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preliminary translation excerpts from the book by Tim Otto Roth: *Bild. Körper. Projektion – eine Kulturgeschichte der Schattenbilder*, Fink (2015)
http://www.shadowgraph.org/culturalhistoryofshadowpictures.html

INTRODUCTION – THE DICSCOVERY OF "PICTORIAL FACULTY" IN THE CAVE

"A strange image" is what Glaukon calls the much-cited shadow scenario that Sokrates outlines in the so-called Allegory of the Cave in the seventh book of Plato's *Republic*.[1] People sit with fettered legs and necks against a wall in a subterranean cavern in such a way that their gaze is fixedly directed straight ahead at the opposite cave wall. Behind the wall, "human images and shapes of animals as well, wrought in stone and wood and every material" are carried by "exhibitors of puppet-shows" passing by a fire. In this way, "shadows of the artificial objects" (*skeuastôn skias*) parade on the cave wall before the eyes of the prisoners.[2] If we look at the scenario from a physical and physiological point of view, regardless of Plato's metaphorical intention, it appears even more strange. If the viewer is to perceive the passing flat light-dark formations as the sole visual entity, this presupposes a cave wall as a perfect projection screen. Such a screen should not become apparent as a spatial object, it must therefore be homogeneous in colour and must not show any unevenness. Furthermore, it must curve spherically around the audience so that the wandering viewer's eye always perceives the shadow projection in the same plane of focus. But even if the spatial-stereometric vision is thus outwitted by the fact that at a certain distance an almost identical appearance is perceived by the left and right eye, the viewer must nevertheless have serious doubts about the supposedly flat

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1 Plato: Politeia, Book VII, 514a–519d. The English translation refers to the translation by Paul Shorey in: Plato: The Republic – books VI-X , Cambridge, MA (Harvard University Press) 1935. I will get back to the literal translation of *atopon* not as "strange" but as "atopian" at the end of this book.

2 Auguste Diès establishes a reference to shadow theater and even cinema by translating the Greek *thaumatopoiois* as puppeteer (*montreurs de marionnettes*), referring to Jowett and Campbell. Cf. Diès, Auguste: Guignol à Athènes, in: Bulletin de l'Association Guillaume Budé (January 1927) 14, pp. 6–19. For Diès, you only have to imagine the cavern replaced by a hall, and you're dealing with a kind of cinema: "une espèce de cinema par ombres projetées". Ibid., p. 8. Diès suspects that in Plato's time shadow plays were also known, cf. ibid.: Encore Guignol, in: Bulletin de l'Association Guillaume Budé (April 1927) 15, pp. 38–46, here pp. 45–46.
Remarkably, the term *skiagraphia* is not used by Plato as well as by other Greek authors in the literal sense for shadow drawings, but refers to pictorial representations that have a spatial effect and are also coloured. The use of the notion *skiagraphia* is discussed in detail by Ernst Pfuhl and Richard Schöne in *Jahrbuch des Kaiserlich Deutschen Archäologischen Instituts* from 1910 respectively 1912. Later examinations connect *skiagraphia* among others with an "impressionist style" creating light-and-shade effects by contrasting colours. Cf. Keuls, Eva: Skiagraphia once again, in: American Journal of Archaeology 79 (Januar 1975) 1, pp. 1–16, here p. 1. The term "sciagraphic process" appears in a diary note by Henry Fox Talbot. Cf. Schaaf, Larry J.: Records of the dawn of photography – Talbot's notebooks P & Q, Cambridge (Cambridge Univ. Press) 1996, p. xviii. "Sciagraphy" becomes temporarily established, especially in England, as the name for X-ray production.

nature of the world. The viewer notices that the entirety of the projection can be perceived more or less sharply by changing the focus of the eye. However, the greatest irritation – leaving aside one's own haptic bodily experience – is likely to be caused by the acoustic environment. The prisoners can talk to each other and the sounds of the people passing the objects in front of the fire echo off the walls of the cave. Although Plato suggests that the sounds can be attributed to the moving shadows, the spatial perception of the soundscape is strikingly at odds with the flat scenery of the shadow projection. Here the prisoners might be encouraged in their doubts about the flatness of their environment by their conversations, as a clear spatial composition of the acoustic neighbourhood becomes apparent: Accordingly, the voices can be localised, whether they come from the left or the right and whether the speakers are closer or further away.

