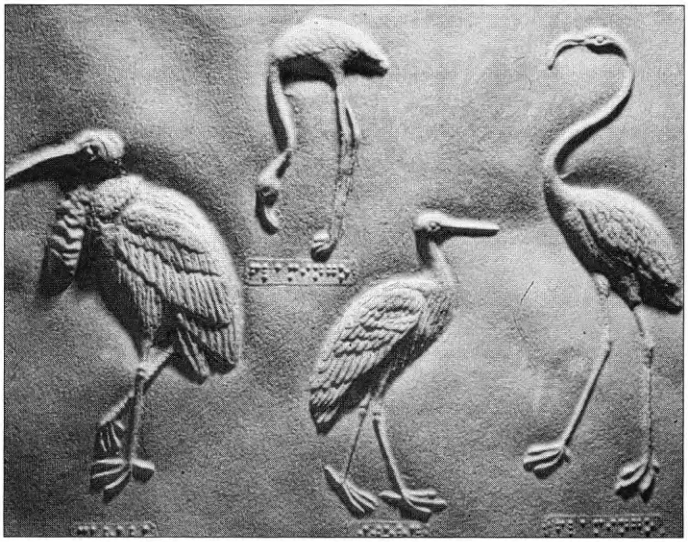
time, as it thus became possible for the poorer institutes to acquire maps for each pupil and to teach geography on a much larger scale.[55]

Kunz explained his theories and ideas on relief pictures under the heading "Bild und Bilder" in *Encyclopädisches Handbuch des Blindwesens*. Kunz begins his lengthy article by describing the reading situation of sighted children, which he then compares to that of blind children. He writes that the sighted child's first book is a picture book which gives him great pleasure and is an important stepping stone in the development of his spiritual life.[56] The increased access to pictures in different types of literature and magazines led Kunz to ask why blind children should be excluded from this rich source of pictures.[57] Kunz advocates not only the usefulness and pleasure of pictures in the teaching of the blind, but stresses that the pictures and maps must be of high quality and produced in several copies. For the teachers to carry out object-lessons efficiently, each pupil had to have his own picture and map at the same time.[58]

Kunz had a clear view of why, in what subjects and in what circumstances relief pictures for the blind were of importance in the educational process. Relief pictures are in many cases necessary when objects cannot be perceived by direct touch. Kunz spoke in favour of pictures, giving examples of the problems that arise when working with objects such as plants and insects which cannot be perceived with the fingers. He emphasised that the teaching models should always be of a size which permitted satisfactory tactile perception.[59] A large part of our physical environment cannot be grasped because of its size or because it may be dangerous to touch. In these cases it is necessary, for the sighted, too, to make the "non-tangible" tangible and available.[60] From Kunz's point of view, nothing hindered the production of relief picture for other subjects as well as geography.[61] He was of the opinion that pictures should be printed for studies in subjects such as languages, history, religion, geography and natural history (including physics, chemistry and biology). Like A. F. Wiberg (see page 199), Kunz could not imagine quality physics teaching without models and relief pictures.[62] Teaching material for physics, consisting of twenty picture pages with a total of one hundred reliefs was produced and sold by Kunz in Illzach bei Mülhausen.[63]

There were, of course, "opponents of paper pictures" who pointed to the risk of lazy teachers confining themselves to the use of relief pictures in their teaching, instead of real objects.[64] The majority of teachers used a combination of objects, models and relief pictures in their teaching.[65]
In this context, Kunz discussed the capacity of tactile perception and the importance of tactile training.

In a lecture at the VII. Blindenlehrer-Kongress in Kiel in 1891, Kunz presented two theories on tactile pictures. The first was the following:



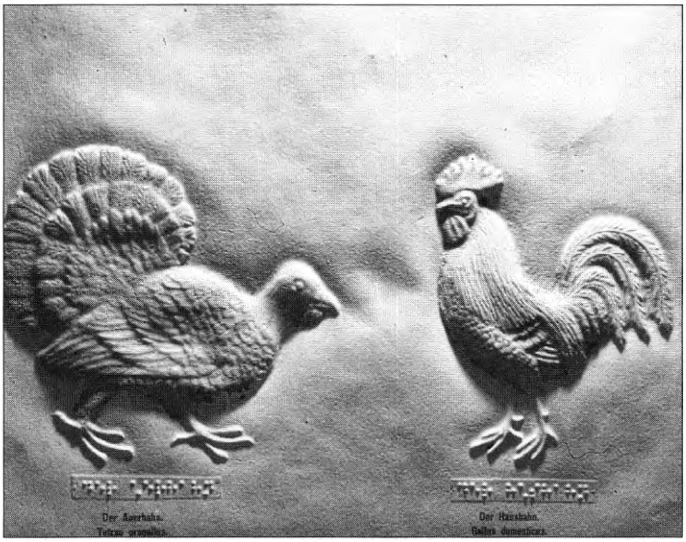
Martin Kunz (Schweizerische Bibliothek für Blinde, Zürich. Photo: author).

> Sufficient numbers of good reproductions make teaching easier and activates the class in nearly every subject in the school for the blind; they make it possible for a great number of things and phenomena to become tangible, immediately and simply, and to be talked about spontaneously by the teacher without disturbing (the pupils') concentration. They are necessary and at the same time inexpensive complements of all the other teaching aids used in object lessons; the principal teaching aids in mathematics and natural sciences, which can hardly be perceived without them; and a valuable "gift" for life. Therefore, efforts must be made to publish works of this type, and applications for support should be made to the associations for the promotion of the education of the blind.[66]

The second theory dealt with how pictures should be used in teaching.

> Illustrations of the human body must primarily be published as half-models, or as flat models, and in the second place, as contour drawings (sketches), which are the lowest category in the descending scale of illustrative material (namely, live animals, stuffed animals, models, half models, flat models and

a.



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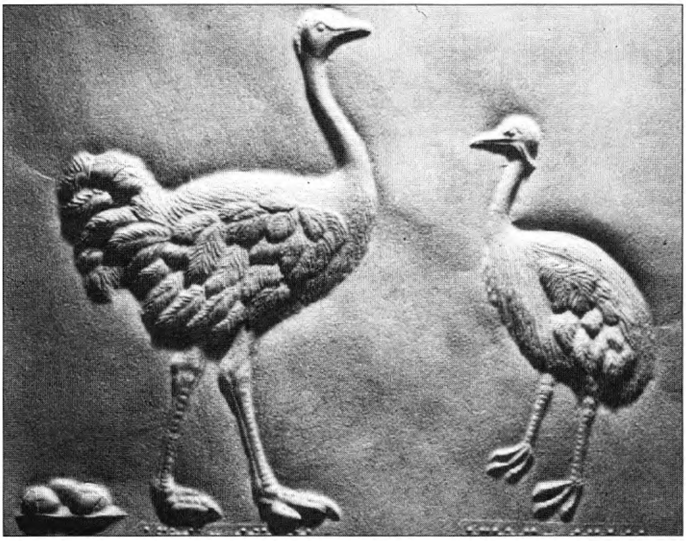


a. The cock capercaille and the domestic cock, Martin Kunz, (Schweizerische Bibliothek für Blinde, Zürich. Photo: author).

b. An African and an American ostric, Martin Kunz, (Schweizerische Bibliothek für Blinde, Zürich. Photo: author).

sketches). Confusion arises when the contour lines are close enough to each other for the finger to distinguish two or more at a time. In this case, the contour drawings must also be made as half or flat models, thus enabling the viewer to feel bodies and surfaces instead of outlines. For the finger, there are no shades and no perspective.[67]

In several of the relief pictures produced by Kunz, we find common animals such as the hen and the cock. This is hardly a coincidence; it is through such pictures of everyday objects, simply designed, that sighted children develop their understanding of pictures. For the sighted, pictures were introduced into teaching by J. A. Comenius in his work *Orbis sensualium pictus* (1642). Kunz had certainly used the contents and design of wall charts as models for his relief pictures. A large part of Kunz's relief pictures are as loose sheets, but there are also examples of series of pictures produced as bound folio volumes. We cannot know whether these collections were sold as bound volumes or were bound at some later date.

Pictures for teaching

All the relief pictures and maps by Kunz in Illzach are made of form-pressed paper. The pictures and the maps are made according to the same concept. On top of each picture page we read: “Abbildung für Blinde, Images pour l'usage des aveugles, Pictures for the Blind, Immagini ad uso dei ciechi”, below which it says “von Direktör M. Kunz Illzach”. Kunz’s pictures were later printed in Steglitz, Berlin (this is only stated in ink print). Kunz enlisted the help of his colleague Biedow of the institute for the blind in Steglitz, when the demand for relief pictures and maps became too great.[68]

The picture motives in Kunz’s relief pictures came from the natural sciences: mammals, botany, fish, reptiles and birds.[69] In mechanics, pictures were produced illustrating acoustics, optics and meteorology. The picture surface was arranged in a way that each picture page presented one or several objects. All the pictures I have seen have braille text (with the exception of the maps) and certain pictures also have text in normal ink print. The texts (ink print as well as braille) are written in two languages: German and French.[70] In sales lists, we are informed that relief pictures from Illzach were sold with or without text.[71] I have found examples of this at the Institut de Valentin Haüy in Paris, amongst other places. At the institute’s museum, there is a book with reproductions of mammals. One of the pictures represent an Indian elephant. The same picture is found on a loose sheet at the Museum of the History of the Blind in Berlin/Steglitz. In the Paris picture, the text is in ink print as well as in braille, while the picture in Berlin is only in braille.

It was thus possible to purchase the Illzach relief pictures in different presentations. There were also varnished pictures, the reason for which was that the varnish protected the pictures from dirt and made them easy to clean.[72]

When there are several objects in one and the same picture, the idea is to show two kinds of the same animal (e.g. the red deer and the fallow deer). The animals are shown in profile, the red deer to the left and the fallow deer to the right. The relief has no texture on the surfaces and showws an unequivocal form against the background. The animals' bodies are detailed and muscles and articulations are clearly distinguishable. Details of the skin are also enhanced. At the bottom of the picture, in the centre, the letters M. K. have been engraved in Italics, with the year and serial number in Roman numerals.

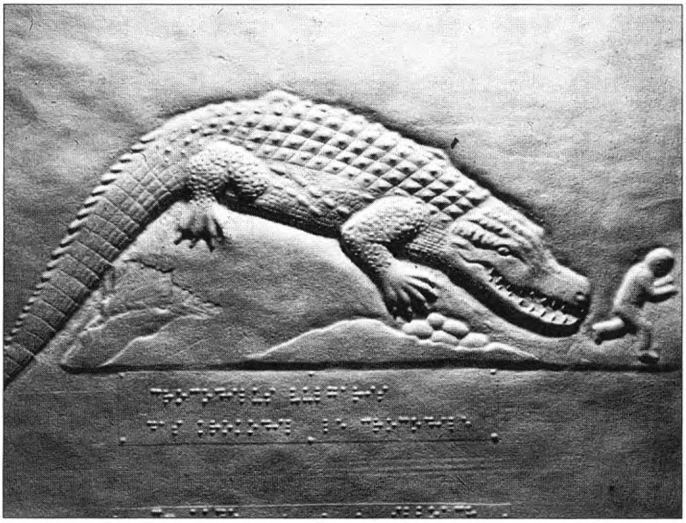
In the relief pictures of different species of birds, the details on sculpted mould are even more distinct. The plumage, rich in detail, not only produces a visual effect, but can also be experienced tactilely. Another example, where two related species are pictured in order to illustrate the differences between them, is the picture of the cock capercaillie and the domestic cock. This relief is also provided with text in ink print and embossed print.

The cock capercaillie is shown in profile and its feet are clearly distinguished, one in front of the other, as if the bird were walking. The plumage is richly detailed and the raised tail is seen from the front, even though the rest of the bird is pictured in profile. By this means, it is easy for the viewer to feel the whole tail with his fingertips. Kunz has thus pictured the bird from two sides and in two situations at the same time. To the right of the cock capercaillie is the domestic cock, pictured at an oblique angle. We see the cock's carefully breast, while the head is in full profile. The comb is strong and clearly visible and tangible in the centre of the cock's head. His feet are shown in semi-profile. The animal is richly modelled and is perhaps rather a visual than a tactile relief.

The picture of the ostriches is somewhat different as it represents an African and an American ostrich. In the bottom left-hand corner of the picture are the ostrich's eggs in what appears to be a bowl. The stately ostrich is placed so that the tail stretches over the bowl and the beak points to the right of the picture. It is thus a profile. Opposite the ostrich, to the right of the picture, there is the smaller, American ostrich. As in the previous picture, the left-hand bird is in full profile while the one to the right is in semi-profile. The legs and feet of the cock to the left are shown as parallel in profile (like the cock capercaillie) while the legs of the American ostrich are shown in semi-profile. In the picture of the deer, their legs are also different. The hind legs of the fallow deer are clearly discernible, while one of the red deer's front legs is barely visible. This has probably been done in an attempt to create perspective.

The crocodile

The picture of the crocodile chasing the fleeing man is very effective. The crocodile's jaws are half open so that you can see his big, sharp teeth threatening the little running figure. The crocodile is in profile; his body is twisted round. Beneath him there is something that looks like cliffs or rocks. The varying textures of the crocodile's leathery skin are well executed. The picture gives a feeling of movement, which is unusual in relief pictures for the visually impaired. This movement is created by the twist in the animal's body and by the leaping man, with one leg in the air, his arms stretched out before him and his body leaning slightly forward. The motif belongs to the sphere of popular culture and the genre is typical of that period when animals were represented as aggressive creatures which were threatening for children.[73] In her essay "... I skapelsen en länk, från Englarne till djuren ... En 1800-talsikonografi" (A chain in creation, from angels to animals ... An iconography from the 19th century), Lena Johansson writes about the iconography of animal motifs as part of the existential question of the period, on the separation between man and nature, where the dog was part



The crocodile, Martin Kunz (Schweizerische Bibliothek für Blinde, Zürich. Photo: author).

of man, in contrast to the wild animals. Children's magazines often included pictures of animals:

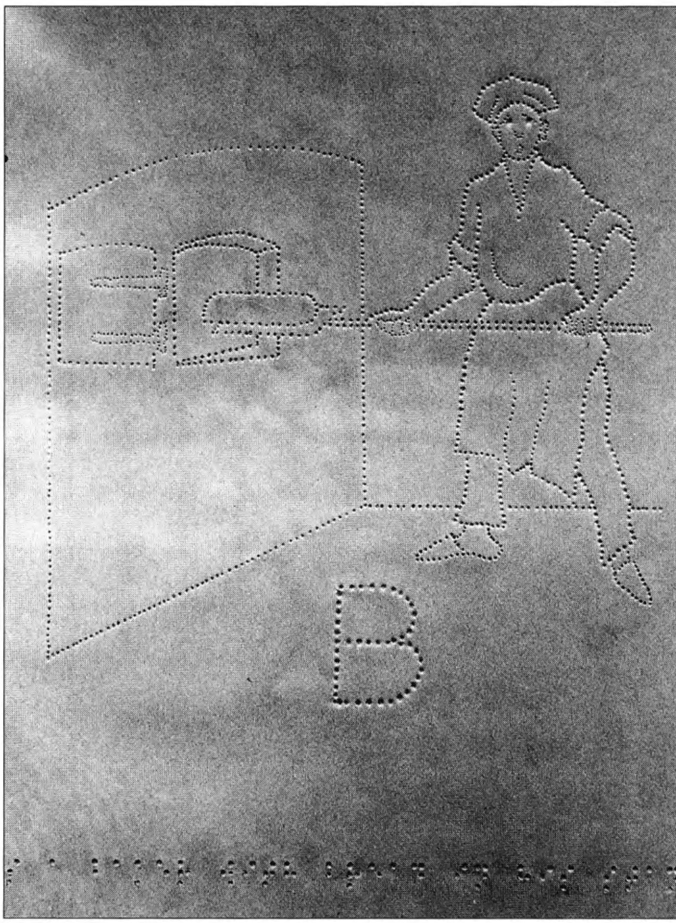
> ... as often followed by animals shown in extremely dangerous relationship to the children. The texts, whose general purpose was to teach zoology, end with the animals being put in their rightful place in Creation, as Scripture would have it. There are descriptions of the character of the boa, the vulture, the lion, the dog, the bear and the crocodile, amongst others, and several of the animals with the important exception of the dog, of course—are considered the very incarnation of evil.[74]

In the chapter "Bild und Bilder" in *Encyclopädisches Handbuch des Blindenwesen*, Kunz begins with a description of the wide variety of pictures which sighted children had access to in newspapers, textbooks and specialised literature. He was probably influenced by the motifs of his time, just as he was influenced by wall-charts when he designed his relief pictures.

The tactile quality of the relief picture

In his lecture at the VII Blindenlehrer-Kongress in Kiel in 1891, Martin Kunz asked whether relief pictures for the blind could be printed in a way that made it possible to perceive the relief and understand the picture satisfactorily. If so, what status would be given to the relief picture amongst the available object-lesson material, and how should it be designed? Was it possible to design a tactile representation in such a way that the blind viewer could instantly grasp the relationship between the representation and the object represented?[75] Kunz's conviction that teaching was facilitated by good relief pictures for classroom use (all pupils should have their own copy) has already been mentioned. According to Kunz, four types of relief pictures should be made. The first should be a half model (i.e. a full model divided length-wise, in high relief), followed by a plan drawing of the model in somewhat lower relief. Thirdly, an outline drawing of the model, and, finally, the relief picture.[76] Kunz points out that the finger cannot perceive perspective or shading; it can only perceive projection.[77] In order for the pupils to learn how to understand tactile pictures, they must start with very simple ones. The picture surface should show a simple object or figure, and animals should also be represented in a way which stressed their individual characteristics. Group pictures should be avoided as far as possible.[78] Kunz maintained that the tactile picture book could even replace the microscope in the teaching of the blind, since many things can be represented in relief pictures which are otherwise impossible to perceive by touch because of their size or other characteristics (they may be either too big, too small or simply too dangerous to touch).[78]

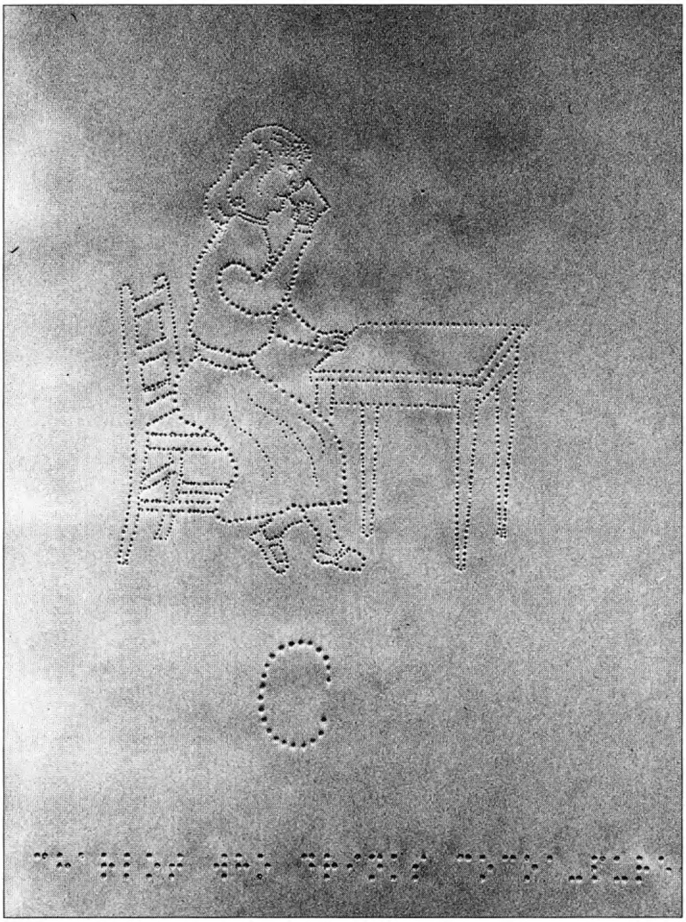
Kunz was, in fact, one of the last to produce relief pictures from a three-dimensional mould. Those who came after him, as well as some of his contemporaries, mainly produced contour relief pictures. Not until the plastic relief picture was invented in the 1960s did this type of picture reappear, though the process has changed somewhat. First a mould is made from a variety of materials; this is then used to create the plastic relief picture in a vacuum press at high temperatures.[80]



"B is for Baker with bread on his peel", A Toy Book with Imitation of Verses (Photo: Courtesy Samuel Hay's Research Library, Perkins School for the Blind).

Picture-books in relief for children

A large number of relief picture books for children were school textbooks, but other kinds of relief pictures also existed, some of which can be classified as entertainment. At the Samuel Hay's Research Library, Perkins School for the blind, USA, there are books, objects and individual reliefs



"C is for Charlot, who drinks cocoa—Pure." A Toy Book with Imitation of Verses (Photo: Courtesy Samuel Hay's Research Library, Perkins School for the Blind).

donated by the writer, Helen Keller. She either used them herself and later donated them to the library, or bought material she herself had found useful and which the pupils at the school could benefit from. Amongst other things, there is a large collection of natural history pictures by Martin Kunz, and in 1918, Helen Keller presented the Perkins School for the Blind with *A Toy Book with Imitations of Verses*. This book has dotted line drawings in two different thicknesses. The thinner lines consist of holes punctured in thick paper. The book is an illustrated alphabet, and most of the stories are very difficult to read tactilely, although the lines themselves are very clear.

A Toy Book with Imitation of Verses is an illustrated primer with one letter of the alphabet (a capital letter) on each page.[80] The same technique was used for both letters and illustrations. There is text in braille at the foot of each page. The relief pictures are not particularly well executed, but are full of charm. They are almost naïf, although no particular style was actually intended. Several of the pictures represent complicated chains of events. The primer starts with A for Ape, and the relief picture shows the ape turning his head as he climbs a tree. His right arm and both legs are facing the left-hand side of the picture, while his head is turned to the right, as he looks at a fruit which he holds in his left hand. All this makes an otherwise simple picture quite complicated for the tactile reader.

The letter B stands for Baker, and the text reads: "B is for Baker with bread on his peel." The picture shows spatial relationships with just a few simple lines. The angle formed between the floor and the left-hand wall is shown by a diagonal line on the left of the picture which meets the horizontal line representing the back wall. The baker is putting bread into the oven (or taking it out). The open oven is shown in perspective. The baker himself, who is facing us, wears the typical baker's hat and apron.

"C is for Charlot, who drinks cocoa—Pure." The relief picture shows a girl sitting at a table drinking from a cup which has no saucer. The chair and the table are in perspective; the table is in reverse perspective and the girl is in profile. It is obvious that this picture is much less skilfully executed than the previous one. The girl's upper arms are too short and her hands and feet too small; its style is extremely naïf.

For the letter R there is a scene which, for the tactile reader, is extremely complicated. "R is a robber, but the police will him press. "The picture shows a boy who has climbed a wall to steal apples. However, a policeman is about to catch him, while a man stands by watching. The wall the boy has climbed is only faintly outlined; the corner stones are indicated, and dotted parallel lines mark the top of the wall. The apple trees are sketchily executed, but the apples themselves are clear. The boy is shown at an oblique angle from behind, and there are quite a few overlapping details in the picture. *A Toy Book with Imitation of Verses* is an example of relief pictures for the blind produced on the same lines as the majority of contemporary picture books.

French relief pictures

In Paris, La Roue's printing-works published three richly illustrated books for adults in embossed print. They dealt with anatomy for physiotherapists, insects and gallinaceous birds. It is not known when these books were published.

There is a long tradition of the visually handicapped training to become masseurs or physiotherapists, as these activities depend on the use of the hands. Vocational training in these professions has mainly been carried out on models and live persons. At the beginning of the 20th century, an anatomical picture-book, *Aide-Mémoire pour les Masseurs Aveu-gles*, was published for masseurs who had graduated in Paris. This "memory aid" consisted of 28 charts.[82]

The pictures consist of solid and dotted lines which create a relief against the background. They show parts of the human body in greater or lesser detail, depending on the subject. The relief pictures are made on porous paper with the result that the relief is difficult to distinguish. It was no doubt clearer when the pictures were new. All the pictures have what are now called reference lines. These are narrow, dotted lines which terminate outside the picture itself in a braille sign. A key informs the reader of the meaning of the braille sign.

The book containing charts of insects has the same format as the anatomical pictures (176 x 270 mm), and is produced on the same type of paper.[83] *Moeurs et vies des insectes* shows one insect on each page, with picture descriptions in braille and ink print in italics.[84] The insects are shown as whole surfaces as well as lines, many of which are dotted lines.

In the relief picture book on gallinaceous birds, some of the pictures are arranged in the same way as the anatomical pictures, that is, with reference lines. Relief is created with surfaces and lines, as in the insect pictures.[85]

Gallinaceous birds were much more common in those days, and I find it interesting that they should have been depicted in relief, with reference lines giving details of the principal characteristics of the various species.

This book was probably produced for blind persons who lived on farms and to some extent took part in everyday chores there.

A Picture-book for the Blind

A Picture-book for the Blind was produced with persons who had lost their sight during the First World War in mind.[86] The contents of the book, probably published in the 1920s, are varied, and information on the picture it was copied from is given with each relief illustration, enabling the reader to study the process of transformation from the visual to the tactile representation, and to some extent, to follow the chain of thoughts which took place when the pictures were adapted to relief. Several of the illustrations are taken from *Distant Lands* and *Lands Beyond the Channel* by the well-known geographer, H. J. MacKinder.[86]

The picture book contains 18 illustrations and is 250 x 355 mm in size; all with their corresponding description.[87] The pictures have a size reference in the form of a dotted line representing the height of the average person. The book is bound and the picture pages printed on strong, white paper. Each spread has text in ink-print on the left-hand page and an illustration on the right-hand page. The relief pictures consist of dotted lines and surfaces filled with dots of varying degrees of coarseness. With a few exceptions, the pictures are surrounded by a dotted line. At the foot of each text page, the origin of the text is indicated. The pictures represent: 1. Charing Cross, 2. The Rialto Bridge, Venice, 3. The Leaning Tower of Pisa, 4. An Oasis in the Desert, 5. The Great Wall of China, 6. A Bison, 7. An African Lion, 8. Whallay Cross, 9. A Norman Arch, 10. Norman Ornamental Moulding, 11. A Perpendicular Window, 12. The Balloon: a Finger Picture, 13. Section of the Heart, 14. Mechanics, 15. Zoology (two spreads), 16. A Spider's Web, 17. Electric Bell, 18. The Maze at Hampton Court.

The preface (in ink-print) not only tells us why the book was produced, but also mentions its unique role.

> THIS IS THE ONLY PICTURE Book of this kind in the world. It is a book designed for those people whose fingers are their eyes—the Blind. For you who can read these words there are thousands upon thousands of picture books to supplement the pictures of life that are always before your eyes. It must not be supposed that a man or woman blind practically from birth, by running their fingers over the embossed drawings in this book, can instantly conjure up a mind-picture of the object represented by means of raised dots. At the same time these pictures can convey an enormous amount of knowledge and pleasure to those of our less fortunate fellow-beings condemned to live in perpetual physical darkness. And if this book comes to you as a reminder of all your sight means to

> you and of the debt you owe to providence for your own inestimable gift or sight then our object has been achieved. The titles of the books from which the pictures were selected are given on the description pages.

A Picture-book for the Blind is not only varied as to the subjects chosen for illustration. Its relief pictures are also examples of different styles. There are pictures with perspective, simply reproduced objects and animals, as well as pictures showing certain stages in their development. The representations with perspective to some extent follow the rules which apply to visual pictures in general. Those elements closest to the viewer are lower down on the picture and are drawn in thicker lines, while things which are farther off are higher up, smaller in size and drawn in thinner lines. The producer has also used what we could call an "inclination gradient" to illustrate the fact that a surface disappears over the horizon Thus the texture becomes denser as it approaches the horizon line.[88]

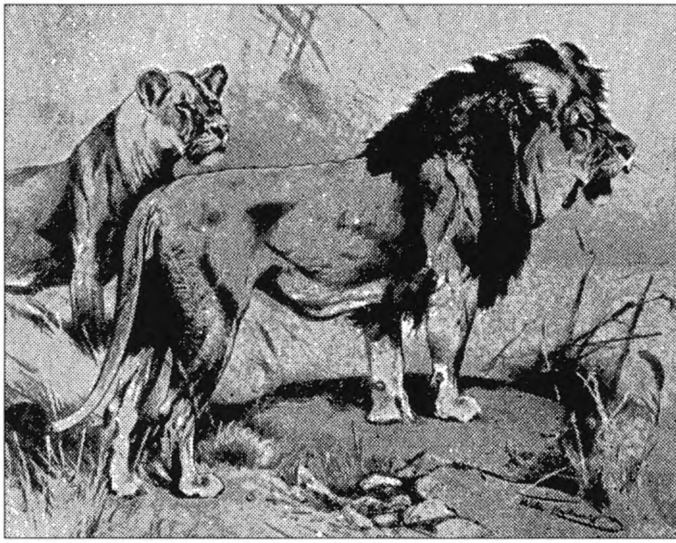
The seventh illustration in *A Picture-book for the Blind* represents an African lion in profile. It has a solid outline and the body surface is filled in with smaller dots. The mane is a series of short, curving, dotted lines. Otherwise it is empty. The eye is marked with a bigger dot and the lines indicating the back legs are thinner. The original of "African Lion" is in *Distant Lands*, where the lion is resting on a hillock. We are looking at him at an angle from behind. His head is turned to the right, so that we see his nose and his half-opened mouth in profile. Behind him, on the left of the picture, we can see the front part of the lioness. The background is suggested by tufts of grass and small heaps of stones.

The relief picture shows only the lion in profile, standing on slightly curving parallel lines which represent the ground. It is framed by a dotted line. No details of the animal's muscular body have been included in the relief picture; its majestic mane is very much smaller and its tail much shorter. The transformation of the muscular body into something quite tame is explained by the fact that the person who produced the relief picture knew nothing about the anatomy of lions. A small, wrongly-positioned bend in the line which represents the lion's front leg makes him look physically impaired. An interesting detail is that the lion's mouth is open in the relief picture, just as it is in the original.

The relief picture has a series of letters which correspond to different parts of the animal (legs, tail, mane, back and front). The descriptive text only appears on the relief picture; there is none on the original in *Distant Lands*. The description of the lion in *A Picture-book for the Blind* reads as follows:

> An African Lion
>
> The lion is shown standing on the crest of a hillock marked G,

a.



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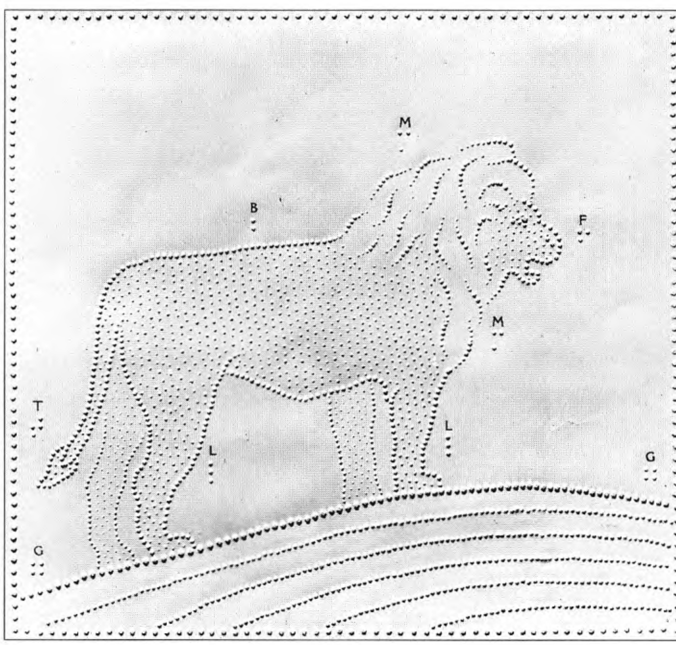


a. An African Lion, Distant Lands by H. J. MacKinder.

b. An African Lion, A Picture-Book for the Blind (Royal National Institute for the Blind, London. Photo: Hans Thorwidd).

the slope of the ground being indicated by parallel lines drawn across the lower part of the picture. F marks the animal's face; the letter is placed just in front of the nose, below which the open mouth and the projection of the lower jaw may be felt. The great mane M, which covers the head and shoulders, is represented by short curved lines, and the long line of the back is shown at B. The tufted tail is marked T, and the legs L.

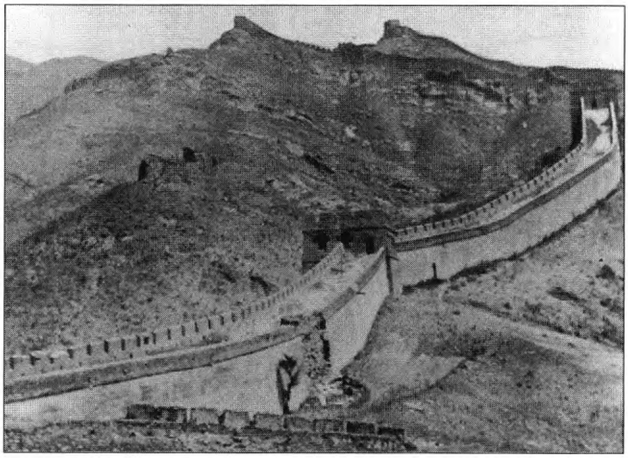
It is thus a description which helps the reader to interpret the picture, since its different elements are marked on the parts referred to. The text accompanying the picture of the bison (before that of the lion), is of the same kind:

> A Bison
>
> The animal is shown in action as it appears when galloping across the prairie. The long grass G, is represented by the curved lines across the lower part of the design. The head of the bison H, is bent down towards the ground, the muzzle almost touching the bent foreleg. The great mass of hair which covers the shoulders like a mane is marked M, and indicated by short curved lines. The tail, waiving in the air, is shown at T, while the sharply-bent forelegs indicate by the letter L.

This picture of an energetic, almost flying bison is one of the best in the book (see cover picture). The original is also in *Distant Lands*. There, the bison is pictured face on but at an angle. He is galloping with his projecting head bent slightly towards the ground; his tail waves in the air. It is obvious that the bison is galloping over fairly short grass. In the relief picture, however, the angle from which the bison is observed has been changed somewhat. The head is now in full profile, the front legs are no longer parallel, and the hind legs are not in contact with the ground. The forceful thrust which one felt in the original is lost. Instead, it looks as if the bison is flying through the air. The changes in the bison are similar to those in the picture of the African lion when it was transferred to relief. The bison's tail is much shorter and simplified in the relief and ends with a stereotyped tuft like the one on the lion's tail. The outline is solid, with the exception of the point at which the left foreleg breaks the line. It is obvious that the person who made it was not sure how the leg should continue under the mane. The bison's strong, right foreleg has the same arbitrary design as that of the lion. Its shaggy hair is represented by short, slightly curving dotted lines, and the body filled in with small dots. The grass is shown as short, curved, dotted lines. There are braille and ink-print references on this picture, too. It is framed by a distinct, dotted line.

Apart from the pictures of individual animals and objects, there are

a.



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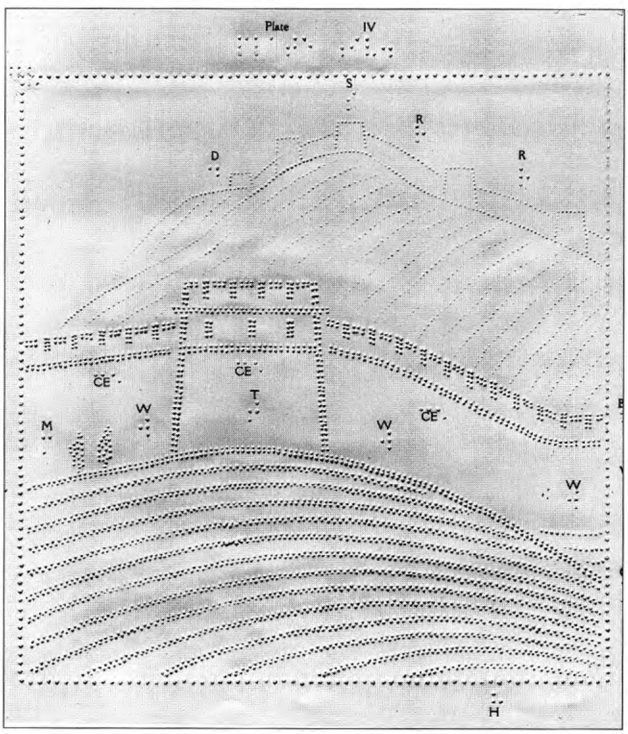
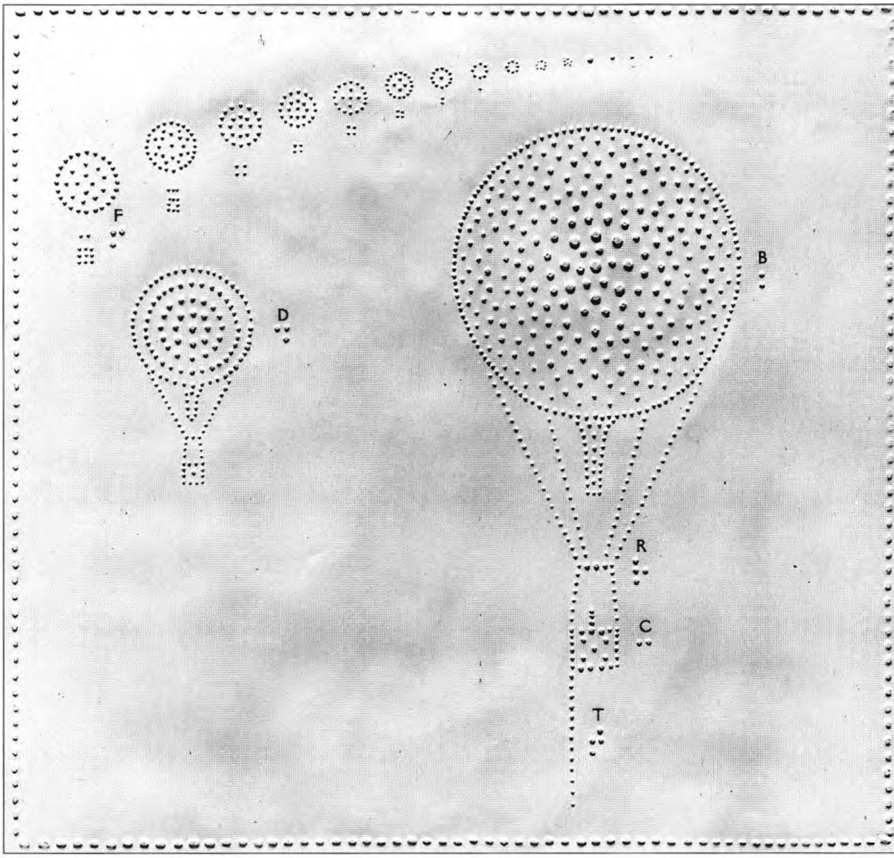


a. The Great Wall of China, Distant Lands by H.J. MacKinder.
b. The Great Wall of China, A Picture-Book for the Blind (Royal National Institute for the Blind, London. Photo: Hans Thorwidd).

also pictures of whole environments, such as the relief of the Great Wall of China. The idea of representing the seemingly endless Great Wall of China to a visually handicapped reader may seem odd, especially since the picture is very specific and shows what the Great Wall looks like in its entirety as well as sections of it. But it does show that the person who made it knew how tactile perception functions. In comparison with the original, it is clear that the angle of the relief picture has been modified to show the wall straight on, and not at an angle and very much foreshortened as it was in the original. The undulating terrain in front of the wall on the original is shown in the relief picture by a series of curved, dotted parallel lines which converge in the lower right-hand corner of the picture, outside the border. The upper line forms the outline of the hill meeting the wall. The viewer is facing the wall and one of the towers on the wall is positioned in the centre of the picture. The composition of the picture is arranged in such a way that the wall continues out of the picture on either side. The prolongation of the wall can be discerned in the upper part of the picture, where it consists of simple, narrow lines without any detail. The landscape between both parts of the wall is indicated by narrow, dotted lines which cross the space between the wall surfaces diagonally.

The descriptive text leads the reader through the picture as it explains its composition.

> The Great Wall of China
>
> Find H outside the lower border. We are supposed to be standing here on a hill-side. The parallel curved lines across the lower part of the picture indicate how the surface of the ground slopes downwards to the right and left, and at the same time it must be imagined as rising and receding from us in a steep slope till we come to the curved line of the crest which is marked C in the margin to right and left. On the left of this crest at M, are the figures of two men, standing at the foot of the Great Wall W, the vertical face of which is shown as a broad, smooth strip, extending right across the picture, and following the curve of the ground upon which it is built. On the highest part of the hill T, marks one of the square towers which are placed at frequent intervals. The battlemented top of the wall is shown from B to B, and CE marks line of a projecting cornice below. /Away in the distance, and towering above the line battlements, appears a great mountain, much higher than the hill upon which we are standing. It slopes upwards and away from us to the right, as indicated by the faint parallel lines. The wall immediately in front of us slopes down into a valley, V, on our right, and disappears out of the picture, but from this point it must be imagined continuing



The Balloons: a finger Picture, A Picture-Book for the Blind (Royal National Institute for the Blind, London. Photo: Hans Thorwidd).

> across the valley and sweeping round to the left until it reappears into the picture at R, where it follows the crest line of the distant height to the summit S, and finally disappears behind a shoulder of the mountain at D.

A Picture-book for the Blind contains a number of illustrations of objects which are difficult for the blind person to grasp: wild animals only found in European zoos or monumental architectonic wonders, whose enormous size is as impossible to perceive as that of the Great Wall of China. It also contains a picture of a cobweb, whose fine, lacy threads cannot, of course be perceived by touch. A frequently-appearing motif in different types of magazines and reviews during the first decades of the 20th century is the hot-air balloon. It is therefore not surprising to find it represented in *A Picture-book for the Blind*. The original is in *Comrades* (March 1918).

The relief picture shows hot-air balloons at various distances from the viewer: from a close-up of the balloon to balloons disappearing into the distance. The picture can also be interpreted as a simultaneous succession, the progressive disappearance of the same balloon into the distance. On the far right of the picture, we see the balloon with its main characteristics very much simplified. The balloon itself is a filled-in circle; the dots in the middle are more pronounced than the rest. The basket hangs under the balloon on four lines which converge on a crossbar connected to the basket by two lines. A short, dotted line rising from the basket represents a person. A line hangs down from the basket.

There is another balloon to the left of this one. This second balloon is farther away than the first, the next is still farther off, and so on. In all, there are 18 balloons in the picture, illustrating their movement through the air. Each successive balloon becomes not only smaller, but more simplified, until the last and farthest away are drawn in very faint dots. To illustrate the gradual disappearance of detail with increasing distance, the number of lines joining the basket to the balloon is reduced to two in the second and third balloons; the centre of the balloons is still clearly marked. When the balloon has moved farther to the left and upwards on the picture, these lines have disappeared. The balloons have references in the form of braille and ink-print letters.

The accompanying text is interesting as it gives a description of the balloon and attempts to explain to the visually handicapped reader what it means to see something at a distance.

The Balloons: a finger Picture

Imagine that the rectangular border represents an open window. The smooth margin of the paper outside the border you must think of as being part of the wall, but inside the border all the smooth that appear represents open space./ Suppose yourself standing at this window while some balloons are drifting by overhead in the clear, unclouded sky. Stretch out your arm through the window as far as you can reach, and move it about in every direction. You would feel nothing. But if you could stretch your arm till it was five or six hundred yards long, you would be able to touch the nearest balloon, the great gas-bag of which is marked at B.

This is a huge hollow ball of silk enclosed in a network of fine ropes, the ends of which converge below, and are attached to a ring shown at R. Below this is suspended the basket or car, C. The short dash above the upper rim of the car indicates the head and shoulders of the aeronaut, and gives an idea of the

> size of a man compared with the bulk of the balloon. A long rope, known as a trail-rope, is often seen hanging from the car. This is marked T.
>
> To the left, and half a mile or more away from you, a second balloon is shown at D. It is really the same size as the first, but being much further away, it has the appearance of being smaller and fainter./ Above this, at F, is a balloon supposed to be a very long way off, and drifting slowly away from you. If you move your finger to the right you will feel how it gradually becomes smaller and fainter as it drifts further away, until at last it quite disappears from touch in the same way that it disappears from sight. At moderate rate of speed it would probably take ten minutes to move from F to the point where it can no longer be seen.

The most interesting aspect of the relief pictures in *A Picture-book for the Blind* is that the artists have employed a combination of thicker and thinner lines and surfaces in order to illustrate distance and depth. In addition, all the pictures in the book have ink-print and braille reference points. In spite of their simplification, however, the pictures are not always any clearer. An example of this is the picture of the lion where the mane has been simplified but has not been made any clearer, as it should have been, considering that the mane is the lion's most characteristic feature.

A Picture-book for the Blind aroused a certain amount of interest when it appeared. The 1921 Christmas number of *The Beacon* contained the following:

> At the Printers' Exhibition recently held at the Agricultural Hall, Islington, great interest was evidenced in A Picture-book for the Blind, which is the production of the Design Department of the National Institute for the Blind /.../ One of the most instructive of these finger pictures is that which represents a balloon as seen at a distance and gradually receding from view. On passing her fingers over this picture a blind girl was heard to exclaim, "I didn't know that objects appear to grow smaller when they recede", a remark which we think amply testifies to the practical value of the contents of this A Picture-book for the Blind.

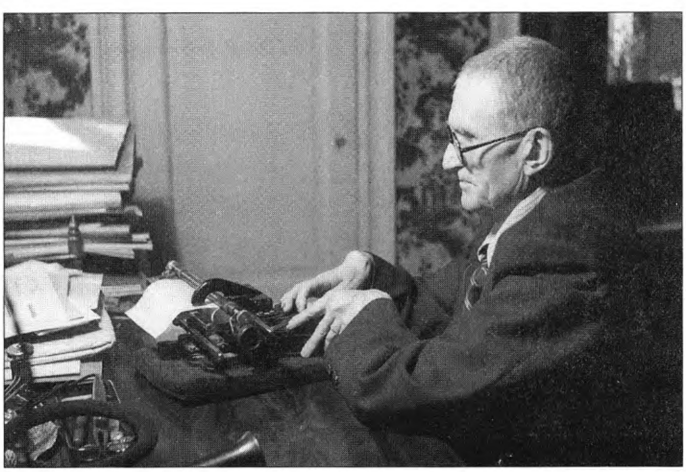
The article also contained information on the technique employed in the production of the relief pictures.

> A word as to the production of the pictures: First a drawing is prepared on tracing cloth. This must be designed with infinite care; it must contain as few lines as possible, and each line must

have its meaning; no detail must be inserted which would prove too small to be felt clearly by the finger. The plate upon which the design is embossed for printing is a folded sheet of thin zinc. This is laid down on a flat bed of pitch, the surface of which has been softened by means of a gas flame; a roller is passed over it until it becomes level and firmly attached to the pitch. When this is cool and hard, the drawing is pasted face downwards on to the level surface of the plate, and the embossing is done by means of a light hammer and steel punches of various sizes. As the plate of metal is doubled, the impression of each dot is received on both sheets at the same time, forming a die and counter-die. In printing, a sheet of paper is simply inserted between the two leaves of metal, and pressure is applied.

Harald Thilander and his illustrated books

Just over ten years after the appearance of *A Picture-book for the Blind*, the Swedish printer, Harald Thilander, published *Tusbildoj* two volumes in Esperanto with a large number of relief pictures. The contents and style of the relief pictures in the first volume resemble those of *A Picture-book for*



Harald Thilander (Photo: Courtsey Tomtebodaskolans Blindmuseum, Solna).

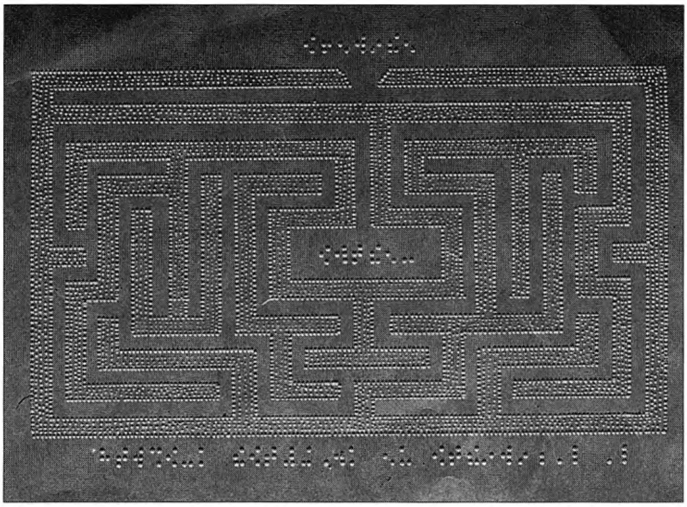
the Blind. The text in Thilander's two volumes is only in braille, in contrast to the English book. The volumes are half the size of the English book, and they are of coarse brown paper suitable for braille. The relief pictures were produced by an Englishman, T. W. Holmes, who used simple dotted lines and dotted surfaces. Many of the pictures were made for the teaching of various concepts, such as the ritual of toasting is made, how prayers are said in different cultures, the difference between a walking-pace and a gallop, and so on.

Harald Thilander was an important printer whose shop was first in Majorsgatan in Stockholm and later moved to Stocksund, He was full of energy and never gave up, in spite of many setbacks in his early years, including serious diseases which left him permanently handicapped.[89]

When Harald Thilander was seven years old, he caught scarlet fever, diphtheria and probably also poliomyelitis. He eventually lost his sight completely, his hearing was much impaired, and his physical strength was consi-derably undermined. Because of this, Thilander was placed in the Eugeniahemmet Asylum in Stockholm, where he was the only visually impaired child. There he came in contact with the braille system. He believed that braille alone would never reach a wider circle of readers in specialized subjects and that it must therefore be based on a common language. The common language chosen by Thilander was Esperanto, and he commenced by copying already existing Esperanto literature.

In 1906, Thilander set up a printing-shop at no. 12 Majorsgatan in Stockholm. It consisted of only one room, which he rented from Karin Höjer, who later became his first wife. Three years later, Thilander was offered the opportunity of expanding his business. Birger Wiggen writes:

> In 1909, Daniel Kjellin, the founder of *De BlindasVeckoblad* (1895), died. He had also printed books and had succeeded in getting public funds in support of his weekly paper. By 1909, it had become an important publication for the association of the blind and for blind people all over the country. Kjellin's death, at the early age of 41, left the review without an editor and without a printing-shop. Harald Thilander offered to take over both. He now had the first economic basis for his activities. In 1912, he took on the editing and printing of an Esperanto magazine, previously published in France, and received some economic aid from a variety of sources. In 1916, however, an event took place which considerably affected the printing-shop's economy. C. A.Thulin founded De Blindas Bokfond (The Book Foundation for the Blind). Thulin, who was an active member of De Blindas Förening and its secretary for many years, lost his eyesight while a student. He understood perfectly the needs of those who were interested in studying. He managed to raise



The Maze at Hampton Court, Tusbildoj (privately-owned, photo: Hans Thorwidd).

> funds from wealthy people and thus create the foundation. The foundation published braille books for secondary school pupils, English, German, French, Latin and Greek textbooks, dictionaries, Tom Moll's volume on physics for secondary studies, with drawings in braille, and mathematics textbooks. It also published several anthologies of poems. All of these were printed at Harald Thilander and Karin Höjer's printing-shop.[90]

After twenty years at Majorsgatan, the Thilanders bought a large villa in Stocksund. They could now rationalize their printing business and also hire employees. From this time on, the Thilanders always had from two to four visually impaired employees, who lived in the villa with them.

Thilander was an influential printer and editor of braille books in Sweden and one of the key members of the international Esperanto movement. It was therefore not surprising that he chose to publish *Tusbildoj*, a two-volume picture book, in Esperanto. In 1930, Thilander published several monthly reviews, including *Margareta för Kvinnor* (Margareta for Women), *Nordiskt Musikblad* (Nordic Musical Gazette), and many textbooks. During the 1940s, the monthly braille magazine, *Månadens Braillemagasin* was created by Blindas Bokfond.

The title of his book, *Tusbildoj* indicates that it contained tactile pictures (literally, "touch pictures"). *Tusbildoj* is similar to an English picture-book published ten years earlier in that its contents are very varied. The braille picture descriptions are detailed, in fact, so much so that they sometimes distract the reader's attention from the pictures themselves.

The frontispiece is decorated with a border of two parallel dotted lines. In the middle of the page there is a five-pointed star. The cardboard cover is very plain, with only the word *Tusbildoj* in capital letters in dotted lines, and under it the title in braille.[91] The braille is printed on both sides. Today, only one copy of the book is known to exist, but there are some loose picture pages.[92] All of the pictures consist of dotted lines and surfaces of varying thickness. The dotted surfaces are either depressed or embossed.

