Jens Schröter

The Complexity of Technological Images. The Four Optical Series

Absztrakt

The role of perception or, to be more precise, theories of perception for the understanding of the history and aesthetics of media is often discussed in an undifferentiated way. One example: Kittler's famous claim – quoted in the exposé for the conference in Szeged – that 'technical media build on overwhelming our senses' presupposes that knowledge about the senses is implied in the genealogy of technical media. But generalized in this way the claim is problematic. There are indeed imaging technologies, which are built to overwhelm our senses – in presupposing knowledge (at least in an empirical sense) about them – e.g. film and stereoscopy. But there are also imaging technologies which do not at all presuppose knowledge on perception, e.g. photography and holography. These media presuppose physical (geometrical or wave) optics, and not physiological optics (Crary). They presuppose knowledge (at least in an empirical sense) about the behavior of light. In the first part of the text these differences are reconstructed by criticizing Crary's approach. In the second part holography is discussed as an important imaging technology from the 20th century, that is not based on physiological optics. Also, there are forms which do not fall in either of these categories. Coming from a long history from drawing and painting and re-emerging in digital images, there are parallel-perspectival representations, which neither accord to human perception nor to the behavior of light. In addition to approximately simulating visual and optical media, digital computers also include non-optical forms of imagistic representation and even combine all the different forms. This point is made in the third part of the paper. Finally, the argument shows that the complexity of contemporary technical imagery cannot be reduced to physiology, optics or non-optical forms alone. Perception is just one element among others.

Szerző

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The Complexity of Technological Images. The Four Optical Series

The role of perception or to be more precise: theories of perception for the understanding of the history and aesthetics of media is often discussed in an undifferentiated way. One example: Kittler's (2010:30) famous claim that technological media build on overwhelming our senses at least suggests that knowledge about the senses is implied in the genealogy of technological media. A similar argument can be found in Jonathan Crary's (1990) famous study *Techniques of the Observer* [1], where Crary argues that a deep epistemological rupture took place around 1820. During this rupture knowledge of the body and perception became central – as a precondition for modern technological media (e.g. the knowledge on the so-called persistence of vision must be given to invent cinema). It seems that the development of all modern image-technologies – to quote the exposé for the conference *Sensation, Perception, Mediation* –'necessarily involves preconceptions of the human sensorium'. *I think that this is problematic*. In what follows I'll try to show why (for a more detailed argument see Schröter 2009). [2]

1. In the first part I will discuss Crary's approach. I'll try to show that he develops a problematic model of media history, which is structured along ruptures between relatively homogeneous epochs – called 'classical vision' and 'modern vision' or to put it more precisely: between *geometrical optics* and *physiological optics*. I will argue that these figures of succession and homogeneity don't work. There is no homogeneous modern regime of vision, which is historically preceded by a classical regime. Modern vision is a layering of heterogeneous strata, to be more precise: *four optical series* – 'series' in the sense of Foucault's *Archaeology of Knowledge* (Foucault 1972).

Stereoscopy is Crary's main example for the modern regime of vision based on physiological optics, because this is clearly a case of a technology based on 'preconceptions of the human sensorium' (as is – by the way – cinema). But Crary has severe problems of dealing with monocular photography, simply because monocular photography is not based on 'preconceptions of the human sensorium', but was developed from geometrical optics and chemistry. Monocular photography doesn't fit Crary's model. And this shows firstly that there are image technologies in modernity not based on 'preconceptions on the human sensorium' and secondly that we need a more complex model of media history.

2. In the second part I will elaborate the idea that there are image technologies in modernity not based on 'preconceptions on the human sensorium'. I will discuss a too little known but in fact very important image technology, which was developed in the mid-twentieth Century and that is holography. It is based on the third series, that is the series of *wave optics* and not at all on the series of physiological optics.

3. In the third part I'll take a look at the fourth series, that is the series of *virtual optics* – that is computer graphics. Computer graphics can simulate approximately all different forms of images, which are based on geometrical, physiological and wave optics. But it can also include types of representation, which are not based on optics at all [3] – not even on human perception. My example will be *parallel projection*, known from drawing and painting, as it reemerges in the realm of virtual optics.

It can be shown that not all forms of technological images presuppose preconceptions about te workings of the human sensorium. An anthropocentric model of media history is thus to be rejected.

(1) Crary's model, stereoscopy (the series of physiological optics) and photography (the series of geometrical optics)

In brief, Crary expresses his central thesis in *Techniques of the Observer* in one passage. He mentions a "passage from geometrical optics of the seventeenth and eighteenth centuries to physiological optics, which dominated both scientific and philosophical discussion of vision in the nineteenth century" (Crary 1990:16).

