Part II: **The Specific Design of Isotype Picturebooks**

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The Magic Knife: Marie Neurath's Use of Sectional Drawings in Isotype Informational Picturebooks for Children

1 Introduction

"We have all been inside a house," reads the text below the sectional drawing of this family home, underscoring the familiar (Figure 1). However, as, the heading suggests, this Isotype informational picturebook invites children to adopt "a strange way to look at a house" (Neurath 1948a, 14). And indeed, the sober architectural line drawing departs from more conventional depictions of houses in children's literature. This transformation of the familiar gaze into the "strange way" of looking is achieved through the magic powers of the graphic designer, who possesses special tools: "but how different [the house] looks", Marie Neurath explains, "when it is cut through with our magic knife!" (ibid.)[1]

Marie Neurath's use of the metaphorical "magic knife" in explaining sectional drawings serves as a mental bridge for young readers. In this metaphor, the familiar concept of a knife, usually associated with cutting or slicing, is employed to make the abstract idea of sectional drawings more accessible. Just as a knife can reveal the inside of an object when it cuts through it, the "magic knife" metaphor suggests that sectional drawings, like the cuts, unveil the inner details of a subject. This metaphor acts as a cognitive tool, connecting the tangible and known idea of a knife to the more abstract concept of graphic design techniques. It helps children grasp the idea that, just like a knife reveals what's inside, sectional drawings expose the inner workings and structures of things in a visually engaging way. In this way, the metaphor enhances the understanding of graphic design for young minds by providing a relatable analogy.

The magic knife opens up "[a] strange way to look" at the world, presenting it in sectional views. A graphic technique familiar from scientific and technical drawing, sectional drawings transform the way we look at things, establishing meaningful relationships between outside and inside, above and below, the visible and the hidden, cause and effect. This magic-knife technique of sectional re-

1 In the following, Marie Neurath is considered as the main transformer and author. However, as she clearly stated in her essay on transformation, the books were the result of the collective team effort of the various members of the Isotype Institute, including researchers, designers, experts, and printers, which she referred to as "a little factory" (cf. Walker 2013a, 399).

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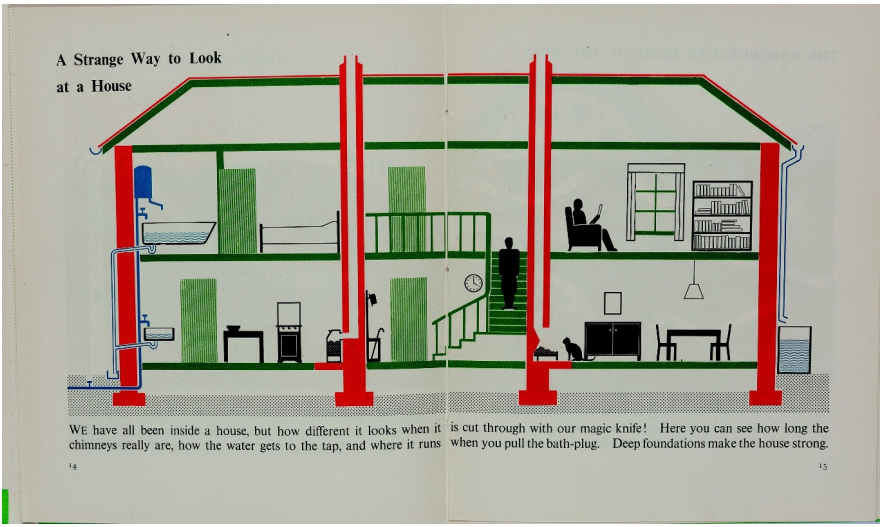

Figure 1: *If You Could See Inside* (1948) by Marie Neurath, pp. 14–15. Architectural cross-section of a family home. Otto and Marie Neurath Isotype Collection, University of Reading.

presentation is a powerful visual tool that plays an important part in Isotype informational books.[2] More broadly, however, sectional views are a key graphic technique in many fiction and non-fiction children's books that present information about what is usually hidden from view. It is all the more surprising that there seem to be no systematic descriptions or studies of sections in children's book. Therefore, while this chapter focuses on Marie Neurath's specific approach to and use of sectional drawings, it also aims to make a broader contribution to research on informational picturebooks by proposing a general typology and terminology for adequately describing and analyzing sectional views (cf. von Merveldt 2018, 242).

While I will cite a few examples from later books, I focus my analysis on the first Isotype book that systematically explores this "strange way of seeing", *If You Could See Inside* (1948). It lays the technical and ideological groundwork for the many Isotype books to follow. Before taking a closer look inside this book, however, it is revealing to go back to Otto Neurath's autobiographical memories, in which he reflects on how sectional views shaped his own personal visual educa-

2 In her exhibition booklet "Marie Neurath. Picturing Science", Sue Walker names and illustrates five major "picturing techniques" used in the Isotype Institute's informational books for children: magnification, cross-section, comparison, component parts, and narrative sequences with repeated base images (Walker 2019).

tion as a child in Vienna and how these impressions informed the Isotype approach to children's books in the London exile. It is within this larger general context of sectional drawings and the specific context of the Isotype Institute that the true contribution of Marie Neurath will become most clearly apparent.

2 Topics and typology of sectional drawings

The topics covered in *If You Could See Inside* range from architecture (house, lighthouse, pyramid, fortress) to biology/anatomy (homes of moles and wasps, chick embryo in an egg), and from geology (cave, volcano, mine) to science and technology (windmill, diving bell, ferry train). Not incidentally, these four domains are the disciplines that rely most heavily on the visual strategy of cross-sections for documenting, visualizing, and transmitting their knowledge (Yee 2020). Architecture and engineering work with blueprints of buildings and plan drawings to help plan construction and communicate with clients; geology uses cross-sections to show the different underground layers of rock, soil, other geological formations and structural features such as faults and folds, visualizing geological time in space; technology (inventions and transportation) focuses on the inner workings and thus the functioning of machines and mechanic inventions; and anatomy, the science of the structure of bodies, carries the idea of cross-sections in its very name: the Greek verb *anatomein* means "to cut open, to dissect". Medicine, biology, and anatomy are the only disciplines using real knives (or rather specialized surgical instruments) to perform real cuts that can be realistically represented (Wall/Mazierski 2018). While geological cross-sections are based on data collection from various sources, including field observations, borehole data, and seismic surveys, architects and engineers draw on plans and construction documents. They strategically choose their section planes, the vertical or horizontal line, which represents the cut through the building, structure, or formation to reveal what they choose to focus on, depending on the specific function of the cross-section. Whether real or imaginary, the section cuts offer new and revealing perspectives on familiar sights.