Tusbildoj begins with the following homage to T. W. Holmes:

> Introduction
>
> Drawings by T. W. Holmes for his blind friends. England, 1930. The "touch pictures" (Tusbildoj), this word, which has become so dear to our hearts, was first used by the promoter and creator of these pictures. Two years ago, when he was already seriously ill, Holmes (who at that time called himself "the illustrating editor of Esperantoligiro") wrote regretting that he had not been able to send any pictures to the paper for a long time. We then suggested that we should produce the pictures which were already in book form. To this he said "No. Wait, as I have in mind many other pictures which I hope to be able to send soon. I would also like to illustrate the title page of the book." He could not but believe that he would be able to continue working for the blind whom he held so dear.
> With the publication of these touch-pictures, our desire is to erect a monument to our benefactor. We hope to be able to continue this work, but in this small book there are only pictures by our unforgettable artist.[93]

The book contains illustrations of different kinds, including the Hampton Court Maze, a hot-air balloon, a flash of lightning, a horse at a walk, a galloping horse, a bee, a ship, the position for praying, the Bridge of Sighs in Venice, a swan, an ostrich and the plan of Thilander's house in Stocksund.[94]

The first two illustrations in *Tusbildoj,* the famous Hampton Court Maze and a hot-air balloon are similar to the one in *A Picture-book for the Blind.* As the books were published at about the same time, and as the illustrator of *Tusbildoj* was an Englishman, it is interesting to compare the texts and pictures of the two books.

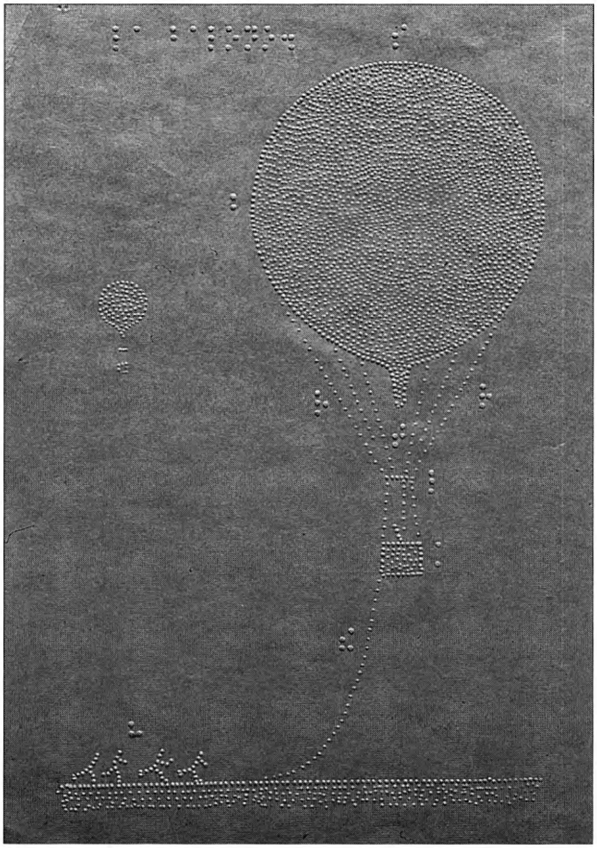
In *Tusbildoj* the Hampton Court Maze is described as follows:[95]

> ### The Maze at Hampton Court
>
> In the middle of the picture is the word "centre". Next to a vertical diagram, there is a description of the well-known maze at the old palace at Hampton Court, near London. The general form has been changed to accommodate itself to the format of the page. The plan of the perplexing little paths, however, is unchanged. The maze was laid out towards the end of the 17th century, and is still one of the most popular attractions at the beautiful palace gardens. It is visited by thousands of people each year, and every day during the summer you can hear shrieks of laughter and exclamations of surprise and annoyance from groups of holiday-makers who have lost their way in the mystifying maze. The paths are separated by walls of thick hedge which are about the same height as the average person, which prevent the visitor from looking over to the next path. The hedges are represented on the picture by broad dotted lines and the paths by solid lines. It is interesting and amusing to look for the right paths leading to the centre of the maze, and then to search for the way out.

In *A Picture-book for the Blind,* the picture is described in the following manner:

> ### The Maze at Hampton Court
>
> The lines represent the hedges; the walks are shown by the smooth space between. The Puzzle is to find the way from the entrance to the open space in the centre and back again. Hampton Court Palace on the Thames, 15 miles south-west of London, erected by Cardinal Wolsey in 1515, was presented by him to Henry VIII, in 1526; and was in great part rebuilt from Wrens designs by William III. It was subsequently occupied by Mary, Elizabeth, Cornwall, the Stuarts, William III, and the first two monarchs of the house of Hanover. In 1604 the Hampton Court Conference, between the Puritans and the Episcopalians, met here under James I, as Moderator. Since the time of George II, Hampton Court has ceased to be a royal residence, and is now occupied by pensioners of the crown. The palace contains a gallery of paintings, rich in Italian works of art. It is one of the finest specimens of Tudor architecture. In one of the green-houses is the famous vine planted in 1768. North of the palace is Bushey Park, a royal demesne over 1,000 acres in extent.

The descriptive ink-print and braille text is in the lower part of the picture.



Balloon, Tusbildoj (privately-owned, photo: Hans Thorwidd).

> The lines represent the hedges; the walks are shown by the smooth spaces between. The puzzle is to find the way from the entrance to the open space in the centre, and back again.

The differences between the two descriptions are obvious. The latter is full of facts with an additional guide. The text of *Tusbildoj* is based instead on the impression a visit might produce on the blind visitor, while there are only a few factual details are given. In *Tusbildoj* several of the picture descriptions also have descriptions of sounds, that is, they mention, for example, the murmur of the people at Hampton Court, or the sound of the galloping horse.

In *Tusbildoj*, the picture of the maze is the first picture in the book, while it is the last in *A Picture-book for the Blind*. One might ask whether the choice of their position obeys some pedagogical plan. The maze may have been put first in the book in order to serve as a simple tactile exercise, although it could just as well have been considered a suitable final exercise in manual dexterity.

The words 'centre' and 'entrance' are written in braille on both pictures. On both, the paths are smooth surfaces between the lines/fields.

I have already described the picture of the disappearing balloon in *A Picture-book for the Blind*. The descriptive text accompanying that picture is among the longest in the book.

Holme's illustration of the balloon is copied to some extent from an illustration in *A Picture-book for the Blind*. Holme, however, has the observer standing on the ground and the balloon approaching. The reduced picture of the balloon on the left of the page shows what the balloon looks like to a person who sees it from far away.

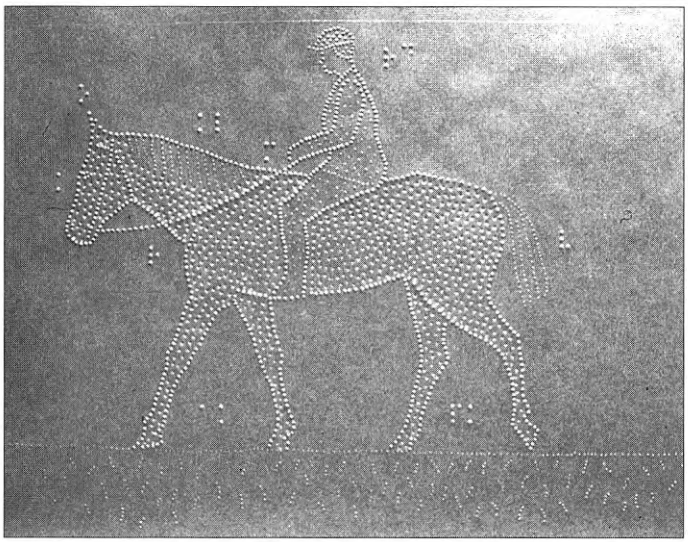
> Balloon
>
> After a successful flight, the balloon approaches the ground. A light wind blows it slowly to the right; the balloonist throws out a line. The line hangs down and part of it trails on the ground. Four people run to catch the end of the line and to help the balloonist land safely. The balloon (b) is a large, spherical bag of silk filled with a gas which is less dense than air. The underside of the balloon has a narrow neck (t) through which the gas was blown to inflate it. On top of the sphere (s) there is an air-regulator. Thin lines hang down inside the balloon and pass through the neck to the basket, thus allowing the pilot to open and close the air-regulator as he wishes. In this way, he can release gas when he wishes to descend. A net of thin but strong lines encloses the silk sphere. From the net, long lines converge downwards and are tied to a strong wooden ring (L). The basket (K) in which the balloonist is sitting hangs from this ring. The basket is round or square in shape. In the sky, to the left, there is another balloon. In reality it is as big as the one just mentioned, but because of the distance it seems smaller.

The technical description of the balloon is strikingly similar to that of the older text.

The following two pictures show a man on horseback, first at a walk, then at a gallop. The picture descriptions lead the reader through the picture; each detail mentioned is indicated by a letter. There are two pictures in profile in a horizontal format. For both pictures, three sizes of dots have been used. The horse has a coarse, depressed surface with a dotted texture;

the outline of the horse is marked with a thin, clearly discernible dotted line. The outline of the horseman is emphasized in the same manner; his body is drawn with sparse small dots.

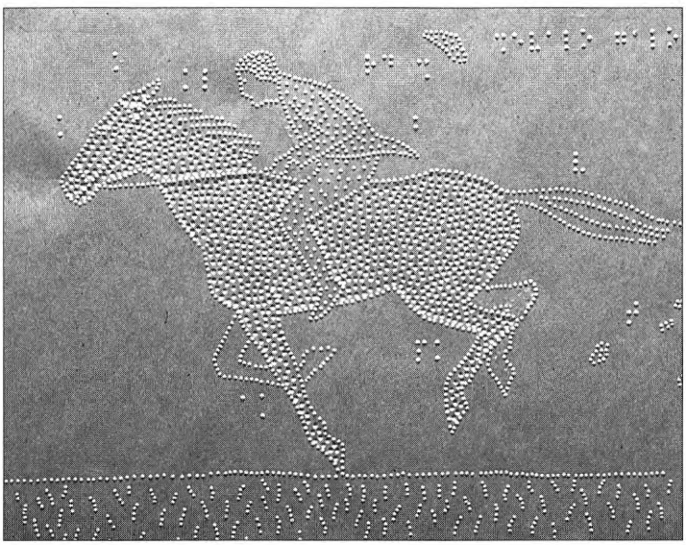
I would like to give another two examples of illustrations from the book which have attracted my attention, as I have never seen illustrations of this type in any other context. The first shows the different positions a praying person may adopt. This picture consists of dots, like all the others. We see a man in prayer, in three different positions. His body, legs and



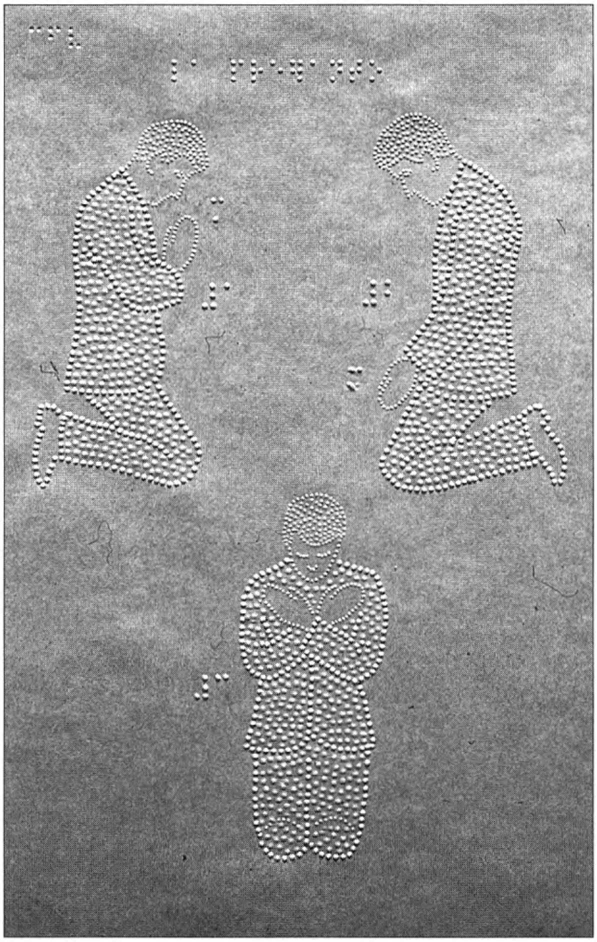
"Horse at a walk. The picture shows a horse with a rider moving from right to left at a normal walk. The horse's head is marked K. The bridle is shown; at his nose we see the reins (r) passing up to the horseman's hand (m). /.../ The forelegs are marked 'ak' and the hindlegs 'pk'. The sound heard when the horse is walking is similar to three-four time in music; that is, a regular repetition of the beats 1, 2, 3 and 4, as the hooves touch the ground at regular intervals. The fore and hind legs move alternately. First, the horse advances the near foreleg, then the off hindleg, the off foreleg and finally the near hindleg."
Tusbildoj (privately-owned, photo: Hans Thorwidd).

arms are shown as coarse, dotted surfaces; his face and hands are empty of dots. The outlines of his head and hands are thin and "sharp".

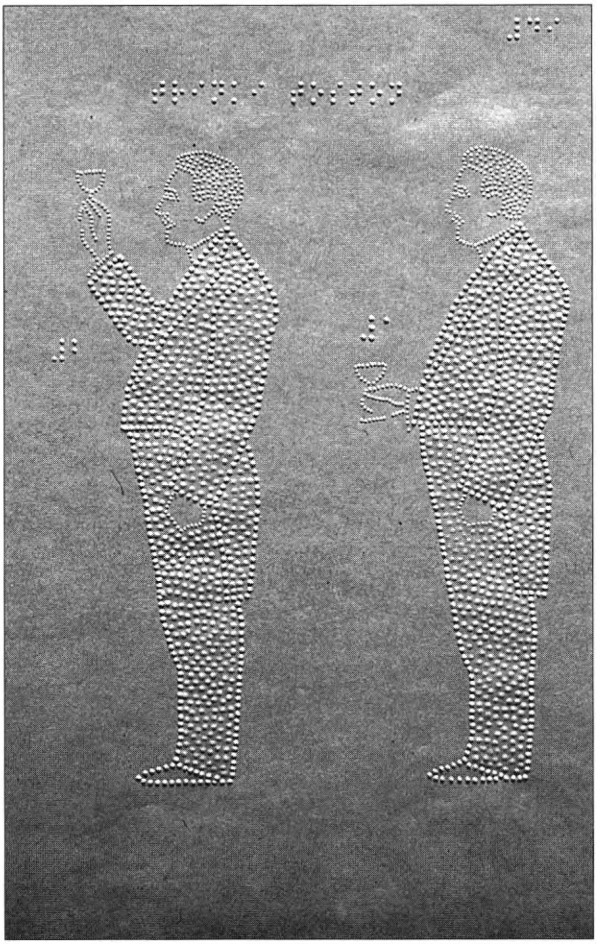
When the first part of *Tusbildoj* was completed, and work was to start on the second, Holmes, the illustrator, had died. The second volume was therefore illustrated by the Dane, Daniel Hwit, and the accompanying picture descriptions were written by Karl Bjarnhov,[96] a well-known personality on Danish radio. The second volume, published in 1932, was also edited in Esperanto and has the same design as the first. The contents



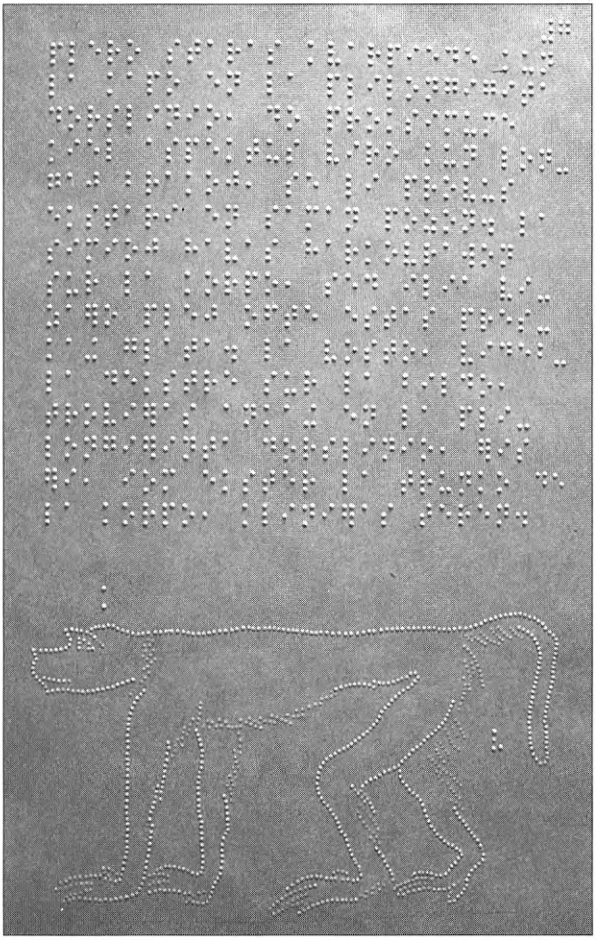
"The galloping horse. In our picture the horse is galloping. Its neck (kl) is lifted, its head (k) stretches forwards and its ears (o) point backwards. The mane (kl) streams horizontally in the air. The rider (rd) bends over the horse's neck. His hat has been blown off and his coat-tails (b) fly out behind him. The horse's tail (v) waves horizontally. The near foreleg (ak) stretches out behind him and strikes the ground with force. The other legs are momentarily drawn in under the body, but the next moment, it is the hindlegs which move downwards and hit the ground, kicking off and driving the horse forwards at such a great speed that the animal flies over the ground and clods of earth and tufts of grass (t) are torn loose and thrown up into the air. When the horse gallops, its feet beat a series of quick, triple time beats, with the first beat accentuated. When its speed increases, the beats follow each other so fast that they sound like one. The sound of a horse at full speed is a series of very strongly accentuated beats." Tusbildoj (privately-owned, photo: Hans Thorwidd).



"The position of a praying person. A person, who had gone blind as a child, asked Holmes what the correct position for praying was. Let us assume that there is no correct, strictly determined rule for this, at least not in the Anglican Church. The kneeling position with clasped hands and closed eyes is the most common. The exact position of the different parts of the body may vary very much. The bent head and the closed eyes seem to be the main characteristics in this context. During out-door services, people often bow their heads and close their eyes while their arms hang in front of them and hold their caps in their hands. We have, however, three drawings which illustrate common positions. In figure 1, the praying person lifts his hands (m) to his chest, places the palms of his hands together, the fingers touching one another lightly. In figure 2, the arms ..."
Tusbildoj (privately-owned, photo: Hans Thorwidd).



"How to make a toast. This picture was also motivated by a question. While listening to the speech prior to the toast, you stand at ease with the glass in your right hand approximately at the level of the watchchain, as in fig. 1. The left hand can hang down by your the side or rest on the table, or on the back of the chair, or you may finger your watch chain or scratch the lapel of your jacket. When the time has come for the toast, you look at the person to whom it is dedicated and lift your glass to your eyes for a moment, as in figure 2, after which you drink." Tusbildoj (privately-owned, photo: Hans Thorwidd).

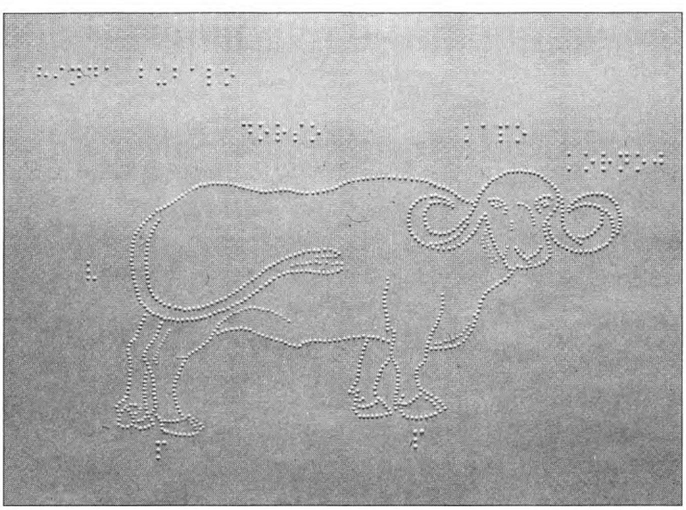


"The Ape. As we all know, according to the theory of evolution, the ape is our nearest predecessor. The resemblance of the ape to Man is, in some species quite striking. There are, however, about 250 different species of apes, each one very different from the other. Some, like the gorilla, are much taller than a man when standing on their hind legs, while other apes are as small as cats. Common to them all are the prehensile toes on their hind feet, which are used as hands. The hands of the front legs or arms have well-developed thumbs. This example is crouched on all fours with his head extending from his back; he looks rather like a long-armed man trying to walk on all fours. The ape is hairy although its face is quite smooth and hairless. The tail appears on the right of the picture as an extension of the back. Below the body, the tail droops towards the ground. The pictures of the cattle-egret, and of the zebu with an egret on its back, are attempts at showing a species of bird in its proper environment." Tusbildoj (privately-owned, photo: Hans Thorwidd).

are, however, exclusively animals and birds. The relief pictures of the animals and the birds are simply dotted outlines. The pages are arranged in different ways: there are whole picture pages and smaller pictures placed within the text.

As in the first volume, there is a combination of picture descriptions and picture guidance for the tactile reader. The contents of the pictures are varied, and some of the pictures were probably meant to be studied simultaneously, as they illustrate differences and similarities. The dromedary and the two-humped camel exemplify two pictures which explain the differences between the two species represented.

In both volumes of *Tusbildoj*, not only complete motifs are shown, but also details which differ from the pictures produced for schools. *Tusbildoj* is for adult readers and therefore conveys another kind of knowledge, which in many ways builds on visual information. The pictures showing how to make a toast, how to pray or what the horse looks like when it moves at a walk or at a gallop do not represent constructions and functions but movement and patterns of movements. The purpose behind this kind of information was probably to try to overcome certain social handicaps which result from a visual disability. The relief pictures of different kinds of animals show not only what the animals look like. The Indian buffalo, for example, is also an attempt at giving an instant picture of a photographic nature.



The Indian buffalo.Tusbildoj (privately-owned, photo: Hans Thorwidd).

> The Indian buffalo. Height at the shoulders 180 cm. The horns may grow to nearly 2 metres in length. The skin is greyish-black and the hair is black. On the picture, we notice that the horns curve towards each other. On our picture, the bull is beating his side with his tail; we see the tail, which ends in a tuft, as an extension of the back, on the left of the picture. The animal is lying on its left side.

The picture and description of the ape combine a visual experience of the animal with a series of facts and information.

Bilderbücher für Blinde

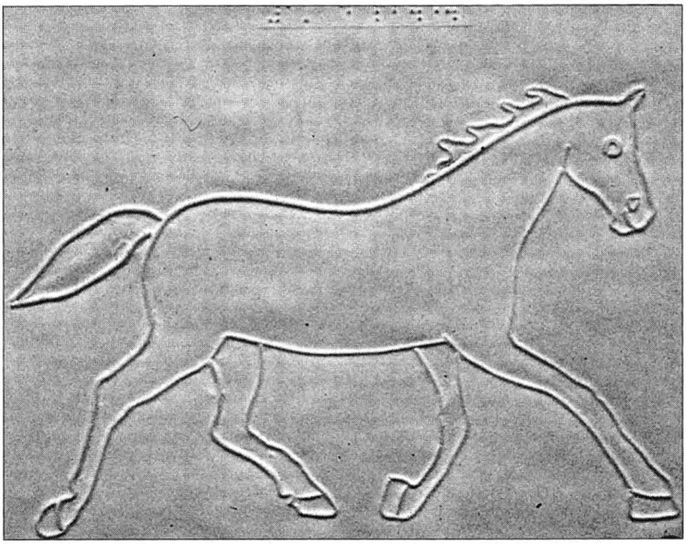
Tusbildoj Part 2 was not the first book of its kind. Kunz had already published a large collection of relief pictures of different mammals, and in the early 1910s, F. W. Vogel published *Bilderbücher für Blinde* 275 x 350 mm in two volumes, the second of which dealt with mammals and was called "Säugetiere in Feld, Wald und Wildnis".[97] Vogel's picture-book contains eight different animals: a horse, a cow, a deer, a dromedary, a giraffe, an elephant, a bear and a lion. The text is in braille.

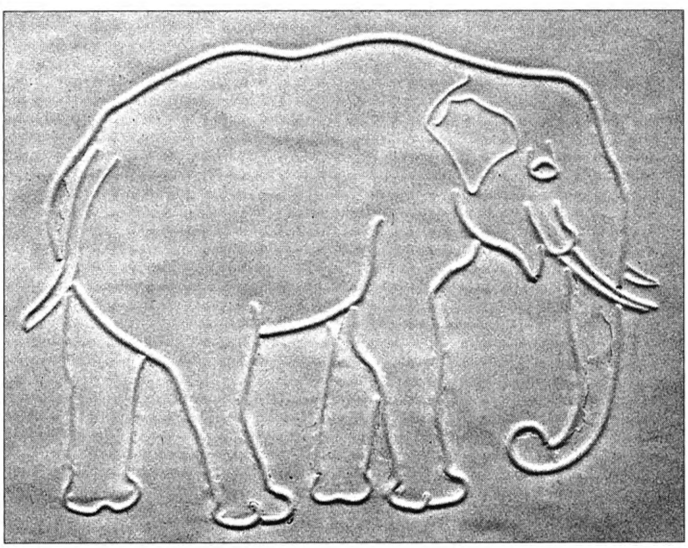
The illustrations in *Bilderbücher für Blinde* are on paper and the relief consists of solid contour lines. I have encountered this type of relief in pictures made by Kull at the institute in Berlin-Steglitz. The relief quality is still very high in Vogel's picture-books and the very simplified figures stand out clearly when the pictures are read tactilely. All the animals are shown in profile and all the lines are of the same thickness. At the top of every picture page there is a text stating the name of the building or the animal.

The first picture is of a horse at a walk; such details as the mane and tail are only shown as contours. The tail is not hanging straight down, but moves vigorously to and fro, just as the mane moves because of the forceful movement of the horse.

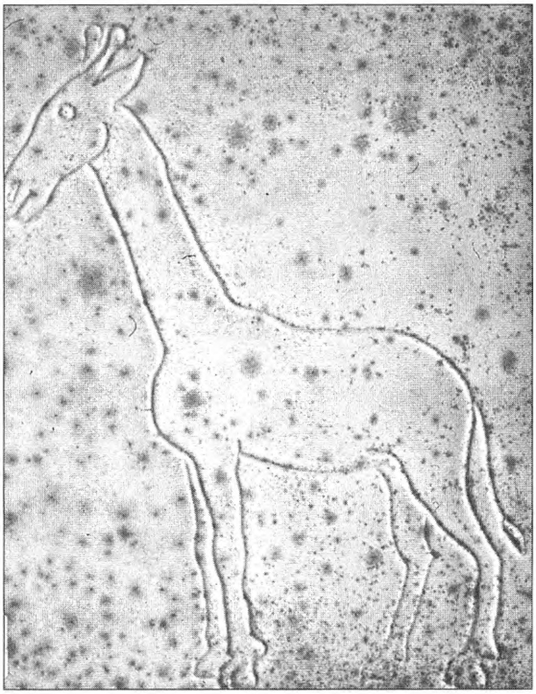
There is a relief picture of the giraffe on the cover as well as inside the book. It is somewhat different from the other pictures in the book, as the proportions between the different parts of giraffe's body are not quite correct. The neck is too short and the head is too big. It is not possible to know whether this was done on purpose in order to make it easier to perceive the head tactilely, or is simply a mistake.[98]

The elephant is a recurring motif in relief pictures. Vogel's elephant is shown in profile but seen partly from behind, so that the root of the tail is visible. The solid line of the back has been broken to make way for the hanging tail. It is therefore easy to perceive by touch that the tail lies on top of the back part of the animal. The ear is a solid line on the animal's side. The line is not closed, which gives the impression that the ear can be moved.





Bilderbücher für Blinde, F. W. Vogel (Schweizerische Bibliothek für Blinde, Zürich. Photo: author).



Bilderbücher für Blinde, F. W. Vogel (Schweizerische Bibliothek für Blinde, Zürich. Photo: author).

Animals of different kinds have been a rather common motif in relief pictures. There were many reasons for this. One is that animals were also common in pictures for the sighted, which is important to note, since most relief pictures were copied from visual pictures. Very few of these animals can be touched in real life, and when this is possible, the whole of the animal can rarely be touched simultaneously, as the visually handicapped would have to in order to feel its complete form. In spite of the large collections of stuffed animals which existed at many institutes, many animals were not represented. A small model or a relief picture were then the only alternatives.

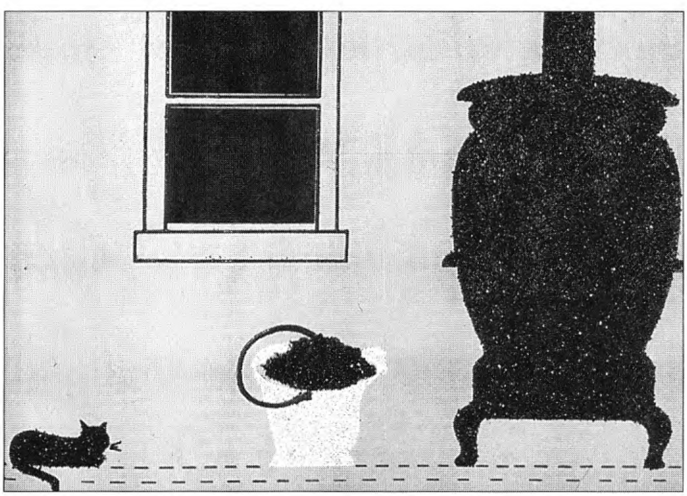
Reproducing colour for tactile purposes

I have occasionally encountered attempts to reproduce colours with the help of varying textures. A late example of this, considering the period covered by this thesis, is *A Picture Book in color for the Blind* by Jeanette Freed and Henry Singer, published in Philadelphia in 1949. The book has 20 pages with accompanying text; its format is horizontal A4. The purpose of this book was:

> ... to introduce pictures to the blind to convey some suggestion of the glory of the beautiful world of color. Instead of visible paints, tactile surface textures are used to produce them. Maps, diagrams, plans and circuits, as well as sketches and pictures can be made available to the reader in this medium...

The authors go on to affirm that books like Lorenxineis's *Pinocchio* would be more appreciated by the braille-reading child, if they had pictures suitable for the blind reader.

A Picture Book in Color for the Blind consists of pictures which are in part easy to perceive tactilely. The book tells a story which takes place during a period of twenty-four hours. It starts with "Early this good morning the sky is a beautiful light clear blue, and in the east above the horizon, we see the sun as a large red disk". On the corresponding picture, we see a blue surface on which there is a red, filled-in circle. The book then tells us

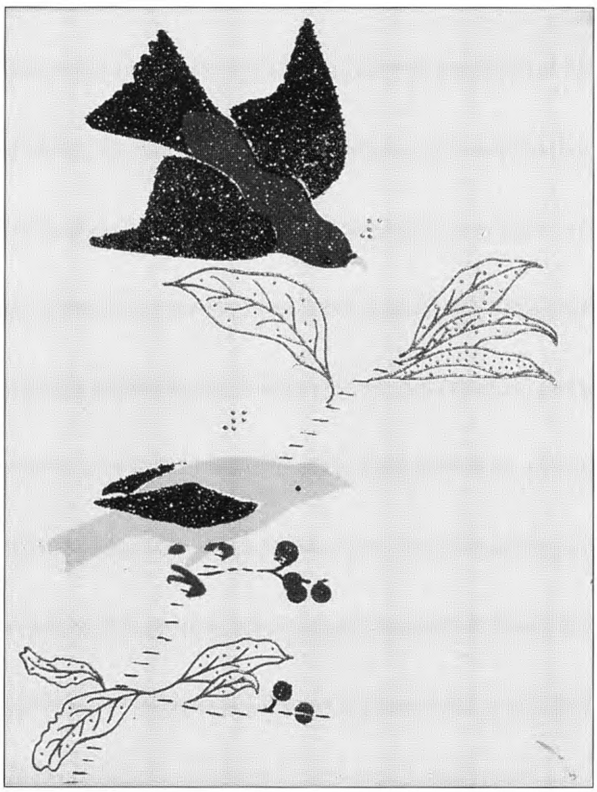


A Picture Book in Color for the Blind (Royal National Institute for the Blind. Photo: author).

how the sun gets stronger as the day breaks. We are told how shadows are formed and the shapes they take, etc. The text and the pictures are well matched.

In the evening, the reader is taken inside the farmer's house, where the cat lies by the stove. The reader is transported to yet another world, that is, the world of the book.

> That evening, we talked about the birds we had heard in the fields and bushes during the day. Our host brought out a set of John J. Audubon's famous books, "The Birds of America". He was delighted to show us his fine edition of seven volumes



A Picture-Book in Color for the Blind (Royal National Institute for the Blind. Photo: author).

> published in New York and Philadelphia from 1840 to 1844. We were so pleased with Audubon's picture of the Scarlet Tanagers, which we found facing page 226 in the third volume, that we made a copy of it. Figure 1 is the male bird with wings spread out in flight. Figure 2 is the female Tanager clinging to a branch of Wild Black Cherry. In the springtime these colorful birds migrate from Mexico to the United States.

After the picture of the birds from the bird-book, there is a page with the starry night sky, and the book ends by stating that the next day there was a rainbow in the sky, and is illustrated with a rainbow in red, green and purple. To enable the blind reader to grasp the colours, the book starts with a colour key. Each colour is reproduced with its specific texture. *A Picture Book in Color for the Blind* is written in braille but has also type-written texts. I have found the book at Samuel Hay's Research Library and at the reference library of the Royal National Institute for the Blind (RNIB) in London. The books are different from the atlas printed by Thilander (see page 182), in which the colours are reproduced in different textures but not in colour, as in this case.

Art and architecture books in relief

R. R. Hayden published *The Braille Picture Book* in June 1941. The book reproduces famous works of art, and is based on *World Masterpieces of Painting* by Kent Rockwell.[99] The introduction to the braille book states the purpose of the edition:

> In this unique book an attempt has been made to bring famous masterpieces of painting within the reach of those who cannot see. Obviously, our hope is not to gain aesthetic pleasure, but to get an understanding of painting that will supplement and enhance our appreciation of sculpture, music and poetry. It is hoped that this book will service a two-fold purpose: providing tangible subject matter for study and affording an accurate background for social conversation in the realm of art.

Two of the paintings represented are described in the braille book, *The Last Supper* and *Poplars in the Thames Valley*.

> Here, in the left foreground, a still river reflects the tall, poplars on the bank beyond. From beneath their silent, motionless security a shepherd's house peeps out between the second and the third trees from the left ...

The relief pictures, in spite of much simplification in comparison with the original paintings, are difficult to read tactilely. The different elements of the pictures lack clear, meaningful outlines, which makes it difficult to distinguish between the various parts of the relief picture. Hayden was, however, aware of the difficulties involved in tactile perception of these pictures. The following comment is found in the book, before the first description.

> Because this field is so new, very little of the raised material will have meaning unless it is accompanied by the friendly explanation of someone who knows art and who has the print at hand or very well in mind. A braille description would be tragic—somewhat like an anchor on an aeroplane! Yet we cannot hope to derive anything from the raised pictures until after we have been introduced to them through their natural medium of sight. As the sponsor of this experiment, perhaps it is fitting that I should offer the first introductions.

The *Braille Picture Book* only has text in braille, which leads us to ask for whom the above text was intended.

Architecture

There have also been architectural relief pictures. This production must, to some extent at least, be considered in relation to maps. That is, there was interest in representing the exterior world for people with severe visual impediments. The architectural pictures were often designed in different ways and were aimed at different target groups, most probably at adults.

When Vogel in the 1910s published *Bilderbücher für Blinde*, it consisted of two volumes: "Religiöse Bauwerke verschiedener Zeitalter und Völker" and "Säugetiere in Feld, Wald und Wildnis". The architectural volume includes the Entrance to an Egyptian temple at Luxor, an Old Babylonian temple (reconstruction), a Greek temple of the Doric order, the Mosque at Delhi, the Japanese temple at Kaya-San, an Early Christian basilica, a Norwegian stave church at Hitterdal and a church in the Gothic-Romanesque style. The buildings are reproduced in the same simple line relief used for the animal pictures.

Drawings from Stockholm

Drawings from Stockholm is a "guide" to Stockholm with explanatory text by Elisabeth Berent and Elin Hök, published by the library of the

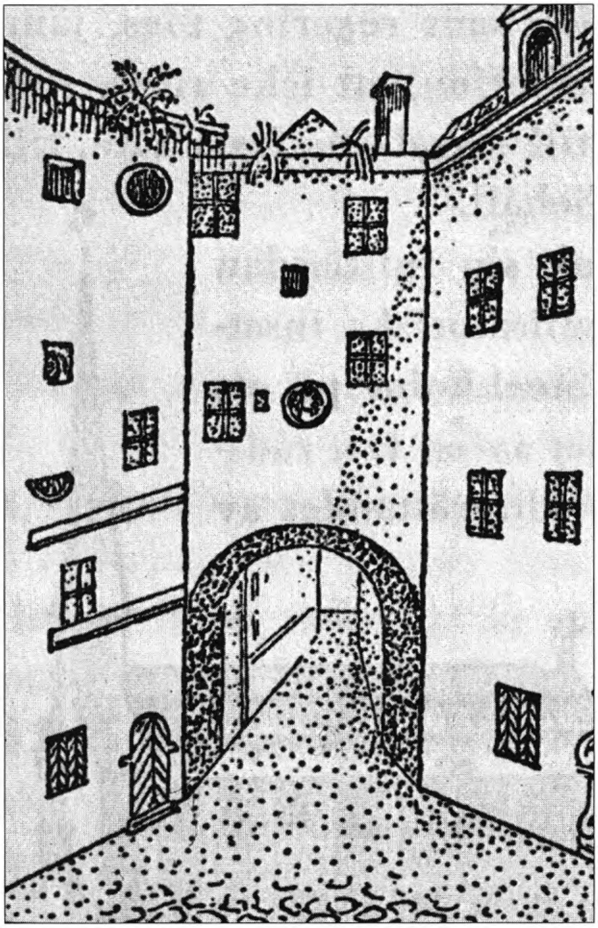
Association for the Blind. It was printed by H. Thilander's printing-works for the blind in Stockholm in 1932. This comprehensive guide to Stockholm is 280 330 x 280 mm in size. The book is undecorated. The blue cardboard cover is very plain; the spine is bound in dark-blue cloth tape. The book contains descriptions and pictures of:

> How the Stockholmers live; the old castle of Stockholm; the city gate at Köpmangatan, 1685, From the castle to the Sluice; Stockholm Castle; the first of the castle; the second floor of the castle, Storkyrkan (the castle church), From the Mynttorget Square to the island of Riddarholmen; the church at Riddarholmen; the surroundings of King Gustav Adolf Square; the Parliament and the Bank of Sweden; the Plenary Chamber of the Parliament, the Opera House, Haymarket Square, Stureplan and Norrmalmstorg Squares, the Concert Hall; From the Central Station to lower Kungsholmen; The City Hall, the first floor of the City Hall, The Town Hall, Near Djurgården, Southern Djurgården, Haga and Science City; the Stadium; Stockholm Library and the Southern part of town (Söder).

The introduction to the book is a presentation of the origins of the texts as well as of the pictures.[100]

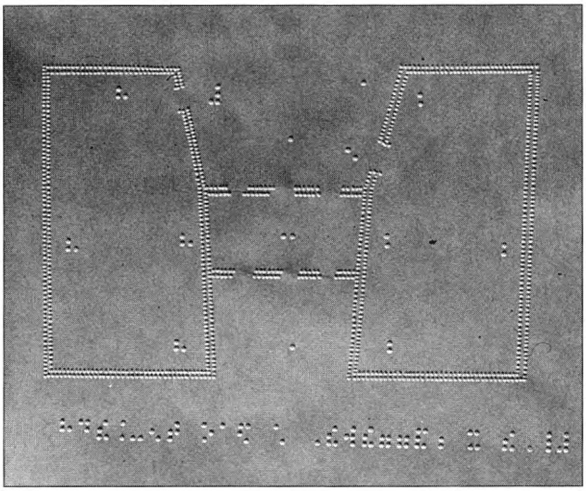
> Introduction
>
> The drawings in this collection have been selected from amongst the plans which appeared in the Swedish Touring Club's yearbook for 1929. The general map of Söder is also based on the map made by the Swedish Ordnance Service in 1930. The plan of the City Library was very kindly made available by professor E. G. Asplund, the annex for 1932 /.../ The plans in the Touring Club's yearbook were produced by the Cartographic Institute, Stockholm; the perspective drawing of the city gate at Köpmangatan by the artist Yngve Berg. In the braille edition, the representations are based on these originals but enlarged and somewhat altered by the engineer Arne Carlén, and some by Märta Henriques and the forestry engineer H. Bergman. The brief descriptions which accompany each drawing have been copied from the above mentioned year-book of the Touring Club and from Nordisk Familjebok, second edition.
>
> *For the library of the Association for the Blind*
> *Elisabet Berent, Elin Hök*

a.



a. From Swedish Touring Club´s yearbook for 1929.
b–c. "In order to understand this perspective drawing you must imagine yourself standing in Köpmangatan, with the sparsely dotted houses b and d on either side of you. In front of you there is an arched gateway, the inner section of which is densely dotted. Above the gateway the continuation of the houses b and d are seen. Both houses (band d) are connected to another house (c) above the gateway. More of the wall b is seen; it has a window. This is because the observer stands somewhat to the right on the street. The surface covered by depressed dots represents the part of the sky visible through the gateway."
The picture is accompanied by a relatively detailed key which provides the reader with yet another way of orienting himself in the picture.
"The key gives details such as: a: Köpmangatan, b: the house on the left side of the street; c: the house built above the city gate.

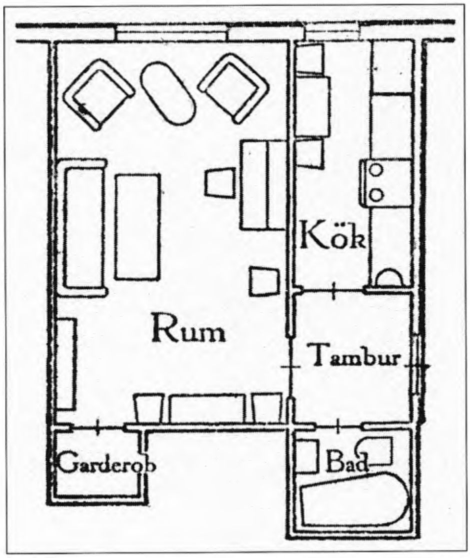
b.



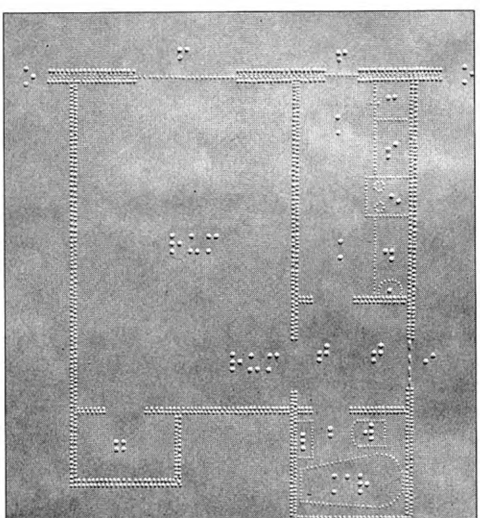
c.

Drawings from Stockholm. (Synskadades Museum, Enskede, photo: Hans Thorwidd).

a.



b.



"How Stockholmers live. The modern apartment with two rooms and kitchen can be quite comfortable, though somewhat cramped." Drawings from Stockholm.
a. From Swedish Touring Club´s yearbook for 1929. b. Drawings from Stockholm. (Synskadades Museum, Enskede, photo: Hans Thorwidd).

It is interesting to note how little the instructions to braille books have changed over the more than sixty years which have passed since that text was written:

> Instructions for use
>
> Some of the most remarkable buildings have been indicated on the plan by fine dots. Statues are marked by round rings. Water is, as usual, represented by large, depressed dots. On the map of Near Djurgården and some other places, trees and grass-covered areas have been filled in with smaller, depressed dots. Roads and streets between them are normally smooth; railway lines are shown with dotted lines. Letters have been added at as many laces as possible; where there has been space enough, the same letter has been given in more than one place (i.e. at the beginning and at the end of a street on the plan). The explanations are given in the annexed key.

The first illustration in the book is a plan drawing of an apartment in the Rödaberg district. The authors give only a very brief description.

On the plan of the modern apartment, details such as the gas cooker, sink, toilet, washstand and bathtub are indicated (that is, those details representative of modern conveniences). The design of the plan and the key are somewhat illogical. There are no instructions as to where on the picture the reader ought to begin, and the first letter a in the key refers to the sink. The relief picture does not show any furniture, in contrast to the original.[101]

The second spread of the book describes the old castle of Stockholm, Tre Kronor. It consists of a plan drawing and a descriptive text with the corresponding key. A brief history of the castle is followed, not by a description, but only by a key to the letters on the plan drawing.

The illustration of the city gate at Köpmangatan, however, does have an accompanying description.

The editors were conscious of the difficulties in making perspective available to tactile readers, but that did not prevent them from representing the picture in the way they did. It seems that they very carefully followed the originals, something which is also evident from the detailed references given in the introduction itself.

In the general pictures (for example, those of Stockholm's castle to the Sluice), important buildings are marked on the map and described in the text. The descriptions, however, refer to the history of the buildings, not to what they look like.

The relief pictures consist of depressed dotted surfaces (one coarse and one finer) and a finely dotted embossed surface. The lines are broken, dotted or solid. All of them are of the same width but are sometimes combined with several parallel lines (with the exception of the broken lines). Some of the plan drawings and maps have an indication of scale.

The titles of the pictures are given at the bottom (for pictures to be read vertically) and at the top (for those to be read horizontally). Other than this, there is no indication as to how the reader was intended to work on the pictures.

Summary

It is worth mentioning that the illustrated book in relief print first appeared at the beginning of the 1840s. If we consider that the illustrated press made its breakthrough in the 1830s, and that the printing of illustrated books, a more demanding variant, was generally established about a decade later, the existence of illustrated relief books for the blind is a most remarkable phenomenon.[102]

In this chapter I have presented a selection of relief picture-books of different kinds. My purpose has been to show the great variety of motifs and technique which have existed. Many of the titles I have mentioned now survive only as a few, unique copies.

The visually impaired person who must use tactile perception to understand a picture is, to a certain extent, in the same position as the sighted person. The access he has had to pictures and his practice in extracting information from pictures determine whether he will be able to interpret a tactile picture and how he will go about it. Those who taught at the institutes for blind pupils were aware, at an early date, of how tactile pictures ought to be designed to allow tactile perception. They also knew that tactile training was necessary. In spite of this, many of the relief books I have described include relief pictures which are difficult to read tactilely. There are several possible explanations of this. One may be that those who had the knowledge of tactile perception and ideas on how relief pictures ought to be designed, were not those who manufactured the pictures. In that case, there may have been certain misunderstandings in the communication between the commissioner of the picture and the commissioned. The technique employed also conditioned the design of relief pictures and in some cases only one method was available. In spite of the wide international network which existed, it appears that the exchange of technical experience in the production of relief pictures was restricted. This may have been because of limited financial resources and lack of time. The entrepreneur who developed a good product therefore came to dominate the market.

My interest in the design of tactile pictures concerns the effects of technical aspects on tactile quality. The technical methods of production do affect tactile quality, just as they condition the stylistic possibilities of design. It is also possible to see how a new aesthetics developed because of a djustments to tactile requirements. I have studied the origins of the most common motifs, most of which are found in the didactic picture culture or within popular culture. In addition there were albums aimed at adults and belonging to the sphere of general education.

Stylistic possibilities

The differences in style found in relief pictures during the period I have studied are limited. This is particularly the case when we compare them with the variations which occurred in visual pictures. This lack of experimentation can be explained by the limitations inherent in tactile perception, but we can also assume that the purpose behind the production of tactile pictures played an important role. The intention was not to experiment with different kinds of representation, such as we find in the history of visual pictures, but to represent, as clearly and simply as possible a phenomenon or an object. The design chosen, in other words, the style, for a relief picture often depended on the ideas on tactile perception on which their execution was based. It is obvious that there existed different theories on how to design relief pictures: with whole, embossed surfaces, as in the pictures made by Kunz, or only with solid outlines. The pictures published by Kunz represented plasticity, in contrast to the pictures with lines and different surface patterns which represented one or several objects. The latter kind of relief, however, renders the shape of the object better than a picture in high relief does.

When Vogel published *Bilderbuch für Blinde*, both volumes showed the animals and the pictures as simple outline-drawings. The relief pictures are simple in execution and could be classified as naïf. Vogel's pictures differ in style from those in *A Picture-book for the Blind*, which are also partly line drawings. The difference between the two books lies in how the lines are drawn. In *A Picture-book for the Blind*, the pictures are more static than Vogel's. The pictures in Tusbildoj, on the other hand, could be considered part of the same tradition as *A Picture-book for the Blind*. This is a rather reasonable assumption considering that the illustrator of *Tusbildoj*, T. W. Holmes, was English.

Where ectypographic relief pictures are concerned, or the pictures in *A Toy Book with Imitation of Verses*, it is not possible to talk of any particular style. And when we compare the architectural pictures in Moon's *Embossed Specimens in 250 Languages & Dialects Maps, Diagrams, Music &C* with those of Vogel's picture-book on architecture, it becomes obvious that Moon's relief pictures are completely faithful to the visual originals. Even when a relief picture is close (or perhaps too close) to the visual original, transfer requires certain changes in style. That is the reason why artistic pictures entail complications.[103]

The tactile pictures that were made bearing in mind the inherent conditions of tactile perception led to a new aesthetics in relief pictures, which consisted of the conciseness of the line and the distinctiveness of the surface. But there is also a kind of non-aesthetics in the sense that the pictures were made by persons who were not expert artists but mainly concerned with the transfer of a picture to relief in order to make it accessible to the blind.

The categories of relief pictures

The motifs which appeared in relief pictures from the 19th century onwards and during the first decades of the 20th century were more or less the same. The pictures had a didactic function within the subject today called natural history, with motifs which included plants and animals, the human body and physical phenomena. Stories were also represented, such as Alston's edition of *Aesop's Fables*. Relief pictures within the didactic picture tradition has its roots in the very oldest example; Alston's edition of *A Peep into the Menagerie of Birds,* and *Aesop's Fables* as well as on *Ektypografischen Bildenwörten Busch.*

During the period in question, a number of albums for adults were published with a variety of pictures which belonged to the pictorial sphere of popular culture as well as to the traditional history of art and architecture. The general educational function of these albums is evident, as they gave information on such different things as the aspect of a balloon, religious buildings and how to make a toast. These pictures embraced not only a variety of motifs, but also a long span of time. The pictures in the albums included historic monuments and buildings, such as the Great Wall of China and plans of Stockholm's old castle, as well as something as modern as a functional apartment.

The publishing of picture-books in relief for adults, with motifs which gave the reader access to cultural expressions such as buildings, paintings and social customs (how to make a toast, how to pray was in itself a modern project, which not only conveyed what was modern in society (for example, the plan drawing of a functional apartment). The books published by Thilander's printing-works (particularly Tusbildoj), his books in Esperanto, the envisioned language of the future, bear witness to this.

V

The tactile map

Today there are a great number of maps which show the physical and political borders and maritime and terrestrial communication routes of the different countries. In his work *Image of science. A history of scientific illustrations*, Brian J. Ford includes two chapters on geographical and astronomical maps, entitled "Mankind in the world" and "The world in Space", in which he describes very eloquently how maps are used in the teaching of the blind. Thanks to maps, globes, horizontariums and tellurions, mankind and the world could be situated within our solar system.[1]

We cannot picture human life if we are unable to orient ourselves in the environment, regardless of whether we make use of natural landmarks or maps.[2] The map is an abstract representation of a specific area, expressed in symbols based on agreed conventions. A map coincides only partly with reality; however detailed the map may be, it remains a highly simplified representation of reality.

The map is the only possibility we have of overviewing areas which cannot otherwise be surveyed. It includes relationships such as location and size. The observer's ability to extract information from a map depends on his access to, or knowledge of, the conventional symbols on the map. This applies to sighted observers as well as to the visually handicapped who must interpret the map through touch. The most common form of relief representation for the visually impaired has been maps of different kinds, including astronomical and astrological maps.