The initial question is: What is 'geometrical optics'? Geometrical optics is a description of the behavior of light especially in the macroscopic realm. It is that field of knowledge that Crary – sometimes under the name 'classical optics' – associates with perspective and *camera obscura*, a field which indeed is exactly connected with that. As Carter writes succintly in the *Oxford Companion of Art* in 1970:

> "Scientific Perspective, known variously as central projection, linear perspective, or picture plane or Renaissance or linear or geometrical perspective, may be regarded as the scientific norm of pictorial representation. The story of its development belongs as much to the history of geometry as that of painting. It is the perspective of the pin-hole camera (and with certain reservations as regards lens distortion) of the camera obscura and the photographic camera. It derives from geometrical optics and shares with that science its basis in physics: the rectilinear propagation of light rays. (Carter 1970: 840) [4]

This means that geometrical optics is a branch of knowledge that describes light as light *rays*, permitting for a nice explanation of reflection and refraction. Therefore, this model of light is the basis of all treatises on *linear* perspective, hence called by this name. Today one can find a respective chapter in every manual on optics (see Hecht 1994: 135-256). And why? Because geometrical optics is relatively easy to calculate and very well suited to calculate optical devices like, for example, a *camera obscura* or cameras in general, and thus it is quite plausible when Crary closely relates geometrical optics with the paradigm of the *camera obscura*. And, by the way, also one central method in computer graphics – appropriately called 'ray tracing' – goes back to geometrical optics. Crary (1990: 1) mentions ray tracing at the very beginning of his book but without taking stock of its explosiveness for his model: How can geometrical optics be a basis of central methods of today's computer graphics if there has been a "passage" away from geometrical optics already around 1820? We sense already that Crary cannot be correct with his thesis that physiological optics has superseded geometrical optics.

Anyway: Because Crary argues that modern vision is structured centrally by physiological optics, it is not surprising that he uses the stereoscope as his main example – because the stereoscopic image was born during the research on visual perception by Charles Wheatstone around 1838. How does three-dimensional vision work? The stereoscopic image was a kind of experimental setup to find out. We are thus in the field of *physiological optics*, which does not deal with the characteristics of light but with the *characteristics of our perception* (one of the most important studies in physiological optics in the 19th century is Helmholtz 1962). In this sense stereoscopy is very obviously based on 'preconceptions on the human sensorium'. Crary (1990: 67-96) develops this relatively extensively. So everything's fine. Not really. One big problem emerges in Crary's argument. It's a little bit vexed, so I'll try to be clear as possible.

Although he uses the stereoscope as prototypical example of physiological optics, that is modern vision in his sense, he also argues that it wasn't stereoscopy but monocular photography that survived. Stereoscopy disappeared as a mass medium at the end of the 19th century (we have to add that it didn't disappear at all – It survived in military or scientific practices, see e.g. Judge 1926, but this isn't mentioned by Crary). If stereoscopy is so typical for modern vision how could it dissappear (at least in Crary's discourse)? Geoffrey Batchen (1993: 86) correctly speaks of a "troubling contradiction" in Crary's argument.

Crary writes: "Photography defeated the stereoscope as a mode of visual consumption as well because it recreated and perpetuated the fiction that the 'free' subject of the camera obscura was still viable" (1990: 133.) This is very hard to understand. Does this mean that the paradigm of the *camera obscura* – i.e., geometrical optics – was recreated together with photography or was being perpetuated (which in no way is the same) shortly after it had supposedly so spectacularly and completely collapsed at the beginning of the 19th century (as Crary insists)? And how and why does it once again revive of all places in monocular photography, which Crary (1990: 13, 27, 31, 32, 36, 57, 118) differentiates ostentatiously from the *camera obscura* six times in *Techniques of the Observer*? Even more disturbing is a formulation in an earlier text: "But if cinema and photography seemed to reincarnate the camera obscura, it was only as a mirage of a transparent set of relations that modernity had already overthrown" (Crary 1988: 43). What does it mean that the camera obscura returns as its own 'mirage'? Evidently, Crary is fighting with the problem that geometrical optics and physiological optics exist next to each other but that this is incompatible with his ‘successionistic’ [5] model.

And this is Crary’s fundamental problem: Explicitly aligning himself (1990: 70-72) methodologically with Foucault who in *The Order of Things* (*Les mots et les choses*, Foucault 1971) describes different epochal *episteme*, which are separated by way of ‘epistemological ruptures’, Crary maintains that in a sort of rupture geometrical optics was superseded by physiological optics at the beginning of the 19th century. Linda Williams (1995: 8f.) already stated that Crary believes that “[...] the representational system symbolized by the camera obscura began to dissolve” and she maintains that “he may go too far when he implies that it disappeared altogether. It seems more likely that this model survives as a rival system.” This seems absolutely correct. Geometrical optics continues to exist next to physiological optics to this day; both adjust, but one does not supersede the other.