The most basic function of section drawings is to "reveal [. . .] through pictures things otherwise inaccessible and hidden from view" (Richards 2017, 86). They can serve various functions ranging from documenting, investigating, planning, constructing, communicating, and promoting (cf. Ross 2017). While magnification, the other graphic technique of showing the hidden, is a visual strategy solely enabled and assisted by technology (Wall and Mazierski 2018, 144–145, 152), cross-section views mainly rely on the powers of conceptualization and imagina-

tion. Sections do not copy an image produced by a technical device such as a microscope or telescope, but visually deconstruct, disassemble, uncover, and reveal what cannot be seen otherwise. Sections are – for the most part – acts of the imagination, extrapolations of sample views, conceptualizations of intellectually reconstructed contexts.[3] The hypothetical title of the first Isotype book beginning with "What if . . ." refers to this imaginary and conceptual quality of section views. The intellectual act of cutting through visual obstacles to reveal and understand the hidden often seems to take on magical powers – hence Marie Neurath's metaphor of the magic knife. Overall, as contemporary digital designer Allen Keith Yee summarizes his observations on the visual art of dissecting, "the cross section can be a revelatory way to depict and imagine the world around us" (Yee 2020, 15).

Historically, the visual technology of sectional drawings is intertwined with the development of technical illustration. It dates back to the Middle Ages, is further developed in the Renaissance by artists such as Leonardo da Vinci, and then again celebrated in the Enlightenment, notably in the picture plates of Diderot's and d'Alembert's *Encyclopédie ou Dictionnaire raisonné des sciences, des arts et des métiers* (1751–1772).[4] The Industrial Revolution fueled the demand for clear and accurate technical documentation. Sectional drawings became crucial in engineering disciplines, depicting everything from steam engines to intricate machinery. In the twentieth century, advances in printing technology and the growth of engineering fields further popularized sectional drawings. The emergence of computer-aided design (CAD) technologies in the 1960s transformed the way technical drawings were created. Today, sectional drawings continue to play a crucial role in fields such as engineering, architecture, medicine, and various sciences. Digital tools have revolutionized the creation and presentation of sectional views, allowing for dynamic and interactive representations. Throughout history, sectional drawings have evolved from practical depictions of architectural and mechanical structures to sophisticated tools for conveying complex in-

3 A striking example of this imaginary and hypothetical nature of cross-sections is Leonardo da Vinci's visualization of a foetus in the womb, which art historian Martin Kemp reveals to be a highly innovative and imaginative combination of a pregnant cow's womb, which he had dissected and visually documented, with a human foetus. Rather than being an analytic anatomical investigation, it is a philosophical reflection on the mysterious relationship between mother and child, macrocosm and microcosm (Kemp 2000, 20–21).

4 Cf. Pannabecker 1998. For examples, see the online exhibition "Technology and Enlightenment: The Mechanical Arts in Diderot's Encyclopedia" at https://libraries.mit.edu/exhibits/diderots-encyclopedia-exhibit-preview/ (20 December 2023).

formation across a wide range of disciplines. The ongoing integration of technology continues to shape the landscape of sectional drawings in the modern era.

It seems no coincidence that sections as infographic strategies peak in times that celebrate the quest of knowledge and the desire to communicate new insights across linguistic boundaries. The universalist vision of the Isotype Institute certainly has its roots in the Renaissance and Enlightenment.

Following this very brief historical overview, it is time to present a simple typology of sectional views. For our purposes, I would like to follow the practice of technical drawing (cf. Richards 2017, 87–91), which proposes a classification into four major types of sectional views: 1) the cross-section, 2) the cutaway view, 3) the exploded view, and 4) the x-ray view.

A **cross-section**, like the one of the house (Figure 1), shows an object or organism as if cut through with a knife, or, in more technical terms, "[a] section, or cross section drawing, represents a particular object that has a vertical plane cut through it." (Yee 2020, 13). In most cases, "the vertical plane is perpendicular to the ground plane" (Yee 2020, 20), granting two-dimensional axial views of objects or organisms. Imagine a cake with icing sliced in half, revealing the number and color of layers. This right-angle cut across a visual plane is termed an orthogonal section, and it has become standard in the repertoire of anatomical and architectural drawings. In anatomical cross-sections, the image corresponds to a frontal view of a dissection performed on the body of an animal (including human) or plant. The knife, in these biological cases, is real and based on scientific practices for research and teaching.

For most other cross-section views, the cut remains metaphorical – the cross-section is a visualization rather than an illustration of an actual dissection: cutting cathedrals, ships, or motors in two remains a conceptual exercise undertaken for planning, construction, or communication purposes. No matter whether based on scientific or conceptual practices, cross-sections are less realistic depictions of structures cut through with real or imaginary knives than stylized visual reductions to the main structural features that need to be communicated. There is a diagrammatic paring down to the relevant information: depending on the function of the image and the graphic conventions of the time, cross-sections select the data they visually organize very differently. Cross-sections, like diagrams, thus are visual tools that are "good to think with" (Reviel Netz, cit. in Bender and Marrinan 2010, 7). Neurath uses this conceptual tool throughout her informational books for children to explain organic structures of plants, for example, to map the layout of the London Underground Piccadilly Circus station (*Railways under London*, 1948), or to explain why freezing water causes a pipe to burst (*Visual Science*, First Book, 1950, 23).

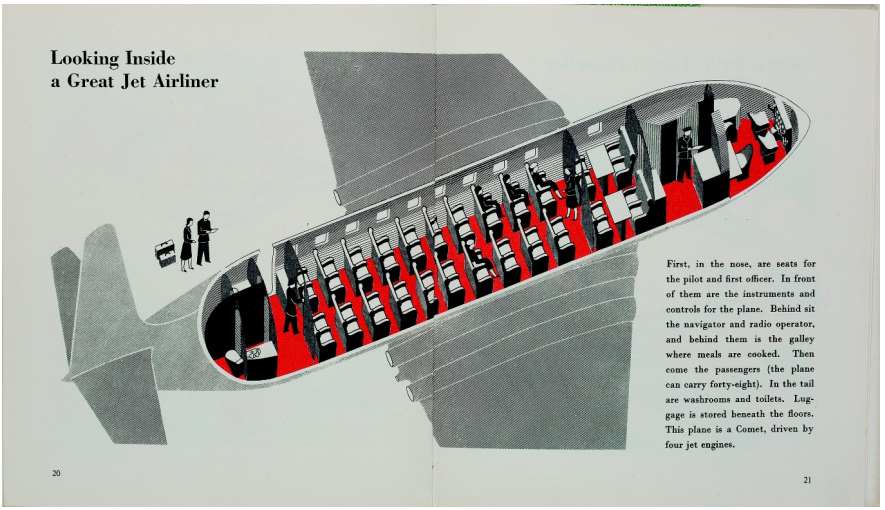

Figure 2: *Rocket and Jets* (1951) by Marie Neurath, pp. 20–21. Example of a cutaway view. Otto and Marie Neurath Isotype Collection, University of Reading.