The tactile map was in part based on principles other than those employed in the visual map. When tactile maps are being produced, two problems present themselves: how should the map be designed so that it can be understood through touch, and how can we realize those ideas technically? When tactile maps were in their infancy, these problems were far greater than they are today. The use of the sophisticated instruments for measuring that were developed for and used in the production of maps from the 18th century on, was not transferred to the design and production of relief maps during the same period. It is possible that a generally increased interest in cartography and topography played a decisive role in the birth of relief maps.[3] The pedagogy, which developed in the teaching of map reading, was based on experiences in the classroom, that is, the pupils began by studying and mapping their own classroom. The blind students learned how topography is represented on a map by studying maps of the immediate environment and of imaginary landscapes with mountains, rivers etc. These maps were often modelled in relief.

No area on the tactile map was represented with measurable accuracy; instead, preference was given to the representation of details which could serve as landmarks for the person who was to interpret them through touch and hearing. These hand-made maps may be compared to Dutch paintings from the latter part of the 17th century, where the topography of the scenery was created by adding details next to each other on the picture surface until a landscape which could be observed from any angle was created.[4] Tactile maps can also be studied from any angle. As in the general production of maps, in the case of tactile maps, the aim was to come to agreement on a set of standardized symbols.

Relief maps have been produced by different techniques; as handmade, unique copies, on form-pressed paper, printed in stereotype or produced by ectypography. They show details ranging from the hemispheres to smaller local areas, and often include the individual institutes for the blind. Even the detailed relief map is highly simplified compared to a map made for visual interpretation, depending on the difficulties inherent in the tactile reading of very small details.

Early relief maps

Geography for the visually handicapped was the subject in which the use of relief pictures, especially maps, was most common. The relief map had been used long before there was any organized education for the blind, and probably belonged to the kind of relief pictures which were first mass-produced for practical, communicative reasons. Sales lists from the final years of the 19th century bear witness to an important production of relief maps and their widespread distribution.[5]

A large part of the tactile pictures and maps were not mass-produced, that is, printed, but were unique, handmade examples. They were generally produced by teachers and other persons who had some connection with the visually handicapped.

Object-lessons were already accepted both in theory and in practice at several of the institutes which were founded at the beginning of the 19th century. One example are Guillié's well developed methods, which he described in *Essai sur l'instruction des aveugles* (1817),[6] a thesis expressing radical and highly-developed pedagogical ideas. Under the heading "Geography", Guillié summarizes the types of maps which were produced in the latter part of the 18th century and at the beginning of the 19th, together with their function. He also indicates the most suitable types. Through Guillié, we learn that when M. Weissenburg of Mannheim was making relief maps, geography lessons for the blind were mainly oral, which meant that the pupils made little progress. Weissenburg's first attempt at map production was unsuccessful, however. He started by making a rough division of Europe and had the map engraved in relief on a plate the size of an ordinary map. He was hoping to be able to print the map in the same way that books were printed in relief in those days. According to Guillié, this was impossible, and the large, hollow volumes of form-pressed paper were too big to preserve the relief.[7] Weissenburg's second attempt at making tactile maps consisted in placing of beads of coloured glass on a map; the colours corresponded to those of the ordinary map. The glass beads were sewn in place. Unfortunately, these maps were not very hardwearing, and besides, the glass beads very soon slid out of place, and no longer coincided with the lines under them.[8] After that, Weissenburg exchanged the glass beads for chenille, which he first ironed out and then sewed into place. Apart from these maps, Weissenburg also produced expensive and well-elaborated maps in different materials, which were much talked about in their time. On these maps, the seas and the rivers were represented in skilfully-cut glass, and the different countries were indicated in sand of varying sizes of grain. The towns were indicated with copper tacks, the size of the head depending on the size of the town they represented. These maps were, however, not hardwearing enough and the sand came away from the surface.[9]

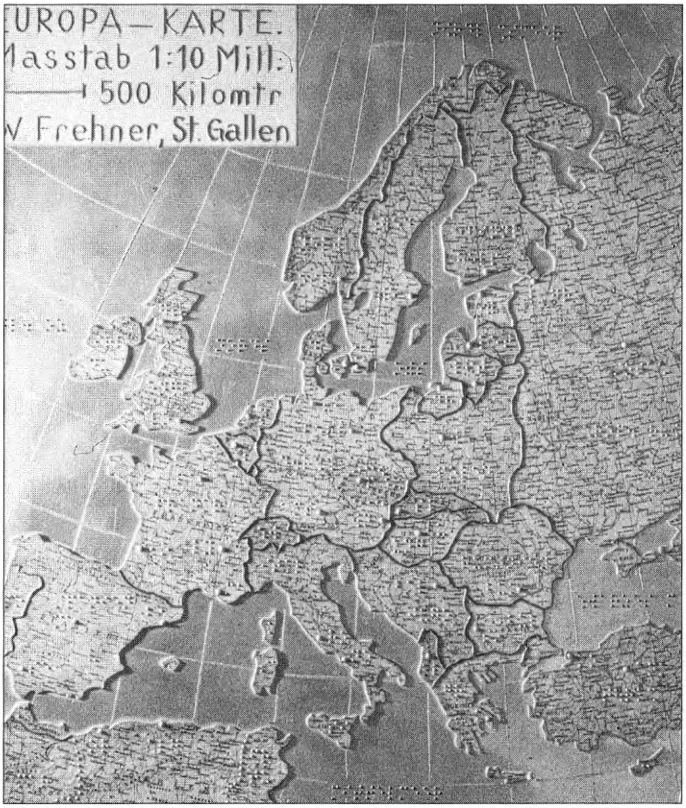
Many of the maps which have survived from the beginning of the 19th century are ordinary maps with raised lines and dots. The early maps of Institute des aveugles only showed the national frontiers with thin steel wires; they were always of different shape and size, to enable the pupils to distinguish the different parts from each other. Haüy had already used maps in his teaching and had, in fact, progressed from the handmade map to the production of printed relief maps.

> These means we have chosen in preference, on account of the ease which they afford us of multiplying, by the assistance of the press, the copies of our original maps for the use of the blind. It will, besides, be more apt than any other to offer itself to the execution of details the most delicate which can affect the touch of these individuals: and the first of our pupils have brought themselves to such admirable perfection in the use of geographical maps, that people see them with surprise, at our exhibitions, distinguish a kingdom, a province, an island, the impression of which is presented to them, independent of other parts of map, upon a square piece of paper.[10]

Before the knowledge of possibilities of printing techniques in the production of relief pictures and maps had been developed and become widespread, teachers in schools for the blind usually produced their own relief maps, for their pupils. These relief maps were often executed on a hard wooden or cardboard board with lines and dots in different materials. It was not unusual to use vivid colours to indicate land, water, towns, borders, etc. The vivid colours were probably applied out of consideration for the partially sighted pupils. In spite of the development of techniques for the mass-production of maps, production of the unique, handmade maps continued.[11]

The handmade maps were of varying sizes, from small maps to be used by the pupil when seated by his desk, to wall-maps about one square metre in size. An example of a handmade map of more recent date is the map of Africa made by Johanna-Marie Greter for the pupils at Sonnenberg Schule

Map of Africa made by Johanna-Marie Greter (Bundes-Blindenerziehungsinstitut, Wienna. Photo: author).



Map of Europe made by W. Frehner (Schweizerische Bibliothek für Blinde, Zürich. Photo: author).

für Sehenbehinderte und Blinde in Baar in Switzerland.[12] The map is cut from wood, the continents are not painted but lacquered, the borders are made of small, red tacks which have been set very close to each other, thus forming a continuous dotted line. The towns and villages are indicated in small ovals with braille writing on them. Lakes and rivers are slightly lower than the picture surface and are painted blue, as is the sea.[13]

There are more and more varied examples of this type of handmade maps in Switzerland. A teacher by the name of W. Frehner, of St. Gallen, made a map of Europe (424 x 525 mm). An ordinary map had been fixed to cardboard or plywood, after which it had been cut out with scissors or a

Maria Theresia von Paradis' map from 1800 (Bundes-Blindenerziehungsinstitut, Wienna. Photo: author).

fretsaw. The borders were indicated with green lines. Each country had its own colour, but as the colours were all of the same tone, the map is of no use to the partially sighted. The capitals are marked, together with one or two other towns in each country. The names of the countries are indicated in braille; sometimes the whole name is given, at others only the initials. The map is interesting because the shapes which represent land have been glued to an aluminium plate, on which the lines of latitude and longitude are engraved. As aluminium is a material which is a good conductor of heat, the heat of the finger is transferred to the metal plate, producing a cool sensation. Thus it creates a good tactile contrast between land and water.[14] Aluminium's capacity as to conduct heat rapidly has also been used in a map which is now in Le Musée Valentin Haüy. It is a map of France with lakes, rivers and mountain ranges; the major towns are marked. A thin sheet of aluminium represents the surrounding seas. The landmasses are made of light brown Masonite. This map of France is not dated like the one from St. Gallen, but we can assume that it is older than the latter, as it resembles the early maps where metal thread was used to represent rivers and borders, and buttons for towns.

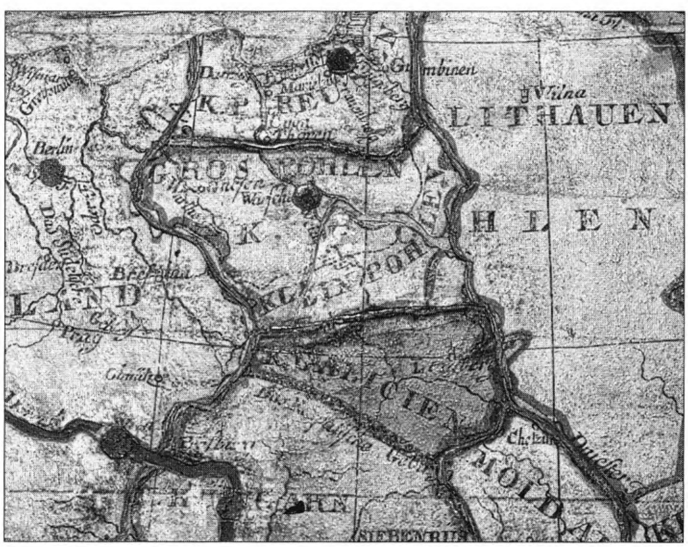
At the School for the blind in Budapest, which is still in existence, there is a relatively interesting collection of handmade maps of different sizes and varied content, representing the school surroundings, Budapest, Hungary and Europe. A variety of materials were used in their production. One map of Kirschenheuter, dated 1927, is made of glass and metal. The map itself is made of glass and the borders and other indications of metal thread and dots. A map from 1904 is made of wood and papiér mâché in combination.

The handmade maps often showed the village or local area, as is the case of the maps from Budapest.[15] In a lecture given in 1892: "Über den geographischen Unterricht in der Blindenanstalt," by M. Kunz, he recommended that teachers and pupils should together produce maps and models of their native land.[16] The first map of the immediate surroundings should consist of a model of the institute and its surrounding.[17]

Maps were made to enable Maria Therese von Paradis to follow the routes of the journeys she made on her concert tours. Her later maps were usually printed, with embroidered lines in relief indicating the borders of countries, regions and rivers. One of her maps, ordered by Weissenburg, has been preserved. It is an ordinary map, embroidered in silk chain stitch then can be folded. The embroidered lines are of different thickness depending on their significance. By using silk of different colours, maps like this could be used by the partially sighted. Maps produced this way were, however, not hardwearing enough to be used indefinitely.[18] Relief embroidery was nothing unusual in those days. At the Kunstindustrimuseet in Copenhagen, there is an ivory cabinet which dates from approximately 1600, whose doors are covered with pieces of silk embroidery, which is partly in high relief.[19]

A map of Europe, made by J.W. Klein for tactile readers, is a simplification of the type of map used by von Paradis. It was made for Jacob Braun, who was Klein's first pupil and studied with him from 1804 to 1805.[20] The map was a colour-print (410 x 50 mm in size), on which the borders were marked with wires and the capitals indicated by glued-on metal buttons. The borders are simplified so that only the characteristic shape of each country is indicated. It is much easier to read a tactile map where the borders, rivers and similar features are not too detailed.[21] We can assume that Klein was aware of this fact when he made this map, but, on the other hand, the material did not allow detailed representation of the borders. Earlier maps made by Klein in Paris, however, show that the simplification was the result of a conscious choice. In the map which has survived, we find the same type of simplification of the embroidered border lines and of the wires which were sewn onto the map to indicate rivers. As Paradis and Klein both lived in the same city, Vienna, it is very likely that Klein had seen or heard of Paradis's maps.[22]

There were different techniques for the application of relief to printed maps made for the sighted. At the museum of history of the blind in Vienna, there is a map of Erzherzogthum Österreich made in 1820 in what was called "masseschrift". The map, in all its simplicity, is similar to modern swell-paper maps: low black lines and relief dots. The black border lines are clearly and simply represented and the different regions of Austria are indicated with the Roman numbers I–IX, which are explained in a key in the lower right-hand corner of the map. Rivers, lakes and larger towns are also indicated. The ink print text on the map indicates that a printed map was used as a model for the design of this "masseschrift" relief map.



Map of Europe made by J. W. Klein (Bundes-Blindenerziehungsinstitut, Wienna. Photo: author).

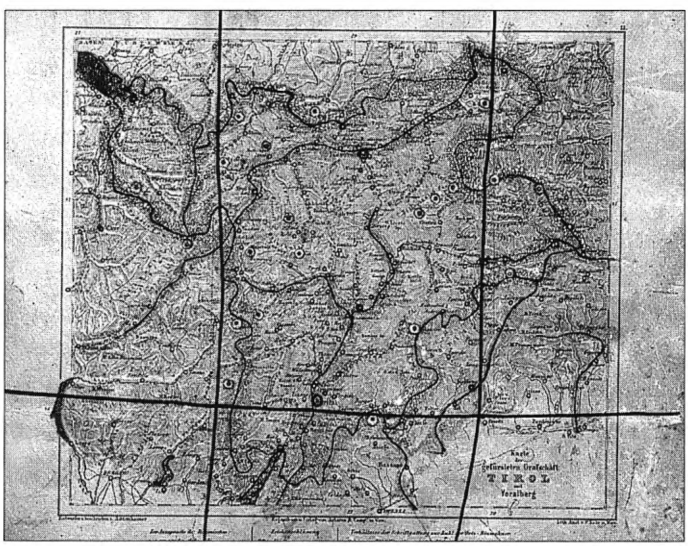
The reading of maps

It can be very difficult to find the exact spot on a tactile picture or map, due to the inherent limitations of tactile perception. Different types of reference points have therefore been applied to relief pictures and maps, to enable the visually handicapped reader not only to locate a particular spot, but also to know the part of the picture surface he or she is touching. An early example of what I suppose to be a kind of reference points for tactile map reading, is a small map of the Tyrol (290 x 250 mm). Its origin and are unknown, but it was probably made in the middle of the 19th century.[23] The basic map is a printed one in black and white, with tactile lines indicating rivers and dots in three sizes to show towns and villages of different sizes. The lakes are cut out and in the holes thus formed pieces of blue cardboard have been glued. The map is executed simply and clearly, and a great number of places have been indicated. Longitude and latitude are indicated by incisions on the outer edges of the map, from which strong threads stretch across the map. The threads create a net over the map, comparable to the grids found on most maps which have co-ordinates. The longitude and latitude not only tell where the reader where, on the globe, the Tyrol is located; they also make it easier for the pupil to find a particular point on the map from bearings.[24] There are early examples of maps where longitude and latitude are indicated by lines on the edges of the map, and bearings in relief print or braille. The relief globe with indication of longitude and latitude was already in use at an early stage in the teaching of the blind. When longitude and latitude were given on the map, it became possible to relate the map to the globe.[25]

When we want to use a map, several factors enter into play. One step in learning to interpret a map is to understand what continent a country belongs to and the geographical location of that country in relation to others. We must also learn what a country looks like, that is, the shape it has on the map. For visually impaired children, as well as for the sighted, familiarisation with the shape of a country is easier if one country is a studied at a time. In support of this learning, there are, for example, jigsaw puzzles where each piece represents a continent, a country or a province. J. W. Klein had already used maps which could be taken apart and put together in his teaching of blind pupils, to facilitate their perception of the shape of each individual country. There are, of course, jig-saw puzzles of maps as well as other games with pieces which must be assembled, for sighted children too. By playing with these jigsaw puzzles, blind children learned the names of the countries, their location, their size and name, and the location of their respective capitals. By 1854, Pressburger Realschuleprofessor Karl Winternitz had already commercialised his *Länderspiel von Europa für kleine Kinder von 5 bis 7 Jahren.*[26] The user's instructions mention that "Diese Spiel ist auch zum Unterricht für Blinde anwendbar". (This game can also be used in the teaching of the blind).[27] In the museum of the history of the blind in Vienna, there is a copy of one of Karl Winternitz's Länderspiel. Each piece of the puzzle corresponds to a country. When we look at the back of the jigsaw puzzle box, we find a map glued to it. There is absolutely no text, except for "Für Blinde", printed at the top of the jigsaw map.[28] Information in the museum tells that this particular puzzle was made in 1899.[29]

Pedagogical methods for teaching map reading had to be developed, as it was difficult for the beginner to interpret a tactile map through touch. Where shall we start, and how are we to interpret the different symbols? Even when the tactile map is simplified, compared to the visual map, it often contains many details. Relief maps differ from relief pictures, which normally only represent one object. In the relief map there is a lot of information about appearance, shape, location, size and relations. In order to understand this information from a map, systematic reading is necessary.

Tactile reading is different from visual reading. When we look at a picture, our eyes move to and fro over the picture surface until we have formed an impression of the whole. Tactile reading is more akin to the



Map of Tyrol (Bundes-Blindenerziehungsinstitut, Wienna. Photo: author).

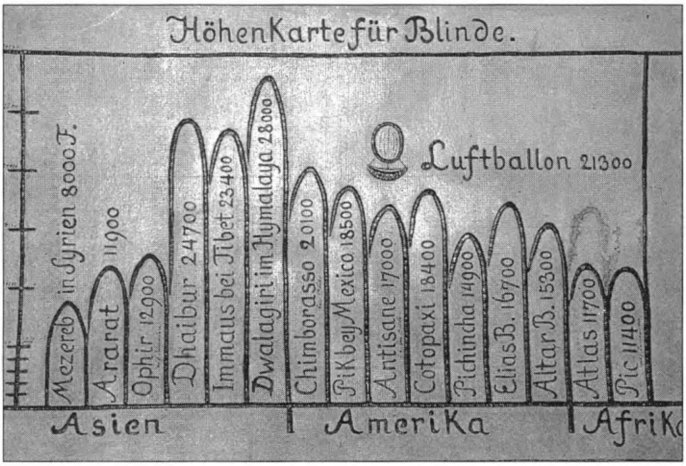
reading of text; the hands are moved a little at a time, to allow identification of the details on the picture surface. The whole surface can also be felt, in order to form a general impression of the contents of the picture, before the hands are moved more systematically over it for the reading of one detail at a time.[30]

Geography lessons for the blind included the teaching of map reading. The pupil began to learn how to grasp the principal characteristics of a country, preferably his own. It was recommended that the pupils should first learn to distinguish between the continents and the oceans, as the outlines of these enormous landmasses are clearly distinguishable from those of the large bodies of water which constitute the oceans and seas, and are thus excellent points of reference for tactile reading. I now quote directly from Josef Pöschl himself in his discussion of two important questions concerning the "readability" of relief maps: the method to be employed in reading them and problems which may arise.

> Thus we first locate on the map of Germany, for example, the two finely-lined surfaces in the north-west and north-east which correspond to the North Sea and the Baltic, and the Jutland isthmus which separates them. From the shores of both seas you then reach the interior of the country as you trace the course of the great rivers Rhine, Weser, Elbe, Oder and Weichsel upstream, with their tributaries for further orientation. It should be noted here that where geographic topics are concerned, in the use of tactile maps, it is emphatically to be recommended that the river systems should predominate, although from first to last this depends on other factors, since the river systems are much easier to locate and distinguish as a skeleton of the whole map than the mountain ranges, which in many cases on maps of countries with a large extent of very high terrain (as, for example, on Kunz's map of Switzerland), often stand out so strongly that they make it considerably more difficult for the probing finger to orient itself.[31]

Ectypographic maps

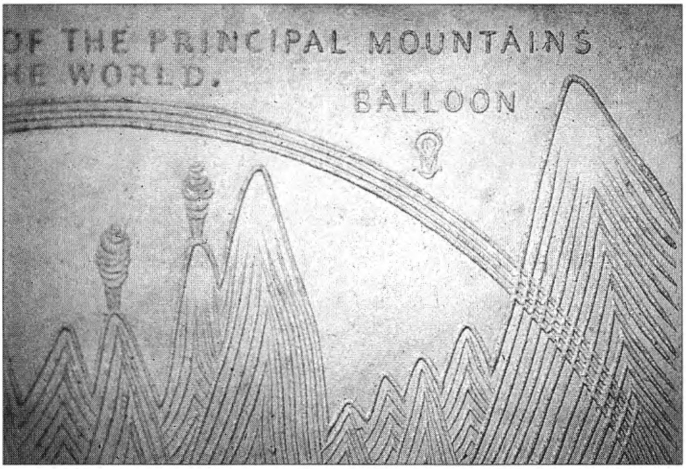
The production of relief maps for the teaching of geography is not p articularly remarkable. It might, however, be worth considering why topographic features were represented in visual form for tactile reading. On a map at the museum of the history of the blind in Vienna, the highest mountain tops of Asia, America and Africa are represented in the form of a bar chart. The heading reads: *Höhenkarte für Blinde*. It is made in ectypography on cardboard (400 x 255 mm) and shows seven mountains in Asia,



Höhenkarte für Blinde (Bundes-Blindenerziehungsinstitut, Vienna. Photo: author).

seven in America and two in Africa. The names of the mountains are written in ectypographic relief on the respective bar. In the picture there is also a balloon at the summit of the mountains. The chart indicates in tangible form the relative heights of the mountains, while it also serves as a reference of the height at which a balloon may navigate. The purpose behind this picture was probably to concretize topographic features with the help of relief, in the same way as abstract concepts such as height and relative height were introduced to the blind pupil. Height is one of the concepts which are difficult to understand without a more tangible description through, for example, a relief picture or a model. This type of chart was also produced by Alston at the Glasgow Asylum for the Blind, including a relief picture representing the length of different rivers and another picture illustrating the heighest mountains in the world. The Scottish map of heights contains a balloon, as does the *Höhenkarten für Blinde.*

> ... containing in relief a representation of the comparative heights of the principal mountains in the four quarters of the earth, ascending gradually from elevations with which the inmates of the Asylum are familiar, (such as Gad's-hill), to the loftiest peak known, viz. Dhawalagiri, or the White Mountain, one of the Hamaleh range, which is at least five miles above the



From Geography and Astronomy for the Blind, Glasgow, 1830s (Danmarks Blindehistoriske Museum, Copenhagen. Photo: author).

> level of the sea can be distinctly felt; the line of perpetual snow or conflation on the equator is rendered sensible by the mountains being rougher from that line upwards by means of a coating of sand; a tangible rainbow is represented, bestriding the mountains, and Guy Lussac's balloon can be felt soaring in the air at the height of 22,990 feet above the level of the sea, being the highest altitude of balloons. The names of the mountains, the parts of the world in which they are situated, and their elevation in feet, can all be ascertained by consulting the knotted strings which are attached to a suitable part of the board.[32]

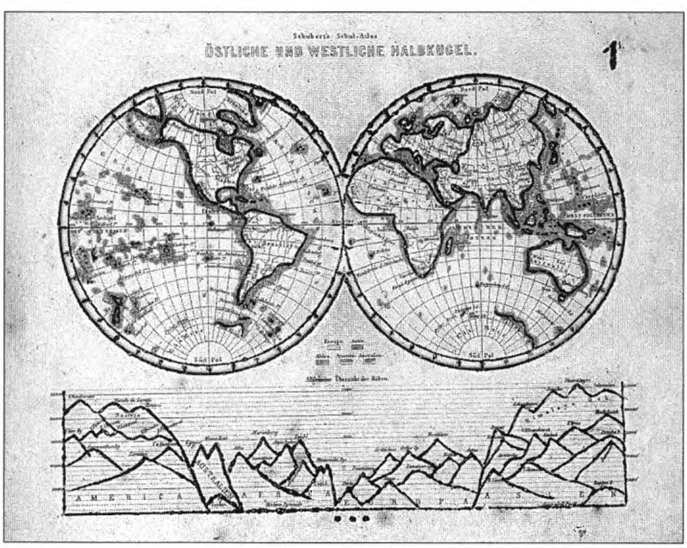
In contrast to the atlas described above which consisted of form-pressed relief maps, *Höhenkarten für Blinde* is made in ectypography. *Höhenkarten für Blinde* may be a further development of a chart included in *Schulatlas für die Unterrichtsanstalt des Österreichischen Kaiserstaates*, published by Ferdinand Schubert in Vienna, in 1837. The first map in the atlas represents the eastern and western hemispheres. On the same map there is also a chart showing the highest mountains peaks of the different continents. The chart, however, is difficult for the tactile reader and lacks explanatory text in relief.

The Austrian school atlas was produced in relatively small format

(280 x 220 mm) and starts with twenty pages in ink print, with information on the contents. There follows a relief page printed in ectypography.

> Verzeichnis des Karten von F. Schuberts Schul-Atlas
> 1. Oestliche und Westliche Halbkugel, 2. Europa. 3. Asien. 4. Afrika. 5. Amerika. 6. Australien. 7. Deutschland. 8. Kaiserthum. 9. Ober -u. UnterOesterlich u. Saltzburg. 10. Tirol. Steirmark, Mähren u. Schlesien. 12. Ungarn, Siebenbergen und Galizien. 13. Stormgeliert der Donau. 14. Palästina.

The maps are in relief applied to ordinary, printed maps. The lines which have been filled in to create the relief are limited to the borders of continents and countries. Different colours have been used for the different European colonies in Africa, which would seem to indicate that the map was also intended for partially sighted pupils. This system, however, could also have been used to facilitate the work of the teacher. The relief maps are simplified to a large degree, compared to the ink print map on which it is made. The person who adapted the maps for tactile reading has not allowed himself to



From Ektypographischer Schul-Atlas für Blinde (Bundes-Blindenerziehungsinstitut, Vienna. Photo: author).

be influenced by the details and shading of the printed map. The borders are easy to distinguish because of their simple design. This school atlas was not, however, the first of its kind. *The Ektypographischer Schul-Atlas für Blinde* was published in 1837. It contains fifteen maps, all without text.[33] The atlas starts with plane maps of the globe, one on each page, followed by continents in isolation. The maps are crossed by lines indicating longitude and latitude in the margins. The landmasses are represented without texture, while circular lines similar to the contour lines indicating height on ordinary maps cover the oceans. The larger mountain ranges are shown on each of the continents, their crests caterpillar-like shapes from which a multitude of lines radiate. These relief maps are difficult to read, partly because of the ectypography which produces a vague relief, but also because they were not, like the pictures in *Ektypographischer Bilderwörtenbuch für Blinde*, adapted for tactile reading.

Samuel Gridley Howe's atlases for the blind

One of the oldest, best preserved atlases was produced by S. G. Howe for Perkins School for the Blind: *Atlas of the United States printed for use of the blind*, 1837.[34] I need not give a detailed presentation of Howe's activities as a producer of maps, as he does this himself, in his introduction to the atlas:

> Introduction
>
> It is known that the contrivances hitherto used in Europe for the instruction of the blind in geography, are very expensive, rude and imperfect. Hardly deserving the name of maps. They were made by hand, either by puncturing through an common map the boundaries and c. or by first pasting a map upon a board, and then gluing up on it. Strings or bits of pasteboard, to present boundaries, rivers, etc. There was no lettering, and no printed explanations, so that the blind could not tell by themselves, whether the portion they placed the finger upon was to represent one part of the globe or another; they required to be taught upon each map, by a seeing person. The first attempt at embossing maps, was made at this institution. After many expensive experiments a method of printing them was devised: and an atlas, the first of the kind was published. It has been found a source of great pleasure and useful knowledge to the blind, who can study it unassisted by a seeing person.
> The present atlas will be found to be superior to the first, in the clearness and strength of the impression. And in the advantage of representing a smaller extent of country on the square inch.

It will give the blind the means of knowing the general outlines, shape and boundaries of each state; the rivers, principal towns, population and general statistics of the whole.
It is the minified gift of Mr. John C. Cray to that class of his fellow beings who are deprived of sight. His reward will be the consciousness of making many a sad heart, glad; and of fitting up many a blank hour with pleasing and useful occupations.
His gift supplies to them, as far as the geography of the United States goes. A most valuable source of knowledge. May his example be imitated by others, until the blind shall have all amelioration to their condition. Which human ingenuity prompted by benevolence can effect. April 1837/S. G. Howe.

There is also an introduction to the reader, written by S. G. Howe.

> Explanation
>
> The blind reader will observe that the present maps are far superior to those first composed and published by me; for this improvement and for many others in printing. I am indebted to the ingenuity of Mr. S. P. Ruggles.
>
> The contractions are, N for north, S for south, E east, W west. The figures on the top and bottom mark the longitude from Washington. Those on the sides the latitude. When a river is mentioned the towns are named successively ascending the river. T after figures denotes, thousands, M millions ST. is for saint. u.s. United States. R is for river. The other contractions will be easily understood.

The atlas is organized in the following way: first there is a map and then a detailed description of it, then another map with its description etc. All texts are written in the so-called Boston-relief. The following year, 1838, yet an atlas was produced, as a complement to the earlier atlas. *An Atlas of the Principal Islands of the Globe for the use of the Blind* by S. G. Howe (Executed at the Institution of the Blind, Boston 1838). In his introduction to this atlas, Howe wrote:

> This atlas is intended as a supplement to the large general atlas for the blind. There are many divisions of the earth, which are so small as to be conveniently represented in maps of the size of these. Islands, Peninsulas etc., which are here represented, are omitted in the large atlas.

This atlas has the same size and technical quality as that of 1837.[35]

The interesting fact is that Howe started his atlas production by publishing *A Geographical and statistical atlas for the use of the blind*,[36] which included physical maps as well as diagrams and charts with different types of geographical statistics. The atlas has twenty-five pages, of which a large part is descriptive text. The first spread shows: Extent of the entire surface of the Globe 200.000.000. The illustration is in the form of rectangles, distributed over the picture surface. In the rectangles there is information on the part of the total surface of the world taken up by various landmasses and oceans, as well as of population size in different parts. The space between the rectangles has a horizontally striped texture. At the bottom of the picture surface, the different religions are given with their respective number of followers: pagans, Buddhists, Roman Catholics, Muslims, Brahmans, Protestants and Jews.

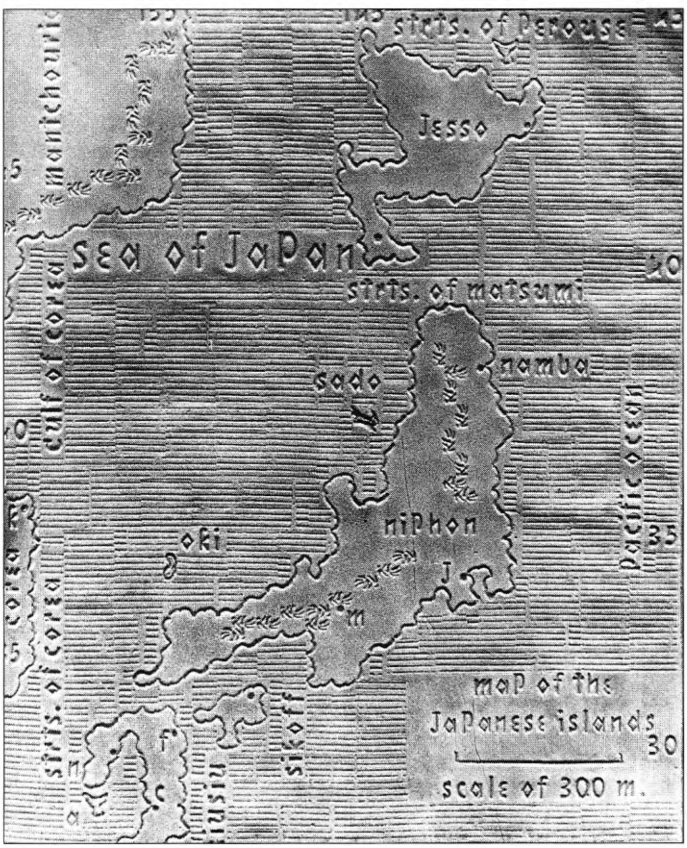
The facing pages in *Geographical and Statistical Atlas for the Use of the Blind* are disposed differently, but detailed descriptions are given with practically all the maps.[37] All of them have a border with indications of longitude and latitude, even if the descriptive text is situated next to the map, on the picture page. There are also lines indicating the scale employed. On the maps there are references in text or letters, of the kind Howe recommended in his introduction to *Atlas of the United States, printed for use of the blind* the following year. An example of the type of description is the one of the map of Europe, which, like all the other maps, has indications of scale, longitude and latitude. The landmasses are smooth and the oceans reproduced in the horizontally striped texture so typical of Howe. The countries are identified either by name or by a letter.

> Europe
>
> Explanation of the map of Europe. On the left are the British Isles: E stands for England, S for Scotland; the only English river shown is the Thames. France is next to Switzerland, marked with an S; above it is Belgium marked with a B; H not separate from Holland; on the right, H stands for Hanover ...

Later atlases or individual maps do not have this type of explanatory text or description found on Howe's maps. It is not unusual, as Howe quite rightly points out, to find that the maps have no indication of countries, seas, rivers and towns or cities. When Kunz introduced his ideas on the teaching of geography and the production of maps, he never discussed the relation between text and map. His maps came with very little text.

A later series of paper maps (360 x 295 mm), produced at the School for the Blind in 1908 show that the horizontally striped texture for water had been abandoned. The water surfaces on those maps are represented by small dots. The maps, which are extremely simplified and of good quality, are similar in aspect to modern, simplified maps on swellpaper. In the Museum of the blind at Tomtebodaskolan in Stockholm there is a bound copy of this atlas, with a hand-written label on the cover stating that the maps were printed in Philadelphia.

There are, however, later examples, from 1920 to 1940, which in many ways resemble the maps that Howe produced. One is a map of France made at the Marburg Blindenstudieanstalt in 1940. The land is smooth and the surrounding seas have a close, horizontally striped texture. Towns and cities are represented by dots of varying sizes and beside each are the first two letters of their name in braille. Narrow, solid lines about half a millimetre in height mark the rivers, and the mountain ranges are continuous surfaces raised above the level of the land. The organization and design of the maps



Geographical and Statistical Atlas for the Use of the Blind (Courtsey Samuel Hay's Research Library, Perkins School for the Blind). Japan.

seem to indicate that they may well be the result of further development of Kunz's maps.

Kunz's maps

In the 1890s, Kunz became the leading producer of maps in Europe; his maps were even distributed in the USA. When Kunz summarized his work in 1906, he had behind him an impressive production of maps. He had produced matricies for eighty-seven different maps of all the then existing countries. No less than 100 000 copies of these maps were produced and distributed on a commercial basis.[38] Kunz himself has described his work on the development of mass-produced relief maps.

> The first attempts at printing were made in Fontaine's old presses with map moulds produced by my sighted school-teachers in Genau. These attempts led to the publication of the small "Repetition atlases" for the sighted. These maps were useless for the blind pupils. I then tried making maps in the same way as embossed print, that is, by hammering them onto sheet metal plates or modelling them in plasticene to be cast in plaster and later printed, in both cases without success. Finally, I tried wood-engraving, and during the year 1883–84 this gave us acceptable, albeit poor-quality maps. Not until 1895 was wood-engraving superseded by models made of wood, paper, brass strips, tacks and putty. From my point of view, and perhaps from that of the history of education of the blind as well, the oldest rough attempts at maps are only of historical value.[39]

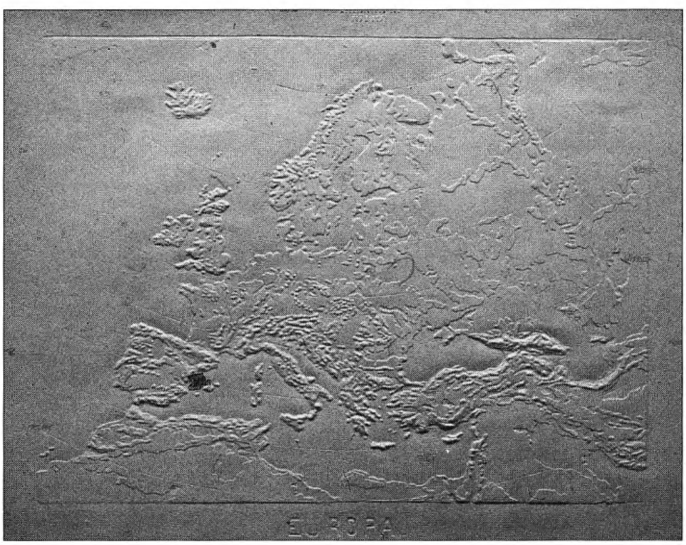
Kunz had adopted the idea of form-pressed relief maps introduced by Ludvig Guldberg, at the Blindinstitutet of Copenhagen. Guldberg was unable to produce relief maps in large numbers.[40] Kunz produced nearly one third of the maps in woodcut during the years 1883–1884.[41] These were smaller in size than the ones produced later (320 x 245 mm), and the relief not as good. Kunz published them in a new edition in 1904, in a portfolio called *Plastischer Repetitions-Atlas Über alle Teile der Erde*. On the inside of the portfolio there are extracts of texts from various specialised reviews, testifying to the positive reception given to the maps when they were first published in 1884. When we compare these early maps with those Kunz made after 1885, the main difference lies in the way the lines of longitude and latitude are indicated by depressed lines on the smooth water surfaces. On later maps, water was represented by a striped texture and the lines of longitude and latitude by short, raised lines on the borders.

In 1885, Kunz invented the technique he was to use for modelling in wood, paper, strips of brass, pins and putty.[42] One of the first maps he made using this technique was of England. It was one of a series of maps produced after a decision had been made in 1885 by "Verein zur Förderung der blindenbildung", according to which 30 000 maps in relief were to be produced and sold at cost.[43] The selection was to be made by the members of the association and the geographic commission[44] in consultation with the supervisory committee, on which there were representatives from Germany, Austria, Denmark and Holland.[45] According to Kunz, the administrative work connected with the publication of the maps was very slow and was much more time-consuming than the production of the maps itself. Between 1886 and 1887, approximately one thousand copies of three maps (of Italy, Spain and Portugal and England) were produced.[46] The location of the text on Kunz's relief maps varies. On the map of England it is placed in the upper left-hand corner and reads: "England, M. Kunz Illzach. Herausgegeben vom Verien zur Förderung der Blindenbildung. Steglitz bei Berlin, 1887." The map is made on the scale of 1:2 500 000 and shows the British Isles including the Orkneys and Shetlands. The mainland is represented as whole areas, raised about two to three millimetres above the surrounding bodies of water, which are indicated by a horizontally striped texture. On the land surfaces, mountains and rivers are indicated. The lines representing rivers are approximately half a millimetre in height, a measurement recommended by Kunz five years before, during the Blindenlehrerkongress in Frankfurt.[47] On the outer margin of the map, longitude and latitude are indicated by a short relief line; in addition, each position is given in braille. The lines of longitude are marked, but on the upper and lower edges of the map there is another type of numbers. The short lines of longitude slope diagonally towards the map picture, to indicate that the earth is curved. Placenames and other text on the map are in ink print only. The map of England made by Kunz is representative of his general production. It shows a marked difference between the landmasses and the water: the former are smooth and the latter have a horizontally striped texture.

It is interesting to compare Kunz's map of England with another map produced in England fifteen years earlier, *England and Wales (Physical map) For the blind,* by J. Brion & Sons in London, in 1872. Constructed and published under the direction of the Council of the British and Foreign Blind Association, 33. Cambridge Square, Hyde Park, London W.[48] The map of England and Wales (450 x 550 mm) includes ink print and braille. The rivers are indicated by thin, relief lines on the smooth, elevated parts indicating land. There is a faintly outlined second relief level, indicating the hillier parts of England. A large number of English placenames are given on the map, with the first letter of the name in braille. The landmass forms a relief against the surrounding bodies of water. The North Sea and the English Channel are shown as plain surfaces. The outer margin of the map has marks indicating longitude and latitude. At the bottom of the map there is a line indicating the scale.

In the lecture "Über den geographischen Unterricht in der Blindanstalt", 1882, Kunz pointed out that on the maps produced at that time in Paris the sea was indicated by a horizontally striped texture, to enable the blind to perceive clearly the difference between land and water. Kunz went on to say that there were no maps for the sighted on which the contrast between land and water was not clear.[49] The Perkins School for the Blind has a map from L'Institution Nationale des Jeunes Aveugles in Paris, which proves that the producers of tactile maps in Paris were familiar with the problems related to tactile perception.[50] The map represents South America and is an example of how, in France, the horizontally striped texture was still being used to indicate water at a later date. The mountain ranges are indicated by a solid line crossed by alternating long and short lines.[51] By varying the length of the lines, tactile perception is able to create the sensation of relief at several levels, which is very useful in the representation of mountain ranges.

On Kunz's maps, water was marked in this very way, as were Howe's maps, produced earlier. In 1850, Moon published relief maps of Europe,



Plastischer Repetition-Atlas über Teile der Erde, 1904, first published in 1883–1884. (Tomteboda skolans Blindmuseum, Solna. Photo: Hans Thorwidd.)

made of paper print.[52] The maps have indications of political borders, rivers and mountains. The oceans have the same, horizontally striped texture as Howe's maps. The question is whether Kunz was familiar with Howe's maps or with Moon's. When Kunz started his activities as teacher of the blind and producer of relief pictures and maps, Howe had been dead for nearly twenty years, while Moon was still alive and active.

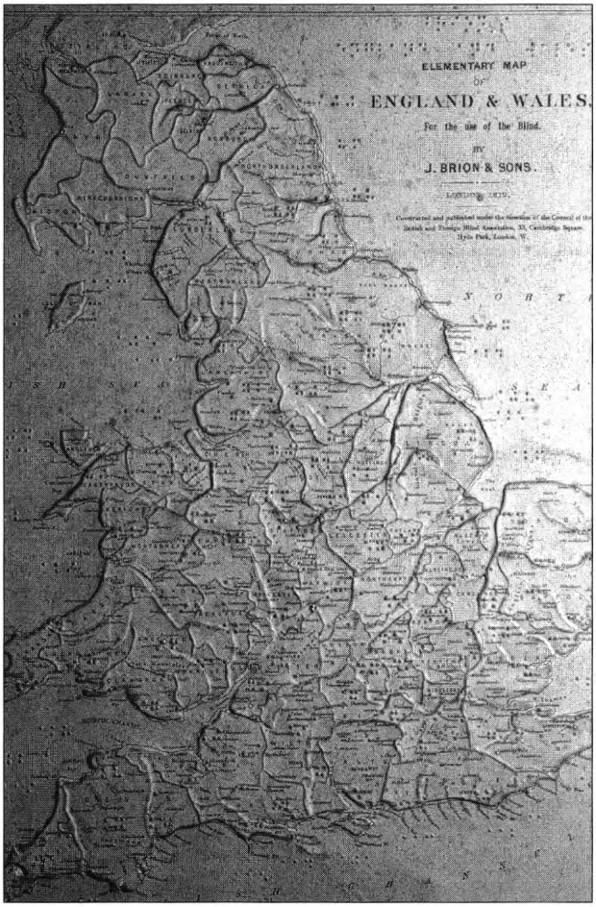
In his lecture in 1882 on the teaching of geography, Kunz had stressed the importance of teaching physical geography in schools for the blind. He also said that the pupils ought to have access to relief maps both during classes and when they had finished school.

> 1. ... since what is relevant, characteristic and permanent of a country, all factors on which its settlement depends, while everything related to politics can be compared to clothes, which are influenced by fashion and a thousand other forces, and which shine today, serve their purpose and are gone tomorrow.
> 2. ... since even today, because of the strict economy which is a necessary virtue in many institutes, not all blind pupils have access after they leave the institute to relief atlases with which they can revise and reinforce the knowledge acquired during their studies. But when the skeleton which held together their remaining geographical knowledge disappears, all relevant knowledge sinks back into chaos, while knowledge in the field of political geography can easily be refreshed and added to in everyday life by reading.[53]

Everything would appear to indicate that Kunz had both the interest and the skill required for work not only in geography and cartography, but also in tactile perception and pedagogy of the blind. His extensive lecture on the teaching of geography in schools for the blind (Frankfurt, 1882), his revised text on the same subject in Mell's Encyclopaedia, published in 1900 and, last but not least, the high quality of his relief maps, all bear witness to this fact.

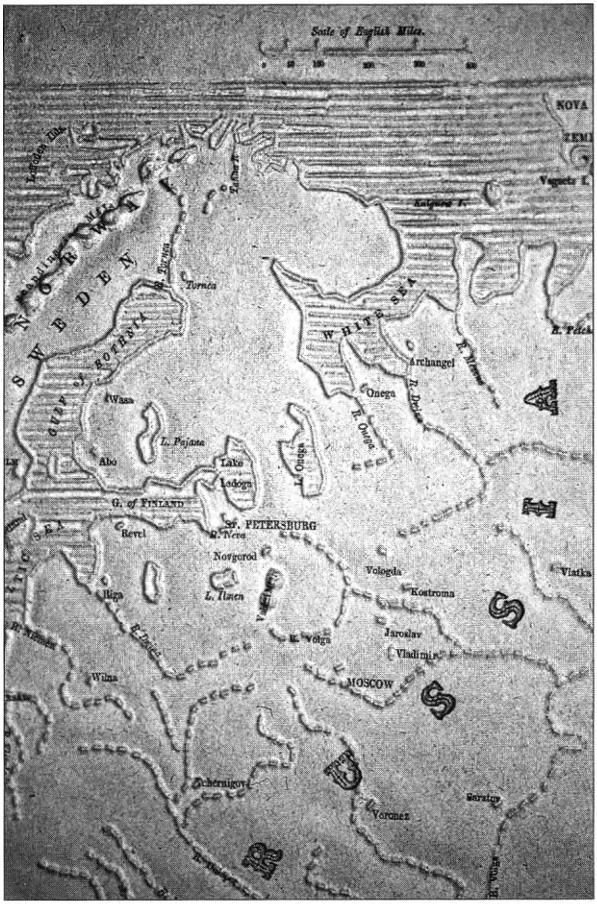
In *The Education and Employment of the Blind: What it has been, and ought to be* (1886), T. R. Armitage described and discussed the quality of different types of relief maps.[54] Armitage emphasized the importance of classroom collections of tactile maps and wrote about the maps available at the time: the French print paper maps, Kunz's and Kull's maps, as well as maps produced by the British and Foreign Blind Association (now Royal National Institute for the Blind). He describes these maps as follows:

> The French print paper maps are plates on which the outline of the land is indicated by a thick line, and the surface of the sea is distinguished from that of land by being crossed by close parallel ridges. The rivers are marked by plain lines, and the



England and Wales (Physical map) For the Blind, 1872 (Schweizerische Bibliothek für Blinde, Zürich. Photo: author).

boundaries of the countries by dotted lines. Maps of the same principle of construction have lately been printed by M. Kunz. /.../ The Germans have therefore lately abandoned the old French system of marking the difference between the sea and the land, and have adopted the English principle of raising the land boldly above the level of the water. The later maps constructed by M. Kunz, of Illzach, as well as those made by M. Kull, of Berlin, are on this principle. They still denote rivers by raised lines, which does not seem satisfactory.

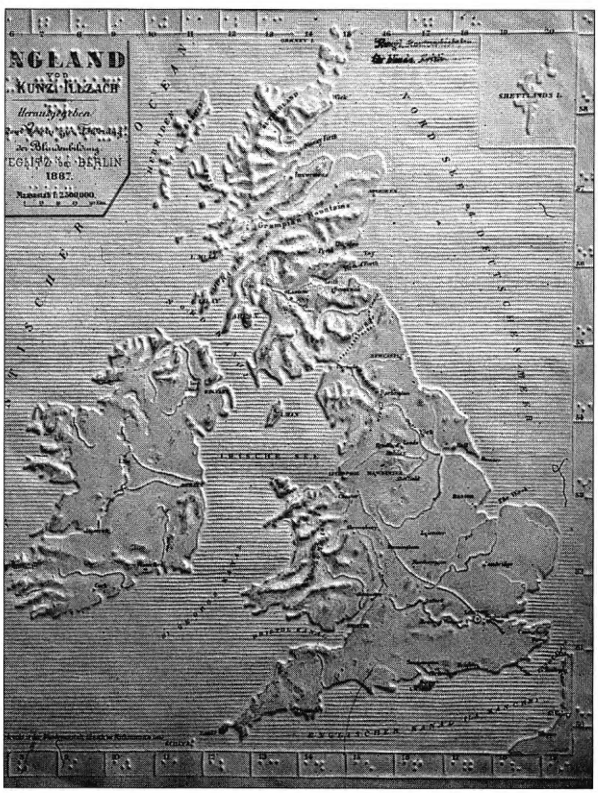


Moons' map of Russia (Bundes-Blindenerziehunsinstitut, Wienna. Photo: author).

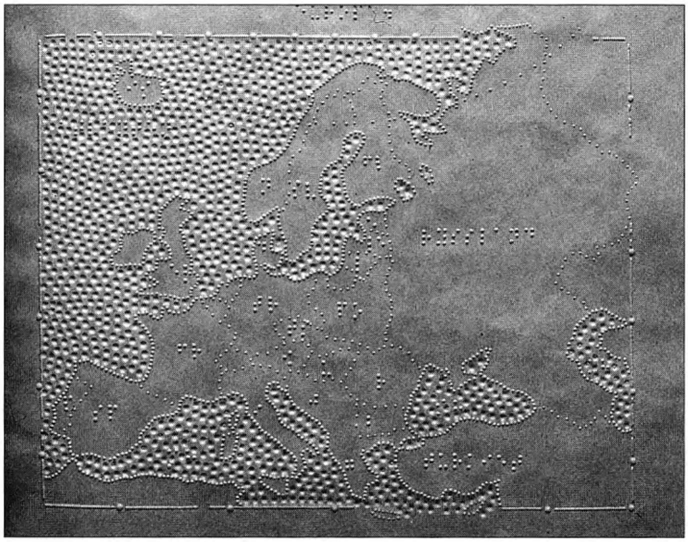
/.../ In the maps constructed by the British and Foreign Blind Association, the principle adopted is to distinguish land from water by always keeping the water on a lower level. The coastline is therefore sharply raised above the sea; this method allows the most complicated coast-lines to be accurately marked, and lakes, even small scale, to be as correctly represented as they are for seeing. Rivers are marked by depressions, the left bank being shelving, the right perpendicular, so that the course of the river can always be ascertained at

> once; moreover, the perpendicular right bank can very readily be followed by the finger. This mode of representing the rivers by depression makes it possible to use raised lines for the political boundaries or railways.[55]

Armitage also mentioned that railway lines and land borders should not be shown on the same map, to avoid creating confusion for the tactile reader.[56]



Map of England, Martin Kunz, 1887 (Schweizerische Bibliothek für Blinde, Zürich. Photo: author).



Europe, from Thilanders' printing company. (Tomteboda skolans Blindmuseum, Solna. Photo: Hans Thorwidd).

Thilander's maps and flags

Thilander's printing company, like most other printers of relief and braille, published a world atlas. One may assume that the world atlas preserved by Synskadades Museum, Enskede (Stockholm), was published by Thilander, though there is no information as to its origins.[57] It is square in shape, 360×360 mm, and contains twenty-five maps. The paper is of the sepia-coloured quality typical of Thilander. The atlas is bound and has a simple cover of strong, dark-brown paper. Each map has a border, except for the first four, which show the globe from four different angles: the Arctic, the Western Hemisphere, the Eastern Hemisphere and the Antarctic.

On all of Thilander's maps, land is untextured; the edges of the continents and other landmasses are indicated by dotted lines. Water is represented by a coarse, depressed, dotted surface on which braille text could be written.

After the maps of different parts of the globe, there are maps of whole continents followed by more detailed maps of each. The atlas starts with Europe; the political borders of the different countries are marked, each of them identified by one or more initial letters. The names of Russia, Turkey and the Atlantic Ocean, however, are written in full. The next map is of Denmark, after which come Finland, Central Europe, the British Isles, France, Holland, Belgium, Switzerland, the Pyrenees, the Apennines and the Balkan peninsula. The other regions, countries and continents are not represented in as much detail, but only generally, in the following order: south-west Asia, south-east Asia, Asia, Palestine, Africa, South Africa, Australia, South America, North America and, finally, the United States of America and Central America. On the latter, the United States of America are distinguished and identified by the respective initials.