If one describes it like this, then all of Crary’s problems dissolve. Monocular photography is not a wondrous resurrection of the *camera obscura* shortly after the paradigm of the *camera obscura* – geometrical optics – supposedly collapsed; it is the *shifted continuation* of the *camera obscura* – more precisely: it is geometrical optics plus photochemical emulsion. Stereoscopy does not disappear either; it continues to be used in the sciences and for military purposes through most of the 20th century.

In principle I agree that in the 19th century physiological optics are *added* to geometrical optics but I think it is wrong that the one *supersedes* or passes over to (“passage from”) the other. They coexist and modify each other. This could be described with another publication by Foucault, *Archaeology of Knowledge* (*L’archaeologie du savoir*) [6], as the parallel coexistence of different *series of optical knowledge*. And how many of these series exist? I have already named two: (1) The series of geometrical optics and (2) that of physiological optics. In my opinion, two more still exist today: (3) The series of wave optics and (4) that of virtual optics. I will explain wave optics and virtual optics later.

In modern times, it is from exactly those four series of optical knowledge (and their mixtures and hybrids) that all technological images emerge – in connection with other forms of knowledge, e.g. chemical knowledge. Most of the technological images which result from the other series than geometrical optics are not based on linear perspective and provide more spatial information than images organized around perspective. Generally they are called ‘three-dimensional images’: photo sculpture, integral photography, lenticular images, the different forms of holography and of volumetry, as well as the interactive three-dimensional image of virtual space (see Schröter 2009). However, the possibilities of these images to convey spatial information are not my topic here.

My whole point is that technological images in the 19th and 20th centuries do not in all cases 'necessarily involve preconceptions on the human sensorium' to exist. To invent photography one must know about geometrical optics and chemistry, but one doesn't need to know anything about how the eyes or the brain works. But to invent stereoscopy you do have to think about the eyes (but you don't need photography – Wheatstones first stereograms were drawings). And both cases exist parallel to each other.

In the next part of my talk I want to stress this point, because one could argue: OK, you're right, in modernity geometrical and physiological optics (and perhaps some other optical series) do coexist, but at least there are no *new* types of technological images invented that are not based on physiological optics. That would be a way to save in a sense Crary's successionist model. But even that doesn't work.

(2) The series of wave optics: holography

I would like to call attention to a certain three-dimensional image that does not appear in any history of optical media (e.g. Kittler 2010) and even less so in any discussion of *Bildwissenschaft*: holography (but see Rieger/Schröter 2009). It is the only pictorial medium that is neither founded on the geometrical nor on the physiological but solely on the third of the series mentioned above – the series of wave optics. It is significant that physics in the early 19th century understood that describing light as a bundle of light rays was inaccurate since existing phenomena like diffraction, polarization and interference could not be explained in that way. Please note that – unlike in Crary's (1990: 85/86) erroneous attempt of constructing it in his *Techniques of the Observer* – this has nothing to do with the fact that physiology discovered around the same time the contribution of the body in perception.

In wave optics – that next to geometrical optics has already had a long and complex history since the 17th century – light is not conceived of as a bundle of rays but as a wavefront comparable to waves in water (see Buchwald 1989). This is the accepted description of light since the middle of the 19th century to this day. [7] That wave optics is the accepted description does not challenge the fact that geometrical optics is still repeatedly used as a description to the present. Geometrical optics is a simplified mathematical representation that remains valid for macroscopic optics, like lens systems or linear perspective in the macroscopic or human scale. Because of the relatively short wavelengths of visible light the wave-effects, like interference, are not easily visible and recognizable in everyday life (but there are exceptions to that, e.g. the vivid colours one can see when watching soap bubbles, which are based on interference). The knowledge of the wave optical characteristics of light – in the series of wave optics – opens up a type of three-dimensional image that transgresses the limitations of geometrical optics, i.e., of linear perspective, *camera obscura*, and photography. [8] And precisely this is holography. Its individual history is very complicated – let me only refer you to the great study *Holographic Visions. A History of New Science* by the historian of science from Glasgow, Sean Johnston (2006). Here, I would like to limit myself to the most essential elements.