While cross-sections remain two-dimensional and do not show depth, **cutaway views** add depth to the visual field. They combine the sectional cut with elements in perspective (Figure 2). As the name suggests, cutaways cut or peel away part of selected outer layers to reveal the internal features in their spatial arrangement. In contrast to the orthogonal view, cutaways show the relationship of the outside to the inside, thus being particularly suited to giving a good understanding of spatial ordering. They create the illusion of transparency: one can look through the skull into the brain cavity, for example, or, as in this illustration, through the casing of the jet airliner. In the context of children's books, this visual technique of cutaway views is particularly appealing, as it retains the vividness and familiar realism of perspectival pictures while providing detailed visual information in its context, thus offering great narrative potential (Ross 2017).

The **exploded view** (Figure 3) takes the parts of an object and visually explodes them across the page.[5] Rather than cutting through something, it takes apart or disassembles, clearly showing the individual parts in relation to each other and to the whole. It is most commonly used in technical illustrations, as it shows the workings, the way and the sequence in which pieces fit together; this way,

5 Sue Walker refers to this technique as "component parts" (Walker 2019). Strictly speaking, this is not a section, but since it shows in detail parts otherwise not visible, it is often grouped together with section techniques in manuals of technical drawing.

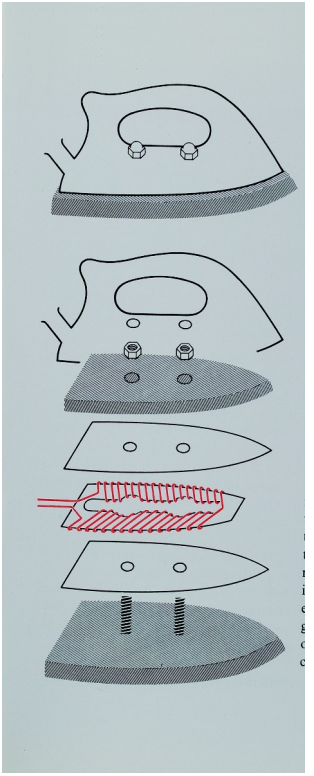

Figure 3: *What Is Electricity?* (1964) by Marie Neurath. Exploded view showing the component parts. Otto and Marie Neurath Isotype Collection, University of Reading.

they can be used as assembly instructions (think: IKEA) or as a way of visualizing how mechanisms work. Marie Neurath uses them rarely and more in the later series for older readers. This image of the electric flat-iron depicts the whole appliance at the top and explodes it into its component parts below, clearly showing the sequence of assembly in which the different layers fit together. As Walker points out, Marie Neurath uses this technique "to illustrate complex processes, or the applications of sources of power, such as electricity." (Walker 2019). The inclusion of everyday objects, advocated by educationalists since the eighteenth century, was also part of Neurath's educational strategy to encourage children to look at their familiar surroundings with new eyes and apply this inquisitive perspective to the world around them.

The **x-ray view or technique of ghosting**, finally, sees through the outer layer as if it was transparent to reveal what is hidden inside. There are two main variants of this magic way of seeing what is inside: while the x-ray view completely dissolves the outside to reveal what is obscured inside, most often focusing on one main feature, such as bones, the technique of ghosting does not

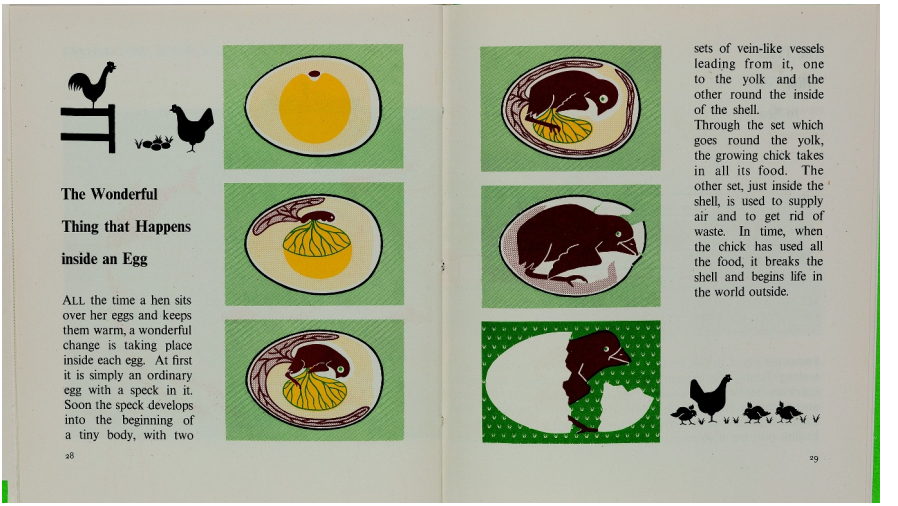

Figure 4: *If You Could See Inside* (1948) by Marie Neurath, pp. 28 – ghosting technique to reveal growing chick. Otto and Marie Neurath Isotype Collection, University of Reading.

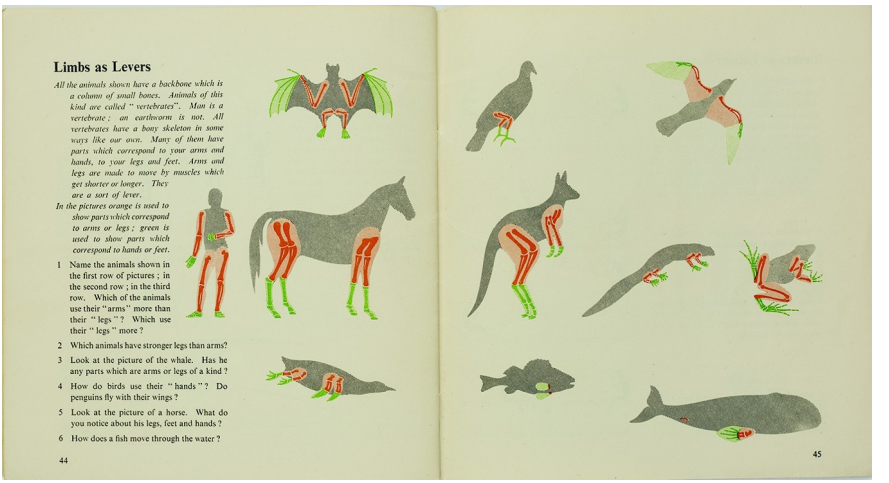

Figure 5: *Visual Science: Book Two* (1950) by Marie Neurath, pp. 44 – x-ray view of lever bones. Otto and Marie Neurath Isotype Collection, University of Reading.

eliminate opaque barriers but renders them transparent. Often used in technical drawings and for promotional effects, ghosting achieves – if well executed – the illusion of an intact outer layer and truly magical powers of the observer to see right through it. It is the visual version of having a cake and eating it. The devel-

opment of the chick, from fertilized egg to the hatching of the little creature, is shown using this technique of ghosting (Figure 4): the opaque egg shell is magically dissolved to grant view inside the egg. In Book 2 of *Visual Science*, Neurath opts for the more abstract x-ray view to illustrate the bones of animals that act as levers (Figure 5). Rather than showing the entire skeletal structure, only the bones acting as levers are visible. While the animals remain grey silhouettes, the lever limbs are highlighted in pale red. The bones corresponding to the arms and legs are color orange; the bones of the hands and feet are color green. This x-ray view is far from realistic – it is a highly selective, highly stylized, color-coded image with the specific intention of illustrating the workings of particular limbs. It is readily apparent to the eye how the relationships between the very different overall structures of each animal's body and the respective lever bones cause the animals to move in the ways typical for their species. Rather than seeking the artistic mastery of ghosting, Neurath prefers the sober x-ray presentation of information without distractions. The aim of this image is to lead the reader to look, compare, and understand. The reduced form of the x-ray view perfectly serves this educational purpose.