Thilander was a driving force in the Esperanto movement and worked in favour of globalization, but his greatest efforts were in favour of the blind and the production of literature for the blind. In 1937, he published, *Flagoj de la nacioj* (Flags of the Nations), a book of flags with text in Esperanto and illustrated with pictures of a great many of the flags from all over the world. This book should be seen as an attempt to extend knowledge to readers on a worldwide scale. Thilander's book of flags is 200 x 285 mm in size; the picture and text pages are light-brown and it is bound in hard covers. Several copies of this book are still in existence.

> ## A brief introduction
>
> When Mr. T. W. Holmes, the English artist who has donated so many geographical maps and other illustrations to *Esperanta Ligilo*, sent us the drawings of these flags – the first attempts at representing colours in relief illustrations for the blind – he did not wish to have his name on the title page. We honour his wishes, and respectfully leave the title page as he designed it. He cannot, however, avoid our heart-felt feelings of joy and gratitude for his valuable gift, nor the joy and grateful thoughts of those who will find this little book interesting and useful.
> The publisher[58]

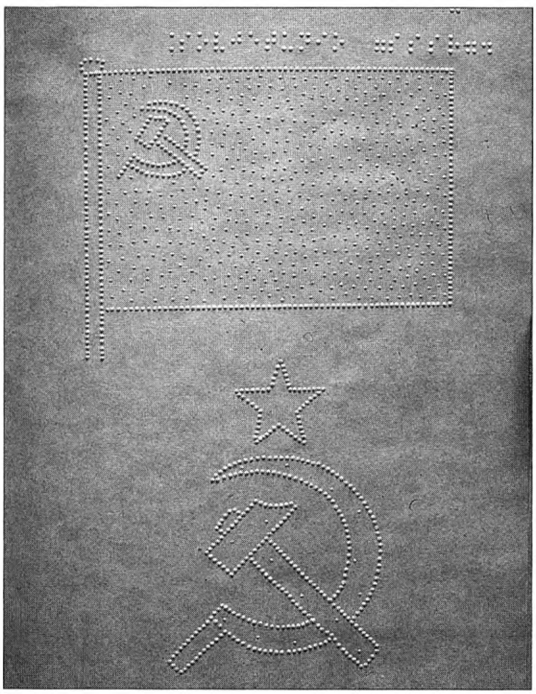
The title page is decorated with a five-pointed star in the centre and edged with double lines.[59] The central star and the edging are in dotted lines. *Flagoj de la nacioj contains* the flags of twenty-eight different nations. Each flag is presented on a double page which shows the complete flag and an enlarged detail. There is also a description and a colour code on the left-hand page.

The flags are made with thin, dotted lines; the surface is textured with dots of different sizes. There is a colour for each flag. This colour code is consistent throughout the book. Red, for example, is always a surface with small, scattered dots. The colour code is explained at the beginning of the book.

> ## Explanation
>
> The two vertical parallel lines to the left of each flag represent

the flagpole to which it is attached. The order of the flags is completely arbitrary, decided only by the availability of material.The different colours of the flags are represented by different surfaces. The surfaces are as follows: White, yellow, red, green, blue, black.

Den gula jordens barn by J. Gunnar Andersson was published by Thilander for De blindas Bibliotek in 1937.[60] It is an account of China's geography, cultural history and people, and an example of how maps and pictures were made in relief for the braille version. Drawings and photographs illustrate the original copy of *Den gula jordens barn*. The motives are varied: photos



The Soviet Union (USSR) Colours: red and yellow.
The flag of the USSR (Union of Soviet Socialist Republics) is red with a yellow emblem in the upper left-hand corner. The lower picture shows an enlargement of the emblem, a crossed hammer and sickle, symbolising the union of industrial and agricultural labour. Above this emblem there is a five-pointed star. (TPB. Photo: Hans Thorwidd.)

of environments and drawings of details such as written characters, patterns on different types of pottery, and geological diagrams of the soil, etc.

In the braille version, there are only a few illustrations: three drawings and a map of prehistoric China. China is represented as an elevated, smooth surface. The surrounding sea has no texture. The cities on the map are raised dots, all of the same size. Next to them are braille letters which are explained in the corresponding key. The rivers are dotted lines; broken lines represent regional and political borders.

The relief illustrations are: *"Profil tvärsöver Gula flodens lopp vid Shan Pai Wan i Kansu"* (Profile of the course of the Yellow River at Shan Pai Wan in Kansu), "Shruthiolithus-ägg från lössformation i Hanan" (Shruthiolithus-egg from the loess formation at Hanan) and "Utvecklingsformer av skrivtecknet Ko" (The development of the written sign Ko). The fact that these pictures were chosen for transfer to relief is probably due to the graphical qualities of the originals, which permitted their reproduction in relief without any great elaboration.

Relief maps for the sighted and for the blind

All relief maps were not made specifically for the blind, and there were some relief maps originally made for the blind which turned out to be more suitable for the sighted. Kunz produced relief maps for the sighted as well as for the blind, and he was in favour of the production of maps which were of interest to the blind and the sighted alike. One such example the map of Switzerland.

A relief map used for both categories of student was the map of New England. Nothing is known of its origins, and there are, to the best of my knowledge, only two remaining copies, one of them at the Perkins School for the Blind, the other at the Museum of the History of the Blind at Bundes-Blindenerziehuns-institut Vienna. They are made in paper relief with a decorative border. The land surfaces are elevated above those of the ocean, lakes and rivers. The borders on the land surface are simple, clear lines, and the mountain ranges are shown as elevated triangles, one beside another. The map is partly coloured; the sea is blue and it has a red and gold striped border. On the reverse of the map at Perkins School the following can be read, on a printed note that has been glued on:

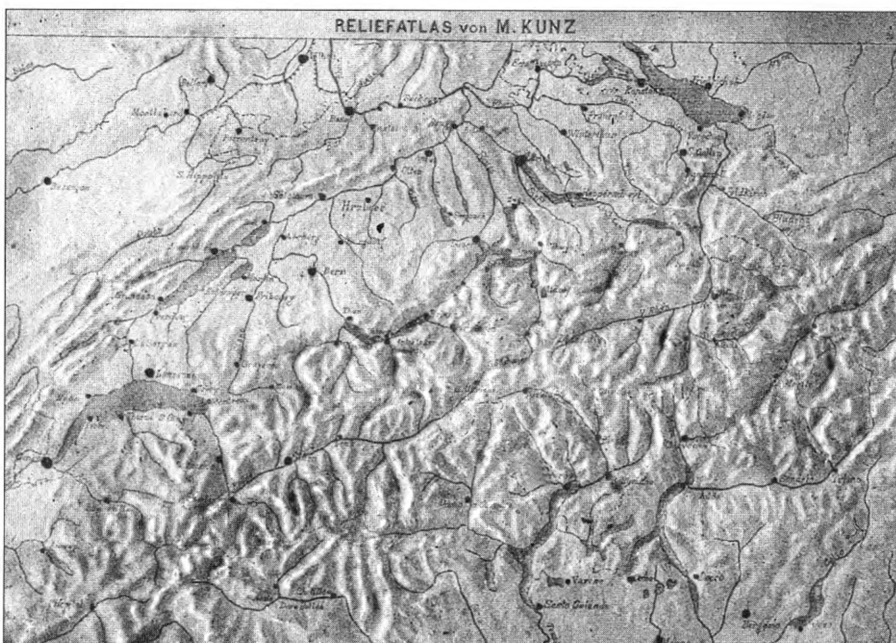
> They were invented to teach the blind geography. It is found, however, that they give a more clear and correct notion of the face of the earth to seeing children either than the commo maps. They represent the face of the country with greater accuracy; the child sees the land rising out of the water; he perceives at

once what a cape, an island, &c mean; he sees the channel of the rivers depressed beneath the surface of the soil, the mountains rising above it, &c.

They furnish, too, an excellent system of teaching the real situation of places, their bearings and distances from each other; the shape of countries, states, &c.: since the places being without any names, the child must retain them by strong effort of memory, and by learning their real and relative situation, unaided by written names.

On a common map, the child searches for the name, and contents himself with this—but the child who can find the word Michilimakinak may, nevertheless, not know within a hundred miles its real position—since the name covers a least that space of the country.

Finally, it is believed that embossed maps afford the best means of testing the knowledge of any person, of the geography



Relief map for sighted, Switzerland by M. Kunz (Bundes-Blindenerziehungsinstitut, Wienna. Photo: author).

of countries, and exercising children by questions about what they have learned on common maps.[61]

Globes in relief and astronomic models

A great variety of relief globes were produced and used for the blind. Globes of different sizes were made of wood, glass, metal, papier-mâché and rubber. These relief globes mainly showed the continents, the extension of the oceans on the earth's surface, mountain ranges, the principal rivers, the borders between countries and the larger cities. The amount of detail on the globe depended on its size; the smaller relief globes, for example, only showed the continents. Latitude and longitude were shown in a variety of ways. For example, raised lines or as indentations extending over the whole surface of the globe were sometimes used, while on other occasions latitude and longitude were only indicated on those areas of the globe which represented oceans and seas (i.e. on smooth surfaces).

During the early history of the teaching of the blind, attempts had already been made to represent the whole globe three-dimensionally. The first known relief globes were the result of experiments made by the first director of the Berlin institute, August Zeune. He had taught geography, and when, in 1802, he wrote his thesis *De historia geographiae*, he was teaching this subject in Berlin. This may explain his interest in the development of relief globes which could serve the sighted as well as the blind, when he became director of the institute in Berlin/Steglitz in 1806.[62] Zeune made his first relief globe in 1806, and it soon became popular throughout Germany. His work on relief globes not only benefited blind pupils; the relief globe, like the relief map, also helped the sighted to understand topography.[63]

The production of a relief globe involved a number of technical difficulties, and Zeune only achieved success at his fourth attempt. The very first relief globe was made in the year when the institute in Berlin was founded. It was made of paper in two layers and had a diameter of one hundred and twenty-five centimetres. The landmasses were made of plaster; the mountains were elevated one inch above the paper surface. Rivers were marked, and bodies of water were distinguishable from the land as surfaces with a coating of sand. The forests were made of moss, while towns and cities were represented by small pieces of cloth. Longitude, latitude and political borders were marked in a way which made them easy to distinguish tactilely, though it is not clear what material was used.[64] This globe enabled both blind and sighted pupils not only to distinguish landmasses, borders, rivers, etc., but also to form an idea of the globe itself. The garrison teacher Carl Adamis (1802–1874) who worked in Berlin, is an example of the increasing use of the relief globe outside the field of special pedagogy. In 1838, he began to specialize in the production of cheap, lithographically printed globes, but soon he was also making large celestial globes and relief globes of the world. In 1852, Adami sold his business to the Buch- und Landkartenhandlung Dietrich Reimer publishing company, where he continued to produce globes.[65]

After his attempt to produce a large relief globe in 1806, Zeune improved and sophisticated his methods. In the years between 1810 and 1814, he tried to make smaller globes which could be mass-produced. These were all later used in the teaching of the blind.[66] He made a globe with a diameter of thirty-one centimetres, after which came other models with diameters of thirty-nine and sixty-five centimetres respectively. These globes, which were for the first time made for the blind as well as the sighted, were coloured; each colour had a particular texture which made it suitable for tactile reading.[67] This, however, entailed problems in the preparation of a material which was sufficiently durable and which permitted the mass-production of the globe.[68] During the latter part of the 19th, and the first decades of the 20th centuries, the production of relief globes continued more or less according to the same principles.[69]

Martin Kunz produced not only large editions of his maps, but also relief globes. In his lecture to the congress of teachers of the blind in Frankfurt a. M. in 1882, he had mentioned the importance of the relief globe.[70] In 1888 he received an order for 300 rubber globes. These globes were small, with a diameter of only ten centimetres. Kunz's relief globes had the same design as the early relief maps, where latitude and longitude were only shown on the plain surfaces representing seas. Plastographische Institute L Dischman in Kassel produced the globes for Kunz. Twenty years later, Kunz improved his globe, and in 1911 he had a rubber globe made by the Gummikammfabrik in Hannover-Linden.[71]

The market for relief globes was not, however, dominated by Kunz. About a hundred years after Zeune's first attempts, Friedrich Conrad, who taught at the institute in Berlin/Stegliz, successfully developed a relief globe, which was commercialised by the F. Schotte publishing firm in Berlin.

The relief globe was used and developed not only in the German-speaking part of the world. Alston had himself established pedagogical ideas on how the teaching of geography ought to be carried out. There was rhetoric in Alston's texts, the purpose of which seems to have been the systematic demonstration of how natural and simple tactile reading was. In the chapter on geography, he starts by describing the globe made of oak. He gives the measurements and weight of the globe.

> Notwithstanding its great weight, the whole is so nicely constructed as to render easy, comparatively speaking, to give the poles any elevation which may be required with regard to the horizon. The water is made smooth, and the land is distinguished from it by being slightly elevated, and its surface

> rendered rough by a coating of fine sand, painted in oil of various colours, in order to distinguish to the eye the political divisions. These divisions are also surrounded by a slight prominence, for the purpose of enabling those for whom the globe is more particularly intended to grope their way. Rivers are denoted by smooth and slightly raised sinuous lines, traversing the rough land in their proper directions; mountains by a series of elevations indicating the position of range; and towns by a small brass knob. The Equator is divided into 360°. The point where the first meridian crosses its is marked by a round knob. A different mark is placed at every 10°, and the intermediate degrees are also distinguished in an appropriate manner. An hour-circle is fixed at the North Pole; and an Analemma, an ingenious constructions, showing the sun's declination, stretches equally on each side of the Equator.[72]

By studying the globe, the pupils could orient themselves on the face of the earth, but the globe as an object is taken out of its context and gives no knowledge of the universe, the movements of the earth nor of its relation to the other planets in the solar system. In order to show all this, horizontariums and tellurions were also used in the teaching of the blind. Karl Schleussner sold horizontariums and tellurions made by Adolf Mang, who taught at the Oberrealschule in Heidelberg. These instruments were described in as follows:

> ... the Horizontarium consists of a horizontal disc on a stand, on this disc a vertical semicircle, with degrees marked on it which represents a meridian, and a screw for adjusting the axis on which the pole star is fixed. Around this the stars orbit on semicircular arms; their position can be changed when required by means of screws. On the time circle, which also represents the equator, the time of day can be read off.[73]

An equally detailed description exists of the planetarium:

> The Planetarium basically consists of the Earth with a device for simulating the moon's orbit, a lamp for the Sun and a reflecting disc. The Earth is provided with screws and is on a vertical axis so that the influence of the Sun's rays on different climatic zones can be demonstrated. These three main parts are fixed on a horizontal rod which rotates on a stand. The rotation of the Earth is mechanically effected by a belt.[74]

The purpose of the production and use of the horizontarium and the tellurion was to give the pupils an idea of the movements of the celestial bodies.

The map—a way to orient ourselves in the world

The oldest map in the world was found in China and dates back to 2 500 years before Christ. It is in relief and represents a burial ground. The map is a visualisation of knowledge in a particular area, while its design is determined by its use. Since the 18th century, maps have been designed with a series of conventional symbols which give them their communicative qualities. We could say that maps convey a clear message of what we can expect to find at a certain point in a town or city, in the mountains or in the forest. The interpretation of the signs on the map, however, requires a certain familiarity with the significance of the symbols used, as well as a degree of spatial capacity, amongst other things. If you can interpret the message of a map, you can extract information from it about your physical position in the room, in the residential area, in the city, in the country, in the continent and on the Earth itself. For those who cannot see the room, the apartment, or the garden they are in, or view the horizon, or look down into the valley or across the meadows, the map and the globe are the only possible means of achieving a wider spatial perspective. The teaching of geography and topography therefore came to be of vital importance in the teaching of the blind, even before the institution of organized education.

In teaching by object-lesson, a special methodology was developed for the teaching of map reading. The innovative aspect of this pedagogy which developed in the teaching of geography at the schools for the blind deserves mention. The production of relief maps and globes of course developed at the pace at which experimentation and the adoption of new ideas moved in those days.[75] These maps and globes also began to be used in the teaching of sighted pupils. In other words, a two-fold pedagogy developed in this field.

VI

Object-lessons and the problems involved in tactile teaching

In order to counteract an unrestrained imagination, a teaching method based on concrete sensory impressions is the most appropriate. Apart from what is available in the immediate surroundings, pictures and models have been used to that end.[1] It goes without saying that pictures and models serve to counteract the imagination, since they show us what something actually looks like or how something works. There is, however, a paradox in this statement, as pictures and models can also make our imaginings life-like.[2] The combination of the concrete and palpable with the possibility of stimulating the imagination was the origin of the object-lesson. Pictures and models stimulate our observation and make us interested in finding out more.[3] Teaching by object-lesson sharpens the external intuition (Anschauungen) and affects the inner perception, which becomes clearer, is reproduced and consolidated through language, and is perfected by repetition.[4]

Teaching by object-lesson follows an epistemological tradition in which the importance of the senses in learning is decisive. The real founder of this tradition was Johann Friedrich Pestalozzi (1746–1827). Pestalozzi's predecessors, who were also of vital importance in the development of teaching by object-lesson, were Bacon, Comenius, Rousseau, Basedow and Locke. Pestalozzi believed that the object-lesson was the only valid method for teaching children, in theoretic subjects as well as in practical work. For Pestalozzi, all insight is created through observation, and in each language there exists a correlation between the creation of concepts and the original, intuitive observation.[5] By progressing from the simple to the more complex, the child develops its understanding and at the same time increases his linguistic capacity. Pestalozzi affirmed that all teaching should be related to form, speech and language (the three components of his famous trilogy).

One of the principles of the object-lesson was that the child should acquire knowledge of what was seen as reality, a knowledge and understanding of which was possible only if perceived through the various senses. The pedagogues who applied the principles of object-lessons in their own lessons, based their teaching on what was available to them in the immediate surroundings: objects, animals and nature itself. They, did, however, also make use of models and wall-charts to explain certain concepts. During the first decades of the 20th century, a movement developed contrary to the use of wall-charts and two-dimensional pictures in teaching, since they were considered, in comparison with models, mere imitations of reality. Pictures and wall-charts offered a preconceived and prearranged perception of the environment which the teacher wished to transfer to the pupil. Critical voices were raised against the use of visual representations instead of taking advantage of the objects available in the physical environment. Furthermore, a distinction was made between perspicuous teaching and teaching by object-lesson. Perspicuous teaching is teaching where an object or a concept is shown or explained verbally, while teaching by object-lesson is based, as far as possible on the object itself and not on a representation of it. This question has been the subject of debate not least in the teaching of children with severe visual impairment. In "Pa jagt i en billedskat" Christian Glenstrup brought to the fore the early criticism of Johannes Höirup on the focus on pictures in the teaching by object-lesson. In 1913, Höirup wrote *"Iakttagelseundervisning i naturen"* (Teaching by object-lesson in nature) where he states that too great an emphasis on pictures interferes with the children's own perceptions of nature.[6] The term "iakttagelseundervisning" refers to a methodology in which the pupils participated actively in nature study, with outdoor lessons, amongst other activities, during which they learned how to distinguish different bird-songs, to discover and identify animals' tracks, etc.

Observation is one of the most important concepts of the pedagogy developed in the teaching of the blind. Teaching by object-lesson was first put in practice during the 19th century and had been generally adopted by the end of the century. Teaching by object-lesson was a subject in itself, but teachers also used this method in subjects such a natural history, geometry, geography and language. The pedagogues stressed the importance of the immediate experience of concrete objects.

In order to discover whether teaching by object-lesson was being practised at an early stage in the teaching of the blind, we must study the concept itself in greater detail and define what we mean by "object-lessons". The concept of intuition (Anschauung) is not inherent in pedagogy, as it is in philosophy or psychology. Intuition (Anschauung) is, however, more than a simple perception or a simple sensory experience. It is a synthesis, a complex sensation or sensory experience. In philosophy, the concept of intuition has traditionally been interpreted in different ways by different schools of thought. A sensation may be a perception, when it takes place externally.[7] Kant held that our intuition was always dependent on the reception of impressions through the senses, due to the fact that human knowledge is limited. Our knowledge of things, therefore, will always depend on our various sense-datas.

Observation may be external or internal. For external observation to occur, a sensory stimulus must be present. This is not always the case with internal observations, which may be conscious or unconscious. The internal observation and the external observation are both forms of perception. An internal observation may be some kind of fantasy, while the external observation is either a localized and figurative or projected and figurative complex of sense-datas. Observation occurs in different forms of time and space.[8] The empirical psychologists believe that the nature of observation is such that we can accept the existence of both external and internal observation. The latter may occur spontaneously, caused by a sensory impression which may be either directly dependent on reality or artefacts that represent reality. Internal observation may also be caused by fantasising, without any sensory stimuli from reality or artefacts.[9]

Our impression of an object is not created through perception; it is something that is learned. If, for example, an older child sees a dog, she can form an idea of its size by referring to her previous experiences of the different sizes of the dogs she has seen. The earlier perception encounters the new impression and merges with it, enabling the child to say: "This is a larger dog." With increasing knowledge, we gain access to new concepts, wich are added to old ones, that is, apperceive the characteristics of the new concepts.[10]

True, it is said that observations have their origin in sensory impressions, and that it is undesirable that the imagination should predominate, but observation is not a question of perception alone. Thoughts and fantasies intervene to a greater or lesser degree in the process of observation.[11] Empirical observation is connected to the developing experience of the person, and it is through observation that our concepts are formed.[12]

The role of teaching by object-lesson for the Blind

> The blind are deprived of an immense amount of unconsciously received, but most effective teaching, which the sighted enjoy—the whole panorama of the universe—the marvellous object-lessons in God's great school—nature. The world of the blind is circumscribed by the little circle which they can span with their own arms, all beyond has, for them, no real existence.[13]

When we study the documents which have been preserved in the form of essays, articles and lectures on object-lessons and teaching material, we find that the position in favour of teaching by object-lesson was based on the oretical consciousness. In 1873, the first European Congress of Teachers of the Blind was held in Vienna. After that, the congress met every three years until 1920, and later changed its name to "Kongress für Blindenwohlfarth" (Congress for the Welfare of the Blind). This change of name was probably due to the existence of a vast number of people who had been blinded during the First World War. They were to be integrated into society by means of a suitable education. The meetings of the teachers of the blind are well-documented; the lectures were published and frequently appeared in the specialised reviews which circulated during this period. Thanks to the congress, it is possible to follow the debates on pedagogy and to gain insight into the pedagogic methods which were advocated and implemented at the end of the 19th century and the beginning of the 20th century.

At the first congress in 1873, the design of the object-lesson was one of the main items on the agenda.[14] It is interesting to note that the debate on

Teaching by object-lesson, A. F. Wiberg in the 1930s (Photo: Courtesy Danmarks Blindehistoriske Museum, Copenhagen).

Teaching by object-lesson, A. F. Wiberg in the 1930s (Photo: Courtesy Danmarks Blindehistoriske Museum, Copenhagen).

object-lessons in the second half of the 19th century dealt mainly with the question of how to counteract the fantasies and misconceptions about their environment which the blind were believed to suffer from. In other words, there was a belief in the possibility of transmitting a more realistic message through a model or a relief picture. There was also an awareness of the difficulties involved. For this reason, a number of theories and methods developed on how to communicate information about the actual as well as the represented environment.

At the Congress of Teachers of the Blind in 1891, the director of the Blindanstalt in Hamburg, Georg Heinrich Merle gave a long lecture entitled "Der Anschauungsunterricht in der Blindenschule."[15] In his lecture, Merle stressed the difficulties inherent in the satisfactory transfer of observations to the blind pupil. He summarized the most important points of the object-lesson as follows:

I. Teaching by object-lesson is intended to create ideas on which representations, judgements and concepts may later be based in order to develop the different senses, especially touch, and language.
II. Object-lessons are very important for sighted children, but for the blind child, they are the main element in his education, as he is unable to develop his concepts fully by his own efforts alone.
III. The object-lessons should be considered an independent lesson at all levels. In the lower classes, it should constitute the principal element of all lesons. In the upper classes, it should be integrrated as much as possible with manual activities.
IV. The object-lesson should be complemented by modelling, where appropriate.
V. The educational content must be adapted to the development of the child. It should be preparatory and should accompany teaching in most subjects, especially in natural history and German, and should therefore be the subject of a special course.[16]

Merle goes on to stress how important it is that the educational content of the pupil's alphabet and his first readers should be adapted to the object-lesson, as far as, in order to produce the desired effect of observation, or what is called "real observation." The media employed should be attractive in order to arouse and develop the pupil's sense of beauty.[17]

Fröbel's pedagogy in the teaching of the blind

The German educational reformer, Friedrich Wilhelm Fröbel (1783–1852) played an important role in the education of the blind. He was the first to make use of children's free play for educational purposes, and has become known for what are called "gifts of play," teaching materials which included blocks of different geometric shapes.[18] In the decades that followed, Fröbel's methods were adopted in several countries, among them Sweden and Germany. Fröbel is considered the father of the kindergarten, and was an important influence in the development of the kindergarten for blind children. His influence was equally great at more advanced levels of education.[19] Fröbel's "gifts of play" are normally divided into four groups:

I. Play with solid shapes: a ball, a sphere, a cube and a cylinder.
II. Play with surfaces: patches for combining to create shapes, and paper squares for folding.
III. Play with lines: "gifts" such as wooden sticks, filing ribbons for

plaiting, strips of paper for plaiting; drawn lines and stitched lines.
IV. Play with dots: "gifts" such as raised dots, peas, seeds, stones, beads, shells and sand.

The purpose of these "gifts" was that the children should separate and put together the different materials, and so begin to form an idea of the law of the whole and its parts, that is, that everything starts with the whole and returns to the whole.[20]

When we study the purpose behind these play-gifts, we understand why Fröbel's methods came to be applied in the pedagogy of the blind. We also understand why the principle of the object-lesson aroused so much interest. A vital part of the basic teaching methods which are of such great importance in the teaching of blind children and which depend to a large extent on tactile perception are based on Fröbel's pedagogical ideas. According to Fröbel, the child must learn to identify basic characteristics such as the material of which an object is made, its size and shape, its colour, its weight. He must also be able to recognise sounds, number, orientation and position.

The play-gifts were made of a variety of materials, which allowed the pupils to study the properties of the different materials. Another aspect was their different sizes, which meant that they could be placed on a scale ranging from small to big, bigger, biggest. Shape was of great importance, and Pestalozzi, by whom Fröbel had been inspired, had himself stressed the role that shape played in recognition. The play-gifts made it possible to study shapes by investigating the similarities and dissimilarities between the various objects and patches. Orientation and position in the classroom was taught through the concepts of verticality, horizontality and the diagonal. The pupils were told to find the centre, which was the intermediary link, and from there to locate an object in the class-room. The centre was found by drawing the classroom on a grid and noting the point at which two diagonal lines intersected. This consolidated the concepts "right", "left", "above", and "below".[21]

The first kindergarten for blind children was founded in Hubertusburg in 1862 and was soon followed by several others. When we consider the influence Fröbel's pedagogy had on the teaching of the blind, it is probably quite logical that it was also applied in the kindergarten. The task of the kindergarten was to transfer ideas and concepts through object-lessons and language practice. The children's receptiveness to the impressions they received through hearing, touch, taste and smell was to be developed by appropriate exercises, which would also strengthen their hands and increase their manual dexterity.[22] K. Krause, a kindergarten teacher in Moritzburg, near Dresden, was one of those who advocated Fröbel's teaching methods, stating that Fröbel's play and movement exercises were a means of reducing and even eliminating the physical weaknesses of blind children, which made them clumsy and lacking in independence. This was especially true in the case of the children's hands.[23] Fröbel's play activities were introduced to blind kindergarten children in exactly the same order as they were presented to sighted children: the ball, the sphere, the cylinder and the cube. The children began by grasping the ball, which was not only a method of getting to know the ball itself as an object but also "roundness" as a concept; it also exercised their hand muscles. According to Fröbel, their first ball should always be made of wool, as this was soft. The ball was thus an excellent educational tool. The children exercised their hands by pressing the woollen ball between their spread fingers, and when they had become acquainted with the ball, they played with it. They could, for example, sit in a ring and pass the ball from one to another.[24]

The ball was also used to develop the blind pre-school children's spatial perception. The ball was attached to a string and was swung in different directions (spiral, pendular or circular movements, for example).[25] Thus the relationships between direction and movement were demonstrated to the children. When the children later played with the sphere, they were told to investigate the relationships between movement and sound, by paying attention to the sound the sphere made when it was rolled on different materials. They also listened to how the sound grew stronger or fainter, depending on whether the sphere was coming closer to them or moving farther away.[26]

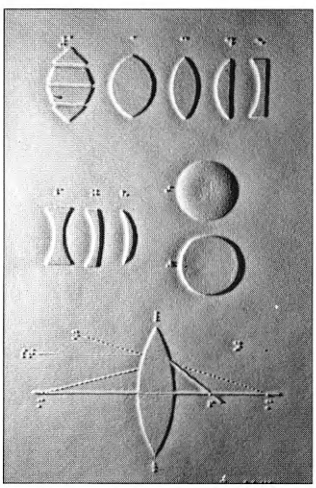
Krause stressed how important it was that blind children should play with the cube, because of the variety of characteristics involved. The cube had corners, edges and faces which were useful in the teaching of concepts. In addition, Fröbel's small cubes (sixty-four in all), which when fitted together formed a larger cube, were extremely useful in the kindergarten. Most of Fröbel's play-gifts and their corresponding activities were used in kindergartens for blind children.[27]

Teaching by object-lesson based on Pestalozzi's pedagogical methods, later developed by Fröbel, was applied in several school subjects. In a memorandum published to celebrate the centenary of the Blindenanstalt in Zürich, Fröbel's importance was discussed.[28] At the institute for the blind in Zürich, they used what were called "Diktamenbeschäftigungen " (dictated activities) in which the children performed certain exercises on their own, under the teacher's guidance. They worked with Fröbel's play-gifts (building-blocks, patches, etc.); with the building-blocks, for example, they built a railway and a train. As they were doing this, they talked about railways in general and about the inventor of the engine. Problems involving lines, surfaces and dots were also introduced with the help of the building-blocks.[29] The modelling and construction of a variety of environments in a sand-box were also a part of Fröbel's play-learning.[30]

The teaching of Physics

In "Maal og Midler for Fysikundervisningen in Blindskole" (Objectives and Methods in the Teaching of Physics in Schools for the Blind), Andreas Fredrik Wiberg who taught at the Kongelige Blindinstitut in Copenhagen from 1897 to 1937, expounded his theories on the teaching of physics. This was, according to Wiberg, a subject in which participative observation should be used. Teaching by object-lesson was, according to its opponents, not the same thing as teaching by participative observation, which was mainly based on "reality" and not on the representation of reality. Through participative observation, the pupils became aware of what they perceived through movement, touch and hearing. In each observation a certain amount of thought is involved.[31] One of the reasons why Wiberg considered the teaching of physics of such importance was that, like the study of all natural sciences, it helps to break down the "dream-world" of substitute perceptions in which he believed his blind pupils moved.[32]

To reinforce the concretisation of the teaching of physics, models, relief pictures and practical, illustrative examples were required, Wiberg maintained. For example, it was possible to demonstrate how the diving-bell functioned with a glass and a bowl of water. One could show how only a



Relief pictures for the teaching of physics, Martin Kunz (Schweizerische Bibliothek für Blinde, Zürich. Photo: author).

small amount of water entered the inverted glass as it was slowly immersed in the bowl of water. By placing a piece of sponge in the bottom of the glass (in its inverted position, that is), the pupils themselves could check how much or how little water the sponge had absorbed.[33]

The laws of nature should be demonstrated with the help of models, and the instruments for performing physical experiments should, according to Wiberg, be designed in a way which allowed the blind pupils to participate in and carry out experiments by themselves. He stressed that the blind pupil can assimilate perfectly the concepts involved in the study of physics, although we should bear in mind that he or she will require more time to do so than the sighted pupil. Wiberg also refers to a debate on the teaching of light where it was held that this particular phenomenon should not be taught to blind pupils, as their feelings might be hurt. Wiberg disagreed with this, since, in his experience, many blind pupils appreciated knowing about the phenomenon of light, even if they could not appreciate it physically. Instead, he suggested that comparisons might be made between sound and light. When light was being taught, Wiberg recommended the use of relief pictures. He mentioned that in Germany there were a number of relief pictures representing the phenomenon of light.[34] The relief pictures referred to are probably those made by Kunz, who had produced a series of relief pictures for the teaching of physics, in which the phenomenon of light was included.

The use of relief pictures in the teaching of physics continued, and in 1927, Harald Thilander published *Moll's Fysik* (Physics) in braille, richly illustrated with relief pictures. This textbook consisted of three volumes in braille and two volumes with the corresponding figures.

On the general use of relief pictures in the natural sciences, it seems that Wiberg was more cautious. He preferred models, but thought at the same time that when a model had been examined adequately, the relief picture served the purpose of a memory aid. The relief picture is most appropriate, he affirmed, in situations such as the following:

> Every teacher of blind pupils, who has ever tried to explain things like the disintegration of forces, movement in the form of impulses or waves, the refraction and reflection of heat rays, the effects of the angle of the sun's rays on temperature, and similar phenomena, must have had to make relief pictures. In the cases quoted, it is necessary to illustrate the direction and relationship of lines. Even the strongest opponents of pictures will have to agree that a relief picture makes it possible to demonstrate these phenomena. Here relief pictures play a role similar to that of the photograph in the teaching of geography. If we have access to good relief prints, these would be preferable to handproduced drawings. I therefore believe that

> the relief prints for the teaching of physics, now in preparation in Germany, will satisfy a real need.[35]

Wiberg emphasized how important it was not to start by presenting the objects without any previous explanation, or by explaining the problem to the pupils before they had been given a chance to investigate the model or the experimental equipment. He suggested that the explanation should be given to the pupils while they were examining the object in question. After that, the pupils should be given an opportunity to describe for themselves what they were doing. By using simple objects such as models of animals, the pupils would gain experience of different types of models which would help to develop their tactile capacity.[36]

About twentyfive years after Wiberg presented his pedagogic ideas, substantial changes had taken place in physics and chemistry, which also affected the teaching of these subjects in special schools. In *The Teacher of the Blind* (1921), Edward Evans, himself a teacher, summed up the developments of these two subjects and their consequences for the teaching of the blind.[37] As the teaching in schools in general had brought about changes which meant that the teacher now carried out experiments in wellequipped science rooms, the teaching of physics and chemistry in special schools found itself in a limbo of forgotten knowledge. Even if most teachers were aware that earlier teaching had allowed the blind pupils themselves to carry out experiments, and that certain phenomena could be illustrated with models and relief pictures, the application of these methods had been abandoned. The author emphasized the importance of giving the pupils the opportunity to carry out some experiments on their own, in order for them to reach a better understanding of chemical processes and physical phenomena. A pupil cannot assimilate such knowledge simply by listening to descriptions of processes, phenomena and their relationships, said Evans, who gave a number of suggestions as to how lessons based on tactile perception could be most effectively taught.[38]

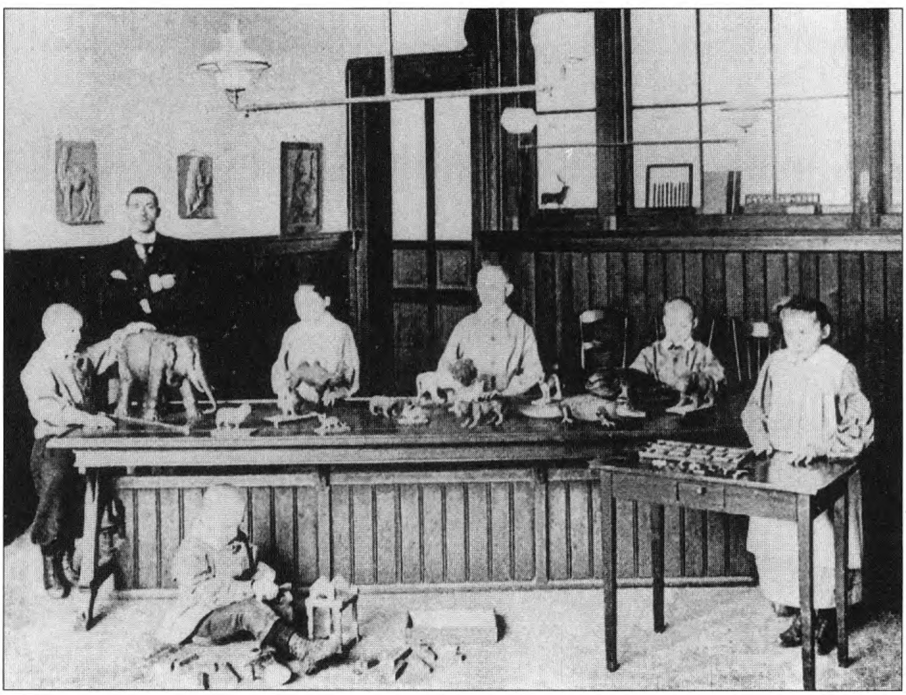
Natural history

Natural history involved the study of man, animals and nature, and occupied a prominent place in the teaching of the blind from the final decades of the 19th century. Lessons took place out of doors and models and relief pictures were used. By 1819, J. W. Klein had introduced natural history as a subject at the blind institute in Vienna, based on Pestalozzi's teaching principles, whereby the pupils studied nature directly.

> The pupil is taken into the garden, and out into the fields and woods. As he touches plants and their different parts, he soon

> learns to distinguish different types; he then grows and tends his own plants. He should be taught to recognise the individual parts of trees, such as leaves, branches, bark, etc., and should be informed of theirs height and the length of their branches so that he can form an idea of the whole. He should then be allowed to hold and touch live animals with appropriate care.[39]

In the decades that followed, however, natural history came to occupy a secondary position in the teaching of the blind, as there was a general lack of suitable teaching materials in the form of literature, relief pictures and models.[40] If we examine curricula dating from the later part of the 19th century, we do, however, find that the subject was being taught at the various institutes for the blind. In the Kongelige Blindinstitut in Copenhagen, for example, natural history was introduced, two hours a week, in the second grade. The pupils learned about mammals, and during



Object-lesson at Refsnaes school in Denmark (Photo: Courtesy Danmarks Blindehistoriske Museum, Copenhagen).

the first six months, carried out tactile investigation of models of plants and different types of leaves and fruits.[41]

In 1900, Zech (a teacher from Königsthal) summarized the state of natural history teaching in schools for the blind, and emphasized that the subject had undergone a change during the preceding decade.[42] In order for the teaching of natural history to produce satisfactory results, Zech believed that it should deal with objects with which the pupils were in contact, directly or indirectly, during their school years or in later life. Care should be taken not to present more objects than the pupils were capable of dealing with at one time. A school garden was a necessary element in the development of the children's knowledge of botany. It was also important for them to know that a plant could not exist without light, air, water, pollination, etc.[43]

Where the teaching of zoology was concerned, Zech was of the opinion that the animals studied should have some connection with man, as this would facilitate the pupils' perception of different types of animal. In a general picture, plants and animals should be placed in their natural habitats. Mention should be made of the fact that plants and animals depend for their existence on a particular type of climate, amongst other factors.[44]

In the curriculum at the Rhenischen Provinzial Blinden-Unterrichts-Anstalt for 1915, the objectives for the teaching of natural history are set out: the pupils should be given a knowledge of the most important features the local area and of more distant regions.

> The teaching of natural history should acquaint the pupil with the most important features of national and foreign natural phenomena, their formation, main characteristics, location and importance to man's primitive economy. Natural history lessons should foment an understanding of and an interest in the vital requirements and habitats of plants and animals, including man, and should educate the pupils in the conservation of nature (animals and plants). Efforts should be made to accustom the children to observe nature responsibly.[45]

This description is in keeping with the practice in most institutes, where a knowledge of plants and animals (their parts as well as the whole) was imparted to a large extent through modelling.

Local history and geography

Some things could not be taught through direct observation, and therefore relief maps, models and terrestrial globes were used in the teaching of geography.[46] It was thought that, adequately taught, the blind pupils were as capable as the sighted of learning geographical concepts.[47] Martin Kunz believed that for the blind to be able become well-adjusted members of society, they had to know about their own country and its political institutions. In the ordinary school, geography lessons started in grade three, when the pupils were approximately ten or eleven years of age.[48] Blind pupils normally arrived at the school for the blind at about that age. The teaching of geography had to be adapted to the needs of the blind children when they arrived in this new environment. First of all, they had to become familiar with their immediate surroundings, that is, the interior and the exterior of the institute and its surroundings.[49] If we take a closer look at Kunz's ideas, we encounter similarities with those of earlier pedagogues. In Vienna, M. Heller introduced map study at the Israelitische Blindinstitut by allowing the pupils themselves to make their own maps with pins and waxed thread. The pupils created relief maps of the immediate surroundings—the classroom, the school playground, etc. using padded disks into which pins were stuck and contours made with waxed thread wound around them. By making these maps, the pupils were able to form for themselves an idea of the shape of countries, river systems, etc.[50]

The teaching of local history and geography has been, on the whole, an interesting aspect of the development of the object-lesson method. In May 1884, *Der Blindenfreund* published a prize-winning thesis by Ferdinand Krüger (born 1840) on the teaching of geography:"Lehrplan und Lehrmittel des geographischen Unterrichts für die vier obern Klasses einer Blindschule." Two years later, in 1886, Krüger was appointed director of the newly-created West Prussian Provinzial Blinden-Anstalt in Königsthal. According to Alexander Mell, Krüger achieved remarkable results in spite of limited resources. He applied Fröbel's methods in his teaching, giving priority to modelling, drawing and manual activities. In his prize-winning thesis, the author starts by pointing out that as Man is the King of all Creation, he must have a knowledge of the world which he is expected to rule. Therefore, a knowledge of geography and history is vital, since geography provides us with knowledge of the natural environments in which great men and different peoples have lived and struggled throughout history.[51] Krüger also gave a detailed description of how tactile maps should be made. He claimed that the most common procedure was for the teachers themselves to make their own individual maps. Preferably, however, each child should have his or her own map during lessons. The study material which the children should have at their disposal was, according to Krüger, a relief globe, a map of Europe and a map of the local area. He also gave instructions for the production of this material. There was no need for the globe to have lines of latitude and longitude, time zones or points of the compass. The tilted axis was equally unnecessary. However, the tropical zones and the polar circles should be indicated, together with the prime meridian, marked off in series of ten degrees. Krüger recommended that the globe should be placed in a corner of the classroom, at a height of approximately one and a half metres. It should have, in any case, a fixed place in the classroom, within easy reach of the pupils.[52]

Krüger stressed that a selection should be made of what was to be represented on the map, as too many details made it impossible for the pupil to grasp any or all of the content. Equally important was the choice of how these contents were represented on the map. Since the blind pupil learns the shape of an object or a room by systematically feeling his way over it or around it, this principle must be adhered to when the world is represented in map form. The pupil should therefore start with the immediate surroundings and work his way outwards. Krüger also recommended that the pupils' first step should be to familiarize themselves with the dimensions of their classroom, then of the whole building and finally of its immediate surroundings.[53]

If the pupils are to grasp topographic concepts such as mountain, valley, hill, river, etc., they must first be introduced to the real thing. Krüger, like Simon Heller before him, insists on the importance of the relationship with reality. The pupil's physical environment, his home, the town where he lives with its streets, roads, squares and bridges, should be the object of his first topographical studies. Other important geographical concepts include, for example, the fact that the sky and the earth apparently meet at the horizon, or the apparent rising and setting of the sun.[54]

When topographical details are reproduced to scale, it is important that the elevation of mountains, for example, should be clearly-marked and easy for the blind pupil to perceive. To this end, it may be necessary to deviate from the real proportions and exaggerate the gradient.[55] Krüger here advocates the rules applied today in the production of relief pictures; that is, certain details are emphasized, either by making them larger than they really are, or by exaggerating their most characteristic features in order to produce the desired effect in the tactile reader.[56] Krüger advised against the representation of rivers and towns before grade four, as they are too complicated for the pupils to follow and only confuse them. On relief maps, the sea and lakes should be approximately one and a half millimetres lower than the adjacent coastal area, while rivers should be raised above the land surface.[57] By grade four, the pupils already knew that rivers were indicated with silk thread, which created a distinct line that was easy to follow. Towns and cities were represented by dots the size of a pinhead. The capital cities of the respective countries should be marked, and provincial borders indicated with bigger dots which could be identified by touch.[58] In my opinion, Krüger intended provincial borders to be indicated by dotted lines.

In order for the pupils to form an idea of the relative sizes of the different countries, they needed maps on which the national borders were marked. General maps should not be overloaded with mountains, rivers, etc. Krüger was of the opinion that geographical features such as these should only be shown on more detailed maps.[59]

Josef Pöschl's description of the teaching of geography at the Blinden-Erziehungsinstitut in Vienna in 1910 proves that the subject was still being as at the Israelischen Blindeninstitut during the 1880s. The pupils started by making a plan of their classroom on the "drawing-cushion" (Zeichenkissen). In this way, they learned how to use scale in the production of maps. A scale which was easy to calculate was chosen (1:20, for example). The pupils then calculated the dimensions of the floor, the walls, the doors and the windows, all of which would be shown on the plan. The different pieces of furniture were drawn on cardboard, cut out and stuck on the drawing-cushion. When the drawing was finished, the pupils were given a relief plan of the classroom on the same scale as the plan they had made on their drawing-cushion. This first plan of the classroom was a basic step towards understanding the concept "map." Work then continued on a plan of the whole building and its immediate surroundings.[60]

In Scandinavia also, there were those who stressed the importance of teaching geography in the blind school, as well as the need for suitable teaching material. At the meeting of the association of teachers in "schools for the abnormal" in Copenhagen, Otto Åstrand from the blind school at Manilla elaborated on this.

> ... as the study of history relies mainly on memory, this subject is one in which the blind pupil can become as skilled as a person who has the use of all his senses. Courses in this subject should not be too short, as its study is of great educational value. It is also a well-known fact that this is a subject the blind person can take a special interest in. The study of geography, on the other hand, is always difficult for the blind pupil, and interests him much less. Studies in these subjects will be considerably facilitated as soon as suitable textbooks in relief print become available.[61]

Landscape models

Kunz advocated object-lessons in the teaching of geography. His ideas and methods in this respect are similar to those he favoured in the teaching of natural history: that is, from reality (as far as possible) to the model and on to the relief map; from the known and concrete to the unknown and abstract. The main teaching objective was to provide the pupils with a basic knowledge of geographical features such as sea, isthmus, shore, coast, slope, hill, mountain, mountain range, mountain peak, etc. To this end, models which were true to nature were produced in Genoa, amongst other places.[62]

There is a long tradition of map making in the classroom, where they were made not only by the teachers for their pupils, but also by the teachers and pupils together. This was true in the case of sighted as well as blind pupils. When Kunz elaborated his guidelines for the teaching of geography, he made reference to material which was being used and developed in kindergartens in accordance with Fröbel's pedagogic theories.[63] Kunz described clearly and concisely how he thought the institutes for the blind ought to carry out the production of maps:

> First, the area to be represented should be sketched roughly on a drawing board, with the basic dimensions accurately shown. The most important features, particularly meanders, river mouths, lakes, mountain passes and mountain summits should be indicated with thicker, raised dots and their corresponding altitude in the case of the latter. Next, the altitude scale must be decided (The blind person who carried out this task must at the same time, of course, hammer the nails) for example, 1:300 000, or 0,001 metre per 300 metres = 1000'.[64]

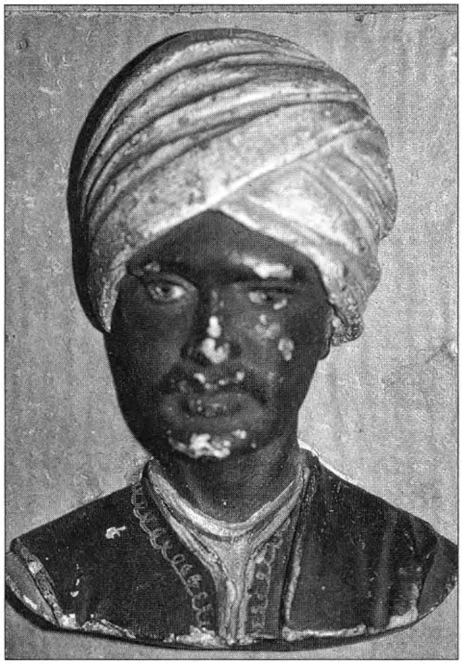
When the main features of the map had been laid out, work continued on the details: the valleys were cut out and the mountains shaped to allow the teacher and the pupil to continue modelling the landscape. Kunz continues his description of the production of a map, mentioning the use of different materials and colours:

> Later, the rivers should be indicated with blue knitting wool which, depending on the importance of the river, could be used straight from the ball or separated into its various strands and made thinner by twisting, the nearer one got to the source of the river. Lakes should be indicated with blue paper, roads with silk thread and the towns and villages with glass beads or nails. If the map was to be kept, the teacher should make a cast of it, to facilitate the making of several copies. For this he could use plaster or some similar medium.[65]

Anthropology

Towards the end of the 19th century there was a change in the teaching of geography. One of the leading promoters of this change was the geographer, Sir Halford John McKinder (1861–1947). Geography studies were oriented towards anthropological studies, which, of course, had its repercussions in teaching in schools. The examples given so far from the teaching of geography do not show such an orientation, but illustrate a confirmed teaching of topography and maps.

There was also educational material for the teaching of anthropology.



An example of a sculpture representing the different races (Danmarks Blindehistoriske Museum, Copenhagen. Photo: author).

In 1897, it was possible to buy "Völkertypen in plastischer Nachbildung" (sculptures representing the different races) from the publishers of educational material, R. Brendel, Grundewald bei Berlin. These sculptures were papier mâchébusts, modelled by Fr. Heynert, and represented supposed "Caucasian, Mongolian, Ethiopian, American, Malaysian, Nubian, Zulukaffir and Bushman" racial types. Each bust was about 20 cm high and, according to the publishers, realistically coloured. These models were not made specifically for the teaching of blind pupils, but the publishers in questions also sold their products to schools for the blind, as many other publishers did.

At the Museum of the History of the Blind in Copenhagen, there is a similar collection, though the figures there are somewhat smaller.

In *The Teachers of the Blind* a debate went on between 1921 and 1922, on the subject of geography and the preoccupation that the subject would distance itself from the teaching of elementary geographic knowledge. The participants in the debate stressed how important it was to have a solid knowledge of the immediate surroundings, the native country and other parts of the world as a basis for knowledge of other cultures and continents.[66]

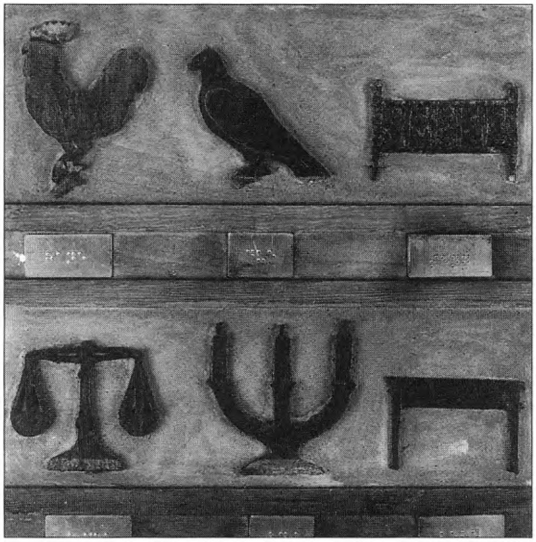
Pictures and models in the teaching of language

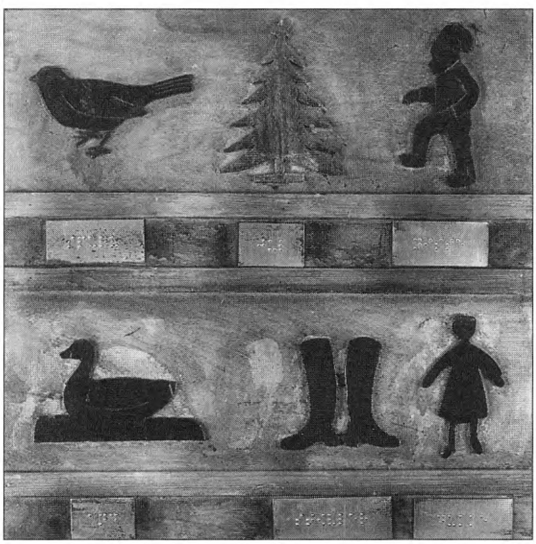
Object-lessons in schools for the blind were not only used to describe environments and objects, but also in the teaching of language. In this respect, interest has centred on the learning of concepts and on how to explain linguistic concepts to the pupil in a relevant and meaningful way, that is, so that the mental picture or idea of the object or concept coincides with reality. Modern theorists in the cognitive sciences, such as Daniel C. Dennett, Peter Gardenfors and Robert L. Solso, have dealt with these questions in a general way. Dennet has also related his discussion on the situation of the blind in *Consciousness Explained* (1991).