Notwithstanding this dimensional contradiction of the two remote senses, the scenario raises an even more fundamental question: is it even possible to understand a planar projection of objects if one has never visually perceived the world as a three-dimensional scene?[3] This question is by no means limited to the projection of objects in the form of shadows, but includes other modes of projection, for example transforming the cave – even though this would be contrary to Plato's intention – into a camera obscura by occluding the cave entrance with a pinhole. The outside world would thus present itself to the prisoners in the form of an upside-down central perspective camera projection. But whether it is a camera projection or a shadow projection, both of these two different forms of projection could not be grasped by the prisoners. As a projection, the two-dimensional appearances do not speak for themselves, but are always a translation from the higher spatial dimension. In order to understand this, it requires the experience of this three-dimensional world and also the understanding of the translation process occuring in the projection.[4]

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[3] See also Sorensens speculation on how Berkeley's "unembodied spirit" would perceive the shadows in Plato's cave: "Berkeley should doubt that the prisoners could even see shadows." Sorensen, Roy A.: Seeing dark things, New York (Oxford University Press) 2008, pp. 115–116.

[4] Plato is well aware of a certain difference between objects and varying forms of representation as picture or effigy. So in 514c he divides the passing objects into *skeuē* and *andriantas*. With regards to the meaning of *skeuē* transcending significantly the "art works" [Kunstwerke] in the German translation by Schleiermacher (515c) see the discussion in: Bormann, Karl: Zu Platon, Politeia 514 b 8—515 a 3, in: Archiv für Geschichte der Philosophie 43 (1961) 1, pp. 1–14.
Plato's concept of image, which in the *Sophistes* distinguishes between a *mimesis eikastikē* and a *mimesis phantastikē*, is addressed, among other things, by: Schuhl, Pierre Maxime: Platon et l'art de son temps, Paris (Libraire Félix Alcan) 1933, p. 5 ff.; Wiesing, Lambert: Platons Mimesis-Begriff und sein verborgener Kanon, in: ibid.: Artifizielle Präsenz – Studien zur Philosophie des Bildes, Frankfurt a. M. (Suhrkamp) 2005, pp. 125–148. The relationship of image and space (*chōra*) in the works of Plato is examined in detail by: Poetsch, Christoph: Platons Philosophie des Bildes, Frankfurt a. M. (Vittorio Klostermann) 2019. For a comparison of the Platonic and Aristotelian pictorial concepts, see also the first chapter in: Alloa, Emmanuel: Das durchscheinende Bild – Konturen einer medialen Phänomenologie, Zürich (Diaphanes) 2011. As far as the process of translation is concerned, the concept of "transposition" plays a central role in Diès' interpretation of Plato. Cf. Diès, Auguste: Livre IV – Esquisses doctrinales, in: ibid.: Autour de Platon, Paris: Beauchesne 1927, pp. 400–603, here p. 400 ff.

Shadows in the artificial light of the prehistoric cave

It is not the purpose below to add yet another footnote in the history of philosophy to the countless interpretations of Plato. The goal of the present study is rather to turn the cave allegory upside down by means of an anthropological speculation. The hypothesis is that the projections of shadows on a cave wall created by an artificial light source were the decisive factor in the development of humans into beings who recognise and make images, a characteristic that, as Hans Jonas [1903–1993] points out, fundamentally distinguishes them as *homo pictor* g from animal beings.[5] In order for early humans to actually develop into image-forming beings, two prerequisites are necessary: On the one hand, they must domesticate light in the form of fire. In this way, humans can play with light and thus emancipate themselves from the heavenly bodies, which hitherto imposed their illuminating function on them according to the rigid rules of celestial mechanics. On the other hand, it requires a more or less uniform projection surface from which the interaction with the light source can be observed from a certain distance. Humans found this in the form of rock outcrops and caves, which offered protection and at the same time kept the fire from going out. The projection scenario that is revealed to humans on the cave wall is fundamentally different from that of the celestial bodies. Until now, they had only known shadows cast by objects in the light of the sun and moon in parallel projection. Here, the great distance of these light sources from the earth results in the light rays arriving almost parallel.[6] The projected shadows might be more or less elongated depending on the position of the celestial bodies. However, the parallel light rays always ensured that the size of the cast shadows remained almost unchanged, regardless of the spatial distance to the projection surface. While the ground usually serves as the projection surface in the case of sky light, a decisive verticalisation of the projection scenario takes place with the passage into the cave with regard to the projection surface. This tilting of the projection screen to the vertical plane is important because it is now possible to distance oneself from the projection. This possibility of distancing is also crucial with regard to pictures. For Vilém Flusser [1920–1991], stepping back from the cave wall is an essential criterion for early man to recognise an image in the paint applied to the wall. For