This differentiation into four types of internal views, the orthogonal cross-section, the cutaway, the exploded and the x-ray view, is one way of classifying the visual technique used to reveal the hidden. In practice, however, many illustrations are combinations of the different types of cross-sections. Cut-aways may be combined with exploded views (a technique Stephen Biesty is fond of using in his cross-section series published by Dorling Kindersley),[6] cross-sections with ghosting. Marie Neurath does this rarely, and never purely for visual interest or entertainment. The default internal view in Isotype books remains the classic, two-dimensional orthogonal cross-section, a simple line drawing without shadowing and using four or fewer coded colors. Perspective seems to be considered a distraction, diverting attention from the relevant information. Only when strictly needed to understand the functioning of an essential part of the drawing does Neurath add another dimension. One such example is the windmill in *If You Could See Inside* (Neurath 1948, 23), which shows how the mill-blades turn the slotted axle, which in turn translates the force of the wind to the lower slotted axle turning the big water wheel. While the architectural structure of the building is depicted in a black cross-cut line drawing, the moving mechanical parts – the mill-blades and the perpendicular axle shaft – are shown in red and in perspective, illustrating the geared mechanism, which transports the rotary motion of the wind blades along three distinct axes to lift the water above sea level. The use

6 https://www.penguinrandomhouse.com/series/FD7/dk-stephen-biesty-cross-sections/.

of perspective clearly serves the understanding of the working of the mill mechanism.

True to their function of revealing and identifying the hidden, sectional drawings generally combine image and denotative text. They typically include labeled features or annotations to provide the relevant terminology and possibly additional information about the depicted object or region. Visual connectors come in the form of callout or leader lines, linking labels, captions, or annotations to specific areas or objects within an image (abundantly used in David Macaulay's *The Way Things Work*, 1988). Arrows and pointers serve the same identifying purpose, visually connecting signifier and signified. Assigning numbers or letters to parts of the illustration is a visually cleaner way of naming, by listing the labels or annotations in a separate legend, clearly separated from the image (as practiced by Comenius in his 1658 *Orbis sensualium pictus*). These labels help viewers name and understand the various components or layers being shown and facilitate communication and comprehension. Interestingly, cross-sections in Isotype informational books come entirely without these features. The only accompanying text consists in headings for the different sections (in the case of *If You Could See Inside* one for each double spread), and a brief descriptive and/or explanatory text, often directly addressing the reader.

To conclude this brief typology of sections, it becomes quite clear that Isotype informational children's books rely on a long and rich tradition of scientific and technical drawings revealing what is usually hidden inside. As we will see in the analysis of her first Isotype children's book, Marie Neurath combines Isotype figures with section view conventions from architecture, anatomy, geology, or engineering to create a coherent and convincing picturebook language inviting young readers to look inside. The transformative process of Isotype image production relies on intensive research in libraries and hence the established repertoire of scientific and technical drawings dating back to the Renaissance, as documented in scientific, professional, and popular publications. The fascination for the cognitive and explanatory potential of sectional views of Marie and Otto Neurath is anchored in this rich tradition.

3 Otto Neurath's visual memories

The idea of presenting the familiar in unexpected ways goes back to Otto Neuraths' earliest discussions about creating books for children. In *From Hieroglyphics to Isotype. A Visual Autobiography* (2010 [1945]), Otto Neurath looks back on visual memories of his childhood and adolescence. This memoir of his visual com-

ing-of-age provides a genealogy to the basic tenets of the Isotype language. Otto Neurath's recollections of printed imagery that inspired or frustrated him in his quest to know and understand his environment serve both as a "collection of comparative visual research" (Neurath 2010, 6) and as an empirical foundation for the Isotype Institute's vision of visual education of children. Cross-sections as one strange way of looking at the familiar played a particularly important part in Otto Neurath's personal visual education. While Marie Neurath had her own, more heavily scientific visual education, her graphic approach was very much inspired and informed by her exchanges with her companion and husband of twenty years. As such, it is hardly surprising that sectional views informed the information language of the picturebook production of the Isotype Institute's London years.

Otto Neurath recollects one childhood incident, which makes the connection between a real knife and a "magic one": As a young boy growing up in an upper-class home of educated Jewish parents in Vienna, Otto remembers slicing a pomegranate in two with a knife and admiring the intricate inner structure of the fruit: the seeds embedded between fine membranes. This look inside the fruit, covered by the shiny red skin, fascinated him. He later compared his autopsy with a cross-section illustration in a botanical atlas he took from his father's library, struck by the fact the illustrators had come up with the same stratagem to show the hidden: cutting through an object and showing the section-view. It was "a centuries-old tradition in botanical books", as Neurath asserts in his *Visual Autobiography*: "Our botanical atlas attracted me partly because it did not only show the plants from the outside but also from the inside [. . .]" (Neurath 2010, 32). This way of visualizing the otherwise invisible allowed him to "subconsciously [learn] a good deal about plants and their parts" (ibid.), thus preparing him to grasp more complex botanical knowledge later on in life. Apart from laying the foundations for further learning, cross-sections also enabled cross-overs to his favorite fiction: "When I thumbed through the plant atlas", he reminisces, "how nice the section of the coconut looked with its hairy skin and the milk, which my Robinson Crusoe swallowed with such great pleasure after he reached his island." (ibid). This synesthetic experience combining sight, touch, and taste shows how the visual strategy strikes young Otto Neurath's imagination and allows him to establish meaningful relationships between inside and outside, fact and fiction, real-world objects and striking visual representations. The simple act of using a kitchen knife to cut a pomegranate in two and revealing the inside thus becomes the archetypal image of looking inside for Isotype imagery.