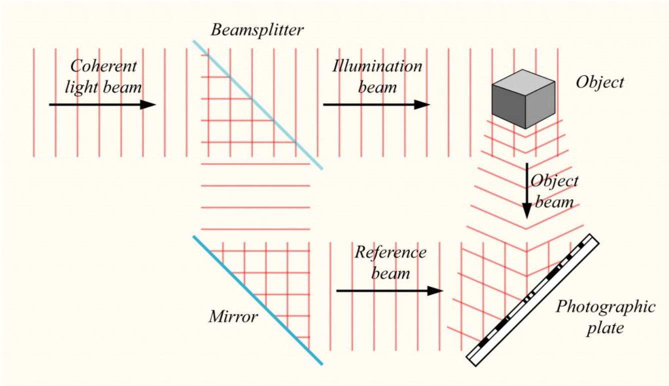

Fig. 1/a – Schema of the holographic recording process

Fig. 1a shows the holographic recording process. In 'normal', monocular photography, light reflected by an object is focused on a photosensitive sensor through its refractions in a system of lenses. Since these refractions travel geometrical-optically (or at least can be described so) we obtain a linear perspective image. In holography, the light reflected by the object is superimposed on the photosensitive sensor with the same light that was used for the exposure of just that object (between the object and the photosensitive sensor there is no lens). The sensor, whether it is a photochemical emulsion or a CCD, records the wave optical interference pattern of this superimposition. The coherence of the light is important here; this is why holographies usually have to be recorded with laser light – only if the light used is in one wavelength and phase you get good interference patterns. If one now conducts light through this recording of the interference pattern again, the original form of the wave is reconstructed, i.e., the object appears in its full plasticity (see Fig. 1b). Such an image is not linear perspective – it completely falls outside of all categories that are generally used for images. For example every fragment of a hologram still shows the whole image, of course only the parts that the respective fragment could 'see' and with a reduced resolution.

Fig. 1/b – Hologram of a mouse viewed from two different viewpoints

Let me first of all underline that the oh-so-different image of holography is not so rare after all. Everyone (at least in the western world) carries one or more holographies with him- or herself – namely on paper currency and/or on credit cards. This is because images that were created with wave optical procedures cannot be reproduced with geometrical-optical procedures like they are for example used for photocopying. This is why holography attained a central role from early on, even if it has come to nothing as an artistic medium and even if it cannot be used as a mass medium. Holography creates images that are indispensable for corporations and state institutions centered on money and bureaucracy precisely because they cannot be reproduced easily. Walter Benjamin's well-known diagnosis of the age of technological reproduction is only halfway correct: Technological non-reproducibility also increased with technological reproduction since not everyone was allowed to reproduce money and national documents (see Schröter et al. 2010). Of course holography as a three-dimensional image is also able to contribute quite a bit to the representation of space; for example, it was in bubble chambers of particle physicists (see f. e. Herve et al. 1982) as well as in materials testing. In this realm, the procedure of *real time holographic interferometry* became more and more firmly established (see Johnston 2006: 191-200). But neither reproducibility nor the potentials of holography to represent space are my topic here.

Again I just want to stress: n*o preconceptions on the human sensorium are necessary to make holograms. How the eyes or the brain work is completely irrelevant – you must know about the wave properties of light, you need a light source that produces coherent waves as laser, you must know about special fine grain foto emulsions to record the interference pattern. That's it.* And interestingly although no knowledge on perception is implied in making a hologram, they have been overwhelming. At least there's a foundational myth for holography somewhat similar to that of cinema. When Leith and Upatnieks presented the first pictorial holograms in 1964, which indeed showed among other things a toy train [9], these never before seen images provoked bewildered and dismayed reactions in the viewers.

Many of the specialists were disbelieving or confused. The toy train appeared perfectly real and yet could not be touched behind the photographic plate. Several questioned where it was hidden or sought the mirrors that had produced the illusion. One feared that his eyes had been damaged by the laser light. (Johnston 2006: 115)

That shows that you don't need to know how the senses work to overwhelm them. This poses an interesting question again in relation to Crary. His argument – with Foucault 1971 – is that the production of knowledge about the human subject, and its body, as is produced by physiological optics, allows the production of spectacle overwhelming the subject's senses. This is a well known foucauldian figure of thought. But what if overwhelming works also without knowledge of the subject and its body? And what does it mean that physiological optics and the forms of images correlated to this form of knowledge coexist with other forms? Doesn't that necessarily imply that there are different 'implied subjects' and its politics in the visual culture of modernity? How can this be described critically?