In the 1830s, Samuel Gridly Howe developed a method in his teaching of the deaf-blind Laura Bridgman in which he used the principles of object-lessons in the teaching of language. To recreate a natural learning process, Howe believed it was vital for the blind pupil to learn as much as possible through real objects and not only through words. He therefore gathered together a wide collection of wooden models and dried plants at the Perkins school. Howe found that tactile experience was especially important for the blind pupil.[67]

In a number of annual reports, Howe described the methods he used in his teaching of Laura Bridgman, and the results he achieved. There is, however, much less explicit information about the pedagogy of the institute in general. In "Education of the Blind", mentioned in chapter II, he explained how important it was that the teaching was adapted to the interests of the pupil. In contemporary specialist reviews he also presented his ideas on object-lessons.[68]

In order to provide Laura Bridgman with a language with which she could communicate, Howe started with simple objects. While showing her these objects (a knife, a fork, a key etc.), he also showed her boards with their names printed in relief. Soon, according to Howe, Laura Bridgman found that the curved lines which formed the word "spoon" differed as much from the lines which made the word "key," as the shape of the spoon itself differed from that of the key.[69] Howe repeated the process with all the objects that Laura Bridgman was able to use, and very soon she learned to combine the right word with the right object. Howe realized that this process was based in the first place on imitation and in second place on memory, but that no intellectual process was involved.[70] Laura was then told by her teacher to form the words from individual letters, and this was when her intellect came into play.[71] When Laura Bridgman had been at the institute for 28 months, her progress was presented in a report.[72] There she





Word-picture relief used by Mathilda Flensborg (Danmarks Blindehistoriske Museum, Copenhagen. Photo: Jørgen Schytte).

was said to have made great progress in expressing her ideas; she could use the hand alphabet and had learned to spell the names of everyday objects around her. Although she had been taught adjectives to describe particular features of objects (for example "hard", "soft" etc.), it was difficult for her to make general statements on similar qualities.[73] She was also taught to understand spatial concepts. She was asked to place a ring on top of, in or above, etc., an object. Here her problem was to name the object she placed the ring in, on or above.[74]

Howe's successor, Michael Anagos (who later taught Helen Keller at the Perkins School for the Blind), wrote the following in the Perkins report for 1879, on the use of objects in the teaching of concepts in the classroom:

> This mode of instruction (tactual observation) is of inestimable value. It bridges over the chasm from the known to the unknown, from the concrete to the abstract, and lays a solid foundation for the mind to work upon. It raises the attention of the pupils and excites their interests. It appeals to experience and stimulates their powers of observation to intense activity. It feeds the mind with real food and raises it out of the slough of inattention and listless activity.[75]

The use of pictures in the teaching of reading and writing has been a common practice with sighted and blind children.[76] In Denmark, Mathilda Flensborg taught at the Refsnaes school from 1910 to the 1940s using words and pictures. For this she had access to relief pictures of different objects and of scenes and situations. The relief pictures were made of wood and are kept at the Blindhistoriska museet in Copenhagen. When Matilda Flensborg started teaching at Refsnaes school in 1912, she had had experience of teaching sighted children by the word-picture method. She introduced it in the teaching of young blind children and found that it was practicable in this situation. Flensborg used pictures cut out of linoleum and mounted on a wooden plate; each pupil had his own wooden plate. This differed from the teaching of sighted children, where wall pictures were used. Apart from relief pictures, word plates and other materials were used. By the 1930s and 1940s, this method had become standard teaching practice. In the 1930s, children's relief story-books were published: *Per og Lise hos Far og Mor* (Per and Lise with Father and Mother) and *Svanebogen* (The Book of Swans). The relief pictures were made of stiff, black buckram.[77]

Agnes Melchior has recounted her personal experiences of the introduction of word-picture teaching in the Refsnaes school:

> A couple of years ago, teachers from the institute visited a school for sighted children where the picture method was used in teaching. /.../ We wondered how we could adapt these

> methods to our particular circumstances. One of our teachers tried to draw the pictures mentioned above (a house, father, mother, a dog, a bird etc.), but it was difficult to make them clear enough for the fingers. It is, of course, not possible to use perspective drawing, so it has to be outlines only, but if this is done, the picture often loses its character, its purpose. But we did not lose hope. The teacher at the prison for young criminals visited us and took the idea with him when he left. Shortly afterwards, he returned with pictures for our texts. After a few improvements, we had all the teaching material necessary, and the teachers could start work with a class of 7–8 year olds.[78]

Agnes Melchior went on to tell how this experiment was a success and how the teacher, who had artistic talent, made the pictures by cutting them out of stiff cloth. Agnes Melchior was the person referred to by this teacher (Mathilda Flensborg?), and Melchior herself thought that she had exposed the teacher to harsh criticism before the results were satisfactory.[79] Either Agnes Melchior did not know that Mathilda Flensborg had been using the word-picture method since approximately 1910, or the history written by Folke Johansen is simplified and in part erroneous.

In "Den grundlaeggende laeseundervisning" (Basic teaching of reading) Mathilda Flensborg tells how she taught Danish using the word-picture method at Refsnaes School.[80] She used, amongst other things, word plates and individual braille types, models of animals, and wall pictures of animals with a simple text added. Each child in the class had a picture poster with thirty-six pictures and a set of word-pictures cut out in linoleum, as well as a variety of materials with which to form words and sentences.[81]

The Vienna pedagogues

During their active years, Johann Wilhelm Klein, Simon Heller and Alexander Mell at the Israelische-Blindeninstitut in Vienna frequently contributed articles to, amongst other reviews, *Der Blindenfreund*, and gave lectures or talks on the teaching of the blind. The Viennese institute came to be of great importance in Europe because of its founder Johann Wilhelm Klein, whose ideas became widely divulged. Klein took on his first pupil in 1804 and founded the institute with eight pupils in 1808. His teaching was oriented towards a very basic education, as his pupils were poor. Klein wrote *Lehrbuch zum Unterricht der Blinden* and based his work on teaching by object-lesson.

The innovative ideas of Simon Heller, director of the institute for the blind in Vienna, developed within the tradition of the object-lesson and its principles, were presented at the second congress of teachers of the blind held in Dresden in 1876.[82] Heller's lecture was entitled "Das prinzip der Unmittelbarkeit in der Blindenschule" and he commenced by claiming that available psychological knowledge of how to educate the blind was not always applied. Instead, the same pedagogy was used as in ordinary schools.[83] It is interesting to note that about twenty years later, Theodor Heller makes the same comment in his essay "Studien zur Blinden Psychologie".[84] When the object-lesson as a method is discussed, it is common to stress the need to provide the pupils with a knowledge and understanding of their surroundings which is based on reality.

Heller was in part critical of the use of material for object-lessons, even when he approved of object-lessons and advocated this method himself. He believed that in the teaching of the sighted, the difficulty lies in summarizing and presenting what is relevant: in transferring from the abstract to the concrete. In the teaching of the blind, however, the problem is reversed; one transfers from the concrete to the abstract. Heller thought that efforts should be made to transmit what he called "the irrelevant". The difficulty in representing the object in abstraction lies in tactile perception, but it is also a problem of mediation.[85] Heller advocated what he called "immediacy" and thought that Pestalozzi's importance had been exaggerated. It is impossible, according to Heller, to transfer the teaching methods of the ordinary school to the school for the blind. If we do so, we present the blind children with a very limited part of their surroundings. It is therefore necessary to integrate education and training; the children must learn to take an active part in their surroundings and not simply receive passively what is presented to them in the class-room in the form of, for example, models.[86]

Heller advocated active learning, where the creative process is part of the understanding. He recommended that the pupils should make geometric figures from paper. But he stressed that these should not be judged by aesthetic criteria. The question was whether the pupils had understood the concepts involved or not. The teaching of geography should start with an investigation of the class-room, and the pupils should learn how the objects in the classroom could be represented. After that, they should continue with the school building, the school yards, its surroundings, the whole village or the town. Then, and not before, would the pupils be ready to understand that maps may represent larger areas such as countries and continents.[87] This basic principle for understanding maps still holds valid, as does the idea of the need for the creative process in the learning of concepts. Heller was of the opinion that Fröbel's pedagogic methods should be used in the kindergarten.

Simon Heller moved from "Das Prinzip der Unmittelbarheit in der Blindenschule" (The Principle of Immediacy in the School of the Blind) to "Das Prinzip der Wechselwirkung in der Blindenschule" (The principle of Interaction in the School of the Blind); the latter being the title of a lecture he gave at the Congress of Teachers of the Blind in Amsterdam in 1885. In his lecture he gave a detailed description of how to proceed in object-lessons, and of the implications of the method. This was only five years before his prize-winning essay "Modellieren und Zeichnen in der Blindschule" (Modelling and Drawing in the School of the Blind) was published. Heller was awarded a prize for the essay by the Congress of Teachers of the Blind which was held in Cologne in 1888.

In "Das Prinzip der Wechselwirkung in der Blindeschule", Heller talks about "interaction" rather than "immediacy". He then refers to: the training of the senses, the study of objects which are illustrative, and the pupils independent search for, and reproduction of objects. By following this principle, the blind will be able to develop their perception of things around them in a way that is impossible through mere observation. When the principle described is applied, the pupils are given a complement, which is what Heller calls "the principle of immediacy".[88] Heller's use of the term "Unmittelbarkeit" is what I would describe as something which is not mediated. In other words, an idea that there is a direct experience which leads to knowledge about the object.

The principle of interaction involves more than one single sense; it involves touch and hearing. Hearing is, according to Heller, an indisputably rich factor in our emotional life and is important in the development of the intellect.[89] Heller's lecture includes a detailed description of how this interaction between object, model and picture occurs in practice.

The role of museums in the teaching of the blind

We may ask what role the cabinet which developed in the 17th and 18th centuries played in relation to teaching by object-lessons. According to Michel Focault and Umberto Eco, museums are not simply a development of cabinets, as the latter merely consisted of a display of unique and remarkable specimens. Museums, on the other hand, developed thematic exhibitions with a view to the future from the start.[90] From a close reading of Pliny's Historia Naturalis, of the physicists Samuel Quiccheberg (1529–67) and Albrecht V. of Bavaria (1528–79) as well as of the collector Johann Daniel Major (1636–93), Michael Bernard Vlentini and C. F. Neikelius, Eva Schultz has found that a considerable amount of scientific research determined the design of "Kunst- und Wunderkammern" between the 16th and 18th centuries. The condescending view that we find in the accounts given by Focault and Eco, repeated by Bennet, can therefore not be considered strictly accurate.[91]

What relationship existed between the museums and object-lessons? Depending on the aspects chosen for the study of the three entities: cabinets, object-lessons and museums, the relationships either seem close or non-existent. The collection, in one room, of different objects from various parts of the world and from different periods, facilitated a kind of a survey, not only of the collection but also of time and space. The richly-endowed private cabinets could hold everything from porcelain figures to life-size anatomical wax models.

When museums began to develop, it was in the character of educational institutions. When objects were collected and displayed in one place by themes and periods, the visitor could form a better idea of a phenomenon, a process or an event. The exhibitions, not the least those of the museums of natural history, became a mixture of illusion and reality. With the aid of pictures and models, an illusion of reality was created, in an endeavour to recreate and illustrate details which comprised whole environments.

When the diorama developed in the natural history museum in the latter part of the 19th century, it in order was to recreate a natural environment for the animals on display.[92]

The fact that Maria Theresia von Paradis was allowed to visit with frequency the Imperial cabinet of antiquities in her home town of Vienna in reward for her diligence, is testimony to the pleasure which the collection could offer the senses other than vision.[93] It is hardly likely that Maria Theresia von Paradis would be a unique exception. This is not to say that all blind persons had access to the Imperial cabinet, but the pedagogy that predominated at the developing educational institutes was, to a large degree, based on practical experiences gathered by the visually impaired themselves. Women, educated and trained in the private sphere, made up a considerable part of that group. These were women who had been raised in an upper-middle or upper-class environment, where it was not unusual to find smaller collections similar to the larger ones or those of the "memorial theatres". We may assume that these, like the Imperial collection in Vienna, were a source of pleasure and knowledge not only for the sighted but also for people with serious visual handicaps.

By the beginning of the 19th century, museums for the blind were opened at the various institutes in Europe. The museums displayed pedagogic objects which were exceptional in some respect, or teaching material considered of historical interest, but there were also objects which were used to complement the normal class-room teaching. Apart from the museums at a number of the institutes, the collections of local museums were also used for groups of blind pupils. The class either visited the museum or borrowed individual objects from it to be studied at the institute.[94] Johann Wilhelm Klein laid the foundation of the museum at the institute in Vienna, where between 1804–1809 he collected teaching material, and tools and machines especially suited to the education of blind pupils. A list dated 1837 shows that the museum founded by Klein held a considerable collection of objects. The collection was taken over and restructured and was later transferred to the Blindenstudienanstalt in Vienna, where it was made available to the general public.[95] During the bombings of Vienna at the end of the Second World War, the museum was partly destroyed. At that time its contents were estimated at more than 5000 objects.[96] From photographs which fortunately survived and are now in the museum of the institute for the blind, it is possible to form an idea of the richness of this collection. From the photos, it is evident that the collection included wooden models of objects as well as of buildings, and models for the teaching of botany and biology, etc. There was also an extensive collection of stuffed animals.[97]

According to Alexander Mell, the blind Dr. Guillebeau of Paris founded Musée Valentin Haüy in 1885.[98] This is reported in Der Blindenfreund of 1887, with information that the museum was housed in Guillebeau's private apartments, and that it was only open to visitors one day a week. According to the news item, the museum had an exceptional, almost complete collection of objects which could be used by the blind. There were, for example, books and reviews in different types of relief print, which allowed tactile reading. Besides the printed items, there were writing apparatuses and educational material of different kinds, as well as numerous card games and chess and domino sets.[99] One year later, a person in Florence by the name of Barbi-Adriani distributed a circular in which he asked for contributions to the museum which he was just opening, the "Musée didactique et industriel pour les aveugles", which had a large collection of historic objects.[100] In Steglitz, the institute's museum was founded in 1890 with financial support from the Prussian ministry of education. This museum distributed a catalogue which contained a list of the objects in the museum, with their corresponding descriptions.[101]

Samuel G. Howe laid the foundations of a museum at the Perkins Institute when he, on behalf of the institute, acquired a relatively valuable collection of wooden models and a herbarium. In his description of the Perkins museum, Nelson Coon does not mention Howe at all, but states that the museum was basically created by purchases made between 1889 and 1890.[102]

Apart from the museums created by the various institutes, public museums also made part of their collections available to visually impaired visitors. In 1931, for example, 39 of the museums in Great Britain had made arrangements for visitors with serious visual handicaps to have access to their collections.[103] From 1949 to 1951, London's Science Museum organized special exhibitions for blind adults. These exhibitions were displayed in rooms where "hand-viewing" was permitted.[104] Much earlier, however, groups of blind visitors had been welcomed by museums in England. The activities initiated in Sunderland are an example of this. They were presented by the librarian and director of Sunderland's Public Libraries, Museums and Art Gallery in *The Museum Journal* in 1913.[105] Groups of blind adults and children could visit the art gallery where a guide described the content of the pictures. The blind visitors were also allowed to touch the paintings and could thus feel the texture of the colour and the canvases, and with guidance feel the contours.[106] Besides the art galleries, guided visits of the natural history collections were also given. During the fourth and last visit, the visitors could investigate a varied collection of models, of engines, for example, the Sunderland Bridge, screw-driven steamships, a lifeboat, aeroplanes or a balloon.[107]

Eleven years later, "the blind missionary and lecturer at the Sunderland and County Durham Incorporated Royal Institute for the Blind" received permission to initiate weekly courses for the blind. Lectures were given on history, literature and natural sciences. These lectures were very popular and gathered audiences of up to 175 every week.[108]

At about the same time, a number of museums opened their collections to visually impaired visitors. These museums are named in a publication dated 1953, which also gives the years in which they initiated their activities.[109] They were: the Metropolitan Museum of Art, New York (1913), the Children's Museum, Boston (1916), the Brooklyn Museum (1920), the Carnegie Museum, Pittsburgh (1922), the Chicago Art Institute (1922), the City Art Museum, St. Paul (1926), the De Young Museum, San Francisco (1932), the Cleveland, Ohio, Museum (1932), the Fleming Museum, Burlington, Vermont (1939) and the Newark, New Jersey Museum (1939). Coon also tells how children from the Perkins Institute would visit Boston's Museum of Fine Arts from time to time, as part of an experiment which attempted to make history come alive for the pupils by letting them touch historic objects of art.[110]

In the summer of 1929, an exhibition was organised in Linköping, Sweden, which consisted of portraits of people from the province of Östergötland; people who, in one way or another, had made important contributions to the history of the country or the province, who were considered of cultural and historical relevance from the 16th century to the present.[111]

Exhibitions as a teaching medium were not used only in the teaching of the blind; the blind themselves were exhibited. Laura Bridgman is a case in point; she was exhibited at the World Fair in London in 1851, where she demonstrated her skills.[112]

In 1923, a much-publicized exhibition was organized at the National Institute for the Blind in Great Portland Street, London, where samples of the skill of the blind in handicrafts were displayed, such as brushes, baskets, mats, machine knitted dresses and relief prints or braille books and relief maps.[113] Visitors were invited to tour the building and observe the printing works in action, as well as blind masseurs of both sexes and blind switchboard operators. Blind artisans also gave demonstrations of their skills. It was estimated that over one thousand people visited the exhibition, which excited great interest among the public. The exhibition was also reported in the press. The Daily News, for example, The Times, the Daily Telegraph and The Morning Post all published articles about it.[114]

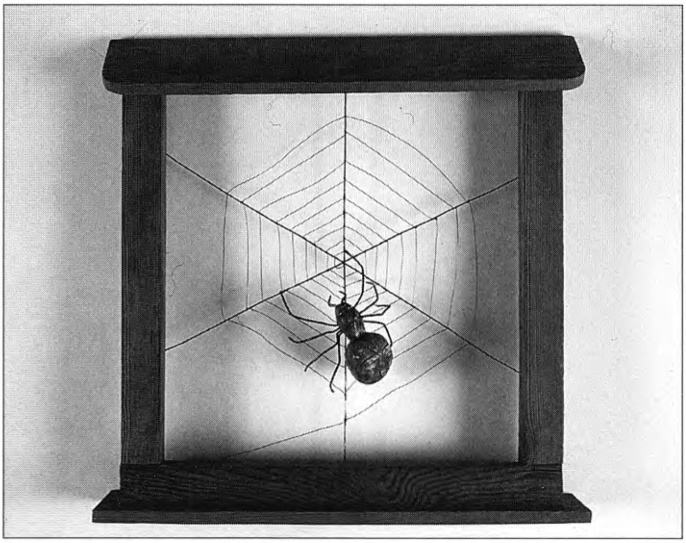
VII

Models and pedagogical theories on modelling and drawing in schools for the blind

Many pedagogues and investigators during the 20th century have shown how creative activities facilitate learning.[1] It is said that if a child is allowed to express itself in pictures, its capacity to interpret other pictures increases.[2] When we try to solve the problems inherent in a creative process, we become more aware of how others have solved similar problems. But the step between successfully creating a picture and interpreting a picture is a long one.[3] It is not unusual for the two and three-dimensional representations made by a person with severe visual impairment to be interpreted as expressions of what that person can perceive of relief pictures or three-dimensional objects, with no consideration given to his previous experience of creative activities. A clumsy drawing by someone with severe visual impairment, who has had very little previous experience of drawing or modelling, does not necessarily indicate the true extent of his ability to perceive and interpret tactile pictures and models.[4]

There is a long tradition of modelling and drawing as subjects in the teaching of visually handicapped children. This form of teaching has been employed to one extent or another all through the development of organized education for the blind. The purpose behind the introduction of relief pictures and maps and models in the classroom was to give the pupils knowledge of the objects around them and to develop their awareness of spatial relationships. As modelling and drawing became established as school subjects towards the end of the 19th century, the pupils worked principally from models and with a variety of templates. The aim was to train the pupils in tactile perception and increase their ability to interpret pictures, maps and models or real objects.[5]

Modelling and drawing were not simply considered as isolated subjects in the curriculum; they were also applied in mathematics, geography and natural history. We could look upon these two activities as part of the craft training, which took place in most institutes. Often both activities were linked to the learning of general concepts and spatiality, which is in keeping with the theories on tactile perception which were in vogue at this time.[6]



Model of a spider, made by Guldberg (Photo: Jørgen Schytte).

Models

Anatomic models for medical studies and other purposes developed in the 17th and 18th centuries, as did the relationship between the text and the picture. In the 1750s, the model-maker Ana Mazollini invented a method of conveying knowledge through the anatomic model, when she numbered the different parts of the body, veins, nerves, muscles, etc.[7] Each number had a corresponding description of the part in question.[8] She also improved her anatomic models by painting them in natural colours.[9]

In the 19th century, the model-maker Louis Thomas Jerôme Auzoux started making anatomic models from papier-mâché. These models were

specially designed to be taken apart, which made them popular with the general public. He also made large-scale models of the smaller parts of the body. Each model was provided with an index and accompanying text. Auzoux had acquired his skill in the production of anatomic models by studying the work of the old wax-modellers of Florence.[10]

The majority of the models used in the education of the blind were not originally made specifically for this purpose. The institutes for the blind bought their models from firms which manufactured general educational equipment. The design of a particular model determined whether it could be successfully employed in the education of the blind without special adjustments. In 1874, the director of the Kentucky Institute for the blind, B.B. Huntoon, ordered a model from Auzoux to be used in the teaching of anatomy to pupils at the institute. In his order, Huntoon suggested that instead of using different colours to indicate the various blood vessels, Auzoux should use different textures to enable his pupils to differentiate between with their fingers.[11]

The anatomic picture may well serve as a direct substitute for the body, but the astronomic picture represents something which cannot actually be touched. In order to create an astronomic picture, it may be necessary to "invent" a configuration which can satisfactorily represent a complicated system. When Copernicus discovered the complex relationships between the celestial bodies and their orbits around the sun, he needed to illustrate his discovery in some way in order to be able to explain it.[12] Copernicus himself expressed the problem inherent in the representation of certain physical relationships through pictures, when he tried to illustrate the spiral orbits of the celestial bodies around the sun.´

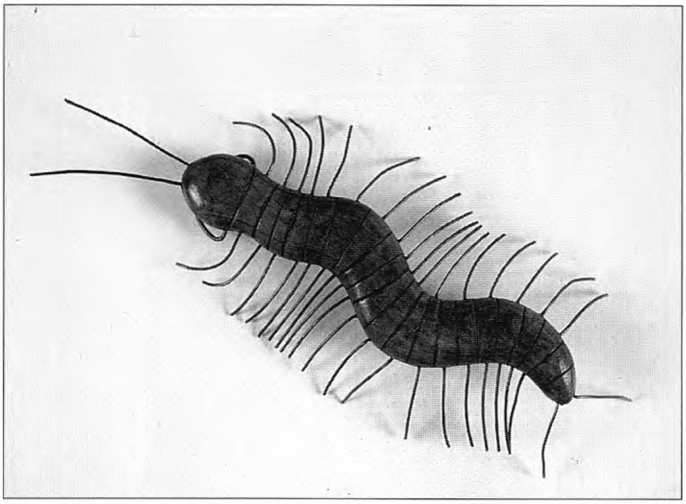
> ... these matters are not easily explained adequatly in words. Hence they will not be understood when heard, I am afraid, unless they are also seen by the eyes. Therefore let us draw on a shpere the ecliptic ADBC.[13]

When the picture was not sufficient, the astronomer Tycho Brahe also constructed models. These models, however, depended on the pictures, and Brahe explained that:

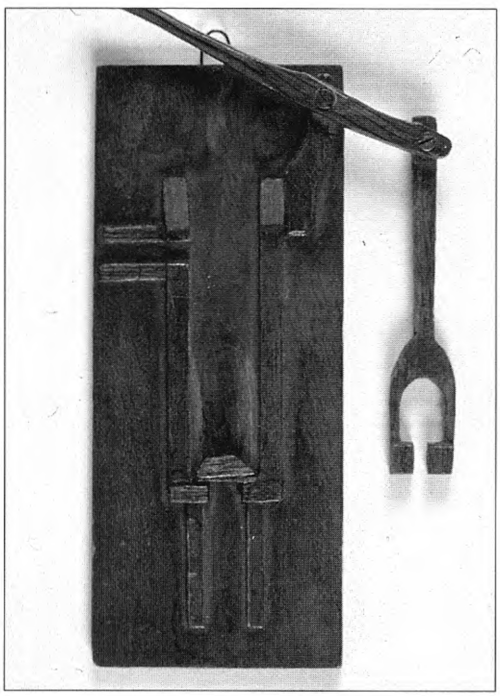
> The construction and use of instrument is understood by careful study of the accompanying figure quicker than through more elaborate verbal explanation.[14]

A general study of models is not relevant to the present study. I will therefore be concentrating on those models which have fulfilled some kind of didactic purpose.[15] Thus it will be possible to present the application of models in the teaching of pupils with severe visual handicaps. The use of models in schools for the blind has, to a large extent, depended on what was available for sighted pupils in the way of models of plants and animals or plaster copies of classical sculptures. These models were either produced by manufacturers of teaching aids or by museums. Models have frequently been used in teaching, particularly in such subjects as natural history, geography or geometry. As many of the models used in the teaching of the blind are no longer in existence, I have had to rely on a wide range of sources, including photographs showing the importance of the model in teaching. Records of promotion leaflets and for models sold are still to be found at all of the institutes I visited.

a.



b.

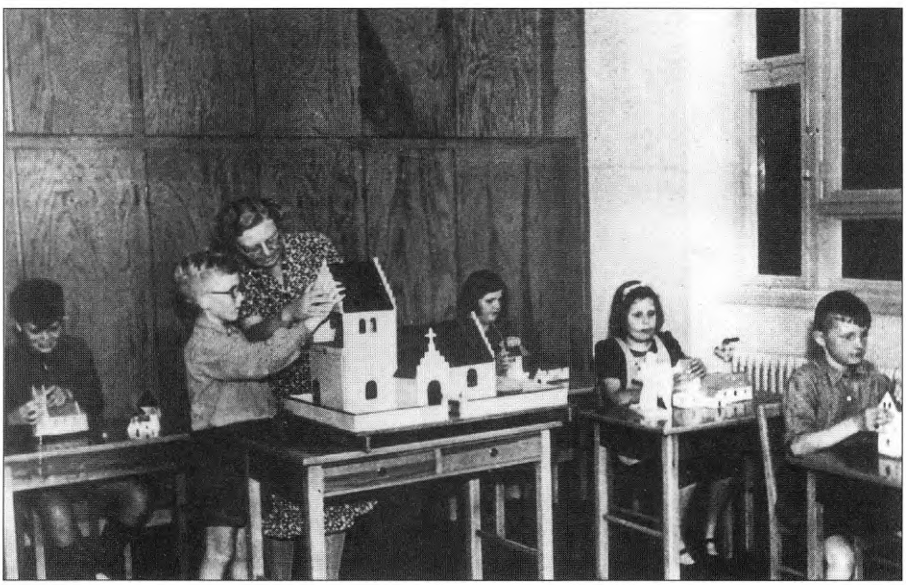


a. Model of a centipede, made by Guldberg (Photo: Jørgen Schytte).

b. Model of a pump, made by Guldberg (Danmarks Blindehistoriske Museum, Copenhagen. Photo: Jørgen Schytte).

Although most of the models I saw were not made with the blind in mind, there are some which were made specifically for blind pupils. These models, such as relief pictures, seldom exist in large numbers, but are generally unique items, handmade by a teacher for use in his or her teaching activities. L. F. Guldberg made himself several models for the natural history classes at the Kongelige Blindinstitut in Copenhagen.[16] He made models and relief pictures of both animals and plants. Amongst other things, there is a spider, a spider in its web, a millipede, and a small relief in wood of a pump.

When Einar Ketting became a teacher of natural history at the institute in Copenhagen in 1906 (where he remained until 1951), the collection of models was renewed. He introduced "biological natural history", exmphasizing the presentation of the animals in their natural habitats. For this reason, the new collection included models of animals and birds in different positions, so that the pupils could, for example, form an idea of what the hare looked like when sitting, hiding or leaping off when startled. In addition to the use of "moving" models, a large part of his teaching took place out of doors.[17]



Miss Gyldenberg, Refsnaesskolen, 1948 (Photo: Courtesy Danmarks Blindehistoriske Museum).

Models of buildings were common, and typical buildings, such as a church, were generally represented. In a photo from the 1940s, Miss Gyldenberg is showing the pupils in a class at the Refsanesskolan what a country church looks like. There is a large model of the church in the classroom. The teacher is guiding one of the pupils over the construction, while the other pupils each have a smaller model of the church to investigate for themselves.

There were also models of buildings specially made for blind pupils. In Nürnberg, Karl Schleussner designed a box of building blocks for blind children. With these blocks the pupils could form simple words as well as make more complicated constructions, such as churches, towers, and bridges. From Blindenheim, in Basel, one could order a box of building blocks, with the corresponding plan for building a model of Blindenheim itself.[18]

It is natural that models of buildings should be of interest to those with severe visual impairment, as the reading of such models is the only possible way for them to grasp architectural effects. In order to develop such an understanding, a finished model is not absolutely necessary, as the building block models have proved.

In January 1920, an article appeared in *The Beacon* on the blind organist, Mr. Boan, who had made a model of his own house, although he had never seen it. The model had taken him five years to build and included all sorts of details. It was put up for sale at St Dustan's Fair, Central Hall, Westminster, and the money went towards St Dunstan's Fund for the Blinded Soldiers and Sailors.

The use of models in the teaching of pupils with severe visual handicaps has often been presented as an alternative to relief pictures. Models were thought to represent the real object much more authentically, thus making them easier for the blind to interpret than relief pictures. There is, however, a long tradition of the use of models in combination with relief pictures in the teaching of the blind.

Modelling

Modelling was already being taught at the Blinden-Erzeihungsinstitut in Vienna in 1835, after which it more or less disappeared for a time.[19] In 1891, Simon Heller, at the Israelitischen Blindeninstitute Howe Ware in Vienna, published an extensive text on the subject entitled *Modellieren und Zeichnen in der Blindenschule*. It includes a policy statement as well as a detailed programme of studies for these activities, and was awarded a prize at the congress for teachers of the blind in Cologne in 1888. In 1890, Friedrich August Büttner published *Das Formen und Zeichnen in*

Bl.-Unterricht, he had also been awarded a prize at the Cologne congress.[20] *Das Formen und Zeichnen in Bl.-Unterricht* is a teacher's manual on modelling and drawing, with detailed information on the contents of both subjects and the grades or levels at which they should be introduced. Büttner and Heller's methods for modelling and drawing coincide. However, Heller's theories are better formulated and more developed that Büttner's.

The annual reports of the various institutes, including detailed timetables for each grade or level, confirm the fact that these creative activities spread to the rest of the continent and Scandinavia.[21] The resulting clay models were often photographed in studios and the photographs then used to illustrate the annual reports. They also appear on a series of post-cards published by the institutes for the blind in presentation of their activities.[22] This would indicate that modelling was a feature of their curriculum which the different educational institutes for the blind were proud to offer their pupils.[23]

To be able to model in clay, the first requisite is a pair of sufficiently strong hands. Secondly, the visually impaired must know how to go about making a tactile investigation of the object to be modelled. For this reason, the importance of hand exercises was particularly emphasized.[24] To reach an understanding of an object or a relief picture, one must make a systematic tactile investigation of it. But dexterity in reading an object or a relief picture does not come automatically. It must be learned, irrespective of whether the reader was born blind or became blind later in life. The learning of a variety of reading techniques demands knowledge of how tactile perception functions. Simon Heller explained how we understand and interpret an object by touch in *Modellieren und Zeichnen in der Blindenschule*.

> 1. When we do stretching and pressing exercises with our hand(s), we are developing spatial relationships at their most elementary level. We are developing an awareness of our hand and fingers in relation to our surroundings. The greater the mobility of the different parts of the hand, the better the role of each can be distinguished one from another, and the clearer our spatial perception becomes.
> 2. When we touch our tactile organ, we are aware of the difference between it and the object we touch.
> 3. This awareness in turn becomes percpetion of shape, as the tactile organ moves over an object other than itself and, touching points distant from one another, combines the different tactile impressions to create one total impression.[25]

Heller was well aware of the difficulties involved in understanding an object by touch and then reproducing it, and that the degree of understanding of the object and the resulting interpretation may vary from individual to individual. Tactile training, however, increased the possibility of arriving at a good "felt understanding", as Heller put it.[26]

A complete understanding and interpretation of three-dimensional objects requires knowledge of plastic decoding or the ability to perceive a plastic vision of the object in question. Simon Heller believed that modelling was necessary in schools for the blind to enable the pupils to conceptualise three-dimensional objects and to develop their ability to interpret them.[27] It is in the act of creation that one comes closest to the relationship between the signified and the significant, that is, to the relationship between the linguistic concepts and their reproduction. Heller's experience had shown him that we should not underestimate the difficulties which arise when we attempt to describe an object accurately. But when the pupil himself reproduces the object and has achieved a certain capacity to create with his own hands, his linguistic capacity also increases. According to Heller, this was due to the fact that our concepts are created through our perception. When an individual's pattern of movements becomes part of his perceptual and conceptual processes, there is transference from the pattern of movements to his linguistic concepts. The same transference takes place when a pupil first feels an object which he then reproduced, after which he returns, to the object to investigate its shape.[28] Heller saw this interaction as the most important part of the modelling exercises.[29] The concept of shape was thus, according to Heller, the interaction, on the one hand, of the capacity to understand shape, to distinguish and judge the relationship between content and purpose, and the capacity to reproduce a given shape, on the other.[30]

The possibility of improving skills in tactile reading in its different aspects with the help of models was indisputable. The pupils exercised their hands to make them stronger and more supple, and at the same time became aware of the structure and the aesthetic aspects of a variety of objects. A positive side effect of modelling and drawing for many blind people has been an increase in their self-confidence.[31]

Heller's method for modelling started with a thorough investigation of the object by the pupil, and it could take several days for him to feel sure of its shape. Heller gave detailed instructions as to how models should be investigated for later modelling. Concepts such as "enlargement" and "reduction" must be made clear to the pupil.[32] He also recommended the types of models suitable for the introduction of motifs as well as materials.

The models used initially must, above all, offer a certain resistance to the probing finger, wihtout any portion of the material breaking off. Edges, corners and rounded shapes must be clear to the touch. Wooden and well-fired ceramic models are the most suitable for the representation of basic shapes; hard fruits, wooden and metal tools for the representation of real objects. Plaster models, soft fruits and pliable, elastic materials should, if possible, be avoided.[33]

When the pupils have assimilated the basic shapes, they can proceed to models representing people and animals (i.e. living creatures). These models need not be solid, but on no account should they be of a pliable material. Plaster models are suitable, according to Heller, but not until the pupil has acquired dexterity should stuffed animals be introduced.[34]

The curriculum elaborated by Heller for modelling started from the moment the pupil was introduced to the different materials. After that, the basic geometric shapes were studied: sphere, hemisphere, oval, cylinder, cube, and prism, cone and pyramid. Heller gave detailed instructions as to how the pupils should be taught to recreate the shapes of the various objects, and how objects around them which has those same shapes should be investigated.[35] When the pupil has learned the basic shapes, they can begin working from models, but the teacher should take great care that the pupil's reproductions are accurately proportioned. As a third step in this first part of the learning process, the pupils should learn how to convert three-dimensional figures into plane geometric shapes. The two-dimensional pictures of geometric shapes should be made with dots and lines. As in the exercise involving three-dimensional geometric shapes, examples could be found in the classroom which coincided with the basic two-dimensional shapes.[36]

When Heller's pupils had completed these exercises, they could start modelling in the way which the first part of the training aimed at, that is, the independent creation of figures/pictures. This independence, however, was limited by the fact that the pupil had to work from a model. The list of objects used in the teaching of modelling is long, and includes everything from a coarse file to a door-catch or a trumpet.[37]

Modelling was, as we have said, not merely an isolated subject in itself, but was integrated into other school subjects. In the teaching of local history and folklore, geography, natural history (zoology, botany, mineralogy and geometry) and crafts, the pupils made models. In local history and folklore and geography lessons, the pupils made models of the classroom, in addition to models of geographical features such as mountains, valleys, waterfalls, etc., and man-made structures such as bridges, viaducts, tunnels, dams, roads, squares and buildings.[38]

The pupils became familiar with animals and insects by modelling anatomical details such as eyes, noses and heads of different animals, birds and insects. The same was done in botany lessons, where the pupils modelled details of plants, as well as whole plants. All modelling was done from models.[39] Not until the pupils had learned to manage the basic shapes were they allowed to work with real plants and animals. They began with simple details of a variety of plants and animals before going on to reproduce the object as a whole.[40]

In an article in *Encycklopädisches Handbuch den Blindenwesens*, Adolf Heck analysed the most important texts on modelling in schools for the blind.[41] He emphasizes the value of modelling in learning, but also the conditions required for positive learning to take place. Positive learning was achieved when, through careful investigation and continuous comparison between the model and the original, the pupil's tactile perception was stimulated and developed. Since training in modelling improved the pupil's capacity to perceive objects and to form concepts about them, modelling came to acquire great importance in all school subjects. The conditions required for achieving positive results in the teaching of modelling were, in the first place, that the pupils should practise modelling throughout their entire school career, and, secondly, that the teaching should be methodical.[42] It should start with easy subjects and proceed to more difficult ones; in other words, it should progress from the simple to the complex and from the familiar to the unknown. Here Heller's methods are clearly in evidence, as they are further on, when the author describes how to start with the basic shapes and other related shapes.[43]

At first, the pupils should work from a model. Later they modelled from descriptions and finally, from memory. They began on a 1:1 scale, went on to reproduce objects on a reduced or enlarged scale. When the pupils had copied the complete figure, they then reproduced it in high or low relief and in outline, in order to understand the full significance of reproduction.[44]

As the teaching of modelling was based on reproduction of models, it became necessary to provide schools for the blind with a well-stocked collection of models. These collections should include the basic shapes such as spheres, cones, cylinders, pyramids and cubes, as well as a variety of tools or reproductions of tools. There should also be objects made of glass, ceramic and wood, models of leaves, flowers, fruits, animals and parts of animals (such as paws, hoofs and heads), and the different parts of the human body.[45] Many of the schools for the blind possessed extensive collections of models. From their annual reports, it is clear that those models were actually used in object lessons, as well as in modelling and in subjects such as natural history and geography.[46]

It is interesting to note that the idea was that each pupil should model according to his or her capacity and at his or her own pace. The teacher should, of course, give the pupils the help they needed, but, as far as possible, should limit himself to guiding the pupil in his work on a figure, and allow him to correct his own work. Each figure had to be completed, even if that meant that the pupil worked on the same task for several lessons. The pupil was not allowed to continue to the next task until a figure was finished.[47]

Reports of the activities at the different institutes confirm that modelling existed as a subject before Büttner and Heller published their studies, which to some extent would indicate that their texts can be considered as surveys of a fairly widespread activity. At Det Kongelige Blindeinstitut in Copenhagen, there are reports of modelling as a subject at the school dating from 1886. Here the pupils modelled from real objects, but were also allowed to use their own imagination from the first grade on.[48] At the Tomteboda school in Stockholm, the annual report for 1888 includes an elaborate programme for the teaching of modelling.

> In order to develop their sense of touch and their awareness of shape, together with their capacity for observation and perception, the boys and girls have taken turns each Friday and Saturday afternoon at 6–3/48 p.m. at clay modelling. The less able have made simple shapes such as spheres, plates of different shapes, cylinders, pyramids, cones, rings, tree-stumps, crosses, anchors, wheels, etc. from models made of wood, plaster, etc. The more skilled have modelled simple ornaments, animals and parts of the human body, etc., from plaster models. The pupils have also been allowed to create small compositions, from their own imagination.[49]

Handicrafts and "sloyd"

From the very beginning, handicraft lessons were a central part of education for the blind. In Sweden, "sloyd" was introduced as a school subject in 1878, but was already an integral part of education for blind pupils. The first blind pupils to complete their education at the Manilla institute in 1808 had been taught to spin, knit and do plain needlework.[50] From the 1890s onwards, there appeared several publications (including lectures) on modelling, drawing and "sloyd" in the education of the blind. These publications presented a carefully elaborated pedagogy and a curriculum for each of these subjects. This pedagogy had been developed over a period of many years, as a lecture given at the Stuttgart congress (1888) for education in manual dexterity testifies.[51] The lecture, entitled "Die pädagogische und soziale Bedeutung erziehlicher Knabenhandarbeit und ihre praktische Durchführung", clearly indicates the importance of an early training, if children are to master a craft. If our hands are to respond to our wishes, they must be trained, says the author, referring to Comenius' "Methods for Acquiring Abilities" in *Didactica Magna"*.

> ... the pupil must learn where and how to use this or that, and while using it, must learn not to make a mistake, or, if that should happen, he must learn how to correct it. He must not make mistakes or get tired of being corrected until he can carry out his work safely and easily without mistakes.[52]

For the pupils to develop the necessary dexterity, the same methods were applied in the teaching of "sloyd": the pupil should start with simple tasks and proceed gradually to more complex ones. When we consider how the teaching of modelling, drawing and crafts was developed, we find that a large part of the methodology employed is derived from Comenius' educational principles. It is therefore worth mentioning that when *Didactica Magna* was translated into Swedish in 1892, it was at the instigation of Otto Salomonson, founder of the Nääs "sloyd" seminary.

By 1892, "sloyd" was established as a subject at the Perkins Institute for the Blind and at Horace Mann's school for deaf-blind children.[53] In an article in the American review *The Mentor,* the readers are told how the Swedish "sloyd" pedagogy from Nääs had spread not only throughout Europe, to Japan, India and several South American countries, but also to Boston.[54] The subject which the author of the article called "American Modification of 'Sloyd'", was introduced by one Gustav Larsson.[55] In this article, a model for the teaching of "sloyd" was presented. Much of the methodology is recognizable as having its roots in the teaching of modelling. First and foremost, the tasks should be given in developmental order, from the easy to the more difficult; from simple figures to complex ones. The activities should be carried out so as to allow the body and the intellect to develop at the same pace, with no disturbing influences created by setting the pupils tasks beyond his or her capacity. Secondly, the activities should be as varied as possible, without making exaggerated demands on the pupil. Thirdly, the activities should lead the pupil, as far as possible, to the production of useful objects, as this was considered morally edifying. The pupils would learn that if each step in the production was executed with care, the finished result would be positive. Models were also used in craft and "sloyd" classes. These models should be constructed in a way that allowed the pupils to draw them, as the production of a model should always be preceded by a drawing of it.[56]

The aesthetic aspects of "sloyd" were also discussed. One of the most important aims in "sloyd" was to stimulate the pupil's aesthetic sense through exposure to the beautiful forms and proportions of the model.[57] Another aspect stressed by the author of the article in *The Mentor* was that working with wood developed the blind pupil's tactile ability. The difficulty in teaching "sloyd" to blind children was, above all, presenting the task in the right way. The only special tools available to the blind pupil were two marking instruments: one for drawing lines on the wooden surface and another for parallel markings. Other tools, such as the ruler, only required braille markings.[58]

Friedrich August Büttner was one of the first pedagogues to recognize the importance of manual dexterity for the blind. In this his thinking was based on Fröbel's pedagogical methods. During his period as director of the institute, Büttner made efforts to adapt the teaching to make it suitable for all blind children. He introduced handicraft lessons and at the institute there were also a department for mentally handicapped blind children. In 1891, a year after the publication of *Formen und Zeichnen im Blinden Unterricht*, Büttner published a curriculum for "sloyd" in the education of the blind, *Lehrgang für den Unterricht in Holzarbeiten in den Blindenanstalten*, written by two of this "sloyd" teachers.[59] When the curriculum was published, "sloyd" classes had been in existence for more than three years at his school. The two teachers who had planned the five-year curriculum for "sloyd" teaching, were themselves in charge of "sloyd" classes. The curriculum covered pre-school and the following four years. It began with very simple exercises and continued with more complex tasks. The utility aspect of the programme is evident from the very beginning. Once the pupils had learned to drive nails into wood and to prize them out with a pair of pliers, they could produce their first object—a simple frame. The tasks quickly moved on to more complex objects, and before the five years were up, the most skilled pupils were expected to have made everything from a nesting-box to a foot-scraper, from a flower-press to a folding chair.[60] When we study the curriculum from Dresden, and especially the quantity of objects which the pupils were expected to make, in spite of their handicap, we cannot help but be impressed.

Very early on, Fröbel's pedagogic ideas on handicrafts had exerted a strong influence in Sweden. At the Royal School for the Blind at Växjö, where the young children (the average age for the year 1884–85 was 9.23 years) were trained in manual activities and handicrafts, the curriculum included:

> *Hand exercises*, for strength and flexibility of the fingers; *Building* with several kinds of building boxes containing solid figures, different types of model houses and furniture, etc., all of which could be taken apart and put together again; *Clay modelling:* spheres, cylinders, cubes, prisms and other simple shapes; *Crossmaking* from models, using lathes; *Manual activities in dried peas or cork;* reproductions of a wide variety of everyday objects and plane and solid figures: *Plaiting* with strips of oilcloth and paper; *Outline-stitching* on perforated cardboard.[61]

It was not, however, possible to carry out high-quality "sloyd" teaching at all institutes. At many schools, the children suffered not only from visual impairment, but also from one or several other handicaps. Elisabeth Anrep-Nordin has told how "sloyd" classes were developed at the Drottning Sofias Stiftelse (Queen Sophia's Foundation for the Blind) in Vänersborg, where multi-impaired children were educated. The deaf-blind children and the less able pupils had difficulty in performing intellectually-based tasks. The type of "sloyd" best suited to them was weaving. They started with a loom for band-weaving and progressed to a full-scale loom. According to Anrep-Nordin, the pupils enjoyed weaving very much, even though they could not distinguish the colours or the patterns of the things they made.[62]

Aesthetic forms

The teaching of modelling also included a freer, more creative element, where the aesthetic aspects of the activity were given a value of their own. Although Heller stressed the more systematic teaching of modelling, where pupils made figures from models, he also defended artistic creativity in its own right.

> The pupil will gradually be presented with aesthetic forms composed of the basic geometric or natural shapes. As the teaching progresses, the pupil is asked to abstract these shapes from the objects, and, finally, to combine them by himself. The ability to reproduce plant and animal forms and parts of the human body will likewise be introduced.[63]

About forty years after the publication by Simon Heller of *Modellieren und Zeichnen in der Blindschule,* Ludwig Münz and Viktor Löwenfeld, the famous developmental psychologist and specialist in children's development in drawing, published their study, *Plastische Arbeiten Blinder.*[64] This was before Löwenfeld published, in 1947, his important study "*Creative and Mental Growth,* in which a chapter is dedicated to "Creative activity and the handicapped".

Plastische Arbeiten Blinder includes a description of the work carried out by blind children at the Israelitischen Blinden-Institutes in Vienna. Münz and Löwenfeld concentrated on how the pupil's spatial perception was expressed in clay or wooden figures which they themselves had made. Münz and Löwenfeld believed that they were the first to carry out this kind of study.[65] In 1910, Burde, a teacher of the blind in Breslau, had already published his study *Die Plastik des Blinden*, which dealt with the three-dimensional figures made by blind children. He, however, had focused on the way in which blind children reproduce spatial relationships.[66]

On the basis of his teaching experience over many years, during which he had made a study of blind children's representations of three-dimensional figures, Löwenfeld elaborated his ideas on how modelling should be taught to blind pupils.[67] While he presented his own ideas, he stressed that there is no one all-encompassing method valid for all teaching situations. There are only useful norms: the appropriate application of these norms depends on the individual teacher, according to Löwenfeld.[68] The teacher must adjust his or her teaching to the feelings, capacities and wishes of the pupils, which is not always easy, he said.[69] The other major difficulty which Löwenfeld stressed are the linguistic limitations involved in communication with blind pupils.[70]

Löwenfeld argued in favour of independent modelling and of letting the pupils reproduce expressions. The face was an obvious subject to start with, as all pupils had had experience of feeling their own faces and the faces of others. Instead of commencing with a standard representation of a face and describing it in terms of basic shapes, Löwenfeld believed it was better to start with the changes which different emotions produce in the face. "What does a laughing face look like? It looks round. What does your face look like when you are sad? It looks longer."[71]

Gradually, the pupils were given more difficult tasks to perform where the increased complexity of expression was accompanied by attempts at greater refinement. Löwenfeld claimed that the more thought and feeling the pupil put into a piece of work, the more elaborate and expressive it became.[72]

After the first step, when the pupils made faces in clay, they were given the task of reproducing the whole head. This brought new difficulties, as the faces they had previously made were masks, which meant that the pupils had only worked from one viewpoint. Now they were asked to shape the whole head, that is, to produce a solid, round figure. At the same time, the head should include details which were in proportion to one another and accurately placed. In this task, Löwenfeld told his pupils to reproduce in their creations, although he insisted that this expressions should not be allowed to distort the true proportions. Correct proportions enhanced the pupil's possibilities of conveying expressions in their figures. It was therefore important for the teacher to point out any shortcomings in the pupil's work, although Löwenfeld warned that negative observations and corrections directed at the pupil's free expression should not be made, as they could interfere with his development.[73]

Löwenfeld attacked the problem by means of tactile investigation of the whole object. Investigating an object with the fingertips allows perception of the object to develop gradually. Once the pupil has formed a first impression of the object, he then returns to it to study it in detail. In this way, the whole is recreated and the mental picture becomes clearer the more time the pupil spends on tactile observations. When a figure is to be reproduced, however, this is not possible. One must have an idea of the figure as a whole, as well as of its details. When a sighted person looks at something, he has at his disposal several simultaneous stimuli which create the whole impressions: light and shadow, colour and form. The blind, however, only have touch, and can only discern shape and material.[74] When we see three-dimensional figures made by blind persons, we must expect to see different kinds of figures, depending on whether the pupil is completely blind, blind from childhood, has been sighted or is able to distinguish differences in light. Löwenfeld also stressed the importance of not rejecting figures made by pupils who were blind from birth because their work does not always coincide with what the sighted person is used to seeing.[75]

Löwenfeld considered that modelling fulfilled two purposes:

on the practical side, the training of the pupil's hand in the transmission of a wide variety of impressions by concentrating on each minimum detail, and, on the spiritual side, his concentration on his own world of thoughts and feelings and their realization. Experience has taught us that this concentration suppresses the pupil's unproductive passive fantasy and leads to concrete thinking. The visible result, on the other hand, is purely artistic, and should never be mentioned in conjunction with the *purpose* of the plastic arts in schools for the blind.[76]

Drawing

Drawing has not, for obvious reasons, had the same importance as modelling in the education of the blind, and has never been an individual school subject.[77] Although a considerable number of articles and books were published in the 1890s on the importance of the teaching of drawing in schools for the blind, it seems that the writers then lost interest in the subject. Through drawing, the blind pupils were supposed to achieve an understanding of how shapes were created with lines and flat surfaces. The belief was that when the pupils created two-dimensional pictures, they formed an idea of the objects around them and became able to appreciate the relationships between them. It was also assumed that their tactile capacity increased, and that this capacity could be applied in geography, natural history and "spatial awareness".[78]

It is that line drawing should come to dominate the teaching of drawing for the blind. Different shapes could be reproduced with the help of ebossed lines. Such lines could be created by drawing with a stylus on heavy paper, by sticking pins close together, or by using a waxed thread or a string of wax. It is worth noting that line drawing dominated the teaching of drawing for the sighted during this period. The line had been regonized by Pestalozzi and inspired him to his drawing system, which utilized a squared paper. This system was constructed so that it was possible to dermine certain points on the object. The teacher could then give an oral instruction of how to draw the picture and a pupil familiar with the system would be able to draw it on the squared paper, without having seen the object.[79] This system was asopted in the teaching of drawing for the blind.