Other vivid cross-section childhood memories include the sections of animals and geological events. Otto Neurath names the engraved cross-section of a lion from Peter Mark Roget's *Animal and Vegetable Physiology* (1867) as an example. It

shows the mighty outlines of a male lion's in a pale, hatched gray, supported by a comparatively slight skeletal frame: "I always felt very much impressed to see how astonishingly slight the skeleton is beneath a lion's mass of muscle and hairy pelt" (Neurath 2010, 32). It is the visual contrast on the printed page between the imposing outside and the vulnerable inside, which elicits strong feelings in the young boy studying the image. Rather than just revealing the bones, this way of presenting the otherwise invisible skeletal structure within the visible exterior invites the child to contemplate the paradox of apparent strength and underlying frailty, sparking philosophical musings. Otto Neurath appreciated the "crude and even rough" drawings (38) of geological evolution in Descartes' *Opera philosophica* because the cross-sections, reduced to simple lines, delivered the information "directly and forcefully" (39), without any distraction. He concludes: "Thus my own childhood experience [. . .] compel me to regard a certain simplicity, combined with impressiveness, as something of importance wherever pictures for children are concerned" (41).

No wonder then that Otto Neurath's concept for Isotype's first informational picturebook was based on the concept and visual technology of cross-sections. *Just Boxes* was supposed to explain "modern implements",[7] such as the radio, cooker (hot box), or refrigerator (cold box) to young children. Since these inventions "present themselves usually in boxes", Otto Neurath concluded that "one has to look into the box to see how they work" (cit. in Walker 2013a, 400). His dummy, joining his love of basic geometric shapes and the principle of combination, shows a series of cross-sections granting insight into the technological innovations of the mid-twentieth century.[8]

Marie Neurath was to rework Otto Neurath's initial book project, adapting it to a younger audience. She decided that the geometrical concept of boxes was too abstract for this age group and focused on the fundamental idea of looking inside as her guiding principle. While pomegranates can be cut with kitchen knives, dissections performed on animals with surgical instruments to expose their muscular and skeletal structure, and geological formations uncovered through elaborate diggings with picks and chisels, there are things that call for *magic* knives to reveal their inner workings. Marie deployed her experience and imagination to magically transform information about the world modern children live in into simple and impressive visualizations. *If You Could Look Inside* (1948) became

7 https://www.marieneurath.org/#early-ideas – "Isotype Books for children".

8 The dummy can be seen as part of the online exhibition, https://www.marieneurath.org/#early-ideas (6 October 2024).

Marie Neurath's first own informational picturebook for children – her successful attempt at using sections to think outside the box.

4 Looking inside the book: *If You Could See Inside* (1948)

Published in 1948 as a Parrish Colour Book for Young Children, *If You Could See Inside* is part of the "Wonders of the Modern World" series, which was intended to "fire the awakening imagination with the wonder of the real world".[9] This first picturebook exploring the possibilities of Isotype in the children's book format is addressed to readers between six and eight, "who have reached the age at which they constantly ask questions" (ibid). In 32 pages, it covers topics from the family home to the deep sea, from chicks growing in eggs to windmills using the force of the wind to lift water. The answers to the children's insatiable curiosity are provided "in pictures which explain at sight" (ibid). The text is minimal with two to five sentences per double-spread, encouraging the children to take a closer look at the images for explanations.

The guiding concept of "looking inside" structures the entire book – not just thematically but also physically. The "little factory" of Isotype designers in collaboration with Max Parrish made clever use of the material make-up of the book to translate the core message into the reading experience: varying compositions of the images on the single or double-spread, thoughtful typographic layout, including choice of size and color, all work together to pace the turning of the pages.[10] This is all the more remarkable given that the Isotype language had been developed for exhibitions, working with large-format panels and charts displayed in exhibition spaces. Clearly, Marie Neurath does not simply transpose exhibition charts into book format but considers the book as a medium with its own logic and ways of interacting between the reader and the pages.

The cover of the original English edition shows a brown hen curiously looking at a yellow egg framed by ears of wheat (Figure 6). The title is set in red sans serif letters and divided into three parts, the typographic layout guiding the readers' at-

9 https://www.marieneurath.org/#header Letter of acceptance. 14 May 1948.

10 Even though Walker (2013a, 401) notes that this early book still lacks the consistency of later Isotype picturebooks, especially in regard to layout and typography, every double-spread within itself exhibits a compelling overall graphic logic. The complete book is accessible online at https://www.marieneurath.org/#early-ideas as part of the online exhibition about Marie Neurath. It is possible to leaf through the pages, reproducing the reading experience quite vividly.

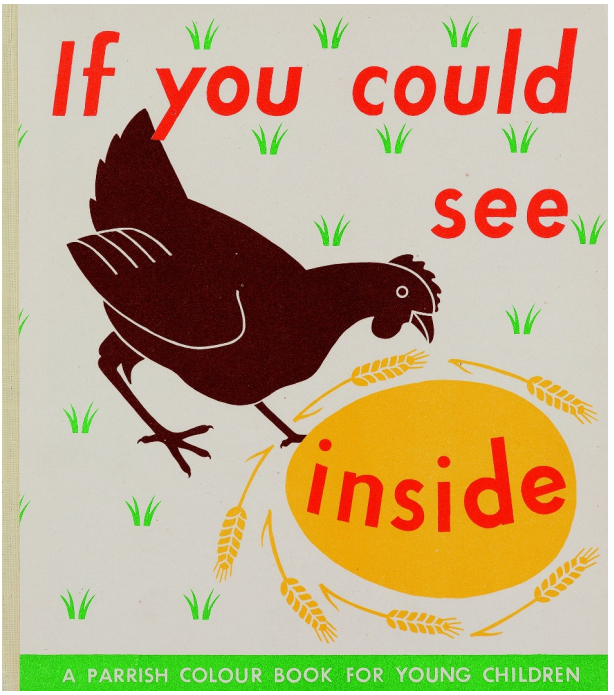

Figure 6: Cover of *If You Could See Inside* (1948) by Marie Neurath. Otto and Marie Neurath Isotype Collection, University of Reading.

tention: "If you could" at the top announces the imaginative "what-if"-dimension of the book integral to sectional drawings; the verb "see" is placed in the middle, just above the eye of the hen – granting visual emphasis to the central act of seeing; the word "inside", finally, is placed inside the egg, slightly curved to adopt the form of the shell, the red of the letters creating a stark color contrast with the vibrant yellow of the yoke. The effect is playful and enticing, inviting readers to open the book to look inside to discover things usually hidden. Even the spacing of the three lines seems suggestive; while the interspace between the first two lines is standard, there is ample visual room between "see" and "inside", resembling the rhetoric effect of pausing to create suspense. Looking "inside" the book thus opens up the imaginary world of "what if" possibilities. While the cover of the German edition uses the fortress as title image, the wording of the title cleverly transposes the visual concept of looking inside into a verbal one: *Außen, innen, was ist drinnen?* (*Outside, Inside, What is in There?*, 1956). By tying the main title to the subtitle by way of rhyme, the "innen" (inside) is encapsulated both graphically and acousti-

cally in the word “drinnen” (within), programmatically announcing the relationship of inside to outside as the guiding principle.