(3) The series of virtual optics and technological images based on no optics at all: The case of parallel projection

But now we have to complicate the situation even more. To repeat first: There are images based on knowledge on perception, that is physiological optics and there are images, which do not presuppose such knowledge, but are based on the two related, but different forms of knowledge about the behavior of light: geometrical and wave optics. But that's not all. There are even images which are based on none of this forms of knowledge. Images that use non-optical representational strategies which mostly stem from the history of drawing and painting. These types of images cannot by defintion be produced with photographic media in the broadest sense (be it stereoscopy, cinema, monocular photography or even holography), but they re-emerge in the fourth series: that is *virtual optics.*

After 1945 the *series of virtual optics* appears only gradually and then accelerates. It approximately includes all previous optical series connecting them in hitherto impossible new ways. Since about 1945, digital computer technology was on the rise and was being increasingly used for the creation of images. As far as one can formulate the three optical series –geometrical optics, wave optics and physiological optics – in mathematical terms, they can also be computed, at least in principle. Virtual optics is, if you will, another name for computer graphics. First I want to make some remarks concerning the simulation of the three optical series already mentioned.

a. Geometrical optics for example knows among other things the law of refraction or the rules of linear perspective. Already in the 1960s these rules began to be being reformulated into algorithms for computers. The computer scientists at the outset of computer graphics took recourse to old treatises. As Lawrence Roberts observed at a panel in 1989: "Well, the mathematics for the three-dimensional display was done pretty much [...] going back to the eighteen hundreds in terms of when they did a lot of perspective geometry" (Siggraph 1989: 72). [10] As I already said: One of the most widespread methods of computer graphics is "ray tracing" (see Watt 1989: 17-24 and 342-369). This name already makes clear, that the model of light as rays still exists in some forms of computer graphics.

b. The laws of wave optics, according to which for example patterns of interference form between two coherent light rays, can also be formulated mathematically, even though in a more complicated manner. As soon as the first experiments with holography emerged in the 1960s different scholars had the idea that it should be possible to calculate interference patterns. If one prints the calculated patterns onto suitable materials it should be possible to artificially create holographies (see Johnston, 2006: 216-220). Today this is regularly done to produce very special optical systems – Holographic-Optical Elements –, which can't be produced otherwise.

c. Physiological optics may be more difficult to formalize as far as it describes rather the characteristics of the human body and less physical facts. Nevertheless already since the 1960s there had been attempts made at using the insights gleaned about the binocular difference necessary for creating a stereoscopic effect in order to generate stereoscopic images by way of computers (see Julesz 1960 for an early text on so-called random dot stereograms). And today, a completely rendered movie like *Up* from Pixar, which was presented in 3D in Cinemas, are examples for how you simulate stereography by rendering each image twofold with two virtual cameras, which are differently positioned in relation to the virtual scene.

So insofar "computer graphics make optic modes optional at all", as Kittler (2001: 35) put it, virtual optics can simulate approximately all other optics. *But* it can also include representational strategies which do not adhere to any optics at all and that come from the history of drawing and painting. One of the most important examples for this is the use of forms of parallel perspective or parallel projection (the following is discussed in more detail in Beil/Schröter 2011).

All types of parallel perspective rendering techniques have in common that the lines of flight of the represented objects do not converge in one or more vanishing points, but remain parallel. That's the main difference from linear perspective, which is focused on the behavior of light. Different types can be distinguished: orthography; axonometric (isometric, dimetric, trimetric), and oblique views (see Uddin 1997).

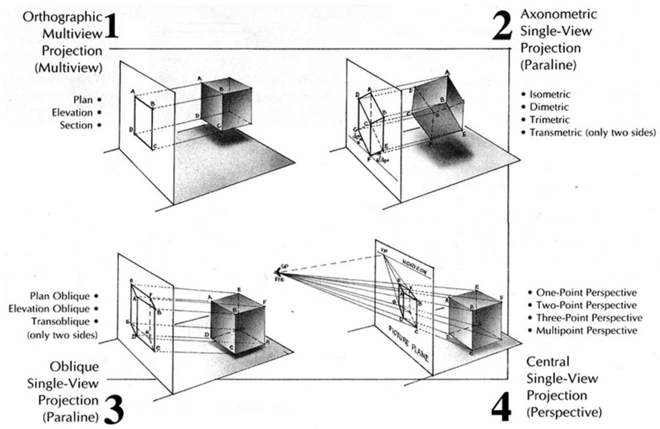

Fig. 2 – Different types of parallel projection (and perspectival projection), from: Uddin 1997: 9.