According to Heller, it was impossible for a blind person to represent a three-dimensional object in a two-dimensional drawing. He stressed that, for the blind, drawing was only a means to an end and could not be compared to modelling. When drawing is included in the teaching of the blind, it is important to be aware of the objectives, and to know what procedures should be adopted in the teaching situation. For a two-dimensional picture to be understood by a blind pupil, he or she must first understand the relationship between a three-dimensional object and a two-dimensional picture of it. A contour drawing resembles the real object in that it reproduces certain of its characteristics. It might also be thought of as a reduction to symbols of the originals, symbols which represent position or direction, as in a map or a diagram, both of which are very useful to the blind.[80]

> Thus, the *sign* or the *symbolic representation* is created through a drawing, and the teaching of drawing converts the teaching aids for the blind (i.e. graphic representations) into efficient educational tools which otherwise would remain empty of content, as the blind person, in contrast to the sighted, does not progress in his educational development by the method of comparison.[81]

To make a drawing meaningful to the blind pupil, something which Heller believed was possible, it is necessary to start by drawing the outlines of objects which are readily to hand, so that the object and the drawing may be compared.[82] For maps, different types of plans and diagrams, this procedure is seldom possible. It is therefore important to train the pupil to interpret the relationship between the three-dimensional object and the two-dimensional picture, before introducing more complex, abstract representations such as maps or diagrams.[83]

For Heller, the objective in the teaching of drawing in schools for the blind was to create an awareness of the fact that a contour drawing may represent a solid object. This was done by making the pupils draw around the outer edge of objects. This, in time, enabled the pupils to understand the converse, that is, to imagine an object from a drawing. Knowing that a drawing may be seen as a symbol could make it easier for the blind pupil to understand that maps and plans are pictures containing symbols which represent the physical environment.[84]

The method advocated by Heller for the teaching of drawing is basically the one he had suggested for modelling and "sloyd". The pupil started with a simple object, manageable enough to allow him to appreciate its contour by following it with the fingers of one hand. Next, larger objects were introduced, divided into two sections: right and left. The pupil moved each hand to the right or to the left until both met, thus acquiring a feeling for and an understanding of symmetry and the importance of the median line. Before the pupil was allowed to make a drawing, he had to show that he understood the shape correctly. This he did by drawing it on the table with his finger. According to Heller, the pupil had to discover the basic geometric shapes in the object before he could make an accurate drawing of it.[85]

When the older pupils began to draw more complicated objects, it was important to let them draw only one of its sides, said Heller. All attempts to make reproductions in perspective must be prevented; it was very bad pedagogy to allow pupils to try to produce any kind of representation in perspective.[86]

Heller based drawing lessons on the basic geometric forms. The first exercise was carried out on a padded disk on which figures were formed by sticking pins into the pad. This exercise was meant to teach the pupils to understand that a line forming a shape goes from a starting point to a finishing point. The pupils practised making different lines before going on to make a variety of shapes. When they had mastered the basic geometric shapes and could put several of them together to make simple figures, they were allowed to start drawing with a pin on paper. Later they were allowed to draw more complicated objects.[87]

The ability to draw was useful in many different subjects, especially in craft lessons, where it could be of great help in basket-making, for example, to be able to design a pattern first with pins on a padded cushion.[88] Two-dimensional pictures could furthermore be of assistance in the modelling of day figures, in order to facilitate the understanding of the whole while working on details.[89]

This utilitarian view on the teaching of drawing was not limited to the teaching of drawing for the blind. Linear drawing was used also in the regular school during the first decades of 19th century. The aim was to train the pupils on (eye-hand) co-ordination for their future work as craftmens.[90]

Different techniques for drawing in schools for the blind

Drawing was introduced early in the teaching of the blind, but it seems that it disappeared. In 1929, when Harald Thilander presented various drawing methods, they were apperently unknown in the rest of Europe. In article "Hvordan Blinde kan Laere at tegne" (How the blind can learn to draw), published in *Medlemsblad for D.B.S* (Dansk Blindesamfund), Thilander described several contemporary and historical methods. The teaching methods used at Tomtebodaskolan fifty years before, in the 1880s, were adopted by J. W. Klein.[91] Thilander points out that it was not drawing in the traditional sense, as the pupils used a padded disk into which pins were stuck. Thread was then wound around the pins to create a relief line. At other schools, the relief line was formed by placing the pins close to each other. On maps, towns and villages were marked with pins of different sizes. Each pupil had access to a padded disk, a quantity of pins and some thread. The pupils made their own maps from detailed oral instructions. The pins were stuck into the padded disk according to the teacher's instructions, and then they wound the thread around them to produce the relief line.

Thilander also tells how the oral instructions could be given:

> First, the borders of the country and the landscape were sketched orally. The work could, for example, begin at the northernmost point. The teacher then said, "From here, the border goes first straight towards the east for one centimetre, then it turns south-east for two centimetres; after that to the south for 1,5 centimetres; then to the south-east for one centimetre", and so on. The pupils tried to fix the pins and the threads according to the teacher's instructions, thus creating the borders in relief.[92]

Thilander stresses that the results were probably not always satisfactory, but that "drawing" certainly was good practice for the pupils' hands and brains, while it helped them to memorize the outline of the landscape or the object. In this comment, Thilander expressed what initially was the basic aim of drawing as a subject in schools for the blind.[93]

Thilander's historical review includes a description of the use of a notched wheel, which had a handle or was fixed to one of the legs of a pair of compasses. The drawing was made on a board covered with felt or woven metal threads. The paper was placed on the board, and to draw one pressed the wheel onto the paper, creating indentations on one side of the paper and a raised line which could be read by touch on the other. The problem with this method was that the drawings were, of course, the wrong way round, and so this method was used mainly for gemoetric figures.[94]

The notched wheel described by Thilander probably belonged to the set of drawing apparatus adapted by Guldberg for empossed drawing. This consisted of:

> 1. an ordinary pair of compasses
> 2. a pair of compasses with a notched wheel fitted to one of the legs, which produced an indented line on the paper,[95]
> 3. a drawing-wheel that took the place of a pen-nib which also had a notched wheel,
> 4. a pricker
> 5. a board with cloth glued to it on which the paper was placed.[96]

This equipment was used particularly for drawing a variety of geometric figures. Geometric figures were also cut out and glued together to form three-dimensional shapes. Guldberg's drawing apparatus was used as an aid in lessons where the pupils worked with paper.

Yet another method used in the teaching of drawing was an apparatus consisting of a metal tape a few millimetres thick, three centimetres wide and at least a metre long. The metal tape was bent to form two parallell parts, one above the other. On the upper side of the lower tape there was a small peg or tooth. A metal rod passed through the upper tape. This rod had a handle and a spring which allowed it to be raised and lowered. On the base of the rod there was a small orifice into which the peg on the upper part fitted. When drawing, the pupil fixed the paper (or the metal plate, if the apparatus was strong enough) between the rod and the small metal peg, then pushed the rod down, producing a raised dot on the surface of the paper. The dots could be made to form lines and figures, and the apparatus could be adjusted to produce dots of different sizes.

However, a more modern apparatus, which interested the contemporary readers of Thilander's article, was the "Vokstraads-Tegnerbraette" invented by Karl Schleussner, former director of the institute for the blind in Nuremberg. This apparatus consisted of a wooden drawing-board measuring 40 x 26 cm, into which the artist could stick the point of his compasses or different types of pins. The board had a drawer with compartments which contained 250 g of wax thread, a dozen pins with heads, six smaller pins, two setsquares, one pair of notched compasses, and a ruler. If the drawing was not to be kept, it could be made directly onto the board, otherwise drawing paper or card was used. The lines were made with the wax thread, which was ideal for tactile reading. When the pupil wanted to draw a straight line, he first tightened the thread and fixed the ends to the board, starting from the middle, thus forming a straight line. If the straight line was supposed to go to a particular point, to run parallel to the edge of the board or to meet another line, the setsquare or the ruler was placed parallel to the line, which was marked off with pins. By twisting several wax threads together, it was possible to work with threads of varying thicknesses.

Agnes Melchior presents a freer application of the "Vokstraads-Tegnebraette".[97] She taught at a pre-school for blind children in Denmark. At the thirteenth Esperanto congress in Stockholm in 1934, she gave a lecture on illustrations and drawing aids in the teaching of blind pre-school children. In her lecture, Melchior told how she had been introduced to wax thread at the Esperanto congress held in Nuremberg, and how important it had become in pre-school education.

> ... I found the wax thread that was being used for drawing geometric figures. I was given a piece to take home, and gave it to my children to play with when they visited me. Once, when I tried to explain to the children how my apartment was furnished and what the building looked like, and so on, I took the wax thread and made a "drawing" of my apartment, of the entrance and of the whole building. Since then, we used wax thread for similar purposes. The children "draw" their toys,

> only their contours, of course, but in this way they create an image of them and learn to investigate more carefully the objects which they want to draw.[98]

During the 19th century and well into the 20th century, the teaching of drawing meant basically that the children "drew" with wax thread or thin strips of metal. There were, however, those who protested against this practice, and in 1894, four years after the publication of Büttner and Heller's study, a man by the name of Zech, from Köningsthal, wrote an article in Der Blindenfreund, stressing the importance of allowing pupils to draw freely, in order for them to learn the extension of form. The free drawing referred to by Zech, meant that the pupils used a thick nib to draw relief lines that could be followed tactilely.[99]

Creation as active learning

To recognize something visually, we must have observed the main characteristics of the object, plant, person, etc. Objects normally differ from one another in shape. By shape we understand the contour or outline of the object, it is its outline that we put down on paper. In an attempt to make this representation clearer, the artist may, and often does, exaggerate those aspects of the object, which are most characteristic of it. It is even more common for the cartoonist to emphasize and exaggerate the physical characteristics of his subject. It is much easier for a sighted person to perceive these characteristics than it is for a person who must interpret them through touch. The pedagogues who worked at the different institutes for the blind understood this. On the basis of their practical experience and theoretic knowledge, they developed methods for stimulating their pupils' tactile capacity. This training included hand exercises, exercises in tactile reading and the creation by the pupils of two and three-dimensional figures.

Because of the difficulties and limitations inherent in tactile perception, systematic training was necessary to enable the blind pupils to form an idea of their immediate surroundings and the world outside. The purpose behind the teaching of modelling and drawing was to increase the blind pupil's capacity to perceive and interpret objects and pictures through touch. This training, however, did not focus on the objects and the relief pictures as such, but on what they represented. The aim was to enable the pupils to recognize plants, animals and the human body by the careful study of models, relief pictures and real objects. They should also learn to interpret maps by comparing, as far as possible, their immediate surroundings with the corresponding map.

Learning was systematic and presented the pupil with progressively more difficult tasks, including those involving the capacity of abstract understanding. Several leading pedagogues of the time stated that creative activities would help the pupils to become more observant of what they perceived through their hands. Modelling and drawing lessons were a training in *learning to feel* and *learning to recognize*.[100]

The teachers at the institutes often had access to large collections of models of everything from geometric shapes and plaster models to stuffed animals and plaster models of works of art, which enabled them to carry out this systematic teaching.

Monitoring perception

While the pupils themselves created two and three-dimensional figures, the teacher could monitor their understanding of them. Pedagogues and researchers have mainly been interested in discovering how blind pupils express spatial relationship in the figures they create.

A number of pedagogues have discussed the relationship between language and creativity. There was always a problem of communication in the process of instructing blind pupils as to how they should carry out certain tasks, since many terms and concepts meant nothing to many of them. This created an even greater problem in the education of the deaf-blind. Elisabeth Anrep-Nordin, who had years of experience of teaching deaf-blind children, was a firm believer in object-lessons. If the deaf-blind pupils were to receive an education which was to be of any practical value to them, the teaching had to be based on their own experience, part of which was gained during their creation of objects.[101]

I have earlier mentioned how blind children used the two and three-dimensional figures they had made to investigate, for example, their understanding of shape and space. In "Några drag ur de dövstummas själsliv", Anrep-Nordin describes one of the pupils at the institute in Vänersborg, the deaf-blind girl, Emile.[102] The description shows what could be achieved through the pupils' own creations:

> Emile—blind and deaf-mute—suffered from a chronic mental disease, and after leaving the institute, spent several years in hospital where she finally died. /.../ At one time she had learned how to knit a doll's dress, which she started by casting on 50 stitches for each piece. The whole dress then had to be made in proportion: each increase or intake had to be in proportion to the others and to the original number of stitches. This task interested Emile more than any other, although she was also very keen on and skilful at all kinds of crotchet, knitting, etc. The dress was finished just in time for the start of the Christmas holidays, when the teacher was to go home. However, before she left, she gave Emile wool and needles and

told her to knit a dress for a little boy, whom she identified. Emile was to start off with 200 stitches, instead of 50 as before. When the teacher returned, Emile had finished the whole dress to correct proportions. She had even sewn the pieces together, using the method she had been shown when making the little doll's dress. If she had made any mistakes as to the size of each piece, she would not have been able to put the whole dress together correctly.[103]

In 1945, when David Katz presented his study of Tomtebodaskolan in "Hur tecknar blinda?" (How do the blind draw?), psychological research into blind children's drawings was already well-established.[104] One of several purposes of Katz's investigation was to see whether children and adolescents who had been born blind expressed spatial understanding in their drawings, and to find out how they did so. This type of research had already been carried out on sighted children by other investigators.[105]

Katz emphasized that the pupils he studied had had no experience of free drawing; they had only drawn specified models. They did their work on drawing-boards which consisted of a frame onto which a thick net had been fastened. By placing a sheet of thick paper on the net and using a coarse needle, it was possible to make relief drawings.[106] The models Katz mentions were geometric shapes and letters which the children copied in relief. The idea behind Katz's investigation was that the children's drawings should pave the way to

> ... increased knowledge about the spiritual life of the blind, and clarify whether it is possible to develop a special technique for the drawing of bodies, so that the one-dimensional picture could give the blind child an unequivocal understanding of the three-dimensional object and thus enable him to draw pictures.[107]

Although the pupils were not given specific tasks, many of them drew geometric figures, and one or two of them covered the paper with their own initials. The pupils had previously used needles and paper for drawing geometric shapes and for writing, which may have influenced the results. Younger children normally like to draw people and animals, but in the group Katz studied, it was the older children who drew animals. Katz concluded that the children with severe visual impairment had had little experience of animals, and so mainly drew non-living objects such as mugs, buckets, chairs, desks, waste-paper baskets, cups, windows, candlesticks, pears, flowers, houses, trees and stars.[108]

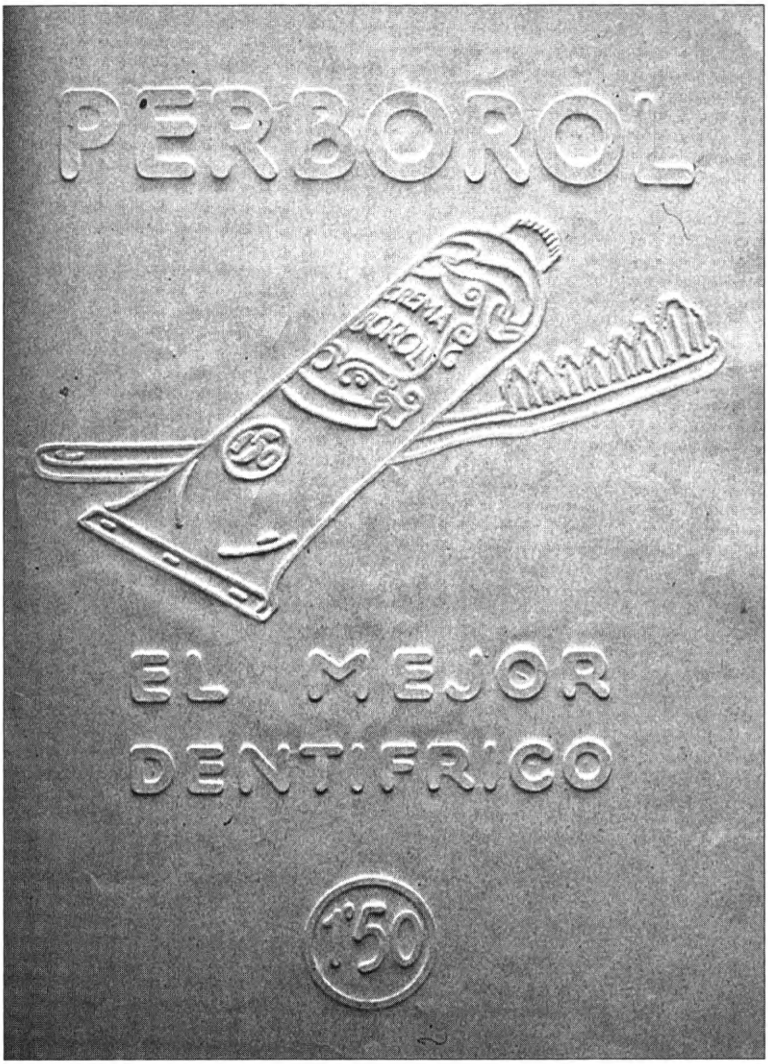
Katz noted that the visually impaired children had not reached the same level of development in drawing as sighted children of the same age. In his analysis, Katz did not allow for the fact that the group he had asked to make drawings had not had previous experience of free drawing, although he mentions this in his introduction. The visually impaired children drew people from the front and animals facing sideways. They never, or very seldom, drew details such as hair, fingers or toes, and often left out the clothes. When they did draw clothes, Katz said that it looked as if they were transparent." He was referring to the "x-ray picture", a phenomenon which sometimes occurs in sighted children's drawings.[109] When comparing the blind children's drawings with those of sighted children, he found that the latter were far better executed than the former. This was not because it was more difficult for the blind children to draw on the drawing-board, but because the visually impaired children had conceptual difficulties in dealing with the task which the sighted children did not have.[110]

Katz asked the pupils to draw a cube, a cylinder, a pyramid, a prism and a miniature four-legged table. The children appeared to have a marked tendency to apply the principle of surface extension in their drawings, while attempting at the same time to give the object a solid form. Katz could see that the visually impaired children reacted in the same way as the sighted children in the group studied, in that they first investigated the shape, then set about drawing it, without checking whether their drawing agreed with the object in question. In consequence, according to Katz, their drawings reflected the children's idea of the object, rather than the object itself.[111]

Katz maintained that since the visually impaired touch one side of an object at a time, the principle of surface extension is the concept which is easiest for them to understand. The problem is, however, according to Katz, that if the blind base their drawings on that principle, it is not possible for those who are not blind themselves to understand how they perceive the object.[112]

One of the pupils drew the net of a cube, that is, a square base with four squares extending from each of its sides. He was then asked to draw a cylinder. He drew a rectangle lengthwise to represent the cylinder, and added a circle to represent its base. He then interrupted his drawing and started afresh. He again drew a rectangle lengthwise, but this time he added a circle at each end. Finally he drew a line along the middle of the rectangle. When, two weeks later, the same boy was asked to draw what Katz called "fantasy drawings" he used the same method—surface extension. He drew the net of a box with its five sides, a flattened football and a screwdriver in the same way.[113]

The purpose of modelling and drawing lessons was to increase the pupils' tactile capacity, while the purpose of the research into their drawing was often to study how tactile perception is expressed. This poses a basic problem, as there are distinct differences between what we perceive and what we are capable of expressing. In addition, a number of studies have shown that our perceptive capacity may not always be matched by our ability to draw or model. When a pupil makes a drawing or models from a model, the situation is rather different, as the results are preconditioned, regardless of whether he works by sight or by touch.[114] However, when pupils are asked to solve a problem without a given model the finished results are their own personal solutions to the problem, as Katz's and other studies demonstrate.



(Photo: Hans Thorwidd).

VIII

Concluding discussion

In my thesis I have considered questions related to visual communication, even though the subject is pictures for tactile perception. Literature on the subject written by pedagogues who were active during the period investigated proves that pictures and maps in relief as well as models were needed in teaching to clarify what a particular object looked like or how something functioned. One of my main findings is the fact that *visual* representations formed the basis of tactile representations. This could partly be explained by the interest in promoting communication between the blind and the sighted. Paradoxically, this communication was made possible by the adoption of sighted people's frames of reference in the choice of the content and design of tactile pictures.

Visual communication and the conditions of tactile reception

Descartes often accompanied his practical experiments with illustrations, although, or perhaps because he believed that pictures did not represent either the imagined or the real. For Descartes, it was enough if the picture to some extent resembled the object.[1] He saw illustrations as a possible way of reaching what cannot be grasped. His illustrations of the lines of force of a magnetic field (1642) are good examples of this.[2]

The idea of making the invisible visible through pictures developed mainly from the 18th century onwards. The internal organs of the body were displayed on anatomical pictures which literally penetrated the skin.[3] There was also great interest in the study of Man's different ways of expressing himself through pictures.[4] Technical inventions were included as complements of artistic pictures as well as to impress the public. There were also illustrations which showed people engaged in chemical and physical experiments.[5]

The tactile picture and the model have enabled the blind to learn how their surroundings may be understood visually and to become aware of the different methods used in visualization. When two and three-dimensional representations for the blind were made, the aim was to clarify, in a tangible and concrete way, objects and certain concepts and phenomena. My study has shown that the visualization categories of the sighted were simultaneously transferred to another epistemological media. (Chapter IV).

The relationship between the representation and what is represented

My investigation shows that tactile pictures and maps, even when they are made for tactile perception, follow more or less the same rules of representation as those which apply to visual pictures and maps, since tactile pictures are normally based on visual originals. In the transfer of the latter, the aim has traditionally been to reproduce the original picture as faithfully as possible. The fact that tactile pictures which look more or less the same as visual pictures were produced depended on the belief in the similarity between tactile and visual perception (Chapter III).[6] This, in turn, has given many blind people the opportunity to learn how to interpret transferred visual representations. At the same time, we must not forget that many blind people have found these picture representations impossible to interpret and therefore meaningless.

The quality of the tactile picture depends entirely upon the knowledge and skill of the person who produces it. The production of good quality tactile pictures requires three basic abilities: a good insight into tactile perception; artistic and technical skills in the production of the picture; and the capacity to forget visual conventions in favour of tactile values.

We can, however, see great differences between the relief pictures made by someone who had artistic talent and those made by someone unfamiliar with the production of pictures. Not only that, there is often uncertainty as to the correct interpretation of the original picture; an uncertainty which has sometimes resulted in obvious mistakes in the relief picture. Original pictures which can be interpreted in several different ways can also lead to unsuccessful relief pictures. There is no specific information on the person responsible for the various steps in the production of relief pictures, that is, whether one and the same person was responsible for each stage in the process, or if several persons were involved in the drawing of the picture, the production of the printing block and the printing of the relief picture.

The difficulties inherent in the tactile interpretation of visual representations, even those of good technical quality, have been the subject of debate on the conditions required for the successful perception of tactile pictures.

For a long time it was more or less generally agreed, for example, that perspective is a visual phenomenon which cannot be perceived tactilely. Instead, objects were depicted from the front, from the side or from above (Chap. IV, VI). In some cases the producers went even further and represented objects in orthogonal projection. This was considered the natural form of representation for tactile reading, as the blind person touches one side of an object at a time. In his investigation of drawings made by blind children and adolescents, David Katz observed that many of them spontaneously showed the objects in orthogonal projection.[7] Katz commented on the relationship between surface extension and tactile perception of an object, but also pointed out that it is impossible to know whether blind pupils imagine what the object looks like and how they do so when they draw them using the surface extension method.[8] One reason why this reading process has not been more extensively taken into consideration in the production of tactile pictures may well be that orthogonal projection was a skill dominated principally by those who produced technical drawings (e.g. industrial designers and architects (Chap. VII).

The gestalt psychological theories on perception, consciously and unconsciously gained ground until they dominated the theories on tactile perception. This is shown by Katz's comments on surface extension (see above). The hypotheses we meet with as to how and what the blind person is able to perceive tactilely have, as in the teaching and training of tactile perception, mainly deal with investigation into the shape of objects. Shape was stressed as being of vital importance for recognition and the basic geometrical forms found in nature were sought. It was believed that by looking for and identifying geometrical shapes in nature (i.e. the round shape of the apple which is similar to that of the sphere) recognition and definition of known and unknown objects were made easier.[9] This, in turn, affected the way in which pictures for tactile reading were made. The shape of the object was given greater importance by an emphasis on its geometrical characteristics. In this way tactile pictures were produced which coincided with the accepted visual perception and interpretation of two-dimensional representations.

In *Philosophy in a New Key*, Susanne K. Langer discusses the qualities that a picture must have to be representative of an object. She stresses that the picture is in the first place merely a symbol and not a duplicate of what it represents.[10] For something to be classified as a picture of a specific object, the picture elements must be arranged in the same way as in the object represented.[11] This means that an object can be reproduced in a number of ways, but that all of them still represent the same object. The question is what happens when we reproduce a representation? Is it still possible to maintain that it is the organization of the elements in the picture which determines the representation? I believe that Langer's reasoning can be applied to the transfer of visual pictures to the tactile medium. The organization and interrelation of the individual elements of the tactile picture (i.e. its composition) normally coincide with the composition of the visual picture.

"Figure and ground"

In 1915, Edgar Rubin published his study, *Synoplevede Figurer. Studier i psykologisk Analyse* (Figures experienced visually. Studies of psychological analysis), which was of great importance in the development of gestalt psychology.[12] Our interpretation of a figure is determined by how it stands out against its background. In his study, Rubin stressed the importance of the fact that a line has two sides. A consequence of this is that a picture can frequently be interpreted in two ways. The classic example is the picture of two profiles facing each other, which can also be interpreted as the picture of an urn.

The knowledge of how the figure ought to stand out against its background and of the ambiguity of lines was of vital importance in the production of relief pictures. The producers of tactile pictures knew this long before Rubin presented his theory on the subject. My study of relief pictures, from Guldberg's in the 1860s to those produced during the first decades of the 20th century, show that they were made to a large extent according to the principles which gave rise to the gestalt psychologists' theories of why we see the objects themselves and not the space between them. First and foremost, we see what is already familiar to us, or what is notably different from the familiar. Things that are represented by solid contour lines are perceived the most clearly. In pictures, therefore, we perceive what is represented most clearly in its entirety.[13] My results in this respect coincide with Boring's observation on the orientation of gestalt psychology in the traditional philosophy of perception. Boring even holds that it has its roots in Locke.[14]

The restructuring of pictures

Because of the differences between tactile and visual perception, changes are necessary when visual pictures are transferred to the tactile medium. Not only are details in the visual picture which are considered irrelevant to the tactile picture left out, but the picture surface itself is restructured in a way which alters the composition. This restructuring may mean that all per spective is eliminated and that objects are shown from the front or from the side, or that all the objects in the picture are lined up. It is therefore very rare to find tactile pictures which represent rooms or open spaces.

Many attempts have been made to transfer two-dimensional works of art to the tactile medium. The purpose was basically to give visually handicapped persons access to the cultural heritage of pictorial art. The intention was, however, to convey the contents of the pictures and not their aesthetic qualities. These attempts at translating pictures from one medium to the other should be seen basically as *the mapping of a picture surface* rather than as artistic transfers. No doubt the value of this type of transfer lies in the fact that it affords the blind person the opportunity of appreciating how people, animals, landscapes, etc., can be represented in a two-dimensional picture. As the picture surface is not reconstructed for the tactile version, and perspective, foreshortening, overlapping elements and half figures are maintained, the visually handicapped are able to appreciate the differences and similarities between the visual and the tactile picture. For this to be possible, however, many of the details of the visual picture must be eliminated. Every transfer of an artistic picture is based, as are transfers of other pictures, on an analysis and interpretation of the main contents of the picture and thus of its message. A transfer is always based on an analysis and interpretation of what is seen in the picture which has been reconstructed; this reconstruction is then expressed in the tactile picture.

This interest in tactile qualities can also be found outside the group of pedagogues and picture creators who worked to fulfil the needs of the visually handicapped. As a member of the Bahuaus group, Lazlo Mohly-Nagy, for example, developed tactile exercises, elaborating on Johannes Itten's studies of materials and textures as part of the compulsory basic school course (the "Vorkurs").[15] Several of these Bauhaus teachers developed methods of investigating the tactility of different materials. One of these was Walter Kaminski, who made his tactile chart in 1927. The circular tactile chart consisted of contrasting tactile materials in two mobile rows. By moving one of the rows, it was possible to combine different materials and investigate similarities and differences between the textures.[16] In the same year, Willy Zierath carried out an investigation into the tactility of different materials which he combined in diagram form.[17] This interest in the tactile qualities of materials formed part of the attempts which were made to define and study the picture in a scientific manner.[18] A representation made for tactile reading differs from a visual representation, while the conditions of tactile and visual perception are to a certain degree the same. The similarity between visual and tactile perception mainly involves the capacity to perceive shapes, lines and spatiality. The understanding of represented s patiality, however, differs considerably in visual and tactile perception, which is the main reason why visual pictures which are transferred to the tactile medium normally require a reconstruction of the picture surface.

In *Über das optische Formgefühl. Ein Beitrag zur Aestetik* (1873), Robert Vischer describes the physiological scanning process, which comprehends the eye as well as the muscular activities required to move the eye. To illustrate this process, he compares vision with touch, while he presents the conditions necessary for tactile perception.

> Scanning is a much more active process than seeing, because it does not simple rely on the natural impulse to seek a relative whole; instead, our eye wanders up and down, left and right, making contact with the individual dimensions. In this process we can distinguish two approaches: first the linear, whereby I define the contours with my fingertips, so to speak; the second (this is the natural and less reflective approach of the two) is a mapping of the masses, whereby I run my hand, as it were, over the planes, convexities, and concavities of an object, the paths of light, the slopes, ridges, and hollows of the mountain. In both cases the movement can be either intermittent and concentrated (dabbled light throughout the foliage) or smooth and flowing.[19]

Vischer was in no way unaware of tactile perception.

> One cannot fulfil its task without the other. If I were blind, I would lack the experience of distance as well as of light and color; without the sense of touch, I would lack definite information about tangible form. The child learns to see by touching, and indeed we should not disregard the fact that this invariably entails not only skin and nerve functions, but also muscle movements. Touch is especially important in learning to "grasp" distant objects, which in visual terms are foreshortened and distorted. As is well known, children reach for the moon as we reach for a plate. Stereoscopic vision provides us with only a plan visual field, and we would inevitably believe that all parts of this field were equidistant from us were it not for the experience gained from our tactile sense: we push the planar visual field away from us with our hand, and thus laid the foundation for the third dimension of space-depth.[20]

To perceive and experience the picture surface as if it had a third dimension is only possible if the picture is observed visually. It is important to distinguish between spatial understanding, that is, to be aware of one's physical position in the room, and the capacity to perceive represented spatiality. The difficulties lie principally in the understanding of representations with perspective.

The perception of tactile pictures and the authenticity question

Over the last few centuries there has been a lively debate about what a person with a severe visual handicap can and cannot perceive. Differences still exist between researchers and teachers, as well as among the visually handicapped themselves. The most heated debate concerns the perception of tactile pictures. The opponents of tactile pictures often argue in favour of the three-dimensional figure as opposed to the two-dimensional relief picture. At the same time, however, the problems inherent in the interpretation of three-dimensional figures is underestimated. Révész has shown in his study (1959) the difficulties which exist in the perception and assimilation of aesthetic experiences through the tactile perception of sculptures.[21]

As my thesis has demonstrated, however, the number of written sources available on tactile pictures is relatively small, whether we consider their production or their use in different contexts. Therefore it is not surprising that so few voices are heard against the use of tactile pictures. This, however, does not mean that there were no opponents of tactile pictures. A. F. Wiberg's comments in "Maal og Midler for Fysikunder-visningen i Blindeskole" (Chapter VI) are one example.

The debate on the production of tactile pictures, and particularly on the transfer of visual pictures to the tactile medium, has often dealt with the question of whether the perception of the picture is authentic or not. I have chosen to exemplify this reasoning with a quotation from *Sympathia*, a review for the blind and their friends, dated 1917. In the article "Målningar och reliefer" (Paintings and reliefs), the editor and publisher Karl Lundin expresses his opinion on the transfer of artistic pictures to the relief medium for persons with severe visual impediments.

> The value of these reliefs is much in dispute among the blind. Opinions are highly individual and depend to a great extent on the degree of blindness. For our part, we are prone to consider these attempts more curious than practical, especially as they do not seem to be able to convey a real impression of the scene, where the objects and figures of the originals are found on different planes. We cannot perceive colours, light and shade or perspective by touch, and only to a small degree linear perspective. It therefore appears that everything is on one plane. For example, a figure in the background in the original picture will, when touched, appear to be a dwarf hanging between the giants in the foreground. If such relief pictures are presented to people who have become blind as adults, especially if they had

> once seen the pictures in question, it is possible that the tactile process will bring back the visual picture to them. If the blind person, on the other hand, has been blind from birth, or if he does not have any idea of the original in question, it is impossible for him to create an image which is anything like it by means of the tactile picture alone. /... / There are, however, as we have hinted, blind people who claim that through these reliefs they perceive the richest impressions of the pictures they represent. We do not want to, and in fact cannot make them change their opinion which we, for our part, believe involves a great deal of autosuggestion.[22]

Lundin's article was written on the occasion of the arrival of two reliefs by the Swiss engineer C. Piachaud which had come to Stockholm through the offices of Harald Thilander. One of the reliefs represented Millet's *Angelus*, and according to information at the Musée Valentin Haüy, Piachaud had made it for his friend Edgar Charles Guilbeau, who taught at the institute in Paris and later founded the Musée Valentin Haüy. It is not clear how Piachaud produced and reproduced these reliefs, but according to Lundin,

Angelus, relief by C. Piachaud.
(Musée Valentin Haüy. Photo: Mogens Bang.)

Piachaud made a mould which he then used to press the relief painting in some plastic substance. A copy of *Angelus* is today kept at the Musée Valentin Haüy in Paris.

I am equally amazed every time I meet the agitated feelings which the reproduction of pictures for persons with severe visual handicaps gives rise to in many people. Is the picture such an important privilege for the sighted that they do not want to share it with the blind? Has the culture of vision grown to be so strong today that it is no longer possible to imagine the importance of the other senses If so, we have reached the unhappy separation of the senses which Crary, in *Techniques of the Observer*, attributed to the last century.

The tactile map

One of my hypotheses is that it is possible to state that the conditions for visual and tactile communication (if it is at all possible to talk about tactile communication) are most congruent when mediated through maps. Even when the sighted person can look out over a landscape, the representation of which he sees on the map he holds in front of him, his visual field remains limited. The map is therefore his only possibility of surveying a larger area, in the same way as the tactile map makes an area or a phenomenon perceptible to the person with a severe visual handicap. The similarities between the visual and the tactile map are greater than the differences, probably because both are based on symbols.

Sine the 18th century, different surface textures have been tried out on tactile maps, in order to distinguish, for example, water surfaces from land masses, where visual maps use colour or different surface structures. On tactile maps, lines indicating borders, communication networks and rivers have generally been embossed, as are towns and cities and mountain ranges. All the details on the relief map can be perceived tactilely as long as there are not too many of them. There must be a certain space around each symbol for it to be distinguished by the fingertips. The modern design of tactile maps developed at a very early date (Chapter V).

There is a natural explanation as to why maps have been so common in tactile representation. Maps were, and still are necessary for the blind

person to orient himself, particularly in his immediate surroundings, and maps are relatively simple to transfer to the tactile medium. The most important factor in the promotion of map production was the fact that the sighted had experience of maps on different scales, which meant that they had visual experience of how an area could be reproduced with different degrees of detail. I venture to state that this has resulted in conscious or unconscious models for the process of simplification which must take place when a more detailed map is transferred to a simple, general map for tactile reading. In addition, the existing symbols for the visual map could to a large extent also be used on the tactile map.

The model and the myth of the unmediated vision

Many have maintained, and still do, that the three-dimensional object is the most natural form for representing something to a person with a serious visual handicap. The model is compared to the tactile picture in which it is almost impossible to represent volume and spatial relationships. If the model is of a size which can be touched, it is possible to perceive relationships such as "in front of" and "behind", which may be difficult to represent and understand in a tactile picture. However, even though the model is better suited to tactile reading than the relief picture, it follows—as does the relief picture—the conventional patterns of the visual representation. The paradox is thus that the models which have been used to illustrate appearances and functions to the blind have to a large degree have been produced with the

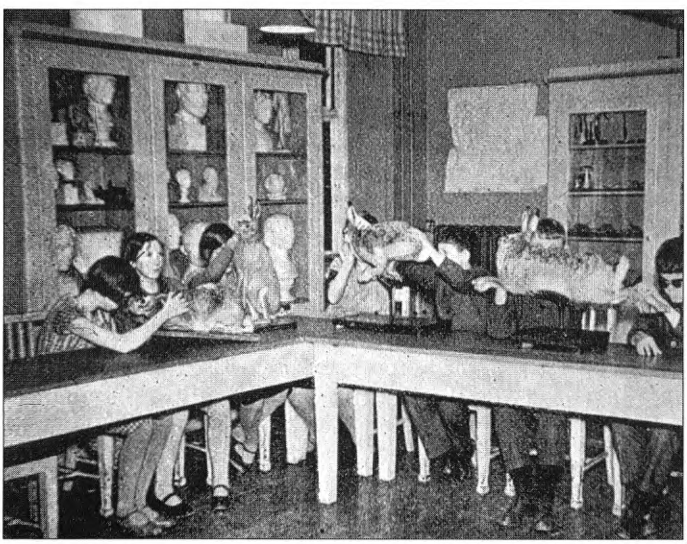
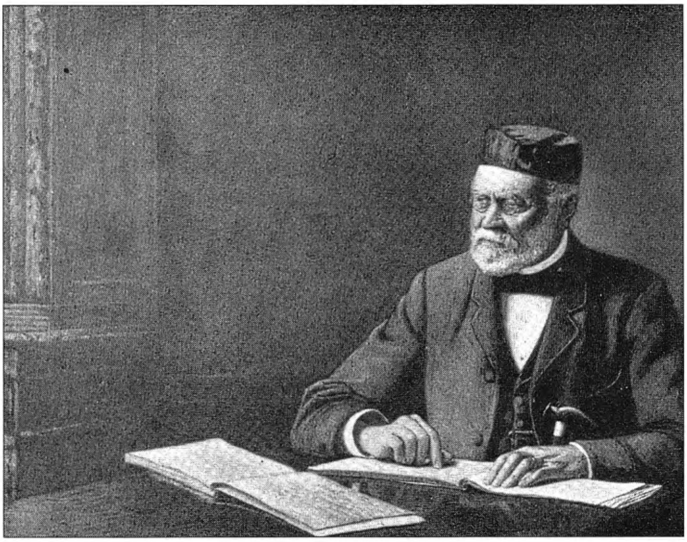


Photo: Courtesy Danmarks Blindehistoriske Museum, Copenhagen.



In 1897 Julius Kronberg painted this portrait of professor N. P. Hamberg (1815–1902) who at that time had been blind for eight years. The painting shows that Hamberg was a leading personality in the field of culture and that braille had become fully accepted only five years after ther foundation of the Braille Library in Sweden. Despite his advanced age Hamberg obviously took an interest in braille. (By courtesy Ulla Hamberg.)

sighted in mind. A three-dimensional representation obeys its own laws, just as the two-dimensional representation does.[23] This means that when models are the medium, we are in fact dealing with visual communication. Adolf Hildebrand has discussed this in *Das Problem der Form in der bildenden Kunst* (1893).

Both painter and sculptor thus deal with the reciprocal idea of form, of image and form, but the painter creates an image in relation to the idea of form, while the sculptor creates a form in relation to the idea of form.[24]

This is also the case when stuffed animals, made especially for the purpose, have been used in the teaching of blind pupils.

In her article *Objects of Knowledge: A Historical Perspective on Museums*,[25] the English historian Ludmilla Jordanova discusses museums as institutions which conveys knowledge. She illustrates the complex relationships between the individual object, the context in which the object is situated and the observer. Museums strive towards offering the visitor a direct experience of a historical epoch or phenomenon, and the visitors in their turn seek this experience. Environments are created to give the feeling of an unmediated experience; dioramas are examples of this. The creation of this illusion of an unmediated vision has been the aim of different types of museums over the last two hundred years.[26] But we might well ask whether this idea of an unmediated and authentic perception of fairly realistically designed models has contributed to the priority which is given to models in the teaching of the visually impaired. There are a number of myths and metaphors in which the sculpture is perceived as a living being which may have contributed to the notion of unmediated perception.[27] When Helen Keller describes her experience of the marble sculpture, she invests the sculpture with life:

> Even though the marble is cold, without life and unsympathetic, compared to the warm hand, the changing face of a friend, it is beautiful to my hand. Its undulating lines and turns are a real pleasure, only respiration is lacking, but under the magic wand of the fantasy, the marble shivers and becomes the divine reality of the ideal. Fantasy gives each line and undulation a quality and to my touch the statue is, in truth, the goddess herself, who breathes, moves and enchants.[28]

When Einar Ketting at the institute for the blind in Copenhagen, used models in the 1930s to show the hare in different positions—jumping, landing, sitting and lying down—it was a direct transfer of *the appearance* of the hare in its various movements. The stuffed hares certainly showed the different movements, but this information was not based on a study of the hare's muscular movements. It was a mere representation of the appearance of the hare in the various positions. Furthermore, the display was so organised that the models of the hare tried to convey a succession of movements, from lying down to sitting and on to jumping, or viceversa, while a number of individual hares were actually being studied. This is, however, the only possible way for the blind to appreciate something of what a hare looks like when it leaps about in the fields, crouches down to hide or sits on guard. From a detailed analysis of the muscles and the different positions of the skeleton, no information is gained about what a hare looks like when observed visually at the distance from which hares are normally observed, since hares "hare off" so quickly when they are sighted that the average person cannot get near enough to study them in detail. The study of the hare is therefore the study of the appearance of a hare in different positions, and by means of the models, the pupils gained access to information which communicated a visual impression where each sequence was "frozen" into a static image (Chapter VII).

The motifs of relief pictures

Pictures and models were used to represent the human body, plants and animals, physical phenomena and functions. There were also transfers of artistic picture and architecture to the tactile medium. The institutes conveyed what was considered basic in the teaching of the blind. In addition to this, there was a fairly extensive offer of literature for adults, in which we observe the reappearance of an increasing modernity in the tactile pictures and maps. The balloon is reproduced as an individual object in *Picture-Book for the Blind* and *Tusbildoj*. The atlas published by Alston in Glasgow in the 1830s and *Höhenkarten für Blinde* (1857) show the balloon in the context of the world's highest mountain. In the 19th century, guidelines developed for how railways should be represented on tactile maps. When Thilander's printing works published *Bilder av Stockholm* in 1932, it not only showed a selection of historical environments typical of Stockholm, but also modern living in a plan of a functional apartment. But this was not only a question of illustrating the developing industrial society. The movement in favour of the blind participated actively in this development through the special teaching methods which developed, by elaborating the techniques for relief printing and, last but not least, by forming part of the Esperanto movement. Harald Thilander, for example, reached international readers by publishing books and reviews in Esperanto (Chapters IV and V).

Tactile pictures were, however, mainly produced for the teaching of blind children and adolescents. The intention behind these pictures was to illustrate plants, animals, the anatomy and physiology of the human body, as well as mathematics and physics. Relief pictures were used as memory aids once the pupils had become familiar with an object, a plant, etc., with the help of a model. The relief picture, on the other hand, was often the only way of illustrating physical phenomena such as the refraction of light (Chapter VI).

The motifs and design of educational pictures depended on the pictorial material available in the form of wall-charts and textbook illustrations. This was already clear from the early attempts at the production of relief pictures.

The relations between text and picture

For a presentation to be 'observable', there must be someone to perceive the appearance, design or function of an object. The 'observability' of a representation is therefore a question of reception of the artefact.

'Observability' is therefore a relative concept, as a presentation can be perceived as observable by one individual and not by another. Observability also depends on the structure of the artefact.

In the great *French Encyclopédie, ou Dictionnaire raisonné des sciences, des arts des métiers*, published between 1717 and 1765, and edited by Diderot and d'Alembert, Diderot's discussion of the relationship between "discourse" and object is found under *"Encyclopédie"*. It is obvious that Diderot considered the relationship between text and picture problematical.[29] Roland Barthes defines the encyclopaedic pictures as "a kind of reasonable synopsis; they illustrate not only the object or its development but also the mind that thinks it." On the picture surface the different elements of the thing were enumerated and presented to the observer as on a table, then to be put together again. Diderot's reasoning was as follows: the reader was given the opportunity of deepening his analysis as much as was required to "distinguish the elements without confusion". This encyclopaedic type of pictures is, in part, a development of the Johann Amos Comenius's idea of conveying knowledge through text and picture, and the encyclopaedic pictures forms part of the development of the school wall-chart, which later became the model for the relief pictures of the 19th century.

Orbis sensualium pictus was published in 1657 and in 1684 it appeared in Swedish under the title *Sinnevärlden i bilder*. The book was widely distributed and in it Comenius develops his idea of the school wall-chart.[30] *Orbis sensualium pictus* has a combination of text and pictures. Each illustration is accompanied by text which was factual as well as conceptual. The text is in several languages. Comenius thus did not abandon the pictures to arbitrary interpretations.

During the period I have studied, there were practically no observations or discussions on the relationship between text and picture in publications for the blind. S. G. Howe pointed out that he provided his maps with texts in relief print, contrary to the practice in Europe, in order to make his pupils less dependent on the sighted environment.

The limits of pictures and of words

When the first organized education for the blind began to develop in Paris in 1784, under the leadership of Valentin Haüy, the purpose was to teach practical as well as theoretical subjects. To make this possible, a written language was necessary. Haüy started to print not only text in relief, and also pictures and maps. He soon had many followers who developed relief printing of text, pictures and maps (Chapter II). The relief text was difficult to read, and when Louis Braille (1809–1852) developed a system based on varying combinations of six points, it gradually supplanted other writing systems.

Today we can reproduce pictures and objects in literature and exhibitions with the help of oral descriptions which can be made accessible in braille, on tape and on CD-ROM. In spite of this, there continues to be a demand for relief pictures and maps, as it is considered unsatisfactory to rely entirely on oral descriptions. How much more bitter therefore is the blind person's disappointment when, on receiving the required relief pictures, they cannot be interpreted. The results of my study do not contradict the professional experience that pictures are no substitute for descriptions, nor are descriptions always satisfactory substitutes for pictures. For the visually impaired to be able to interpret tactile pictures through touch, explanatory text is required, and for the blind reader to follow a description, a map or a picture is often necessary.[31]

The investigations represented in my thesis have shown that the tactile picture and the tactile map have a relatively long history and that the pedagogues of the blind were at an early stage aware of the development of printing techniques and the resources they offered them (Chapters II, IV and V). Although pictures and maps were produced from the very beginning of teaching of the blind, the history of these efforts has to a large extent been forgotten. Today it is difficult to appreciate the importance that pictures will have for persons with severe visual handicaps in the future. The greatest likelihood is, however, that pictures for the visually impaired will continue to be strongly affected by contemporary *visual* culture.

(Photo: Hans Thorwidd).

Notes

Chapter I: Introduction

[1] *Uddannelsehistorie 1991*, Harry Haue (ed.) and others. 25 årsbog fra Selskabet for Dansk Skolehistorie og Odense Universitetsforlag, 1991.
[2] Eriksson, Y., Strucel M., *A Guide to production of tactile pictures on swellpaper*, 1994.
[3] Eriksson, Y., *Konsthistoria för synskadade*, Rapport 1994:2, TPB, Enskede 1994; "Taktila bilder", *Taktilt—inte se men röra*, Nationalmuseum's catalogue 578; Eriksson, Y., Tebelius-Murén, E., "On making tactile—an exhibition project in Nationalmuseum, *Art Bulletin of Nationalmuseum Stockholm*, Vol. 1–2, 1994–1995.
[4] *The Beacon*, January, 1917, p. 15.
[5] The Museum für Naturkunde in Berlin has trained curators by the middle of the 19th century and a vast collection of animals and birds. Models for teaching were borrowed from the institute in Steglitz.
[6] *Psychology of touch*, 1991.
[7] Warren, D. H. and Rossano, M. J. "Intermodality Relations: Vision and Touch", *Psychology of touch*, 1991.
[8] Kreuger, L. E., "Tactual perception in historical perspective: David Katz's world of touch", p. 4 et seq. *Tactile perception. A Sourcebook*, 1982.
[9] Merley-Ponty, M. *Phenomenology of Perception* (Engl. translation 1962), 1979, p. 315.
[10] Ibid.
[11] A drawing cushion consists of a rubber drawing-board covered with a plastic film. When drawn on, an embossed line is created. In that way, the visually impaired can draw freely and at the same time feel the figure or letter he or she is drawing.
[12] Kennedy, J. M., *Drawing and the Blind. Pictures to touch*, 1993, p. 56 et seq.
[13] Millar, S., "A reverse lag in the recognition and production of tactual drawings: Theoretical implications for tactile coding", *The Psychology of Touch*, 1991.
[14] Information recieved from Samuel Hay's Research Library.
[15] Mell, A., *Von Vives bis Haüy*, 1952, p. 14 et seq.
[16] He reads *Den blindes tidsförsonare.*
[17] Comenius, J. A., *Didactica Magna* (1657), 1989. p. 71.
[18] Ibid, p. 89–92.
[19] Ibid, p. 94.
[20] Quoted from: Marianne Schuber (1986), *Begründung des deutschen Blindenbildungswesen*, p. 41. Pampaedia translated into German from Latin in 1960. "Nur aussermenschliche Geschöpfe werden von der vervollkommenden Pflege ausgeschlossen. In dem Masse, wie jemand an der menschlichen Natur Anteil hat, soll er an jener

Wartung teilnehmen; besonders dort, wo die Natur sich wegen eines inneren Mangels nicht selber helfen kann, äussere Hilfe nötig."

[21] Quotation from: Marianne Schuber (1986). *Begründung des deutsches Blinden-bildungswesen*, p. 41.

"Namentlich deshalb ist mit dieser Pflege nicht auszusetzen, weil die Natur ihre Kraft anderswo um so ausgiebiger entwickelt, wenn ihr verwehrt ist, sie in einer bestimmten Richtung zu entfalten—fallt ihr nur geholfen wird. Denn Beispiele zeigen ganz deutlich, dass von Geburt Blinde durch die Hilfe des Gehörs zu bedeutende Musikern, Juristen, Rednern usw. wurden, ähnlich wie von Geburt Taube sich zu hervorragenden Malern, Bildhauern und Handwerken ausbildten. /.../ Immer ist irgendwo ein Eingang zu der vernüftigen Seele vorhanden, und dort muss Licht hineingetragen werden."

[22] Comenius p. 160, cf. Gibson, J. J., *The Ecological Approach to visual Perception*, 1979.

[23] Comenius p. 202.

Chapter II: The development of teaching of the blind

[1] This was in no way unique to the pedagogy which developed for the blind. Iréne Matthis, for example, mentioned how Freud, through his observations of his first patients and their descriptions of their symptoms, turned their personal experiences into concepts. Cf. Matthis, I. *På Freuds divan*, 1994, pp. 19 et seq.

[2] An example of one such historic survey is Levy, W. H., *Blindness and the Blind*, 1872.

[3] The first pre-school was founded in Saxony in 1862.

[4] See: Diderot, D., *An Essay on Blindness in A letter to a person of distinction* (1749); Kretschmer, R., *De blindas historia. Från äldre tider till blindundervisningens början* (1925).

[5] This was done to show that certain handicapped individuals could often perform very successfully, in spite of their handicap. This concours with Bordieu's theory which claims that every society permits what he calls "miracles" to happen. Bordieu's miracles are those individuals who begin life in marginalized social strata and yet manage to succeed against all odds. These miracles are proof that the factors which prevent an individual from breaking free from his social inheritance are not inherent in the social structure itself.

[6] From the first decades of the 19th century to 1950. Borg, O. E., *Minnen från den svenska blindundervisningens 75-års jubileum*, 1883; Mell, A., *Von Vives vis Haüy*, 1952; Plenge, J., "Fra fortid til nutid", *Statens Institut for Blinde og Svagsynede i København* 1858:5 *, November* 1958, 1958; Wiberg, A. F., *Blindsagens Historie*, 1901.

[7] Ibid.

[8] Weiner, Dora B., *Bulletin of the History of Medicine*, 1974:48, p. 60.

[9] With these words, Reinhold Kretschmer, principal of the Niederschlesiche Provinzial-Blindenanstalt in Breslau, commences his *De blindas historia. Från äldre tider till blindundervisningens början,* (History of the Blind: From the Early Days to the Beginning of Education for the Blind), 1925, Swedish translation, Stockholm 1937, p. 5.

[10] Ibid., p. 5.

[11] Ibid., p. 33 et seq.