The rest of the front matter in both editions continues this inside pull: the half title highlights the “inside” by using a green font to contrast with the brown font of the rest; and the internal title page creates a forward momentum by decentering the double-spread: the bibliographic information (author name, ISOTYPE logo, imprint etc.) is shifted to the left while the illustrated title on the right spills over the gutter, setting the conditional “If” in green letters on the left half and placing the “inside” in bright red font on the far right, above the blades of the windmill. This calculated visual imbalance catapults readers onto the next page, which presents the table of contents. Before having looked at a single cross-section, readers will have made the real-life experience of opening the book and looking inside, guided by the well-chosen paratexts and the clever overall design of the book.

The rather heterogeneous table of contents combines fourteen enticing subject headings with schematic vignettes in “gay colours”[11] indicating the contents of the chapters. Six of them feature the preposition “inside”, promising to show what usually remains hidden: “A fairy palace *inside* a hill”, invites readers into a cave, “*Inside* a fiery mountain”, shows them the bowels of a volcano, and “*Inside* the deep sea”, lures them deep into the ocean with a diving chamber, for example (italics mine). Some headings seem more mysterious than others. Despite the romantic title, “Digging for buried treasure” leads to a coal-mine, and “The lonely house that stands in the sea” shows the workings of a lighthouse. Some ask questions (“Can we see inside a balloon?”), while others provide answers (“How the wind is used to raise water”, about windmills). It is a rather eclectic collection of topics, visually connected by the graphic information technique of sectional drawings.

Three of the headings use verbs of visual perception: “A strange way to *look* at a house” (Figure 1), “If they [sic] could *see* inside” (Figure 7) “Can we *see* inside a balloon?” (Figure 9) [italics mine]. They explore the ways and limits of looking: Are there normal and strange ways to look at things? Do things look different from another perspective? What is visible to us? Taken together, these three headings surreptitiously provide a miniature philosophy of visual perception, suggesting that seeing is cultural (there are normed ways of seeing), positional (depending on your position, what you see is not the same), and physical (depending on the physical properties and states, elements can be more or less visible to the human eye). *If You Could See Inside* thus reveals much more than just the in-

11 https://www.marieneurath.org/#header Letter of acceptance. 14 May 1948.

side of sites, structures, organisms, and things; it teaches children that looking is an epistemological, cultural, and possibly even ethical practice. The conditional "if" of the title opens up new possibilities of understanding and engaging with the world. The title *If You Could See Inside* is a shorthand for the mission and vision of the Isotype Institute: producing intelligent educational images that grant understanding and new insight. If visual education were taken seriously, it seems to suggest, books would help build a better world.

5 A strange way to look: Three sections

Let us finally take a closer look at the use Marie Neurath makes of the visual possibilities of sectional views in her first informational book for young readers, *If You Could See Inside*. She incorporates principles of the Isotype Institute with standard techniques of scientific and technical drawing in a unique way to produce sober but engaging lessons of age-appropriate visual education. Apart from the learned scientific literature – such as the botanical, zoological, and geological atlases mentioned by Otto Neurath in his *Visual Autobiography* – contemporary popular magazines provided ample visual inspiration for showing hidden insides and sectional views (cf. Ross 2017). I have chosen three double-spreads, which illustrate different ways in which Neurath makes innovative use of the graphic technique of sectional drawings: First, the cross-section of a family home, which introduces the Isotype way of seeing as "a strange way to look" at familiar surroundings (Neurath 1948, 14–15); second the magic cut through a hill revealing a secret tunnel under a besieged castle (12–13) as an example of how the cross-sections foster an active, engaged way of looking; and, finally, the internal view of the cave (6–7), to show the way in which text and cross-section image collaborate to guide children in the process of scientific thinking.

The double-spread of the house presented in the introduction of this chapter perfectly illustrates how Isotype informational books depart from both children's books and technical drawings to create their own distinct visual language and pedagogical approach. Under the heading "A Strange Way to Look at a House" (Figure 1), the image shows a single-family home in the standard architectural orthogonal view, a simple two-dimensional line drawing. The exterior front walls are magically cut away to grant insight into the living spaces of the home: kitchen on the lower left, dining room on the lower right, bathroom and bedroom on the upper left and library or reading room on the upper right. The middle section, to the left and right of the gutter, shows the staircase, connecting the rooms. While

the rooms are sparsely furnished, the attic and basement crawl space remain entirely empty.

"We have all been inside a house", the text below the house reads, "but how different it looks when it is cut through with our magic knife!" Small details such as the possessive pronoun "our" for the magic knife and the exclamation mark at the end of the sentence reveal how urgently Marie Neurath invites children to change their habitual viewpoint and to make the strange Isotype way of looking at things their own. "These pictures", she will later write in the preface to the *Visual Science* teachers' notes, "are not meant to show you exactly how things look but give you information about them, like a map or an engineer's blue-print" (Neurath 1951). It is this shift away from the way "how things look" to "information about them" that is at the core of the Isotype transformative process.

This departure from mimetic representation *of* things to presentation of information *about* them is most apparent in the use of colors. Rather than aiming for realistic colors, the double-spread showing the house uses consistent color-coding to identify the different building materials or different categories of things: red for masonry or cement, green for wooden structures, such as flooring, doors, or staircase. Black is reserved for furniture and a few accessories, such as a hat, a cane, a bowl, and books, as well as for the stereotypical Isotype people and cat inhabiting the house. Blue shows where the water runs in the house: "how the water gets to the tap, and where it runs when you pull the bath-plug" (14–15). Finally, the ground on which the house is built, is represented by screen-print dots in black. None of the color-coding is explained in the text or legend, no key is provided. But there is no need, since the coding is so clear and self-explanatory, provided readers take the time to look closely at the pictures. This semantic use of color clearly signals that Isotype books offer a "different" way of looking at things, one encouraging children to think in categories (immovable building materials and moving or movable accessories and inhabitants), to develop analytic capacities (by recognizing and differentiating between brick and wood, for example), and to adopt a descriptive-explanatory rather than a narrative stance. Details such as the color-coded brick flooring under the fireplaces inform attentive viewers about fire safety. Again, the focus is not on "how things look" but on learning what they do and how they work. The result is a highly schematic, stylized cross-section in form and color, which challenges customary ways of looking at everyday surroundings.

This "strange" cross-section of a house radically departs from the dollhouse view familiar from children's books, which usually use perspective and fill the

rooms to the top with amusing or endearing details.[12] There are no children or toys in this view, no gnomes or mice; merely a cat sitting in front of the fireplace, which may capture a child's imagination. Rather than promoting an identificatory and imaginative reading of the images, however, the text guides the child in the new, "strange" way of seeing: Instead of focusing on the cat or people, the reader is encouraged to develop an eye for architectural detail: "Here you can see how long the chimneys really are [. . .]". And thanks to the clear red lines, even very young children will be able to see that the chimneys do not start at the rooftop but reach all the way down to the heater in the kitchen and the fireplace in the living room. Building on facts they are already familiar with, child readers will discover new things in Neurath's cross-section of a family house: foundations, pipes, and drains. More importantly: They will understand by way of looking how the things relate to each other and what their functions are: stability, aeration, and circulation of water, for example. The Isotype cross-sections thus do not primarily reveal things hidden from view but makes things visible that usually go unnoticed. They are tools serving the visual education of children and henceforth their overall emancipation. Simply reproducing the world and showing "how things look" is not what these cross-sections are designed to do. Their job is to introduce even the youngest readers to strange ways of looking. "Because they have an unusual job to do", Neurath insists in the same preface of the teacher's notes, "they [the images] are made in an unusual way" (Neurath 1951a).