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5 Jonas, Hans: Homo pictor und die differentia des Menschen, in: Zeitschrift für Philosophische Forschung 15 (April–Juni 1961) 2, pp. 161–176. Ian Hacking likewise links the anthropological difference with image-making and, without direct reference to Jonas, speaks of the human being as *homo depictor*. Cf. Hacking, Ian: Representing and interviewing – introductory topics in the philosophy of natural science, Cambridge u.a. (Cambridge University Press) 1983, p. 134. Alloa points to an "anthropological interest in pictures" already with Aristotle: Cf. Alloa, Emmanuel: Das durchscheinende Bild, Zürich (Diaphanes) 2011, p. 36.

6 Since the sun is not a point-shaped luminous body but has a certain extension, it can be observed that with increasing distance the edges of the cast shadows become diffuse and the shadow gradually fades away. Cf. the chapter *Sunlight and shadows* in: Minnaert, Marcel: The nature of light & colour in the open air, New York (Dover) 1954, pp. 1–7.

him, stepping back formally means "existence" as a "strange utopia into which one enters and out of which one makes images."[7]

This existential retreat to one's own point of view may have already begun when looking at and playing with the shadow projections on the prehistoric cave wall. In the glow of the fire, humans became acquainted with a new way of playing with shadows, following completely different rules for dealing with space: central projection. The closer the shadow-casting object came to the fire, the larger its shadow was cast onto the projection surface, up to the point of being gigantic. From an anthropological point of view, this primeval "projective geometry drama of growing, becoming and vanishing,"[8] as the Polish avant-garde filmmaker and writer Stefan Themerson [1910–1988] put it, may have left corresponding traces over the millennia in the way humans deal with and perceive projections. At the beginning, the cave inhabitants may have been more or less passive observers of an unintended shadow play, but they may soon have felt invited to experience and explore this play of light and shadow with their own bodies. However, the change in the position and nature of the light source was also part of this. For example, the size of the flame changes the character of the shadow cast. If the flame is large, the projection appears diffuse; the smaller the flame, on the other hand, the more contrasty and clearly contoured the shadow cast appears. A relatively small flame was offered by the hand-held stone lamps, which are said to have been used very early.[9] Such lamps, attributed by experiments with the luminosity of a candle, also allowed to move around the objects.

When Hans Jonas establishes the anthropological difference precisely in the fact that man as *homo pictor*, in contrast to animals, is a being that can recognise and also produce pictures, he also relates this ability to the handling of shadow projections:

> The natural play of shadows, however, may well be the first to lead humans to the idea that there is a representational imagery and that such a thing can be captured by tracing the outline.[10]

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7 "Dieser seltsame Un-ort, in den man dabei tritt und aus dem hinaus man sich Bilder macht [...]", cf. Flusser, Vilém: Eine neue Einbildungskraft, in: Bohn, Volker: Bildlichkeit, Frankfurt a. M. (Suhrkamp) 1990, pp. 115–126, here p. 116.

8 Themerson, Stefan: The urge to create visions, Amsterdam (Gaberbocchus + De Harmonie) 1983, p. 60.

9 Lorblanchet, Michel: Höhlenmalerei – ein Handbuch, Sigmaringen (Thorbecke) 2000, p. 17.

10 "Sehr wohl mag aber das Naturspiel der Schatten den Menschen zuerst darauf bringen, daß es eine vertretende Bildlichkeit gibt und daß sich dergleichen durch Nachzeichnen des Umrisses festhalten läßt." Cf. Jonas, Hans: Homo pictor – Von der Freiheit des Bildens, in: Jonas, Hans: Organismus und Freiheit. Philosophie des Lebens und Ethik der Lebenswissenschaften, ed. by Gronke, Horst, Freiburg (Rombach) 2010 (critical complete edition, vol. I), pp. 277–316, here p. 281. This comment, made in a footnote, is missing from the first publication of the essay. The essay was already written in English by Hans Jonas in the 1950s, but first appeared in 1961 under the title *Homo pictor und die differentia des Menschen* (Homo pictor and the differentia of man) in a translation into German made by himself. For the various versions of the essay, cf. ibid., p. 606.