[12] Kretschmer, R., 1937, p. 48

[13] Ibid, p. 33 et seq.
[14] The legend tells how this was originally built for 300 crusaders who had been blinded by the Turkish sultan, 20 each day for 15 days. But this, according to Kretschmer, is not mentioned by Joinville, companion and chronicler of Louis IX. Most probably the hospital was a work of charity, and QUINZE-VINGTS was founded to attend to crusaders who had contracted eye diseases through contact with the Egyptians.
[15] Wealthy people brought grave plots at the cemetery of Quinze-Vingts, with the promise that a blind would say prayers for the souls of their benefactors. Through the sale of graves and legacies to the blind, Quinze-Vingts came in time to be wealthy. This fortune, however, was lost by Rohan, Louis IX's almoner, who robbed the blind of their inheritance and fortune. Rohan managed to persuade the king to sell the property of the hospital under the pretext that a large number of blind persons would be given shelter with the money made by the sale. But Rohan secretly bought a large part of the property himself and paid his vast debts with the profits. Thus the blind inmates had to change their spacious hospital for a small barrack-like construction. During the Middle Ages, brotherhoods of the blind were created, influenced by the merchants' and craftsmen's guilds. Kretschmer 1937, p. 39.
[16] Ibid.
[17] Various historians have testified to this, including Haüy himself.
[18] Foucault, M.,*Vansinnets historia under den klassiska epoken*, (1961) 1973, p. 62.
[19] Ibid., p. 68.
[20] Wiberg, A. F., 1901, pp. 6-8.
[21] Some sources write the name "Lesueur".
[22] Mell A., *Von Vives bis Haüy*, 1952, p. 7.
[23] According to other sources, a callous caféowner in 1771 began these performances by blind "musicians". Cf. Ek G., *Den svenska blindvårdens uppkomst och utveckling*, 1938, p. 5, Alfred Mell in *Von Vives bis Haüy,* 1952, p. 5; states that in 1771, a concert was given by 300 blind musicians at St. Ovide-Markte.
[24] Haüy, V., *An Essay on the Education of the Blind,* (1786) 1894, pp. 30–31.
[25] Weisenburg is also written Weissemburg", Weisenbourg" or "Weisembourg".
[26] Haüy, V. (1786), 1894, p. 31; Wiberg, A. F., 1901, p. 4.
[27] Weiner, D. B., "The Blind Man and the French Revolution", *Bulletin of the History of Medicine*, 1974:48, p. 62.
[28] Ibid. p. 63.
[29] According to the information in Moldenhawer, J., *Det kongelige Blindeninstituts Historie,* 1905, p. 1*:* "This book was printed in softly-coloured relief print" (in copies for sighted readers print was pressed flat).
[30] Many reading methods for the blind had already been tried out, but Haüy found them inefficient. He also gives some examples of moveable relief letters placed on a tray, which he says were used by a blind man from Puiseau to teach his son to read. Diderot described this system in his *Lettre sur les aveugles*. In yet another method, letters were formed by piercing the paper with a sharp point. The author tells us that Miss von Paradis employed this system for writing cards.
[31] "The first known endeavour to present the blind with readable characters belongs to the sixteenth century, when letters were graven in separate blocks of wood. In 1575, Rampasetto produced wooden letters in relief, not separate, but in stereotyped form. Both of these were laid aside as too cumbrous and expensive, and, in 1640, Peter Moreau, of Paris, cast letters in lead; whilst, in 1783, M. Fournier cut punches and struck matrices, in which type were cast and printed from, at expense of M. Rouillé de l'Etrange, Treasurer of the Philanthropic Society in Paris." Robert Hugh Blair, *Education of the Blind*, 1876, p. 3.

[32] Haüy, V., (1786) 1894, p. 12.
[33] When Howe visited the institute, he found the training too theory oriented. Schwartz, H., *Samuel Gridley Howe. Social Reformer 1801–1876*, 1956, p. 50.
[34] Wiberg, A. F., 1901, p. 5.
[35] Dr. Alexander Skrebiszky, Paris, 1884. "Valentin Haüy à Saint-Petersbourgh", *Der Blindenfreund*, 3–4/1885.
[36] Wiberg, A. F., 1901, p. 5.
[37] Heller, R., "Educating the Blind in the Age of Enlightenment. Growing Points of a Social Service". *Medical History*, 1979, 23:392–403.
[38] Kretschmer, R., 1937 p. 154. Kretschmer does not give the source of this statement. Nevertheless, I consider it important enough to merit being quoted here.
[39] Heller, R., 1979. Mell, A., *Encyclopädisches Handbuch des Blindwesen*, 1900, p. 833. Kretschmer, R., 1937, p. 153 et seq.
[40] Printed in Rotterdam in 1686 and 1687 (in French in 1718; in German in 1687 and 1693).
[41] Kretschmer, R.; 1937, pp. 154–155; Mell. A., 1900, p. 803.
[42] The reglet is an aid for making notes in braille. It consists of two metal plates joined by a hinge. These plates are approximately 5 cm wide and 20 cm long. On the upper plate, rectangles are punched which correspond to the braille cell on the lower plate. When writing, you fix a sheet of paper between the plates and, to make the braille letters, push a pin into any of the six holes in each braille cell. When the pin is pushed down, a relief impression is made on the back of the paper. When working with a reglet, you must use "mirror writing" (that is, the letters are written from right to left and back to front).
[43] Kretschmer, R., 1937, p. 156. Kretschmer does not give the source of this information.
[44] Mell, A., 1900, p. 678.
[45] Weissenburg from Mannheim went blind at the age of seven. He wrote perfectly and read from characters he had contrived for himself before he had ever seen any others. He was a skilled geographer, and made maps and globes which he used in his studies. He had also invented an arithmetic board which differs very little from Saunderson's. Guillié, *An Essay on the Instruction and Amusements of the Blind*, (1817) 1894, p. 54.
[46] Kretschmer, R., 1937, p. 126; Mell, A., 1900 p. 836.
[47] Wien. Med. Wschr., 1955, Nr 47.
[48] Stefan Zweig, *Själens läkekonst*, Stockholm 1932, p. 51 et seq. For a more accurate description for a scientific point of view, see Karin Johanisson, *Magnetisörernas tid. Den animaliska magnetismen i Sverige*, 1974, p. 16 et seq.
[49] Kretschmer, R., 1937, p. 160.
[50] Ibid.
[51] Marlene Jantsch, "Das Leben der Maria Theresia Paradis und seine Bedeutung des Blindenbildung", *Wiener Medezinische Wochenschrift*, 47/1955; Mell, A., 1900, p. 576–577; Kretschmer, R., 1937, p. 147– 148, p. 159–160.
[52] On the course for researchers, *Art, Gender and Modernity* (NorFa, 1996), at the University of Helsinki, I discussed the traditional mythology surrounding women which has probably contributed to the fact that women's achievements in pedagogy for the blind have generally been underrated. In spite of this, there is a long tradition of energetic and prominent women in the history of the blind.
[53] In the exhibition catalogue, *Ulrica Fredrica Pasch och hennes samtid*.
[54] Yalom, M., *Blodssystrar*, (1993) 1997, p. 17.
[55] This can be seen in the annual reports of different institutions, where the subjects taught (with the number of hours for each) are given.

[56] Ek, G., 1938, p. 65 et seq; Key, E., "The blind in Sweden", *The Mentor*, Oct. 1891.
[57] "A letter on Education of the Blind" (1774) p. 13, reprinted in *Some Books and Papers about the Blind*, 1894.
[58] A. F. Wiberg, 1901, p. 5 et seq.
[59] The tenth edition was published in 1846.
[60] Alston, J., 1839, p. 10.
[61] Ibid., pp. 32–34.
[62] At the end of the 18th century, Johannes Moldenhawer published a pamphlet for parents on how they should stimulate their blind children. This was distributed free of charge.
[63] Alston, J., 1846, p. 9.
[64] Alston, J., 1839, p. 22.
[65] Schwarz, H., 1956, p. 31 et seq.
[66] Ibid., p. 7.
[67] The New England Asylum moved to a building which had been donated by Colonel Thomas Perkins The institute adopted his name, which it still bears today. Wiberg, A. F., 1901, p. 11.
[68] Horace Mann was, amongst other things, secretary of the Massachusetts Board of Education from 1837 to 1848. Schwarz, H., 1956, p. 94.
[69] Howe, S. G., 1833, p. 3 et seq.
[70] Ibid., p. 10.
[71] Ibid., p. 11.
[72] Schwarz, H., 1956, p. 50.
[73] Ibid., p. 51.
[74] Ibid.
[75] Ibid., p. 57.
[76] Wiberg, A. F., 1901, p. 11.
[77] Ibid., p. 51 et seq. According to the historian, Harold Schwarz, who in 1956 published a biography of the Scottish pedagogue, Howe did not expect any problems in the reading of relief print—nor did many other teachers of the blind.
[78] Katz, M., 1968, p. 181, where he refers to Norman Dain's *Concept of Insanity in the United States 1789–1865*. Schwarz also describes how Howe came to focus more on inherited factors (p. 271 et seq).
[79] Wanecek, O., *Geschichte der Blindenpädagogik*, 1969, p. 44 et seq. In *Begründung des deutschen Blindenbildungswesens*, (1986), Marianne Schuber has demonstrated the importance of the founders of institutions (Klein in Vienna, Zeune in Berlin, and Müller in Baden) in the development of German education of the blind.
[80] Wiberg, A. F., 1901, p.7.
[81] Ibid., p. 9.
[82] Plenge, H. J., 1958, p. 18.
[83] Ibid., p. 27.
[84] Ibid.
[85] Ibid.
[86] Ibid.
[87] Borg, O.E., *Om institutet för döfstumma och blinda i Sverige*, (1854), p. 10.
[88] Ibid., p. 11 et seq.
[89] Ek, G., 1938, p. 8 et seq.
[90] Ibid., p. 9–12.
[91] Öfre Manilla has been described by Åman, A., in *Om den offentliga vården*, 1978, p. 229 et seq.
[92] Ek, G., 1938, p. 11–12.

[93] Ibid., p. 12.
[94] On the architecture of Tomtebodaskolan, see Åman, A., 1978, p. 235 et seq.
[95] The object-lesson training in the first grade consisted of (4 hr): simple descriptions and stories with the use of materials available (objects in the classroom; tools; model houses, churches and ships; cards and coins; copies in papier maché of the human body; seeds, spices, pictures of mushrooms and toadstools; rulers, scales, weights, etc.), as well as speech training. All of this was directed at developing the children's capacity of observation and perception, and stimulation their imagination.
[96] Kongl. Blindinstitutet på Tomteboda vid Stockholm, *Redogörelse för skolåret 1888–1889*.

Chapter III: Tactile perception

[1] This is pointed out by the American literary historian, William R. Paulson, in *Enlightenment, Romanticism and the Blind in France,* 1987. Robert Heller seems to have had similar ideas concerning Denis Diderot, who in 1749 published *Lettre sur les aveugles à l'usage de ceux qui voint.* Heller believed that Diderot's interest in the blind does not refer to the blind as persons, but is of a metaphysical nature. "Educating the blind in the age of enlightenment. Growing points of a social service". *Medical History*, 1979, 23, p. 393.
[2] Stafford, B. M., *Body Critcism. Imaging the Unseen in Enlightenment*, 1991, p. 401 et seq. Boring, E., *A History of Experimental Psychology*, 1950, p. 12 et seq.
[3] Diderot was imprisoned just after the publication of *Lettre sur les aveugles.*
[4] Mirzoeff, N., *Silent Poetry. Deafness, Sign and Visual Culture in modern France*, 1996, p. 35.
[5] Mirzoeff, N., 1996.
[6] Jay, M., *Downcast Eyes,* 1993, p 26.
[7] Lindberg, David C., *Theories of vision*, Chicago (1976), 1981, p. 89.
[8] Chalcidius, *Commentary*, in *Timaeus a Calcidio translatus*, ed. Waszink and Jensen, p. 256. Quotation from Lindberg, 1981, p. 89.
[9] Jay, M., 1993, p. 27.
[10] Blumenberg, H., "Light as a Metaphor for Truth" (1957), *Modernity and the hegemony of vision*, ed. Levin, 1993, p. 30–54.
[11] Derrida, J., *Mémoires d'aveugle: L'autoportrait et autres ruines*, Édition de la Réunion des musées nationaux, 1990.
[12] William R. Paulson has given examples from novels and dramas whose theme is the relationship between virginity and blindness. See: *Enlightenment, Romanticism, and the Blind in France,* 1987, especially chapter 3: "Curing Blindness: a modern myth", p. 72–94.
[13] Helen Keller, *Min religion*, Stockholm, 1929, p. 95
[14] Ibid.
[15] Derrida, J., 1993, p. 112.
[16] Ibid., p. 16.
[17] Ibid., p. 5.
[18] Jay, M., 1993, p. 29.
[19] Ibid.
[20] Ibid. p. 44 et seq.
[21] See: Damisch, H., *The Origin of Perscptive*, 1994; Elkins, J., *The Poetics of Perspective*, 1994; Kemp, M., *The Science of Art*, 1990; Marcussen, M., *Perspektiv. Om rumsoppfattelse og rumgengivelse*, 1887; Panofsky, E., *Perspektiv som symbolisk*

form (1924–25) 1994.
[22] Jay, M., 1993, p. 29; Lindberg, D. C. (1976), 1981, p. 116.
[23] Locke, J. (1690), *An Essay Concerning Human Understanding*, Book II, chapter IX, § 8.
[24] Marc-Wogau, K., *Filosofin genom tiderna*, Stockholm 1967, Volume III, p. 172–173.
[25] Locke, J., bk. II, II, § 1,2.
[26] Ibid., bk. II, IX, § 9.
[27] Very early in my doctoral studies, Lena Johannesson pointed out that this was a semantic problem. I have later found that contemporary philosophers also discussed it. Johannesson's discussion of the difference between the capacity to perceive a shape and the capacity to interpret it was very important when John M. Kennedy, Monica Strucel and I carried out our investigation on which *Från föremål till taktil bild* (Solna, 1997) is based.
[28] Morgan, M., *Molyneux's Question*, 1977, p. 10.
[29] In a recently published thesis on the history of ideas, on the *Molyneux's problem. Three centuries of discussion on the perception of forms* (1996), Marjolein Degenaar presents the most general summaries: between 1772–1782, the Swiss philosopher Jean-Bernard Mérian published a number of articles in which he attempted to explain how Molyneux's problem had arisen. In contrast to later works, such as an article by John Davis (1969), Michael Morgan's thesis (1977), and a biography of Molyneux (1982) by John Gerald Simms, Mérian's articles are limited to the 18th century. Although Molyneux's problem has also interested more recent philosophers and researchers, it had already fallen by the wayside in the debate in the 19th century. Degenaar notes that Berkeley, Condillac, and Diderot have used the problem as the point of departure for their theories on perceptual psychology and knowledge. Molyneux's problem is then one of several interesting questions in a context of theories of spatial perception. In the psychological and pedagogical articles and theses on tactile perception which I have read, I have not been able to find any author who has referred to Molyneux, even when they have mentioned the problem itself.
[30] Degenaar, 1996, p. 26.
[31] Ibid., p. 28.
[32] Baxandall, Michael, *Shadows and Enlightment* (1995), 1997, p. 18–19.
[33] Berkeley, G., *Essay towards a New Theory of vision* (1709), 1:46.
[34] Ibid., § 44.
[35] Ibid., § 46.
[36] Ibid., § 127.
[37] Degenaar, M., 1996, p. 30.
[38] Berkeley, G., 1709, § 140. See: Chapter VI, "Pictures and models in teaching".
[39] Ibid., § 135.
[40] Ibid., § 142.
[41] Berkeley, G., 1709, § 105.
[42] Degenaar, M., 1996, p. 35.
[43] Ibid., p 35–36.
[44] Reid, Th., *An Inquiry into the Human Mind*, 1764, VI, § xxiv in Degenaar, 1996.
[45] Ibid., VI, § xx.
[46] Ibid., VI, § iii.
[47] Ibid., VI, § ii.
[48] Ibid., VI, § xxiii.
[49] Ibid., VI, § iii.
[50] Degenaar, M., 1996, p 39.
[51] Ibid., in endnote 2: "Synge to Quayle, 6 September 1695, in Locke 1976–1999,

vol. 5 (1979), no. 1984. Molyneux enclosed a copy of Synge's letter with the letter he wrote to Locke on Tuesday 24 December 1695. Synge's letter was published by Locke in 1708.

[52] Degenaar, M., 1996, p. 39.

[53] Ibid., p. 43., Leibniz, G. W., *New Essays concerning Human Understanding*, 1765, Vol II, chapter ix, 1 8.

[54] Degenaar, M., 1996, p. 45.

[55] Berkeley, G., (1709), 11:150–159.

[56] Degenaar, M., 1996, p. 43.

[57] Ibid., p. 56.

[58] Ibid., p 53.

[59] *Der Blindefreund*, 1884/ N.1. u.2, p. 9.

"Dem bereits mit der Staarbrille ausgerüsteten Kinde wurde ein grosser runder Apfel und eine kleine schlanken Birne vorgehalten. Auf die frage, was das wohl sei, antwortete das Kind: "Dast ist ein Apfel und das ist auch ein Apfel". Als nun der Tastsinn zu Hülfe genommenwurde, unterschied das Kind sofort den Apfel von der Birne."

[60] *Der Blindefreund* 1884/N.1 u. 2.

[61] Degenaar, M., 1996, p. 57–59.

[62] Ibid., p. 67–68; Morgan, 1977, p. 61.

[63] Condillac, E. B., *Essai sur l'Origine des connaissances humaines,* (1746), part I, ch. vi, § 1.

[64] Degenaar, M., 1996, p. 68.

[65] Condillac, E. B., 1746, part I, ch. vi, § 14 in Morgan, 1977.

[66] Diderot, D., (1749) 1895, p. 21.

[67] Diderot, D., 1749, p. 49.

[68] Boring, E., 1950, p. 27 et seq.

[69] Ibid., p. 28.

[70] Ibid., p. 110.

[71] Ibid.

[72] Ibid., p. 236.

[73] Bain, E., *The Senses and the Intellect,* 1886, p. 160.

[74] Ibid.

[75] Ibid.

[76] Ibid., p. 172.

[77] Bain. E., 1886, p. 176, this statement is based on Weber's results.

[78] Fowler, R. *Some observations on the Mental State of the Blind, and Deaf, and Dumb, suggested by The Case of Jane Sullivan, both Blind, Deaf and Uneducated,* 1860.

[79] Fowler, R., 1860, p. 26. Dr. Brown is probably Thomas Brown (1778–1820). Brown explained the principle of association that he called "suggestion"; it can be used to explain the distinction between perception and sensation.

[80] Houlgate, S., "Vision and Reflection an Openness: The "Hegemony of Vision" from Hegelian Point of View", *Modernity and the hegemony of vision*, 1993, p. 100.

[81] Ibid., p. 103 et seq.

[82] Wiberg, A. F., *De Blindes Følemetoder*, Köpenhamn, 1926.

[83] Mell, A., 1900, "Tastsinn", p. 770–791. The author of the chapter is Dr. Zoth.

[84] Ibid.

[85] Ibid., p. 776.

[86] Ibid., p. 783: "Der Ortssinn oder Raumsinn der Haut is das Vermögen, den durch Erregung bestimmer Nervenendingungen in der Haut erzeugten Empfindungen den richtigen Ort im räumlichen Vorstellungsbilde der Hautoberfläche anzuweisen. Es tritt also im Bewusstsein stets zugleich mit der Empfindung con Druck, Temperatur

oder auch eines Gemeingefühles (Schmerz, Kitzel) die Vorstellung des gereizten Ortes auf, im allgemeinen recht sicher bei den Sinnesempfindungen, weniger sicher bei den Gemeingefühlen (s.diese). Dadurch dass gleichzeitig eine bestimmte Gruppe benachbarter Orte der Haut durch ein äusseres Objectgleichartige oder verschiedenartige Tasteindrücke erhält, und wider an einem und demselben Orte beim Abtasten des Objectes die verschiedenartigen Sinneseindrücke, die von den einzelnen Theilen des Objectes hervorgebracht werden, in bestimmter Reihe und Richtung vorüberziehen, wird Grundlage für die Verstellung der Gestalt und Oberflächenbeschaffenheit des Objectes gegeben, fast ausschliesslich durch diese Fähigkeit, wenn die Mitwirkung, des Gesichtssinnes ausgeschlossen ist; aber auch bei erhaltenem Gesichtsinne ist, sie oft von wesentlicher Bedeutung für die Richtigkeit der Gebildeten Vorstellung."

[87] Ibid., p. 790: "Die philosophische Streitfrage, ob die Grundlagen der Raumanschauung angeboren sind (nativistische Anschauung), oder erst durch die erfahrung von jedem einzelnen Individuum erworben werden, (empiristische Anschauung) ist damit noch nicht enschieden."

[88] Heller, Th., "Studie zur Blinden-Psychologie", 1895, p. 226.
"In der letzten Zeit macht sich das Bedürfniss nach einer psychologischen Grundlegung der Blindenpädagogik immer dringender geltend. Die Behandlung derselben von rein praktischen Gesichtspunkten aus, welche bis jetzt allen Fortschritt begründet hatte, liess angesichts neuer, immer schwieriger werdender Aufgabe die Blindenbildung im Stiche, so dass diese im letzten Jahrzehnt kaum einem Schritt vorwärts machen konnte."

[89] Heller, Th., "Die vorliegende Arbeit will durchaus nicht beanspruchen, eine erschöpfende Darstellung des psychologischen Verhaltens der Blinden zu geben, sie hat sich vielmehr die Aufgabe gestellt, der Blinden dieselbe von den Irrwegen unfruchtbarer Speculation und planlosen Beobachtung zurückzulenken".

[90] Heller, Th., 1895, p. 227.

[91] Ibid., p. 228.

[92] Ibid., p. 229 et seq.

[93] Ibid., p. 232.

[94] Mell, A., 1900, p. 530 & 781.

[95] Heller, Th., 1895, p. 233: "... erstes der Raumsinn der sensible Fläche, welcher die elementaren Empfindungen in Bezug auf das wahrnehmende Subjectin eine extensive Ordnung bringt, zweiten die Beweglichkeit des Sinnesorgans, welche die Stellung des letzteren den räumlichen Verhältnissen der Aussenwelt anpasst.

[96] Ibid., p. 234: "Weder die Tastbewegungen noch das System der Localzeichen sind im Stande, den Raum zu erzeugen, sonder beide sind nur Bedingungen, unter welchen sich die Raumvorstellung des Blinden entwicklet ...Überall dort, wo der Blinde zu einer präzisen Raumauffassung gelant, wirken beide Factoren auf das innigste zusammen, sie verhalten sich zu einander wie Synthese und Analyse."

[97] Heller, Th., 1895, p. 236.
The translation of Anschauung are from *Filosofi lexikonet*, Red. Poul Lübcke, Stockholm 1988 and Russel, B., *A History of Western Philosophy*, 1946, p. 681.

[98] Heller, Th., 1895, p. 236.

[99] Ibid., p. 246: "Wenn ich diese Tastbewegung vornehme", bemerkte die Versuchsperson Oscar Sch., "so stelle ich mir dabei stets meinen Zeigefinger vor, der von einem Punkt zum andern geht". Bei den willkürlichen Tastbewegungen sind also immer Associationen mit analysierenden Tastbewegungen wirksam. Daraus erklärt es sich auch, dass die Tastbewegungen um so bemerkbarer werden, je grösser die Anzahl der punktförmigen Eindrück ist, je schwerer also die simultane Auffassung derselben durch den Raumsinn der Haut wird. Werden diese Hautbewegungen ausdrücklich untersagt, so bestehen sie demnoch als unwillkürliche Begleiterscheinungen

der subjektiven Analyse des Eindruckes fort. Die Tastzuckungen sind demnach nicht anderes als unwillkürlich gewordene Tastbewegungen."
[100] Ibid., p. 249 et seq.
[101] Ibid., p. 250 et seq.
[102] Ibid., p. 406.
[103] Ibid., p. 407.
[104] Ibid. p. 251: "Um das Umschliessen des Objectes zu ermöglichen, muss die Hand ihre Ruhelage verlassen, alle Gelenke vollziehen eine Adduction, welche ihr Ziel erreicht hat bei möglichst alleseitiger BerÜhrung des Objectes. In diesem Stadium sind die Bewegungsempfindungen von vornehmlicher Bedeutung."
[105] Ibid., p. 252:
1) ob er einen eckigen oder einen runden Körper in den Händen habe. Im zweiten Falle findet eine im allgemeinen gleichmässige, im ersten Falle eine ungleichmässige Vertheilung der druckempfindungen statt, da dieselben sich an den Kanten und Ecken qualitativ und intensiv anders darstellen als and den Flächen der Objecte;
2) ob der Körper regelmässig oder unregelmässig sei. Bei runden Körpern stützt sich dieses Urtheil haupsächlich auf die Innervation der Handmuskulatur, bei eckigen auch auf die Auffassung der Entfernungen von Ecken und Kanten.
[106] Ibid., p. 253.
[107] Ibid., 1895, p 429: "Will der Blinde sich ein Object im weiteren Tastraume in wahrer Grösse vorstellen, so reduciert sich sine Vorstellung auf die Succession der Tastbewegungen, welche bei der Abmessung desselben erforderlich waren. Lenkt er seine Aufmerksamkeit auf die Verhältnisse der Form, so muss er eine Verkleinerung des Objectes in der oben bezeichneten Weise vornehmen; eine unmittelbare Simultanvorstellung ist immer nur im engeren Tastraum möglich."
[108] Ibid.: "Vergeblich werden wir uns bemühen, das Gesamtbild eines grossen Gegenstandes in unmittelbar vor unserem Beobachtungsstandpunkt vor, so sehen wir uns gezwungen, das Bild des Objectes gleizhsam aus seinen Theilen zusammensusetzen. Wollen wir uns eine Simultanvorstellung des Gegenstandes ermöglichen, so müssen wir in der Phantasie das Object in eine grössere Entfernung rücken, woraus sich nothwendig ergibt, dass wir das Simultanbild wesentlich verkleinert erhalten. Ebenso stellen wir uns ein Haus, einen Berg etc. für gewöhnlich ungefähr in der Grösse eines Photogramms vor, die Vorstellung der Entfernung des Beobachters von dem Object ermöglicht aber einen Schluss auf die wahren Grössenverhältniss."
[108] Lange, F. H., *Från mörker till ljus. En skrift om blindheten i det praktiska lifvet*, 1916, p. 15–16. Lange (born 2 Oct. 1859) was a carpenter and became member of De Blindas Förening (DBF) in 1908.
[110] Ibid., p. 17.
[111] Doctor Guillié, Director-general and principal physician to the Royal Institution for the blind at Paris, Knight of the legion of Honour, member of the Royal Academy of Sciences, and of many other learned societies. I have not found any information giving his first name or dates of birth and death.
[112] Guillié, *An Essay on the Instruction and Amusements of the Blind* (1718), English translation, 1819, London 1894, p. 1–2.
[113] Ibid., p. 17.
[114] Ibid., p. 18.
[115] Ibid., p. 21.
[116] Ibid., p. 70–72.
[116] Ibid., p. 73.
[118] Kunz, M., "Neue Versuche über das Orientierungsvermögen und das Ferngefühl", *Zeitschrift für Experimentelle Pädagogik,* 1908, p. 1.

[118] Ibid., p. 2. Kunz does not provide information on the character of this enormous number of experiments.
[120] The concept "Fehrngefühl" was criticized by Prof. Meumann, *Zeitschrift für Pädag. Psychologie und experimentälle Pädagogik*, 1908.
[121] Ibid., p. 3:1. "Ferngefühl ist nicht jedem Blinden eigen. Durch die Erblindung als solche wird es nicht hervorgerufen und von der Zeit der Erblindung hängt es nicht ab, wohl aber, höchst wahrscheinlich, von Erblindungsursachen. — Es kann deshalb nicht anerzogen werden; wohl aber kann Übung die Aufmerksamkeit schärfen.
2. Das Ferngefühl ist mit dem Orientierungsvermögen nicht identisch. Wir dürfen nur als Hilfsmittel des letzeren betrachten.
3. Ein besonderer (sechster) Sinn mit eigenem Sinnesorgan is das Ferngefühl nicht. Es handels sich nur um aufmerksamen Gebrauch der den Blinden und Taubblinden gebliebenen Sinnesorgane. Gebrucht und Geschmak kommen nicht in Betracht."
[122] Ibid., p. 4.
[123] Ibid., p. 7.
[124] Fausing, B., *Drömmebilleder*, 1988; Johannesson, L., "Den olydiga bilden", *Den olydiga boken,* 1995.
[125] Fausing, B., 1988, p. 323.
[126] Sandström, S., *Intuition och åskådlighet*, 1995, deals with this problem.
[127] Snyder, J., "Picturing Vision" *The language of Images*, 1980, p. 223 et seq.

Chapter IV: Relief pictures for the visually impaired—a great variety

[1] In Swedish these distinctions do not exist.
[2] Eriksson, Y., *Att känna bilder*, 1997, pp. 80–84. Eriksson shows how orthogonal projection is used in France.
[3] Katz, D., 1945, "Hur tecknar blinda?" *Nya psykologiska strövtåg*, 1945, pp. 150–154. Similar results have been achieved by other researchers in recent years; see Kennedy, K. M., *Drawings and the Blind*, 1993, chap. 4.
[4] Katz, D., 1945, p. 150.
[5] Sandström, S., 1996, p. 33–36.
[6] Gombrich, E., "Mirror and map", *The Image & the Eye,* (1982), 1994.
[7] Kennedy, J. M., (1993), suggest that outlines are perceived in term of axes, not contours, and that vision and touch may operate with outline in the same way., p. 21.
[8] See chap. VIII, "Figure and ground".
[9] Y. Eriksson, M. Strucel: *A guide to the production of tactile graphics on swellpaper*, 1995, Y. Eriksson "Taktila bilder" i *Taktilt—inte se men röra*, Nationalmuseum 1995; *Konsthistoria för synskadade*, 1994.
[10] Mell, A., 1900, p. 187.
"Die erhabend herzustellenden Linien werden mit Gummiwasser geschrieben, gezeichnet oder gedruckt, noch bevor sie trocknen mit einem finen harzpulver, das ungefähr die Zusammensetzung des Siegellackes zeight, überstreut, und der Überschuss des Pulvers sodann entfernt. Wird nun der feine Harzstaub des mässiger Hitze auf eigenen Vorrichtungen hierzu geschmolzen, so erhält man glatte Linien von mässiger aber gut warnehmbarer Höhe."
[11] Johannesson, L., *Xylografi och pressbild*: bidrag till trägravyrens och till den svenska bildjournalistikens historia (*Wood-Engraving and Newspaper Illustration. A Contribution to the histories of Wood-Engraving and of Swedish Press Illustration during the 19th Century*) Stockholm, 1982, p. 56.
[12] Ibid., p. 54.

[13] Ibid., p. 56.
[14] Ibid., p. 57.
[15] On the front page is the following text: Enthaltend: die vorzüglischsten bildlich darstellbaren Wörten aus dem Gebiethe der Naturgeschichte mit Abbildungen, jede in der Begrenzung eines Octav-Blattes nach den besten Mustern gezeichnet. Entworfen und herausgegeben von Felix Freisauff v. Neudegg. K.K. Hauptmann, Ritters des Kaiserl. Österr. Leopold-Ordens, und Mitglied des K.K. Blinden-Institut in Wien. Erster Band. A. Bis L. Wien, 1839. In Commission in der Mechitaristen-Congregations-Buchhandlung.
[16] Mell, A., 1900, p. 187.
[17] I am not sure if there is a second volume; in Berlin there is another copy of the first. It is possible that the second volume was never published, as the production of the book made great demands on financial resources and time. It is also possible, and speculation may be permitted, that the relief pictures were too difficult for tactile reading.
[18] The contours of all animals are filled in, except for those of two small hares and a raven. They have probably been left out as too small for tactile reading.
[19] In *Art and illusion* (1959) Chapter 2, and in *Psychology and the visual arts* (1969) p. 215 et seq., Ernst Gombrich discusses the importance of the original in the design of the picture.
[20] "... Die Anschauung bildlicher Darstellungen ist daher als eine der zu betrachten, und von vielen Schweriegkeiten, mit denen man bei dem Unterrichte der Blinden zu kämpfen hat, mag wohl das Entbehren dieses Hilfsmittels eine der wesentlichsten seyn. Nur durch sinnliche Anschauung kann ihre Einbildungskraft geregelt, vor Ausartung vewahr, und vor Irrthum nach Möglichkeit gesichert werden. Manches Unbestimmte oder minder Klare im—Texte wird durch die Gesammtanschauung, welche eine gute bildliche Darstellung gewährt, deutlich; abgesehen davon, dass derlai Anschauungen sehr viel dazu beitragen, dem Gedächtnisse das Geschaft des Behaltens und Reproducirens der an sie Geknüpften Begriffe zu erleichterh./ Um den Bilden das Anschauen mittels des Tastsinnes nicht zu erschweren, wurden die Gegenstände nach einem ziemlich grossen Maasstabe gezeichnet. Die Grösse eines gewöhnlichen Octavblattes wurde für die grösse, der einzelnen Abbildungen als Grenze angenommen, ohne jedoch auf ein bestimmtes grössen verhältniss der verschidenten Abbildungen unter einanderen Rücksicht genommen zu haben. Aus demselben Grunde erscheint auch auf jedem Blatte nur Ein Gegenstand abgebildet./ Dem ursprünglichen Entwurfe gemäss, sollte dieses Bilderwörterbuch die vorzüglichsten bildlich darstellbaren Wörten aus allen Zweigen der Wissenschaften, Künste und Hantwerke, grosstheils in deutscher, lateinischer, französischer und englisher Sprache, und die Abbildungen dazu, jede in der Begrenzung eines Octavblattes, nebs einem kurzen Texte enthalten, mithin en encyklopädisches seyn. /.../ So entstand gegenwärtiges Werk, das nur Abbildungen von Genständen aus dem Gebiethe der Natur geschichte enhält. Ist es nun gleich minder umfangsreich, so hoffet derselbe dock, dass darum nicht minder brauchbar seyn werde. / Uebrigens wurde bei dem Entwurfe desselben auf Bestimmtheit und Correktheit der Umrisse, auf der Darstellung und auf Zweckmässigkeit der Wahl der Gegenstände, die grösste Sorgfalt verwendet. — Sollte aber demohngeachtet nicht allenthaven der gewünschte Grad von Vollkommenheit erricht worden seyn, so möge man es den Schvierigkeilten der Aufgabe zuschreiben, und wenigstens den Eifer nich verkennen, mit welchem ich das mir dabei vorgesteckte Ziel, den Blindenunterricht zu erleichtern und auch ausserhalb dem Institut möglich zu machen, verflgte./Wien am 30. Januari 1839/ Der Verfasser."
[21] Entworfen von Felix Freisauff von Heudegg. k.k. Hauptmann, und nach erfindung desselben ausgeführt in der K.K. priv. Ektypographischen Anstalt, Wien.

[22] *An account of the Recent Discoveries which have been made for facilitating the Education of the Blind, with specimens of Books, Maps, Pictures & C. for their use*, (1837) published by the Scottish clergyman James Gall who on his own account published a number of religious books in relief print for the blind. The most known of these books is *Gospel by St. John for the Blind*, which appeared in the beginning of the 1830s. He also developed an alphabet; the triangular alphabet. It was made up of triangularly shaped letters printed in relief. These triangular letters were simplified to enable tactile reading.
[23] Gall, J., 1837, p. 51.
[24] Ibid.
[25] Printed in Glasgow at the Asylum's Press by John Alston. The book was sold by John Smith and Son, Glasgow; Smith Elder and Co. London; John Johnstone, Edinburgh, William MacComb, Belfast and J. Robertson, Dublin.
[26] In the exhibition catalogue *In touch—Printing and Writing for the Blind in the Nineteenth Century*, 1981, p. 25, Elisabeth M. Harris writes: "The Edinburgh competition revealed two camps—those who wanted to work with the Roman alphabet and those who wanted to break free of it. In the alphabet camp was authority—teachers and directors of schools for the blind. They argued that the blind were dependent upon seeing people, and that a strange writing system would cut them off from the "real world". In awarding the prize to Fry's system om simple sans-serif capital letters, the nod was given to supporters of the alphabet". (p. 25) Alston himself writes that he does not find Fry's system good enough, so we may doubt Harris's judgement in this matter, Alston, J., 1839, pp. 10–13.
[27] The poem is "The happy land": There is a happy land, /far, far away./ Where saints in glory stand/ bright, bright as day,/ oh, how they sweetly sing, worthy is our saviour king;/ loud let his praises ring/ praise, praise for aye. Come to this happy land,/ come, come away;/ why will ye doubling stand?/ why still delay?/ Oh we shall happy be, when from sin and sorrow free!/ Blest, blest far aye. Bring in that happy land/ beams every eye—/ kept by a father's hand/ love cannot die./ On then to glory run;/ be a crown and kingdom won;/ and bright above the sun/ we reign for aye
[28] This information comes from the exhibition catalogue for *In touch* by Elizabeth M. Harris, Washington D.C., 1981, p. 25.
[29] At the Museum of the History of the Blind in Vienna, there are moulds and a couple of small relief pictures (approx. 100 x 100 mm). The motives are: From pupa to butterfly; Giraffe with rider and an eagle. This shows that small relief pictures were made in other places as well.
[30] When I found the book, it had literally been thrown into a cabinet at the Royal National Institute for the Blind in London.
[31] It is difficult not to make associations with the small illustrations which Oliver Goldsmith (1728–1774) made of his trips around Europe. Goldsmith wanted to become a physicist and illustrated his books with engravings covered with small pictures of, among other tings, birds and details of birds. The illustrations were sometimes only a few millimetres in size, and could scarcely be seen with the naked eye. The small pictures in Alston's book are nearly as impossible to distinguish in detail with the finger, as Goldsmith's small pictures were to the eye.
[32] A copy of the book is found at the Samuel Hay's Research Library, Perkins school for the Blind, Boston.
[33] As to the fables, the purpose was obviously another. The text of "the Cock and the precious Stone" reads as follows: A cook seeking for food upon a dunghill lighted upon a precious stone, so called & esteemed by the foolish world. After he had viewed & considered it a while, thus thought wihtin himself: a barleycorn would have served my turn better, & nourished me, which the sight of this glittering stone

cannot do./ The moral. Honesty, industry & pains never go unrewarded. Virtue itself is its own reward, if it meets with no other from an ungrateful age."
[34] Published by Alnwick: printed and sold wholesale and retail by W. Davidson.
[35] In *Xylografi och pressbild* (1982), Lena Johannesson writes about Thomas Bewick's great influence through his books on natural history, by which three novelties were introduced: a national ornitological survey, documented in pictures, the wood-engraving printing technique and a new form of illustrative art, composed of vignettes. The latter are not only decoratively placed, but are active components of the genre. (p. 82).
[36] *The watercolours and drawings of Thomas Bewick*, ed. Bain, I., vol. I, London, 1981, p. 34–35.
[37] There are also a number of pages with several pictures on each. In *Bruno Liljefors. Naturen som livsrum*, 1996, pp. 63–107. Allan Ellenius describes the development of pictures of nature: from the very severe type of representation showing the animal or bird in an unnatural pose, to the picture of the animal or the bird in its natural environment and in a typical position or movement. As many of the relief representations were copied from pictures, it is natural that relief pictures also changed. This can be observed in some of the relief pictures portraying a common tern on its eggs, and a jumping squirrel, in the TRC museum of the blind.
[38] Jägerskiöld and Kolthoffs *Nordens fåglar* (1895–99) was part of the ambition at that time of representing in a popular form the birds of that particular region. Ellenius, A., 1996, p. 185.
[39] Published in York 1828.
[40] The figure is an alternative geometric presentation of the algebraic identity proper, (a2+b2)/2={(a+b)/2}2 + {(a–b)/2}2. The simple geometric proof is based on Pythagoras's theorem with two right-angled triangles, ADF and AEF, which have a common hypotenuse. The triangle AEB is half a square.
[41] Levy, H., 1872, p. 98.
[42] Mell, A., 1900, p. 355; Sakula, A., "That the blind man may read: the legacy of Valentine Haüy, Charles Barbier, Louis Braille and William Moon", *Journal of Medical Biography* 1998;6: 21–27. The Moon-writing is still used today.
[43] Levy, H., 1872, p. 99.
[44] Moon's publications were also sold by The Home Teaching and Free Circulating Library Association for the Blind in Philadelphia. Mell, A., 1900, p. 355. This information is also found in Embossed Specimens of Reading, published by Moon after 1884 (the exact year cannot be established).
[45] This can be read on the fly-leaf of the world atlas produced by Kunz in the 1890s. In his annual report for 1884–85, Kunz reported on the export of maps which at the same time were sent to German and Danish institutes. *38. Jahresbericht über das Evangelische blindenwerk zu Illzach bei Mülhausen*, p. 25.
[46] At the School for the Blind in Budapest, the maps were still in use in 1994.
[47] At the Tomteboda school´s Museum of the Blind. When the vocational school in Kristinehamn was closed and evacuated in the early 1990s, there were a number of maps. I want to express my thanks to the librarian, Sten Gustafsson, who gave me this material.
[48] The relief pictures seem to have been widely distributed; I have found them in a number of European institutes.
[49] Mell, A., 1900, p. 437.
[50] M. Kunz in *Fünfundzwanzigster Jahresbericht über das Evangelische Blindenwerk zu Illzah*, p. 11 et seq. It is worth noting that at that time, a draughtsman by the name of Zipelius taught at the school and was a member of the school board.
[51] 1877 war K. auf der geographischen Ausstellung in Berlin für die von ihm aus-

gestellten plastischen Karten in ehrenvoller Weise ausgezeichnet, und auch in Paris und mehreren anderen Orten wurde er prämiert. Die von den Schülerinnen in Genau hergestellten Schichtenreliefblätter dienten später in Illzach zu ersten Prägeversuchen, welche zur Herausgabe des K'.schen plastischen Repetitionsatlasses für Sehende führten, aines Atlasses, der gegenwärtig in vielen höheren Schulen Deutschlands und des Auslandes gebraucht wird, under der seinem Hersteller mit anderen Arbeiten 1891 einem der wenigen vom geographischen Weltcongresse in Bern verliehenen Preise eingetragen hat.

[52] Moldenhawer J., *Det Kongelige Blindinstituts Historie*, 1905, p. 86.

[53] Mell, A., 1900, p. 438.

[54] Ibid.

"Zwei Jahre lang unternahm er hunderte von Ersuchen, um ein geeignetes Reproductionsverfahren für den Reliefdruck zu finden. Und so entstand, langsam aber sicher, der jetzt so verbreitete Atlas für Bl.-Schulen, der wohl an keiner deutschen und österreichischen B.-Anst. Fehlt und ebenso in der Schweitz, in Dänemark, Russland u.s.w. in Benützung steht. Alle diese Arbeiten unternahm K. ohne Aussicht und ohne Anspruch auf Gewinn, da er, um die Sache nicht zu vertheuren, stets nur die Erzeugungskosten berechnete. Der geringe Reinertrag, der sich erzielen liess, kam seiniger Anstalt zugute, die er in ihrer Entwickelung nach jeder Richtung zu fördern suchte. Wie könnte sonst die Karten so billige zu kaufen sein? Heute sind 150 Formen vorhanden, die zum grossen Bl.-Atlas in 81 Karten, zu zoologischen, bootanischen und physikalischen Bildern u.s.w. dienen. Mit dieser arbeit hat sich K. ein Denkmal in der Geschichte des Bl.-Wesen gesezt: seine Arbeiten besteigtigten das verschiedene Vorgeleghender einzelnen Anstalten, sie beseigtigten auch den bisher nicht zu umgehenden Einzelunterricht in der Geographie, indem die leichte, selbst armen Anstalten mögliche Erwerbung der Karten für jeden Zöglin die Möglichkeit der Einführung des Massenunterrichtes bot."

[55] Kunz, M. in Mell, A., 1900, p. 77.

[56] Ibid.

[57] Ibid.

[58] Ibid., p. 79.

[59] Ibid., p. 78.

[60] When he writes that he sees no impediments, this should probably be read to mean that relief maps were the most common and accepted type of relief pictures. "Sollen wir nun hier stehen bleiben und geographische Bilder als allein berichtigt und ausführbar ansehen? Ich glaube es nicht!" Kunz (1891) *Das Bild in der Blindschule*, p. 6.

[61] Kunz, M. *Das Bild in der Blindschule* in 39. *Jahresbericht des Evangelischen Blindenwerk Illzach bei Mülhausen*, (1891) p. 28. , p. 8.

[62] This information comes from one of the sales lists I have had access to. 38. *Jahresbericht den Evangelischen Blindenwerks.*

[63] Kunz used the expression "Papierbilder".

[64] Kunz in 38. *Jahresbericht des Evangelischen Blindenwerk Illzach bei Mülhausen*, p. 27 et seq.

[65] Kunz, M., *Das Bild in der Blindenschule*, 1891, p. 9.

"Gute Abbildungen in genügen der Zahl erleichtern und beleben den Klassen unterricht in beinahe allen Fächern der blindschule; sie Ermöglichung unmittelbare und rasche Veranschaulichung unzähliger Dinge und Erscheinungen, die allen Unterrichtsfächern unvorgesehen zur Sprache kommen können, also nicht mit Mittelpunkte des Intresses stehen./ Sie bilden eine notwendige und zugleich billig zu beschafrfende Ergänzung aller unserer Veranschaulichungsmittel, eine Hauptstütze des matematischen und naturwissenschaftlichen Unterrichts, der ohne sie kaum denk-

bar ist, und eine wertvolle Mitgabe für das Leben. Er ist deshalb die Herausgabe eines derartigen Werkes anzustreben und der Verein zur Förderung der Blindenbildung zu ersuchen, demselben sine Unterstützungangedeihen zu lassen."
[66] Kunz, M., 1891, pp. 12–13.
[67] Ibid., p. 10.
[68] In photos (in Annual report's) of the institute in Illzach, it is possible to identify Kunz's models in the school's collection of stuffed animals and fish.
[69] In Comenius' *Orbis sensualium pictus* (1642), the text was in several languages. This was also the case in, for example, relief pictures for the sighted. The picture book with alphabet verses dated 1846 (Darmstadt) is an example of this. The picture pages are light blue with white relief and have a decorative white border.
[70] *52. Jahresbericht der Blinden-Erziehungsanstalt, Illzach-Mülhausen*, 1908–1909, 1909.
[71] This was also common in oil prints.
[72] Johannesson, L., "... I skapelsen en länk, från Englarne till djuren ..." En 1800-talsikonografi." *Historiens vingslag*, 1987.
[73] Ibid. pp. 245–246.
[74] With this final question, Kunz touches upon the production of pictures in general. I will discuss this more in detail in the last chapter.
[75] This pedagogy is used and advocated even today; see Fromm, W., *Meine Fingern lernen sehen*, 1991; Eriksson, Y., 1997a and 1997b.
[76] Everyone agrees with the conclusion that different degrees of light and shades of colour cannot be perceived tactilely, but the question of perspective arouses greater controversy. John M. Kennedy and Paul Gabias (1992) maintain that it is possible to show perspective in a tactile picture, since perspective can be appreciated by touch. Others believe that perspective is one way of representing space, while James Elkins has demonstrated that the use of perspective to represent space is of late invention. The debate on whether or not it is possible to convey perspective in a tactile picture has had great bearing on tactile interpretation of pictures in general, and on the way in which a picture should be changed when it is translated into the tactile medium in particular. I will come back to this when I discuss relief pictures which are made directly from visual, two-dimensional pictures.
[77] Kunz, M., 1891, p. 4.
[78] Ibid., p. 4. The comparison is interesting from a contemporary point of view, as there was great interest in optical instruments (including the microscope) from a philosophical perspective.
[79] There is a parallel with this development in the later change from thermoform to the much simpler swellpaper picture, with relief on only one level.
[80] The braille includes typical abbreviations. The system of abbreviations varies from one language to another.
[81] *Aide-Memoire pour Masseurs Aveugles*; 28 plansches anatomique precédé (breveté à Paris) de A. Getty. Plansches anatomiques par R. Morley
[82] Both books are published by "La Roue", a printing works for braille in Paris.
[83] The author is J.-H. Fabre, Plansches d'insectes exécutée par Mme Desbarbieux.
[84] Aviculture: caractères extèrieurs des racos gallinec (Extraits) de Votellier. Plansches en relief de Mme. Desbarbieux.
[85] National Institute for the Blind, 224–6–8 Great Portland Street, London, W 1. The book was probably published around 1920, perhaps in 1921, when it was reviewed in *The Beacon*.
[86] Sir Halford Mackinder introduced into the political georaphy a view of the Earth as potentially ranged in two camps—the land power of Eurasia, the "heartland", which had following the decline of Siberia, gaind ascendance over the sea power of

the "maritime lands", including the continents.

[87] The term "picture description" is used nowadays to describe text which leads the reader step by step through a tactile picture. See also Eriksson; *Att känna bilder* and "Taktila bilder" i *Taktilt—inte se men röra*.

[88] Gunnar Jansson of the department of Psychology, at the University of Uppsala, has carried out extensive basic research into the possible perception of inclination gradients. His results are that it is possible to perceive very small differences of nuance in an object reproduced on a flat surface, by changing the inclination gradient.

[89] The person who knows Thilander's history the best is Birger Wiggen, one of the few persons alive who knew this remarkable printer from Stocksund.

[90] TPB series of reports 1994:1.

[91] The book measures 200 mm x 275 mm and is stapled together.

[92] TPB conserves a number of these sheets, which I have also found at the Valentin Haüy museum in Paris. I have also seen a thermoform version of the butterfly picture, which suggests that the paper picture was used as a mould.

[93] The text was translated from Esperanto and taped on cassette by Birger Wiggen.

[94] The plan of Thilander's house and printing works in Stocksund are an indication of the interest in Thilander and his activities.

[95] The text was read and translated from braille and Esperanto by Birger Wiggen. Immediately afterwards, it was written down, but there may be some minor changes in comparison with the printed text.

[96] He was very well known on Danish radio, especially in the 1950s and an author.

[97] Blindesdruckverlag F. Vogel Hamburg 33, Hufnerstrasse 122/124. I have not managed to find any information on Vogel. I have, however, found his books in all German archives.

[98] This uncertainty is interesting, and must be seen as the result of the high quality of the pictures.

[99] Birth of Venus, Young lady with a muff, Girl with a cat, The fair-haired boy, Madonna, Child, St. John, Angels, The last Supper, Sunflowers, The Ansidei Madonna, The shrimp girl, The age of innocence, A boy with a rabbit, Pinky, The last of England, The blind girl, A summer night, Off Valparaíso, The Angelus, Charles I, Poplars in the Thames Valley, The ambassadors, Lady at a spinet, The syndics, Philip IV, The idle servant, Venus and Cupid, Courtyard of a Dutch House, The music lesson, The fox hunt, The swing. C. Barkus has read the braille text and transferred it into ink-print.

[100] The text was read aloud by Ingela Johansson, which has facilitated my work very much as the braille is printed on both sides of the paper and therefore is very difficult to read visually. The text also has abbreviations which are difficult for the inexperienced person to interpret. The text was taken down from dictation, which means that there may be minor differences between the original and my quotation.

[101] *Svenska Turistföreningens Årsbok*, Stockholm, 1929, p. 295.

[102] Johannesson, L., "Den inbrutna bildens entré", *Den svenska boken 500 år*, 1983, p. 296.

[103] See Eriksson, Y., 1994.

Chapter V: The tactile map

[1] Man's need to understand the relation between the individual, the earth and the universe with the help of models has been described in *Modelle der Welt. Erd- und Himmelsgloben*, ed. Peter E. Allmayer-Beck, 1997.