This active, thinking, and very engaged way of looking is even more evident in the double-spread showing a besieged castle on the hillside (Neurath 1948,12–13) (Figure 7). The privileged knowledge of what is hidden inside the hill signifies the difference between a battle lost and won. This is made clear by the heading "If they could see inside". It is an illustration of a situation that looks very different depending on what kind of information one is privy to. Contrary to the house section, which refuses narrative engagement with the image, this one unfolds its visual power through visual narrative. From the outside, the party besieging the castle, equipped with cavalry, many foot soldiers carrying bows and arrows and pulling a catapult, seems to pose a serious threat to those defending the castle. Two important pieces of information invisible to the attackers reverse the situation, however. The cross-section, performed with the magic knife, reveals on the far right that the castle possesses a very deep well, providing the defendants with plenty of water and assuring their hygiene and well-being. A bit further to the

12 View the blog post "Welcome to the Dollhouse: The Best Cross-Sections in Picture Books" at www.mrslittle.com for numerous examples from nonfiction and fiction ranging from the 1970s to the present.

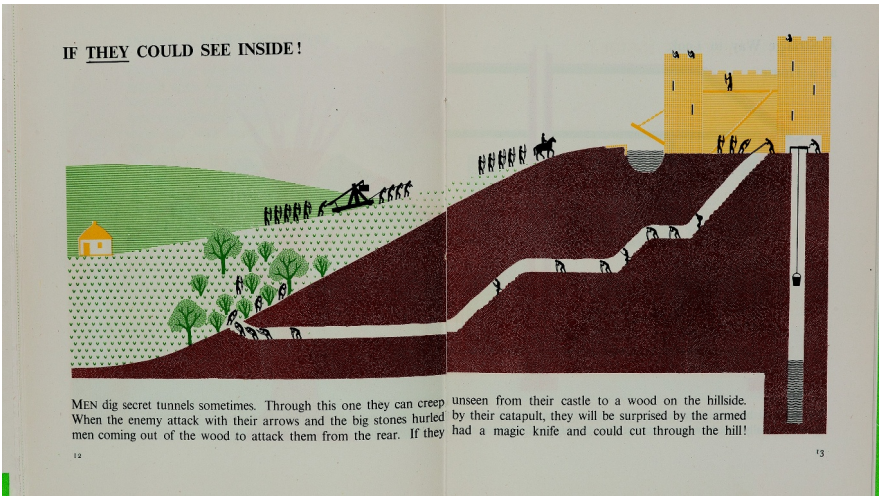

Figure 7: *If You Could See Inside* (1948) by Marie Neurath, pp. 12. Sectional view of hillside revealing secret tunnel. Otto and Marie Neurath Isotype Collection, University of Reading.

left, a castle inhabitant lifts a trap door, revealing a secret tunnel cutting across the hill and surfacing in a little wood, right behind the attacker's army. Three groups of defendants, all carrying bow and arrows, are using this secret weapon: one group waiting to enter the tunnel, another one working its way down, and the last one already spilling out at the other end of the tunnel and into the woods, ready to surprise the advancing enemy. Unaware of what is happening inside the hill, the enemy army focuses their attention on the frontal attack and leaves its vulnerable back exposed. "If they had a magic knife and could cut through the hill!" (Neurath 1948, 12–13), the text reads, making it very clear that knowledge of what is hidden signifies power. Learning about the secret things and hidden workings of their everyday world was to empower the children looking at these images. The cross-section of the castle on the hillside encourages them to take different positions – that of the confident but blind attackers, and that of the cunning defenders whose intimate knowledge of their surroundings gives them the advantage to win the battle thanks to strategy rather than force. There are valuable lessons to be learned here. Looking at Isotype children's books not only promotes visual literacy but also empowers children to become critical thinkers. It encourages them to look beyond the surface and examine the world around them more deeply, helping them to become conscious and responsible individuals and citizens.

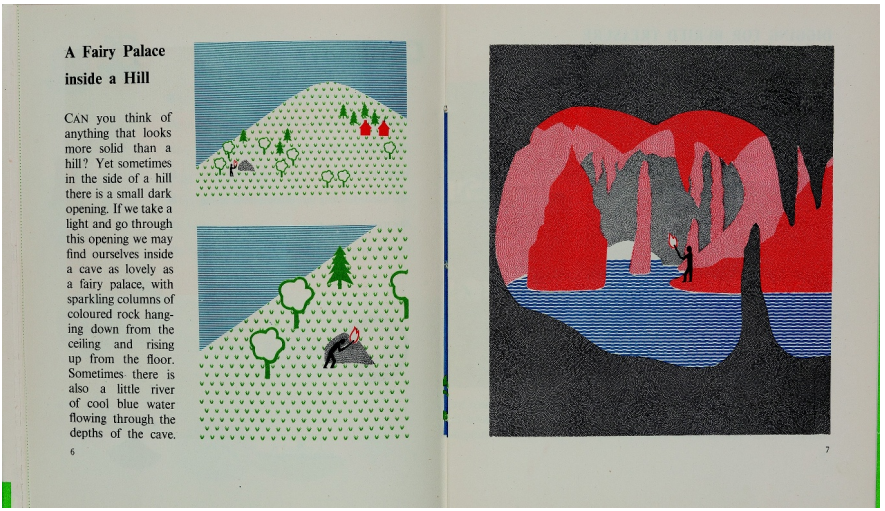

Figure 8: *If You Could See Inside* (1948) by Marie Neurath, pp. 6. Sectional view of a cave (right). Otto and Marie Neurath Isotype Collection, University of Reading.