Jonas essentially emphasises retracing, i.e. practical drawing comprehension, as a condition for understanding pictures. In view of the fact that it may have been the artificial shadows at the fire that not only confronted humankind with the nature of projection, but also allowed it to be experienced and comprehended in a playful way, the question arises whether this evolving *homo projectans* did not create the preconditions for the *homo pictor* in the first place. There is some evidence for this hypothesis. Numerous legends connect the projection of shadows with imagery to the extent of locating the origin of painting or even sculpture in the outlining of shadows.[11] However, this connection between shadow and picture already presupposes the comprehension of analogies, for which the legends of origin do not offer the slightest explanation.

Many characteristics of shadows can be transferred to images: shadows are not objects, but can rather be described as insubstantial, two-dimensional phenomena. They are two-dimensional structures that cannot be grasped tactilely, but only convey themselves sensually to the sense of vision through their visibility. Shadows appear on surfaces, but they are not part of the surface.[12] The same applies also to pictures. When Konrad Fiedler [1841–1895] describes pictures as "immaterial formations" [stofflose Gebilde],[13] it is precisely due to the fact that they constitute a two-dimensional phenomenon that is actually only visible. Although every picture has a material support, the actual object of the picture is not part of the pictorial surface, but refers to something beyond the surface. In this respect, what essentially distinguishes pictures is that they are not identical with what they show. Precisely this non-identity of object and its representation could already be experienced very vividly by prehistoric cave dwellers in the form of shadow projection. The decisive factor here is that the viewer can simultaneously see both the projected object and its flat shadow cast. If he looks at the objects in the room and their relationships to each other, he potentially becomes aware that their projective translation as shadows on the flat cave wall can have a completely different effect. The comprehension of this projective translation process and the resulting non-identity of a spatial object with its flat representation is not only crucial for an understanding of shadows. The fact that this is also the basic condition for the interpretation of pictures in general is the fundamental theory of this book, which I will explain in more detail in the first chapter.

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11 Kris und Kurz also refer to a Kalmyk and Indian legend in addition to Pliny. Cf. Kris, Ernst; Kurz, Otto: Die Legende vom Künstler – ein geschichtlicher Versuch, Frankfurt a. M. (Suhrkamp) 1980, pp. 102–103.

12 Todes, Samuel: Part II. Shadows in knowledge – Plato's misunderstanding of shadows and of knowledge as shadow-free, in: Selected Studies in Phenomenology and Existential Philosophy 5 (1975), pp. 94–113, here p. 95.

13 Boehm, Gottfried: Konrad Fiedler – Schriften zur Kunst I, München (Fink) 1991, p. 192. In this context, Hans Belting even goes so far as to equate pictures and shadows refering to Dante: "[...] an image is and remains a shadow if one compares its substance with that of an actual body." Cf. Belting, Hans: An anthropology of images – picture, medium, body, Princeton (Princeton Univ. Press) 2011, p. 135

However, an essential difference between shadow and picture is how they relate to the represented object to which they refer. Whereas in the case of a shadow the object illuminated with light is present and can thus be compared with the two-dimensional representation, this does not apply to a picture. The capacity of pictures consists precisely in making an absent object present, i.e. representing it, by its "pure visibility" in a surface.[14] The decisive factor for the creation of a picture is the act of pictorial fixation. If, for example, a shadow is circumscribed in the cave with a piece of charcoal and the object casting the shadow is subsequently removed, a certain form of pictorial representation of the object remains with the silhouette. If such a flat artefact is now interpreted as a representation of an object, Jonas assumes that we are dealing with a human-like being. However, Jonas considers decisive for the "pictorial faculty" of a *homo pictor* not only the corresponding mental imaginative faculty, but also the physical capacity to translate an idea into a representation pictorially: "The envisaged form is not embodied by the wish, and the inner command of the *eidos*, with all its freedom of mental drafting, would remain ineffective had it not also the power to guide the subject's body in execution."[15]

The present work intends to set a different accent here. As indicated in the early shadow scenario already outlined, the examination and understanding of shadow projections is an essential prerequisite for the acquisition of a "pictorial faculty". It is therefore hardly surprising that it is precisely on cave walls around the globe that the first pictorial representations appear, when they had previously already served as a projection surface for plays of light and shadow. Even if some of these early paintings suggest a representation of shadows, the point here is not to associate these first pictorial expressions of humanity with shadows. Rather, it is a question of whether a learning process with shadow projections in particular and other forms of projection in general, which has possibly not been completed to this day, did not begin with the prehistoric play of light and shadow.[16] This process cannot be interpreted as a preliminary stage towards a modern understanding of pictures, but is rather its basic condition and thus constitutively determines what we generally

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14 Wiesing, Lambert: Phänomene im Bild, München (Fink) 2000, p. 10.