Such parallel projections have been known for a long time, even before the development and systematic presentation of linear perspective in the 14th and 15th century, and came to be used alongside and connected with linear perspective very often. They have several characteristics, which distinguish them from the linear perspective images: *Parallel projections are neither related to the behavior of light* [11] *nor to an observing subject – there is no vanishing point, that means there's no place prescribed for a beholder*. Evans wrote in relation to the representation of architecture:

> "In orthographic projection the projectors do not all converge to a point, but remain parallel. *Because this is not the way we see things*, orthographic drawing seems less easy to place. It does not correspond to *any aspect of our perception of the real world*. It is a more abstract and more axiomatic system. […] The advantage of orthographic projection is that it preserves more of the shape and size of what is drawn than perspective does. It is easier to make things from than to see things with. So it is not surprising that orthographic projections are commonly encountered *on the way to* buildings, while perspectives are more commonly encountered *coming from* buildings." (Evans 1989: 20; the first two accentuations are mine)

We can therefore represent an object *one the one* hand as it looks (for a subject) or at least as it it would look like ('realistically'). But *on the other hand* we can also represent an object it structurally is or should be. The important point here is of course that Evans stresses the fundamental distanceof parallel projections from perception: *This is not the way we see things.* And again: Although these images do not presuppose any knowledge or conception of perception, but are – let's say – algorithms for translating objects into planes and planes into objects, they work – and they are very, very important. They are important *because* they don't presuppose anything about human perception. They leave some of the limits of perception behind, that's why they are used. And where are they used? Their most important role up to today is their use in architectural, engineering and technological design practices.

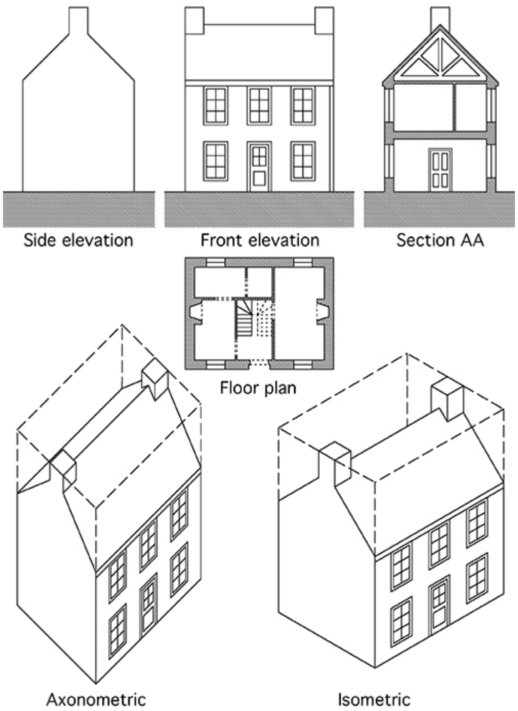

Fig. 3 – Different types of architectural drawings in different types of parallel projection, http://upload.wikimedia.org

That's why Evans writes that 'orthographic projections are commonly encountered *on the way to* buildings'. Orthographic and other types of parallel projections are less used for depicting something existing and visible – they are used in practices of producing future things, such as design drawings, because they represent spatial relationships more clearly and in a way more easily understandable for architects and engineers. [12] Linear perspective in contrast produces too much foreshortening and transforms lengths and angles. The viewpoint of an implied subject produces too much distortions – not enough spatial information can be transported.

Therefore parallel projections are central to the emergence of modern technological culture, since at least the 19th century, most of the technological drawings were done in different forms of parallel projection. Just a very few examples. Already in 1822 Farish described isometric projection, an axonometric representation method that uses some benefits of orthographic projections but is easier to understand. Isometric projection soon became essential for technological drawing, that is for the development of modern technological culture (Farish 1822; see also Booker 1963: 14-127). It was no coincidence that Farish's method was presented during the industrial revolution. In the 19th century numerous textbooks on various parallel-projective rendering techniques appeared. Also all image technologies, that produce linear perspective images, e.g. cameras or TV sets, insofar they are machines, presuppose technological drawings rendered in parallel projection – as one example see this explosion drawing of a portable tv from 1994.