[2] In "Karte, Globus, Weltmodell", Rudolf Schmidt makes a historical survey of the development of the map and the globe. *Modelle der Welt. Erd- und Himmelsgloben*, ed. Peter E. Allmayer-Beck, Wien, 1997.
[3] See Alpers, A., "Chapter 4. The Mapping Impuls in Dutch Art", *The Art of Describing*, 1983; Ford, B. J., "6. Mankind in the world", "7. The world in space", *Images of Science*, 1992; Johannesson, L. *Den massproducerade bilden*, 1978, p. 134–139; Widmalm, S., *Mellan kartan och verkligheten. Geodesi och kartläggning 1695–1860*, 1990.
[4] Alpers, S., 1983, p. 126–133.
[5] These sales lists are: *List of Embossed Books, Maps, Applances and Tangible Apparatures for use of the Blind, Boston*, 1886; *Lehrmittel-Verlag, Blindanstalt Illzach-Mülhausen*, 1908.
[6] Published in English translation in 1891.
[7] Guillié (1817) 1894, p. 101.
[8] Ibid.
[9] Ibid., p 102.
[10] Haüy (1786), 1894, p. 24.
[11] In *The Education and Employment of the Blind; What it has been, and ought to be,* 1886, T. R. Armitage mentions that in different schools, large wall maps had been made for the blind students. The best tactile wall maps were, according to Armitage, made from wood by the American Printing-House in Louisville, Kentucky, and by the American Institution, Boston. p. 34
[12] In the museum in Vienna there are a couple of maps with the following information on their reverse: Sonnenberg, Schule für Sehenbehinderte und Blinde, Landhausstrasse 20, Ch 6340 Baar. Von 1925–1981 in Ch-Friebourg. "Solchen karten wurden in den 40er-Jahren von Sr Johanne-Marie Greter hergestellt. Jedes Exemplar musste einzeln von hand gefertig werden. Sr Johanne-Marie arbeitet 1942 im Sonnenberg, zuerst als Lehrerin, später als Heimatleiterin." Several maps made by her have been preserved.
[13] Several copies exist in Switzerland, Hungary and France, among other countries.
[14] In the exhibition *Tactile—not to see but to touch*, we used this property of aluminium in one of the paintings, to convey the contrast between land and water. Carl Larsson. *Gubben och nyplanteringen* (the relief picture was made by Annica Norberg). Eriksson, Y. "Taktila bilder" *Taktilt—inte se men röra*, exhibition catalogue nr 578, Nationalmuseum, Stockholm 1995.
[15] Josef Pöschl, teacher at k.k. Blinden-Erziehungs-Institutes in Vienna, has in "XI. Der geographische Unterricht", *Der Blindenunterricht*, Vienna 1910, decribed the production and use of the wooden map. He stresses the importance of a plan of the institute or school building with surroundings, but also that it was desirable to have a model reproducing the aspect and shape of the building. p. 136.
[16] The lecture was given at the Blindenlehrerkongresse zu Frankfurt a.M. am 27. Juli 1882. From: Kunz (1907) 1856–1906 *Geschichte der Blindenanstalt zu Illzach-Mülhausen i.E.* Even today, teachers and pupils together make relief maps by hand. It is way of getting to know the surroundings and to understand the concept "map". See: Eriksson, *Att känna bilder*, 1997, chapter 4.
[17] Kunz, M., 1882, 1907.
[18] Guillié, (1817), 1894, p. 102 et seq.
[19] Ass. Professor Anna-Lena Lindberg called this cabinet to my attention. Although the people at the textile department of Kunstindustrimuseet are not aware of any similar example of relief embroidery, it is probably not unique but was also employed in other places.
[20] The following text can be read beside the exhibition case in the museum of the

history of the blind in Vienna: "Die Ländern nach den Grenzen ausgeschnitten, diese mit einem Rande versehen, die Teile wieder zusammengesetzt u. Aufgeklet; daher Flüsser und Meere vertiefl."

[21] Edman, P., *Tactile Graphics*, 1992. Ericsson, Y., Strucel, M., *A Guide to production of tactile pictures on swellpaper;* Hinton, R., *Tactile graphics in Education,* 1996; Levi, F., Rolli, R., *Disegnare per le mani,* 1994.

[22] At the Valentin Haüy Museum, there is a map from the turn of the 18th century made in the same way: an ordinary map printed in colours with lines made of some type of paste which produces a relief. The shapes of the countries are simplified more or less in the style of the Austrian maps.

[23] The map is found in the museum in Vienna.

[24] This system is now being introduced in maps for the visually handicapped. One example is: Tellgren, A., *Getting in touch with Stockholm—city guide for visually impaired people*, 1998.

[25] Later in this chapter I will elaborate on the globe and give more examples of maps.

[26] A sales list from Blindendruck-Verlag und Buchdruckerei F. W. Vogel in Hamburg, V. Nachtrag zum Verlagskatalog vom April 1906. Ausgabe Dezember 1910, includes "Geographisches Serienspiel für Blinde und Sehende". The following can be read about the game: "Ein sehr interessantes und unterhaltendes Kartenspiel, an dem sich ohne weiteres gleichzeitig Blinde und Sehende beteiligen können. Das spiel besteht aus 60 Karten, die mit doppeltem Aufdruck in Punkt- und Schwarzdruck versehen sind. Dem spiel ist eine Anleitung in Schwarz- und Punktdruck beigegeben, die ein schnelles Erlernen der Spielregeln ermöglicht. Nebst elegantem Kartenbehälter u. 120 Speilmarken Preis Mk. 1,80."

[27] Pöschl, J., 1910, p. 143.

[28] The piece of the puzzle which corresponds to Switzerland is missing, either because it was lost, or because the map was intended for a Swiss pupil for whom Switzerland was the point of reference. Today the puzzle is kept in Vienna, which does not necessarily mean that it was used in teaching in Austria. The museum has a rich collection of maps and books from different parts of the world, which were donations.

[29] The map measures 490 x 410 mm. The question is whether it is unique or part of a serial production.

[30] See Eriksson, Y., 1997 b, Ch. 3.

[31] Pöschl, 1910, p. 141. So suchen wir z.B. auf der Karte des Deutschen Reiches zuerst die beiden im Nordwesten und Nordosten Befintlichen schraffierten Flächen der Nord- och Ostsee und die zwischen beiden gelegene Halbinsel Jütland auf, von den Küstender beiden Meere gelangt man dann in die innersten Landesgebiete indem man die grossen Flüssen Rhein, Weser, Elbe, Oder und Weichsel aufwärts verfolgt, die samt ihren Nebenflüssen wieder zur weiteren Orientierung dienen. Überhaupt sei gleich hier bemerkt, dass es bei Behandlung eines geographischen Gebietes mit Benützung der tastbaren Landkarten Unbedingt empfehlenswerter ist, die Hydrographie der Ortographie, obwohl erstere durch letztere bedingt ist, die vorauszuschicken, da die Flusslinien in den meisten Fällen ungleich leichter aufzufinden und zu merken sind, also besser als Skelett des ganzen Kartenbildes zu dienen vermögen als die Gebirge, die übrigens auf Karten von Ländern mit vielen mächtigen Bodenerhebungen (z.B. auf Kunzschen Karte der Schweiz) oft so stark hervortreten, dass sie dem tastenden Finger die Orienterung sogar bedeutend erschweren.

[32] Alston, J., *Statements of the Education, Employment and International Arrangements, adopted at the Asylum for the Blind*, Glasgow 1839, p. 29–30.

[33] Nach der Erfindung desselben ausgeführt, in der k.k. priv. Ektypographischen Anstalt, Wien, im Schrämlischen Bücherverlge, Dortheer-Gasse, No 1111. Eigenthum des Verfassers. A note in the copy of the atlas which is kept at Samuel Haüy's

Reserach Library, gives the following information: "1 copy at K.K. Blinden Institut. Vienna. 1 copy at Perkins Institute. A third copy probably does not exist", Mell, 1902.
[34] *Atlas of the United States printed for use of the blind.* At the expense of John E. Cary; under the direction of S. C. Howe, Institution for the Education of the Blind, Boston 1837.
[35] Howe also produced other types of relief pictures. In the Samuel Hay's Research Library there is *Diagrams Illustrative Compendium of Natural Philosophy for use of the Blind,* by S. G. Howe. Printed in New England Institution for the Education of the Blind. 1836. Format 160 x 215 mm, 56 pages with illustrations of good quality. The pictures are made exclusively of relief lines.
[36] On an original plate by Samuel G. Howe: Executed at the Institution for the blind, Boston 1836.
[37] The text is printed in what was called Boston-relief, which was the simple style developed by Howe.
[38] Kunz, M., 1907, p. 61.
[39] Ibid. p 84: "Die ersten Prägversuche wurde mit der alten aus Fontaines übernommenen Presse an Schichten-Kartenformen angestellt, die von meinen sehenden Schülerinnen in Genua modelliert worden waren. Diese Versuche führten später zur Herausgabe des kleinen "Repetionsatlasses" für Sehende. Für Blinde waren die Blätter unbrauchbar. — Ich versuchte dann, die Kartenbilder, mit Punktschrift, in Blechplatten zu klopfen oder sie in Plastilina zu modellieren, in Gips abzugiessen und zu prägen, aber beides ohne befriedigenden Erfolg. Schliesslich verfiel ich auf das Gravieren in Holz (Holzschnitt), welches 1883–84 wohl brauchbare, aber nicht gute Karten lieferte. Schon 1885 wurde der Holzschnitt durch Modelle aus Holz, Pappe, Messingstreifen, Stifte und Kitt ersetzt. Die ältesten Kartenskizze haben für mich und vielleicht auch für die Geschichte der Blindenbildung nur historischen Wert."
[40] Plenge, J., "Fra fortid til nutid", *Statens Institut for Blinde og Svagsynede i København 1858 5, November, København*, 1958.
[41] Kunz, M. *1907*, The maps Kunz produced in woodcut were: 1883–84: 1. Italy, 2. Spain and Portugal, 3. England, 4. Südwest-Deutschland, physikalisch, 5. Südwest-Deutschland politisch. 6. Nordwest-Deutschland physikalisch, 7. Nordwest-Deutschland politisch, 8. Nordost-Deutschland. 9. Südost-Deutschland physikalisch, 10. Südost-Deutschland, politisch. 1984–85. 11. Europa, 12. Asien, politisch, 13. Afrika, politisch, 14. Nordamerika, 15. Südamerika, 16. Australien, 17. Hinterindien und Sundainseln, 19. Kleinasien (historisch), 10. Frankreich mit Provincialgrenzen, 20. Deutschland, Übersichtskarte, 21. Österreich-Ungarn (politisch), 22. Niederlande, 23. Griechenland. 24. Schweiz, politisch, 25. Der Regierungsbezirk Aachen, physikalisch, 26. Der Regierungsbezirk Aachen, politisch.
[42] Kunz, M. (1882), 1907. p. 84.
[43] Kunz commented on this as follows: Im Dezember 1885 hat der Verein zur Förderung der Blindenbildung nach Überwindung kleinlicher Eifersucht, beschlossen, 30 000 Karten, die nach seiner Stoffauswahl bearbeiten werden sollten, in Verlag zu nehmen und dieselben unter dem Ankaufspreise Abzugeben.
[44] The geographic commission referred to by Kunz may well be the one created at the beginning of the 1880s, composed of teachers from various European institutes for the blind.
[45] Kunz, M. (1882), 1907 p. 85.
[46] Up until 1897 (incl.), thirty-one maps had been published.
[47] Kunz, M., (1882) 1907, p. 104.
[48] The predecessor of today's National Institute for the Blind (RNIB), founded by T. R. Armitage in 1868.

[49] Kunz (1882), 1907, p. 103.
[50] The map was received by Perkins School in July, 1909. It is made of celluloid and measures 430 x 530 mm., including the border.
[51] This technique was later used by Monica Strucel in the production of maps for SIH Läromedel of Solna.
[52] Published at Moon's Establishment for English, and Foreign Books, Maps, o.c. for the Blind, 104. Queen's Road, Brighton.
[53] Kunz (1882), 1907, p. 102.
1. weil dasselbe das Wesentliche, Charakteristische und Bleibende eines Landes ist, von dem auch dessen Besiedelung abhängt, während alles Politische mit einem der Mode und tausend andern Einflüssen unterworfenen Kleide vergleichen werden kann, das heute glänz, seinen Dienst tut und morgen geht.
2. weil auch heute noch infolge der Sparsamkeit, die für viele Anstalt eine notwendige Tugend ist, nicht jeder Blinde nach seinem Austritt aus der Anstalt einen Reliefatlas Verfügung hat, mit dessen Hilfe er die früher gebildeten Vorstellungen wieder auffrischen und erhalten könnte, und mit dem Schwinden des Skelletes, an dem die übringen geographischen Vorstellungen festhielten, das ganze einschlägige Wissen ins Chaos zurücksinkt, während die Kenntnisse aus dem Gebiet der politischen Geographie durch den geselligen Verkehr und die Lektür leicht aufgefrischt und ergänzent werden können.
[54] Armitage, T. R., London 1886.
[55] Ibid., p. 35
[56] Ibid.
[57] The Atlas is part of the historic collection of The Swedish Library of Talking Books and Braille (TPB).
[58] Translation from esperanto by Birger Wiggen.
[59] The text of the title page reads: *Flagoj de la nacioj; libro de reliefaj diagramoj por la blinduloj. Kespiranta yigelo inversali gazeto por la blinduloj*, 1932.
[60] Andersson, J. G. *Den gula jordens barn,* 1932.
[61] A typewritten note, also glued to the back of the map, reads: "Map of New England found in the attic of Perkins Institution, May 1912".
[62] Hildebrand, K., 1939, p. 118.
[63] Hildebrand, K., "Reliefgloben für Blinde, ihre Geschichte und Konstruktion", *Die deutsche Sonderschule,* München, 6, Jg. 1939, p. 119.
[64] Hildebrand, K., 1939, p. 118.
[65] Wawrik, F., "Die beröhmtesten Globenhersteller", *Modeller der Welt. Erd- und Himmelsgloben,* Wien 1997, p. 65.
[66] Ibid.
[67] Ibid.
[68] Ibid., p. 120.
[69] Hildebrand, K., 1939, p. 121–124; p. 186–191.
[70] Kunz, M. (1882), 1907, p. 101; Hildebrand, K., 1939, p. 186.
[71] Hildebrand, K., 1939, p. 186.
[72] Alston, J., 1846, p. 22.
[73] Schleussner, K., *Blindenlehrmittel,* Nürnberg, 1906, p. 29: ... besteht das Horizontarium aus einer auf einem Fusse ruhenden wagrechten Scheibe, einem senkrecht daraufgestelleten Halbkreise, welcher einen Meridian vorstell, der mit Gradeinteilung versehen ist, einer verstellbaren Achsenschraube mit aufgestecktem Polarsterne, um welchen sich auf halbkreisförmigen Armen die Gestirne drehen, deren Stellung nach Bedürfnis durch Schrauben verändert werden kann. Auf dem Stundenkreise, der zugleich als Aequator dienen kann, sindd die Tageszeiten abzulesen.

[74] Ibid., p. 30: Das Planetarium besteht im Wesentlichen aus der erdkugel mit Vorrichtung zur entsprechenden Darstellung der Mondbewegung, einer Lampe als Stellvertreterin der Sonne und einer Reflexscheibe. Die Erdkugel kann mit schräger und senkrechter Achse versehen werden, um Beeinflussung der Erde durch die verschiedne Auffallenden Sonnenstrahlen in klimatischer Beziehung veranschulichen zu können. Diese drei Hauptteile ruhen auf einer horizontalen Stange, die sich auf einem Fusse dreht. Die bewegung der Erdkugel wird durch einen Treibriemen vermittelt.
[75] The materials and techniques used in the production of relief globes were the same as those used in the production of ordinary globes. Rudolf Schmidt makes a historic survey of the development of maps and globes. Schmidt, R., "Die Herstellung und Verwendung von Globen", *Modelle der Welt. Erd- und Himmelsgloben,* ed. Peter E. Allmayer-Beck, Vienna 1997, p. 36–38.

Chapter VI: Object-lessons and the problems involved in tactile teaching

[1] By counteracting an unrestrained imagination, the pedagogues intended to prevent the creation of images not built on sensory impressions and counteract false notions. See, for example, Wiberg, A. F., "Hvorledes udvikles og kontroleres den blindes Rumsopfattelse?" How is the blind's perception of space developed and controlled?/ Off-print of proceedings from the *VI Nordiska Mötet för Abnormsaken,* 1915.
[2] The need at that time to find visual metaphors has been studied by Christine Quarford: *Condiallac, statyn och barnet. En studie i upplysningstidens filosofi och pedagigk*, 1998.
[3] L. Johannesson described this in *Den massproducerade bilden* (1978) /The mass produced picture/ and in *Om skolplanschsamlingen och Gamla skolmuseet i Linköping* (1995) /On the collection of wall charts for schools and the Old school museum in Linköping/ In Sweden, object lessons seem to have disappeared as a concept, at least if we are to judge by the major Encyclopaedias. As late as in 1948, Encyclopaedias still included articles on subject-lessons.
[4] Rein, W., *Encyclopedisches Handbuch der Pädagogik* (II. Auflage) Bd. 1. 1903, p. 200.
[5] *Encyklopädie Erziehungswissenschaft,* Bd. VII, 1985, p. 331.
[6] Glenstrup, 1991, p. 84.
[7] Rein, W., 1903, p. 207.
[8] Ibid., p. 200.
[9] Ibid., p. 202.
[10] Ibid, p. 201.
[11] Ibid.
[12] Ibid., p. 203.
[13] This quotation is from Mr Neil's lecture "The Psychology of Blindness, and the Education and Training of the Blind", where he cites the american historian William H. Prescott (1796–1859) who, in spite of severe visual impediment wrote an important work on Spain under Ferdinand II and Isabella I, based on sources other than printed material. *Yourshire School for the Blind. Report of the Jubilee celebration and of the Conference of managers & Teachers*, July, 1883, p. 73.
[14] The second main point was relief writing and different printing techniques.
[15] *Verhandlungen des VII. Blindenlehrer-Kongresses in Kiel vom 3. Bis 7. August* 1891, Kiel 1892.
[16] Merle, H., in *Verhandlungen des VII. Blindenlehrer-Kongresses in Kiel vom 3. Bis 7. August* 1891, 1892, p. 114 et seq.

I. Der Anschauungsunterricht dient zur Bidlung von Anschauungen, auf welchen Vorstellungen, Urteile und Begriffe basieren, zur Bildung der Sinne, besonders des Tastsinnes und zur Bildung der Sprache.

II. Wenn der Anschauungsunterricht für sehende Kinder schon von grosser Wichtigkeit is, so bildet er für das blinde Kind das Hauptmoment der Erziehung, weil dieses nicht imstande ist, aus eigner Machtvollkommenheit seine Anschauungen in nennenswerter Weise zu erweitern.

III. Der Anschauungsunterricht ist in allen Klassen als selbständiger Unterricht zu betrachten. In den unteren Klassen ist er als Hauptglied des ganzen Unterrichts zu betrachten, in den oberen Klassen so viel als thunlich mit Handfertigkeitsunterricht zu verbinden.

IV. Der Anschauungsunterricht is durch den Modellierunterricht angemessen zu ergränzen.

V. Der stoff für den Anschauungsunterricht ist dem Entwickelungsgange des Kindes anzupassen, gestaltet sich als vorbereitender und begleitender Unterricht für die meisten Fächer, besonders für naturgeschichlichen und deutschen Unterricht und is demgemäss durch einen bestimmten Lehrgang zu ordnen.

[17] Ibid., p. 118 et seq.

[18] Krause, K., "Fröbel in der Blindenschule", Vortrag, gehalten bei Gelegenheit des IV. Allgemeinen Blindenlehrer-Kongresses zu Frankfurt a.M., am 25, juli 1882; Öman, B.-L., *Fröbels lekteori och lekgåvor,* Lund 1991.

[19] Bertha von Marenholtz-Bülow was a close friend of Froebel's and when he died, she continued to work towards the realization and development of his ideas.

[20] Öman, B.-L., 1991, p. 37.

[21] Ibid., p. 13.

[22] Mell, A., 1900, p. 403.

[23] Krause, K., 1882, p. 24.

[24] Ibid., 1882, p. 14 et seq.

[25] The ball on a string is part of Fröbel's first play-gift and was intended for the small child, i.e. children only a few months old. The idea was that the mother should play with her child and swing the ball in different directions to give the child a concrete idea of spatial concepts.

[26] Krause, K., 1882. p. 15 et seq.

[27] Ibid., p. 17.

[28] Fröbel's pedagogy had been introduced at the Zürich institute by Marie Bürkl. She had visited institutions for the blind in Illzach, Berlin, Stegliz, Kiel and Vienna. *Denkschrift zum hundertejährigen Bestand der Blindenanstalt Zürich 1809–1909.*

[29] *Denkschrift zum hundertejährigen Bestand des Blindenanstalt Zürich 1809–1909*, p. 121 et seq.

[30] Ibid., p. 123.

[31] Wiberg, A. F., "Maal och Midler for fysikundervisningen i Blindskolen", *Aarsberetning om Det Kgl. Blindeinstitut i 1894–95,* 1895, p. 35.

[32] Ibid., p. 35. A. F. Wiberg elaborated on this problem in his article "Hvorledes udvikles og kontroleres den blindes Rumsopfattelse?" Extract from proceedings from the *VI Nordiska Mötets för Abnormsaken,* 1915.

[33] Wiberg, A. F., 1895, p. 38.

[34] Ibid., p. 40.

[35] Ibid.

Enhver Laerer, som forsögt at forklare blinde Børn saadanne Forhold som Kraftens Opløsning, Kaste- och Bølgebevaegelse, Varmestraalernes Brydning och Tillbagekastning, Varmens Afhaengighed af Solstraalernes Retning o.l, vil sikkert have vaeret nødt til at framstille ophøjede Tegninger. Det gaelder her om at anskueliggöre Liniers Retning og Forhold. At en saadan Anskueliggörelse er mulig ved Relieffremstillning, vil selv Billedernes ivrigste Modstandere indrømme. Relieftegningen spiller her en lignende Rolle som Kortet ved Geografiundervisningen. I Stedet for haandtegnede Fremstillninger vil det vaere en Lettelse at have gode Relieftryk. Jeg tror derfor, de fysiske Relieffremstillninger, der forberedes fra tysk Side, ville afhjaelpe et virkeligt Savn.

[36] Ibid., pp. 42–44.

[37] Evans, E., "Elementary Experimental Science for the Blind", *The Teacher of the Blind,* Oct. 1921.

[38] Ibid., p. 90–93.

[39] Mell, A., 1900, p. 542.

Man führe den Zögling in den Garten, ins Feld, in den Wald, lassen ihn die Gewäschse und ihre einzelnen Theile betasten, und er wird sie bald unterscheiden lernen, Gewächse planzen und ihrer warten. Von grossen Bäumen lehre man ihn einzelne Theile, Blätter, Zweige, Rinde, u.s.w. kennen und gebe ihm die Höhe und Ausbreitung der Äste nach ungefährem Masse, um ihm einen Begriff von dem Ganzen zu verschaffen. Dannlasse man ihn Thiere (lebende) mit der nothighen Vorsicht befühlen.

[40] Mell, A., 1900, p. 542.

[41] *Beretninger om det kongelige Blindeinstitut i Kjøbenhavn 1884–1887*. År 1884–85.

[42] Zech-Königsthal, "Gedanken über den naturgeschichtlicher Unterricht in der Blindenschule". *Der Blindenfreund* 2–3/1900.

[43] Ibid., p. 37 et seq.

[44] Zech-Königsthal, "Gedanken über den naturgeschichtlicher Unterricht in der Blindenschule", *Der Blindenfreund* 3/1900

[45] *Lehrplan für die Rheinschen Provinzial-Blinden-Unterrichts-Anstalten,* Düren, 1915, p. 33.

Der naturgeschichtliche Unterriht soll den Zöglingen die Bekanntschaft mit den wichtigsten heimischen und fremden Naturkörpern nach ihrem Bau, ihren Eigenschaften, ihrem Vorkommen und ihrer Bedeutung im Haushalt der Natur und für den Menschen vermitteln. Er soll Verständnis und Teilnahme für die hauptsächlichsten Lebenserscheinungen und Lebensbedingungen in der Tier- und Pflanzenwelt, sowie im Menchenleben wecken und zum Natur- (Tier- und Pflanzen-) schutz erziehen. Die gewähnung der Kinder zu einer aufmerksamen Beobachtung und ihrer Erziehung zu sinniger Betrachtung der Natur is überall zu erstreben.

[46] Pöschl, J., 1910, p. 135.

[47] Armitage, T. R., *The Education and Employment of the Blind: what it has been, is and ought to be.* 1886, p. 33.

[48] Kunz, M., "Über den geografischen Unterricht in der Blindenanstalt" (1882), 1907.

[49] Kunz, (1882), 1907.

[50] Armitage, T. R., *The Education and Employment of the Blind: what it has been, is and ought to be,* 1886 (2nd ed.), London, p. 33.

[51] Krüger, F., *Der Blindenfreund,* 1884, p. 66.

[52] Ibid., p. 75. Krüger even suggested that the globe should be kept in a sewing-machine case when it was not used.

[53] Krüger, F., 1884, p. 65–77.

[54] Ibid., p. 77.

[55] Ibid., p. 75.

[56] Eriksson, Y., Strucel, M. *A Guide to production of tactile graphics on swellpaper,* 1994.

[57] Krüger, F., 1884, p. 75.

[58] Ibid., p. 76.

[59] Ibid.,
[60] Pöschl, J., 1910, p. 135. This teaching method is still in use, for example in the teaching of picture and form at the Resource centre of Tomtebodaskolan.
[61] "Möte i Kjøbenhavn af den abnorme Skoles Lärere og Lärerinder", *Nordisk Tidskrift för Blinde-Dövstumme- og Idiotskolen*, 1868, p. 105.
[62] Kunz, M. (1882), 1907, p. 61.
[63] Ibid., p. 107.
[64] Ibid. ... Zuerst wird das darzustellende Gebiet in groben Zügen, aber in den Hauptdimensionen richtig, auf das Brett gezeichnet. Die wichtigsten Punkte, namentlich die Biegungen der Flussläufe, Flussmündungen, Seen, Pässe und Berggipfel werden durch stärker markierte Punkte und die entsprechenden Höhenzahlen angedeutet (der Blinde, der diese Arbeiten ausführen will, muss natürlich gleich die Nägel schlagen); dann wird die Höhenskala bestimmt, z.B. 1:300 000, d.h. 0,001 m pro 300 m = 1 000'.
[65] 'Ferner werden die Flüsse durch blaue Strickwolle, die, je nach der Wichtigheit der Wasserläufe, ganz genommen oder gespalten und gegen die Quelle zu durch Drehen verdünnt wird, — die Seen durch blaues Paper, die Verherswege durch Seidenfäden und die Ortschaften durch Glasperlen oder Nägel angedeutet. Ist die Karte so ausgeführt, dass sie bleibenden Wert hat, so word der Lehrer gut tun, sie abzugiessen, um so mehrere Exemplar zu gewinnen. Er kann sowohl Gips als andre derartige Massen dazu verwenden.'
[66] G.F.R., "The Teaching of Geography", *The Teacher of the Blind*, Apr. 1922, p. 11–13.
[67] Freeberg, E., "More Important Than a Rabble of Common Kings": Dr. Howe's Education of Laura Bridgman" *History of Education Quarterly*, 3/1994, Vol. 34, p. 312; Katz, M., B., *The Irony of Early School Reform*, 1968, p. 131–138.
[68] Katz, M.,1968, p. 131–138.
[69] *Ninth Annual Report of the Trustees of the Perkins Institution and Massachusetts Asylum for the Blind*, Boston, 1841, p. 24.
[70] Ibid., p. 25.
[71] Ibid., p. 26.
[72] *Ninth Annual Report,* 1841.
[73] Ibid., p. 29.
[74] Ibid., p. 30.
[75] Coon, N., *The Place of the Museum in the Education of the Blind,* American Foundation for the Blind, New York, 1953, p. 16.
[76] The *Toy-book with Imitation of the Versus* described in Chapter IV is an example of this.
[77] Johansen, F., *Sådan fik danske blinde et skriftsprog*, 1983, p. 109 et seq. Flensborgs teaching was based on the methods developed by Margrethe Marstrand.
[78] Agnes Melchior, "Något om illustrationer och teckning som medel i undervisningen av bilda barn i Danmark". /Some comments on illustrations and drawings as a tool in the teaching of blind children in Denmark/. A lecture given at the 13th Esperanto Congress for the Blind, Stockholm 1934. The lecture is translated and copied from braille by Birger Wiggen.
[79] Ibid.
[80] *Det Kgl. Blindeinstitut paa Refsnaes 1898–1. November 1948,* 1948, p. 55–63.
[81] Ibid. P. 56. In a speech at the Congress of Teachers of the Blind in Colongne, Johann Oppel discussed "Die Sprache der Blinden" and explained the importance of providing the blind pupils with ample experience of the words and concepts taught.
[82] *Der II. Europäische Blindenlehrer-congress*. Dresden, 1876, p. 87–104.
[83] Ibid., p. 87.

[84] Heller, Th. in *Philosophische Studien,* (ed.) Wilhelm Wundt, 1895.
[85] Heller, S., 1876, p. 89.
[86] Ibid., 89–104.
[87] Ibid., p. 89–104.
[88] Heller, S., 1885, p. 136.
[89] Ibid., p. 136–137.
[90] Benett, T., *The Birth of the Museum*, 1995, p. 213.
[91] Schulz, E., "Notes on the history of collection and of museums", *Journal of History of Collections* 2(2)(1990), pp. 205–218.
[92] This development has been shown by Karen Wonder in *Habitat Dioramas. Illusions of Wilderness in Museums of Natural History,* 1993.
[93] Mell, A., 1900, p. 577.
[94] Coon, N., *The Place of the Museums in the Education of the Blind*, 1953.
[95] Mell, A., 1900, p. 520.
[96] Coon, N., 1953, p. 10.
[97] Many of the museums founded during the 19th century by different institutes still exist, and are open to the public, even if not on a regular basis. They are normally funded by voluntary associations, as the state grants to museums generally are too limited to cover costs of personnel. Those who are in any way involved in the activities of the institutes, or who are active in associations, normally participate without receiving any financial compensation. Consequently, the collections are not as well-conserved as they should be, considering that many of the objects on display are quite unique.
[98] Mell, A., 1900, p. 520.
[99] *Der Blindenfreund,* No. 2, 1887, p. 32.
[100] Mell, A., 1900, p. 520.
[101] Ibid., p 521.
[102] Coon, N., 1953, p. 36.
[103] Ibid., p 10.
[104] Ibid.
[105] More detailed information was given in my essay "Tactile pictures", *Tactile—Not to see, but to touch*, Catalogue of Nationalmuseum, Stockholm, 1994.
[106] Deas, J. A. Ch., "The showing of Museums and Art Galleries of the Blind", *The Museums Journal,* Sept. 1913, p. 85–89.
[107] Ibid., p. 91.
[108] *The Beacon,* July 1929, p. 10.
[109] Coon, N., *The Place of the Museum in the Education of the Blind,* American Foundation for the Blind, 1953.
[110] Ibid., p. 11.
[111] *De Blindas tidskrift,* 1928/5, p. 12.
[112] Freeberg, E., "More Important Than Rabble of Common Kings"; Dr. Howe's Education of Laura Bridgman", *History of Education Quarterly,* Fall 1994, p. 306.
[113] *The Beacon,* July 1923, p. 5 et seq.
[114] Ibid., p. 5–7.

Chapter VII:
Models and pedagogical theories on modelling and drawing in schools for the blind

[1] Maria Montessori, Fröbel, F. W., Steiner, Rudulf, H. Gardner and others.
[2] Viktor Lowenfeld, Ellen Winner, Matti Bergström and others.
[3] Eriksson, Y., *Att känna bilder*, 1997, p. 98–108.
[4] See: Kennedy J. M, 1993.
[5] Münze, L., Löwenfeld, V., *Plasticher Arbeiten Blinden*, 1934; Büttner, A., *Das Formen und Zeichnen in der Blindenunterricht*, 1890; Heller, S., *Modelliren und Zeicnen in Blindschule*, 1891.
[6] Ibid., Hecke, R., "Warum und wie ist das Modellieren in Blindenanstalt zu treiben?" *Der Blinderfreund*, 10/1887.
[7] Ercole Lelli (1702–1766) placed anatomic models of wood and wax at the disposal of the anatomic-pathologic cabinet at the University of Bologna. The cabinet was meant for students of surgery and drawing. Lelli's student Giovanni Mazollini (1700–1755) was never recognized, in spite of his studies and the large number of models he produced. After his death, his wife Anna (né Morand) continued the art.
[8] Engelbert, D., *Ideen über die beste Anwendung der Wachsbildnerei,* 1798, p. 86.
[9] Ibid.
[10] Davids, A. B., "Louise Thomas Jerôme Auzoux and the paper mâchéz anatomical model", *Atti del congresso internazionale sulla ceroplastica nella scienza e nell'arte (Firenze 3–7 giugno 1975)*, pp. 257–274.,
[11] Ibid., p. 272.
[12] Martin Kemp has poinited out that no new configuration of vision was created, even when the results of Copernicus's and Kepler's research and visual insight produced knowledge on the complex relation between celestial bodies and their orbit around the sun. Kemp, M., "Temples of the Body and the Body and Temples of the cosmos: Vision and Visualization in the Vesalian and Copernican Revolution", *Picturing Knowledge. Historical and Philosophical Prblems Concerning the Use of Art in Science,* 1996.
[13] Ibid., p. 67.
[14] Ibid., p. 71.
[15] There are many examples with which the wide-ranging application of models can be illustrated. At the National Marine Museum in Stockholm, there is a model of a warship, dating from about 1790, of the type preferred by Crown Prince Gustav Adolf. According to information on index cards dating from 1913, this model was once used at the drill school in Stockholm. The high quality of the model indicates links with the real vessels built in the 1780s at Karlskrona. It is said to have been sent to the Military Academy at Karlberg in Stockholm. Both military and naval cadets were trained at the academy, which explains the need for teaching models. At the World's Fair in Chicago in 1896, Denmark exhibited in its pavillion a 1:5 scale model of a "sloyd" classroom built to the plans of the Danish pioneer in sloyd, Axel Michelsen. The model was left behind in Chicago, but in the years between 1940 and 1949, Valdemar Clausen, a sloyd teacher, made a copy of the lost model. The model represents, in minute detail, everything that should be to hand in a sloyd classroom. They say that the tiny planes are so perfectly made that they can actually be used for planing. A model of a gymnasium was made in Denmark by the architect who designed the full-scale gymnasium. This particular model was made for the Kongresse for Skolebyggerner, held 2–7 August 1910.
[16] Plenge, J.,1958, p. 29.

[17] Ibid., 1958, p. 30.
[18] At many of the institutes where visually impaired pupils were taught, there are models of the institute itself.
[19] Mell, A., "Handfertigkeiten und Arbeiten verschiedener Art." *Der Blindenunterricht,* 1910, p. 212.
[20] Büttner was "Hofrat" and director of the Institute for the blind in Dresden.
[21] See annual reports form late 19th century.
[22] An example of a collection of postcards can be seen at Prov. Blindenunterrichtanstalt in Neuwieder, from 1932. Archive: Blinden-Museum Berlin/Steglitz.
[23] In a film made to celebrate an anniversary of the school at Tomteboda in 1930, in which some of the activities are shown, there is a sequence involving modelling from plaster models.
[24] Hand exercises were also stressed in relation to Braille reading.
[25] Heller, S., *Modellieren und Zeichnen in der Blindschule*, 1891, p. 6 et seq.:
1. Wenn wir mit der Hand und ihren Glieder Dehnungen und Pressungen ausführen; dadurch wird die einfachste aber auch grundlegende räumliche Auffassung, die Unterscheidung unserer Hand und ihrer Glieder in Bezug auf ihre Lage im Raum erzeugt. Je grösser die Beweglichkeit der Theile gegen einander ist, desto schärfer können dieselben von einander gesondert werden, und desto sicherer wird die Grundlage räumlicher Unterscheidung gebildet.
2. Wenn wir under eigenes Tastorgan betasten. Hierbei kommt die Underscheidung des Tastorganse von dem Tastobjecte zum Bewusstsein und dieses wird
3. Zur Auffassung der gestalt erweitert, wenn das Tastorgan sich an Gegenständen ausserhalb seiner selbst hinbewegt, so fortschreitend von einander ernfernte Punkte berührt und die hierduch erzeugten Empfindungen sammeln zu einem immer grösseren Ganzen vereinigt.
[26] Heller, S., 1891, p. 7. More than 20 years later, Wiberg, a teacher at the Blindinstitut in Copenhagen, investigated the problems related to tactile reading. He carried out an experiment in which he filmed blind pupils who were extremely clever at recognizing objects by touch. After studying their techniques, he used his findings in his own teaching of less able pupils, by showing them techniques which they could apply to the interpretation of objects by touch. The result of this study was presented in a pamphlet in which Wiberg shows in words and pictures how an object should be read by touch in order to become totally familiar with it. A.F. Wiberg (1926), *Den blindes følemetoder. Foredrag hold ved det syvende nordiske möde för abnormsagen i Trondhjem 1926.*
[27] Heller, S., 1890, p. 8.
[28] Ibid., p. 9.
[29] Ibid.
[30] Ibid., p. 12.
[31] Mell, A., 1900, p. 510.
[32] Heller, S., 1891, p. 19.
[33] Ibid.
"Diejenige Modelle, welche im Anfange Anwendung finden, müssen vor allem dem tastende Finger einen gewissen Wiederstand entgegensetzen, ohne etwas von ihrem Stoffe abzugeben; die Kanten und Ecken sowie die abgerundeten Formen müssen deutlich hervortreten. Es eignen sich am besten Modelle aus Holz und aus gut gebranntem Thon für die Darstellung von Grundformen, und harte Früchte, Wekzeuge und Geräthe aus Holtz und Metall für die von Lebensformen, wogegen Gypsmodelle, weiche Früchte und Biegsame ealstiche Lebensformen möglichst auszuschliessen sind."

John M. Kennedy is the contemporary researcher who has underlined the importance of the edge and the corners to tactile reading.
[34] Heller, S., 1890, p. 19.
[35] Ibid., p. 22.
[36] Ibid., p. 24.
[37] Ibid., pp. 27–28.
[38] Ibid., p. 29 et seq.
[39] Ibid., p. 30 et seq.
[40] Büttner, A., *Das Formen und Zeichnen im Blinden-Unterrichte,* 1890, pp. 8–12.
[41] *Der Blindenfreund* 10/1887.
[42] The schooling considered here was of two years in kindergarten plus another six years.
[43] Mell, A., 1900, p. 510 et seq.
[44] Ibid.
[45] Mell, A., 1900, p. 510 et seq.
[46] *Beretning om det Kongelige Blindeinstitut i Kjöbenhavn 1884–1887.*
[47] Mell, A., 1900, p. 510 et seq.
[48] *Beretning om det kongelige Blindeinstitut i Kjöbenhavn* 1884–1887.
[49] *Kongl Blindinstitutet å Tomteboda vid Stockholm. Redogörelse för skolåret 1888–1889,* p. 12.
[50] Borg, O.E., *Minnen från Den svenska bildundervisningens 75-års jubileum,* 1883, p, 11. The "sloyd"-seminar in Nääs started in 1874.
[51] M.b. Schenckendorf-Görlitz, "Die pädagogische und sociale Bedeutung erziehlicher Knabenhandarbeitund ihre praktische Durchführung" Deutsches Congress für Handfertigkeits-Unterricht zu Stuttgart 1886, mit Anmerkungen für die Blindenschule. *Der Blindenfreund,* 3/1887–6/1887.
[52] "Die Hand wird zur Bewegung und zu gewissen Thätigkeiten geübt, zuerst dass das Kind anfange, se in der Gewalt zu haben und sie auf das Verlangen seiner Vernunft zu bewegen, dann dass das Kind anfange, dann dass es seine Arbeit ohne augenscheinliche Fehler hervorbringe, und endlich auch schön und schnell arbeite" from *Der Blindenfreund,* 3/1887, p. 38. In Swedish in J. A. Comenius (1657) *Didactica Magna* Daidalos (1989) p. 208.
[53] Trybom, J. H., "Sloyed", *The Mentor,* 1892/5, 1892/6 Vol II.
[54] Trybom, J. H.,"Sloyd", *The Mentor,* 1892/5, Vol II, p. 161.
[55] In "Om 'folkkonst' och andra moderniteter", Lena Johannesson wrote about "sloyd", and mentions that Swedish "sloyd", that impossible-to-translate cultural invention, had conquered the world long before "smörgårbord" or "ombudsman" commenced their odyssey. *Folkkonsten—all tradition är förändring,* 1992, p. 32.
[56] Trybom, J. H., "Sloyd", *The Mentor,* 1892/5, Vol II, p. 162.
[57] Ibid.
[58] Trybom, J. H., "Sloyd", *The Mentor,* 1892/5, Vol II, p. 206.
[59] D. Dietrich, teacher at the Kgl. Blindenanstalt in Dresden and S. Köhler, teacher at the Kgl. Blindenschule in Moritzburg.
[60] *Lehrgang für den Unterricht in Holzarbeiten in den Blindenanstalten,* Dresden, 1891.
[61] *Kongl. Blindskolan i Vexiö, Redogörelse för läsåret 1884–1885,* p. 10.
[62] Anrep-Nordin, E., *Berättelse över Anstaltens Verksamhet under dess tjugofemte arbetsår 1910–1911 jämte Återblick i den förflutna 25-års-perioden.* 1911, p. 92 et seq.
[63] Heller, S., 1891, pp. 34-35: "Dem Schüler werden in stufenförmiger Anordnung Schönhetsformen, welche auf geometrische Grund- oder auf Naturformen zuruckzuführen sind, als Modelle vorgelegt; im weiteren Fortgange des Unterrichtes wird der

Schüler angehalten, solche Formen von Gegenständen zu abstrahieren und schliesslich selbst zu combinieren. Die Fertigkeit, Planzen und Thierformen nachzubilden und Theilen des menschlichen Körpers darzustellen, wird für diesen Zweck ebenfalls in Anspruch genommen."

[64] Münz, L., Löwenfeld, V., *Plastische Arbeiten Blinder,* 1934, p. 10 et seq. The study occupies a unque place in history and has not direct follower. In 1992, Arnehim carried out a similar study "Perceptual aspects of art for the blind", *To the Rescue of art: twenty-six* essays, 1992.

[65] L. Münz, V. Löwenfeld, *Plastische Arbeiten Blinder*, 1934. Viktor Löwenfeld was best known for *Creative and Mental Growth* (1947).

[66] Burde, "Die Plastik des Blinden", Sonder-Abdruck aus der Zeitschrift für angewandte Psychologie, 1910, Leipzig.

[67] Viktor Löwenfeld: "Vom Entstehen der Plastiken" in L. Münz, V. Löwenfeld (1934) *Plastische Arbeiten Blinder.*

[68] L. Münz, V. Löwenfeld, 1934, *Plastische Arbeiten Blinder,* p. 100.

[69] Ibid.

[70] Ibid., p. 101.

[71] Ibid., p. 102

[72] Ibid., p. 103.

[73] Ibid., p. 104 et seq.

[74] Ibid., p. 105 et seq.

[75] Ibid., p. 107.

[76] Ibid. "Die praktische, die Hand, als Vermittlerin einer grossen Zahl von Eindrücken, durch die Konzentration auf kleinste reifbare Dinge zu schulen, und die geistige, die Konzentration auf die eigene Gedanken- und Gefühlswelt und deren Verwirklichung; diese Konzentration verdrängt die unproduktive passive Phantasie und führt, wie die Erfahrung heute schon lehrt, zum konkreten Denken. *Die Wirkung* nach aussen ist hingegen eine rein künstlerische und darf nie im Zusammenhange mit dem *Zweck* des plastischen Gestaltens für die Blindenschule genannt werden."

[77] Büttner, A., 1890, Heller, S., 1890 in Mell's Encyclopaedia "Bild und Bilder".

[78] Zech-Köningthal. "Das Zeichnen in der Blindenanstalt", *Der Blindenfreund 1894/October.*

[79] Frost, U., *Förlagor och teckningsläror*, 1988, p. 89.

[80] Heller, S., 1890, p. 38 et seq. Heller anticipated a debate which is very alive today on what a person with severe visual impairment atually perceives in a tactile picture. See also Chapters I and VIII.

[81] Ibid., p. 39: So ergibt sich aus der Zeichnung des *Zeichen* oder *die symbolische Darstellung*. Auf diese Weise erhebt der Zeichenunterricht Lehrmittel des Blindenunterrichtes, die in graphischen Darstellungen bestehen, zu wirkungsvollen Bildungsmitteln, welche sonst inhaltsam oder inhaltslos bleiben, da der Blinde nicht wie der Sehende fortgesetzt und in einem immer höheren Grade in der Schule der Vergleichung lernt.

[82] Heller, S.,1890, p. 39.

[83] See also Eriksson, Y., *Från föremål till taktil bild* samt *Att känna bilder,* 1997.

[84] Heller, S., 1890, p. 39 et seq.

[85] Ibid., p. 41 et seq.

[86] Ibid., p. 42. Today there is a lively debate on perspective representation in relief pictures and on the creative work produced by the blind.

[87] Heller, S., 1891, p. 47.

[88] Thilander, H., "Hvordan Blinde kan Laere at tegne", i *Medlemsblad for D.B.S.* 1929/21, årg. 14.

[89] Wiberg, A.F., "Tegning i Blindeskolen", *Nordisk Blindetidskrift*, 1936/1;

Thilander, H., 1929.
[90] Frost, U., 1988, p. 91–98.
[91] Thilander, H., 1929.
[92] Ibid.
[93] Ibid.
[94] Ibid.
[95] The leg to which the wheel was fixed could also be placed vertically to remain immobile during the exercise. This apparatus was made by Wildau. Wiberg, "Tegning i Blindeskolen", *Nordisk Blindetidskrift,* 1936/1.Wiberg, "Tegning i Blindeskolen", *Nordisk Blindetidskrift,* 1936/1.
[96] Ibid. I ask myself if this instrument was used by the pupils, or by the teachers for the production of pictures. The relief pictures made by Guldberg are kept at the Blindhistoriska museet in Copenhagen, and may well have been made with the help of this instrument.
[97] In *Verzeichnis der Lehrmittel und Schreibmaschinen für Blinde* (1906, pp. 11–12) by director Schleussner, the following information is given about the drawing board: Schon vor Jahrhunderten hat man sich bemüht, für Blinde, die sich wissenschaftlich beschäftigen wollten, Vorrichtungen auszudenken, durch welche die Herstellung von Reliefzeichnungen, besonders geometrischer Art, ermöglicht werden sollte und wissenschaftlich gebildete Blinde verstanden es vielfach, ihre Vorstellungskraft durch selbsterfundende sinnreiche Apparate zu unterstützen. Die meisten derselben sind jedoch entweder zu kostspielig oder zu umständlich in der Handhabung oder zu unvollkommen in der Leistung. In den letzten Jahrzehnten hat man, abgesehen von Modellierunterricht, von Welchem hier nicht gehandlet werden soll, nur Veranschaulichung der Raumlehre, Zeichnungen aus Rohrkern oder Wachsfäden von den Schülern herstellen lassen, die ihren Zweck in ziemlich befriedigender Weise erfüllten. Nur die Darstellung von Kreisen und ihren Teilen stiess auf Schwierigkeiten und befriedigte niemals wollkommen./ Das Bestreben, die blinden Schüler möglichst mit den gleichen oder doch wenigstens ähnlichen Mitteln arbeiten zu lassen, wie die Sehenden, führte zu den Versuchen, krummlinge Zeichnungen vermittelst eines Stachelradzirkels herzustellen. Sie hatten den Nachteil, dass die Zeichenfläche nach der Herstellung der Zeichnung umgewendet werden musste, um letztere dem tastenden finger wahrnehmbar zu machen. Abhänderungen oder Erweiterungen der Zeichnungen liessen sich nur sehr schwer oder gar nicht ornehmen. Diesen Uebelständen ist durch das in obiger Abbildung dargestellte Zeichnenbrett und den dazu gehörigen Zirkel abgeholfen.
English: Several centuries ago, attempts had already been made to invent a variety of apparatuses for those blind persons who wished to carry out scientific work; apparatuses which would enable them to produce relief drawings, especially of a geometric nature. Scientifically educated blind persons have also, in many places, managed to find methods of improving their perceptive capacity by means of ingenious apparatuses of their own invention. Most of these are, however, either too expensive or too complicated to use, or too inaccurate in their performance. Over the last few decades, with the exception of the teaching of modelling (which is not dealt with here), only geometry has been made accessible in object lessons. The pupils have been taught to make drawins using their "rohrkern" or wax thread and these have proved fairly satisfactory. The reproduction of circles and their parts, however, was difficult and never quite successful./. The efforts to let the blind pupils work, as far as possible, with the same or similar materials as the sighted led to attempts to produce curved figures with a set of compasses which had a notched wheel. The disadvantage was that the drawing surface had to be turned over once a drawing had been made, to check with the finger whether the drawing was successful. Modifications or exten-

sions of drawings were difficult or impossible to make. This disadvantage can be eliminated with the drawing-board and the corrsponding compasses pictured above.
[98] Agnes Melchior (1883–1945 She was a visually impaired pre-school teacher for blind children). "Något om illustrationer och teckning som medel i undervisningen av blinda barn i Danmark." Lecture given at the 13th Esperanto Congress for the visually impaired, Stockholm 1934. The lecture was translated into Swedish by Birger Wiggen who brought it to my notice.Translated by Briger Wiggen·
[99] Zech-Köningsthal, "Das Zeichnen in der Blindenanstalt", *Der Blindenfreund* 11–12/1894.
[100] See: Büttner, A., 1890; Heller, S., 1891, p. 38 and Mell, A., 1900. p. 855. When modelling and drawing teaching started in earnest at the institutes for the blind, in the 1890s, Alfred Lichtwark started the teaching of art at Hamburger Kunsthalle. Lichtwark initiated the art-pedagogic work as director of the institute in 1886. His aim was to awaken children's interest in art but also to teach them to see. The basic principle of Lichtwark's pedagogy was to start from things that were known to the pupil and to proceed gradually to the unknown. The pupils also learned to verbalize what they saw, i.e. to give a picture description. Anna-Lena Lindberg (2nd edition, 1991), *Konstpedagogikens dilemma*, p. 122, 140 et seq.
[101] Anrep-Nordin, E., 1911, p. 203.
[102] Ibid., p. 203 et seq. The text was originally published in *Psyke*, 4:e year of publication. volumes 2 and 3, 1909.
[103] Ibid., 1911, p. 203–204.
[104] Eng, H., *Barnetegning,* 1922, Goodenough, F. L., *The measurement of intelligence by drawings,* 1926.
[105] In *Die umgekehrte Perspektive und die Fluchtachsenperspektive* Anders Almgren (1971) has written about early researchers into the subject. Among them he mentions Georg Kerschensteiner (1905) *Die Entwicklung der zeichnerschen Begabung.*
[106] This drawing board was constructed by the then headmaster of Tomtebodaskolan, Gustav Ek.
[107] Katz, D., 1945, p. 118.
[108] Ibid., p. 130 et seq.
[109] Ibid, p. 134 et seq.
[110] Ibid., p. 133.
[111] Ibid., p. 142.
[112] Ibid., p. 142 et seq.
[113] Ibid., p. 148 et seq.

Chapter VIII: Concluding discussion

[1] Baigrie, B. S., "Descartes's Scientific Illustrations and "la grande mécanique de la nature", *Picturing Knowledge. Historical and Philosphical Problems Concerning the Use of Art in Science.* 1996, p. 87.
[2] Ibid., p. 123 et seq.
[3] This has been dealt with in detail by Barbara Maria Stafford in *Body Criticism. Imaging the Enlightenment Art and Medicine,* 1991.
[4] See Lena Johannesson, "Darwin som den felande länkande? Om den vetenskapliga illustrationen som källa och felkälla: från fysionomister till NVC-forskare", 1987.
[5] See Stafford, B. M., *Artful Science. Enlightenment Entertainment and Eclipse of Visual education,* 1994.
[6] Heller, Th. 1895; Katz, D., 1945; Kennedy, J. M., 1992, 1993, and others.

[7] Katz, D., 1945.
[8] Katz, D., 1945, Hans Pettersson maintains, erroneously, that David Katz's contribution to gestalt psychology was marginal and of little or no consequence, Strangely enough, he makes this statement while quoting from Gregor Paulson's *Upplevt* (Borås, 1974, p. 51) in which the author mentions the importance of Katz's theories. Pettersson. H., *Greger Paulson och den konsthistoriska tolkningsproblematiken*, 1997, p. 53, note 15 (p. 221).
[9] Heller, S., 1891; Büttner, A., 1890.
[10] Langer, S. K. *Philosophy in a new key,* (1942) 1951, p. 68.
[11] Ibid., p. 70.
[12] John M. Kennedy has brought Edgar Rubin's study to the fore, in relation to the understanding of tactile perception. Kennedy, J. M., 1993.
[13] Koffka, K., *Principles of Gestalt Psychology,* London, 1935, p. 208–210.
[14] Boring, E., 1950, p. 600 et seq.
[15] Wick, R., *Bauhaus Pädagogik,* 1982, p. 108.
[16] Ibid., p. 156.
[17] Ibid.
[18] Ibid., p. 159.
[19] Vischer, "On the Optical Sense of Form: A Contribution To Aesthetics" (1873), *Empathy, Form and Space,* 1994, p. 94.
[20] Ibid., p. 95.
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The pedagogical methods of the object-lesson have played an important role in the teaching of the blind. In order to clarify concepts an phenomena, teacher of the blind made use of relief pictures and maps and models. The pictures and maps produced specifically for the teaching of the blind were from early date based on theories of tactile perception. Different techniques were employed in the production of tactile maps and pictures, and their quality depended very much on the skill and knowledge of the persons who made them. Vital factors in the production of successful tactile pictures and maps were a knowledge and understanding of tactile perception, artistic and technical skill, and the ability to bypass visual conventions in favour of tactile qualities. *Tactile pictures. Pictorial representations for the Blind 1784–1940* is the first comprehensive investigation of the representation of pictures for the visually impaired from the perspective of history and the theory of pictures.