The third and final cross-section double-spread presented here, the "Fairy palace inside a hill" (Figure 8), shows how the text guides the reader's sense of observation (outer eye) and fosters the power imagination (inner eye) to encourage a habitus of scientific inquiry, filled with awe. Rather than using captions, callout lines and annotations, the Isotype informational books for younger children provide a text, which embeds the cross-section in miniature dramatic scenarios, at times of cinematic quality. The verbal information does not simply identify facts, explain specific details, and provide answers but addresses and engages readers and invites them to ask further open-ended questions, thus emulating the process of scientific thinking. The double-page granting insight into the cave takes viewers/readers gradually closer and deeper into the magical inside by proposing a three-panel sequence: beginning with a panoramic view of a mountain ("Can you imagine anything more solid than a mountain?"), the next image zooms in on a "small dark opening" on the side of the hill. A silhouette Isotype person holding a torch is about to enter. "If we take a light and go through this opening", the text continues, and the facing page offers a full-spread cross-section view of the cave. The "magic" of Marie Neurath's visualization resides in the gradual approach to the hidden inside, while the use of the personal pronouns "you" and "we" creates intimacy and complicity. Readers feel taken serious and readily embark on the scientific mission. The hill, which seems to embody the impenetrable, – is shown to have a small opening. What was concealed and dark, becomes apparent and

illuminated: Marie Neurath holds the light of the graphic designer to the darkness of the cave. The sectional cut through the cave walls appears as flat gray frames and two shades of red show the depth of the cave, reminiscent of nineteenth-century accordion peep shows. While in the first two frames, the viewers were following closely behind the genderless Isotype person, identifying with them, the final image shows the person in the distance. The magic effect is amplified by the reference to a fairy palace. The inside of the hill is described as "lovely", with its "sparkling columns of coloured rock". Rather than whisking children away to fairy worlds, however, Neurath guides them to discover geological phenomena. The verbal comparison to the fairy landscape merely serves as a way to express the wonder and awe at the heart of scientific inquiry. True magic, is the message, is knowledge revealed.

It may seem paradox that Neurath uses the metaphor of the magic knife to describe her rather rigorous approach to the picturing technique of cross-sections. Her sober, effective style rather seems to practice a kind of utilitarian *Entzauberung*, a de-enchantment of the supposedly magical childhood by focusing on mechanical inventions, engineering exploits, and natural phenomena, presenting them in two-dimensional line drawings and using a reduced palette of colors. And yet, the magic of Isotype informational books is closely linked to the awe and wonder of science and scientific thinking. In fact, the process of "transforming", the Isotype way of translating complex information into simple pictograms and images, could be considered to be magic. The magic knife metaphorically invoked by Neurath to produce simple yet powerful sectional views revealing the hidden is the graphic information designer's tool to select and to focus, to make visible and highlight, to bring into relation and compare, to engage and to empower. It truly is a "strange way to look" at things and raises the all-important question at the root of scientific thinking, "what if . . .".

6 Conclusion: Popping the metaphor

The sectional drawings of Isotype informational books are at the intersection of technical drawing, scientific illustration, graphic information design, and children's book illustration. At their most basic, sections enable a better understanding of the internal structure and composition of objects, areas, or organisms. More importantly, however, they serve as a powerful educational tool that foster curiosity, facilitate understanding, and spark a sense of wonder about the world. They encourage exploration, critical thinking, and engagement, making learning enjoyable and memorable for young readers. The last page of *If You Could See*

Inside is at once a poignant illustration of the magic of the graphic design technique of sections and of its limitations (Figure 9).

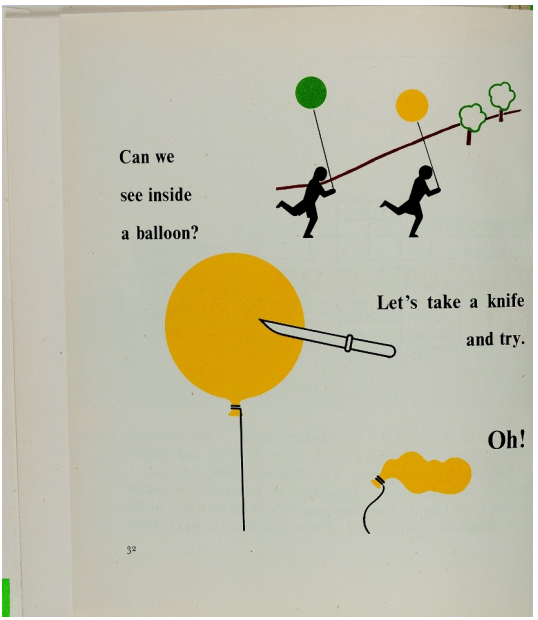

Figure 9: *If You Could See Inside* (1948) by Marie Neurath, p. 32. Popping the metaphor. Otto and Marie Neurath Isotype Collection, University of Reading.

"Can we see inside a balloon?", the text asks, and playfully proposes an empirical approach to the scientific query with a simple experimental setup: "Let's take a knife and try" (Neurath 1948, 24 – 25). Following the rather cheerful image showing stylized silhouettes of a boy and a girl with balloons skipping across the page, the close-up picture of the yellow balloon will cause kids to hold their breath: a sharp knife is pointing right at the toy, about to perform the painfully delightful experiment. The final image of the brief visual sequence presents the sad result, a busted balloon, accompanied by an at once laconic and emphatic "Oh!"

What a finale to an entire book dedicated to looking inside! It injects a rare dose of humor, an element of surprise, and seems to suggest that there are things we cannot see.

Marie Neurath's use of a literal knife to puncture the balloon at the end of the book appears to be a clever and symbolic choice. The unexpected outcome, with the balloon deflating instead of revealing its inner contents, could be interpreted as a metaphorical statement about the limitations of graphic design. By

physically popping the balloon, Neurath might be illustrating that while graphic design, represented by the "magic knife" metaphor, can provide insights and understanding, it also has its boundaries. Some concepts or aspects may remain elusive or resistant to visual representation. The simple exclamation "Oh!" in the text emphasizes surprise, perhaps encouraging readers to consider the unpredictable nature of both graphic design and the exploration of knowledge. This thoughtful and cleverly choreographed conclusion adds punch to the book, inviting readers to reflect on the nuanced relationship between representation, visualization, and the inherent complexities of the subjects graphic design seeks to illuminate.

The metaphor of the "magic knife" in the context of Marie Neurath's Isotype children's books can thus be viewed as a meta commentary on strategies of visualization and graphic design within the realm of informational children's literature. The "magic knife" metaphor becomes a symbol not only for the act of visual dissection but also for the tools and strategies used in graphic design to simplify and communicate complex information. In the world of Isotype, where clarity and accessibility are paramount, the magic knife embodies the creative and transformative power of visualization techniques. Moreover, the deflation of the balloon at the end introduces a layer of self-awareness, suggesting that while graphic design can reveal and simplify, it also acknowledges its own limitations. This meta commentary encourages readers, including children, to appreciate the thoughtful choices made in visual representation, fostering a critical awareness of the strategies employed in conveying information through graphic design in the context of children's literature.

Finally, the deflation of the balloon on the last page of Marie Neurath's first informational Isotype book can also be seen as a subtle foreshadowing for the later exploration of more complex and invisible phenomena. By starting with the elusive concept of air in the balloon, Marie Neurath lays the foundation for a progression into more abstract and invisible subjects like electricity, sonic waves, telegraph signals, and beyond in subsequent books. Some phenomena are inherently challenging to represent visually, yet the pursuit of understanding and visualizing the "invisible" remains a central theme in the development of graphic techniques across Marie Neurath's body of work.

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