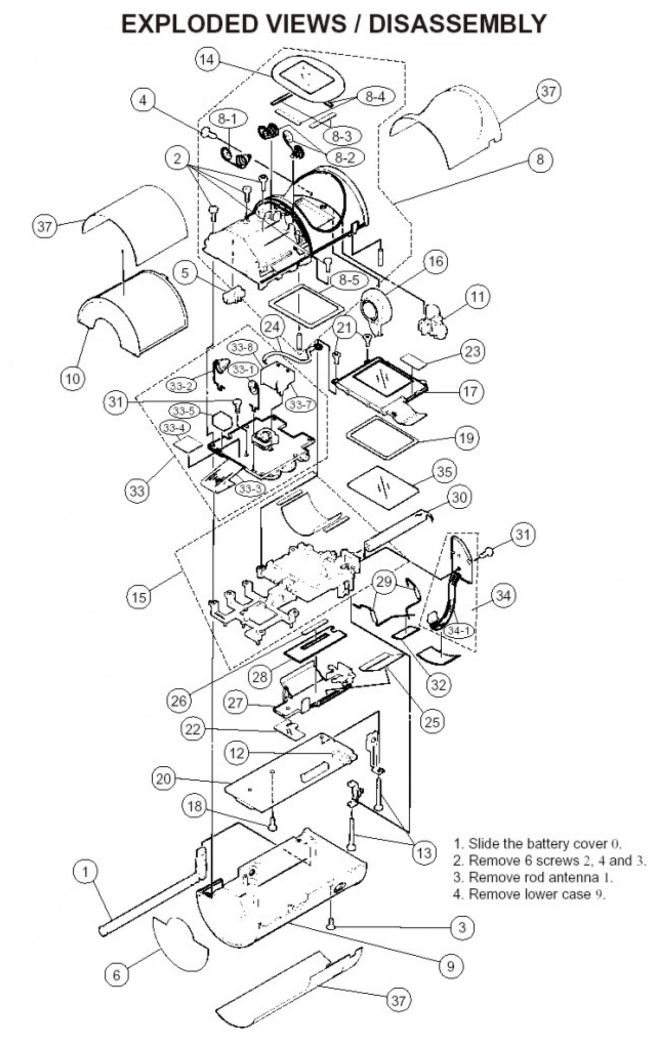

Fig. 4 – Explosion drawing of a portable tv, http://www.taschenfernseher.de/bilder/tv-350-exp.gif, 9.18.12

Now it cannot and should not be the goal of this paper, to reconstruct the whole culture and the various forms of parallel perspective representations of medieval times up to now, although it should be mentioned that it was the central procedure of spatial representation in asian painting for a long time (see March 1931). I will finally focus here on the role played by such representations in digital images, computer graphics or to put in the terminology used here: in the series of *virtual optics*. Two concluding examples:

1. Parallel Projections in CAD-Systems: Since the early 1990s computers became more and more important in architectural and technological design practices. In so called computer aided design (CAD) parallel perspective images are of central importance.

2. Computer Games [13]: It was isometric projection, that for the first time today allowed typical game mechanics at all, as the simulation of gravity (and thus falling from a surface, e.g. *Marble Madness*). One of the earliest instances, when architectural forms become implemented in computers games, *Crystal Castles* from 1983 is done in parallel projection – the formal connection of computer games to the tradition of architecture and engineering in parallel perspective drawing is obvious.

The view that such forms of isometric projections are only intermediary steps on the way to full linear perspective in computer game graphics is often justified with the argument, that parallel projections are only used where there is not enough calculating power to do the images in linear perspectives. Sometimes this is true: There are many game genres (almost) only in a linear perspective version – in the case of the *first-person shooter* this representation method is defining for the genre (see Beil 2010). However, isometric views have by no means disappeared, but were and will always find their niche, especially in the strategy genre (e.g. *Sim City 2000*, *Civilization II*), where they remain to this day still one of the most common rendering techniques. The main reason for the continuing use of isometric projection in certain genres is the better view of the (game) action by the constant scale and easier predictability of spatial relations. It is about games in which an overview presentation is more important than individual points of view. One could say, that the implied subject is more god-like and looks down onto the scenery than to be implied in the spatial setup of the scene.

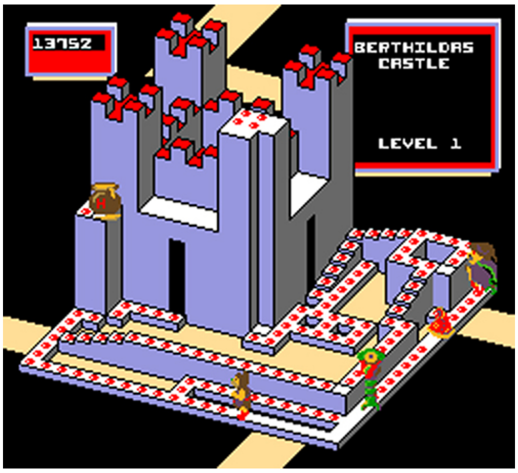

Fig. 5 – Parallel perspective view in Crystal Castles (1983)

4. Short conclusion

A very short conclusion: There are four optical series – geometrical, physiological, wave and virtual optics. The images resulting from the series other than geometrical optics do not adhere to linear perspective or its limitations. Only the image technologies emerging from physiological optics involve 'preconceptions of the human sensorium'. [14] Perception is one element in the construction of technological images, but only one element among others. That also means that Crary's foucauldian perspective concerning the construction of the observing subject is too monodimensional. As was mentioned in my essay it seems that there are several different forms of subjectivities implied by different forms of optical knowledge and their corresponding images. [15] The politics of modern vision is therefore more complex than Crary seems to suggest and remains a topic for research.

To make knowledge on perception the necessary condition for the emergence of any type of technological images would be a too anthropocentric or even biologistic view of things. Of course all images are viewed – and in this sense all images are connected to perception. But this essay is only about the question how technological images historically emerge – and if these processes in any case presuppose knowledge on perception. The answer is: no.

Jegyzetek

1. Mentioning here Crary at once with Kittler is somewhat problematic. Although Kittler argues that media technologies build on overwhelming the senses, that does not necessarily imply for him that media technologies are based on knowledge of the human body (or perception) – quite similar to the way it is argued here. He describes the "history of optical media [as] completely independent of individual or even collective bodies of people". Exactly this results for Kittler in "an overwhelming impact on senses and organs in general" (2010:30). Therefore it is not surprising that he explicitly criticizes Crary's body-centered approach (148).
2. The book will appear 2013 in an English translation with Continuum International Publishing Group.

3. Hence the notion of virtual optics is slightly paradoxical.
4. Carter's idea to call linear perspective 'the scientific norm of pictorial representation' might be highly problematic, but rejecting this claim changes nothing about the principal argument of my essay."
5. 'Successionistic' in the sense of preferring a successive description.
6. In his *Archaeology of Knowledge*, originally from 1969, Foucault criticized his own 'successionistic' approach from *The Order of Things*: In "*The Order of Things*, the absence of methodological signposting may have given the impression that my analyses were being conducted in terms of cultural totality" (Foucault 1972: 16). Foucault criticizes his own earlier approach, used by Crary, to describe cultural totalities following one after another (in Crary: classical vision – modern vision).
7. The situation is even more complicated by the fact that since Einstein's essay of 1905 "On a Heuristic Point of View about the Creation and Conversion of Light" that received the Nobel Prize in 1919, light is regarded both as wave and as current of particles since there are phenomena like the photoelectric effect that themselves cannot be explained with wave-theory (Einstein 1967). So one could say that there is one more optical series, namely quantum optics – but it's not discussed here because it doesn't add much to imaging technologies (except from CCD sensors and laser in holography). See Fox 2006.
8. The three-dimensionality of holography is also completely different from that of stereoscopy. While stereoscopic images are pseudo-threedimensional, holography is really three-dimensional in the sense that one can move in front of the image and see different aspects of the object, even when using only one eye (see Fig. 1b).
9. Is it just a coincidence that the first pictorial hologram shows a train – similar to the mythical train that in early cinema deeply shocked the audience (see Bottomore 1999)? It seems so, there is no evidence that Leith and Upatnieks intended an iconographical allusion. Because of their little kids a toy train simply was available.
10. 'Three-dimensional display' means here perspectival representation.
11. Only some telephoto-lenses produce images which seem to resemble parallel projection. Another exception is the so-called 'orthophoto' in which perspectival distortions are corrected using a three-dimensional model of the terrain (sometimes generated using stereoscopic procedures).
12. This is why the instruction manual for furniture of IKEA shows the pieces of furniture in parallel projection. But, as anybody knows, it remains difficult to build these pieces of furniture. But when linear perspective were used in the manual, the construction would be even more difficult.
13. The following considerations are based on cooperation with Benjamin Beil, for which I am very grateful.
14. At first that seems irritating when one thinks of the 'eye-point' in central perspective. This (and the several illustrations in which the lines of flight convergence in a human eye) seems to suggest that also central perspective, although it belongs to the field of geometrical optics, implies knowledge on the human body. But that's not true. The eye-point is a purely mathematical object, the point of convergence of the lines before the plane. It is conventional to mark it with an eye, although one has to occupy that point with one eye to see the perspectival construction correctly. But one can construct a perspectival image without knowing anything about the human body. Already Alberti (1970: 47; accentuation in the original text) in his famous first treatise on perspective (from 1435) knew this: "*Nor is this the place to discuss whether vision, as it is called, resides at the juncture of the inner nerve or whether images are formed on the surface of the eye as on a living mirror. The function of the eyes in vision need not be considered in this place*". This is why Lacan (1998: 86/87) insists that perspective is not necessarily tied to vision and could also be constructed by blind people. Central perspective (aka geometrical optics) is a simplified description of the behavior of light (understood as rays). To clarify this point again: Parallel Perspective isn't even that, because light doesn't

behave like that. Parallel Perspective is an abstract algorithmic procedure of representation. Images don't have to emerge from vision and/or light.

15. Not to mention the complex processes of reception.

Irodalomjegyzék

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