15 Jonas, Hans: Homo pictor and the differentia of man, in: Social Research 29 (Summer 1962) 2, pp. 201–220, here p. 218. For Jonas, the pictorial faculty also articulates the potential of transcending the real: "The freedom that chooses to render a likeness may as well choose to depart from it." As early as 1776, Lavater pointed out the liberating potential of freehand drawing of a silhouette, since there the artist could learn "the great arcanum - to unite determination and freedom [Bestimmtheit und Freyheit]". Cf. Lavater, Johann Caspar: Physiognomische Fragmente zur Beförderung der Menschenkenntniß und Menschenliebe, Leipzig u.a. (Weidmanns Erben und Reich) 1776 (Vol. 2), p. 91.

16 Kaufmann argues that it took until the early modern period to adequately represent shadow projections pictorially. Cf. Kaufmann, Thomas DaCosta: The perspective of shadows – the history of the theory of shadow projection, in: Journal of the Warburg and Courtauld Institutes 38 (1975), pp. 258–287. The difficulties of adequately depicting the sun's shadow were demonstrated in 2018 in the exhibition *Schatten im Blick?* [Shadows in view?] presenting engravings from the early modern period. Cf.: Roth, Tim Otto; Ketelsen, Thomas (Ed.): Schatten im Blick? (Wallraf-Richartz-Museum) 2018.

recognize as pictures. When Belting, in his anthropology of images, demands that image studies should take more account of the "physics of the image" in order "to accord the mediality of all images a separate place",[17] the present study here intends to follow up on this demand and consider whether every picture cannot fundamentally be described as a phenomenon that stands in a physical-projective relationship to what it represents. A picture could thus be understood as the fixed form of a projection. Understanding a picture would ultimately mean pursuing physics and geometry imaginatively and placing the two-dimensional representation in the imagination in a projective context.

Shadowgraph versus photogram

In order to explore the relationship between projection and image more closely, the work focuses more on the relationship between shadow and its recording as a shadow picture. There are various ways of recording a shadow in the form of a picture. This can be realised by means of manual drawing and painting techniques. However, since a shadow is caused by the projection of an object by means of light, photochemical or photoelectric recording methods can also be used to fix it pictorially. With light-sensitive recording material, a shadow can be captured in two ways. The shadow can be photographed from a projection surface using a camera. But the light-sensitive material can also become a projection surface itself by exposing the shadow directly onto it. I call this form of shadow picture a shadowgraph.

Shadowgraphs will be the particular focus of the question posed here. In a way, it is a revision of the Platonic allegory of the cave, in that Socrates and Glaucon are sent into the cave again after more than 2000 years – but this time with a roll of photographic paper under their arms in order to capture the shadows on the cave wall. What the two Athenians can potentially discover thereby will be traced through the application of a procedure used by scientists and artists. In the sciences, shadowgraphs in the form of the X-ray process already caused a visual revolution at the end of the 19th century. Although in photo-amateur circles, but also in occult practices, shadowgraphs were also produced in the 19th century, the visual arts discovered the shadowgraph for themselves relatively late, after the First World War.

In art, the problematic term photogram has gradually become established for this way of shadow record. This term was introduced by artist and Bauhaus teacher László Moholy-Nagy [1895–1946] in his book *Malerei – Photographie – Film* [Painting – photography – film] in 1925.[18] In 1937 Beaumont Newhall still

[17] Belting, Hans: An anthropology of images – picture, medium, body, Princeton (Princeton Univ. Press) 2011, p. 12. Belting refers here to Peter Weibel und Walter Seitter. The latter also addresses the physics of images in connection with shadows in: Seitter, Walter: Physik der Medien, Weimar (VDG) 2002.

[18] Moholy-Nagy, László: Malerei – Photographie – Film, München (A. Langen) 1925. The book was published in 1927 in a revised version, which is already noticeable in the title by the changed

asigned the "photograms" by Moholy-Nagys and the "Rayographs" by Man Ray as "shadowgraphs" in the first edition of his *History of Photography*, to which Moholy-Nagy vehemently objected in a letter of 4 July 1937 to Beaumont Newhall.[19]

It is surprising that Beaumont Newhall adopted the term "photogram" in his repertoire of terms. The term proves to be problematic, especially from a photohistorical perspective, as it has been used before in analogy to camera-photographic pictures.[20] Even today, the term finds completely different uses, e.g. in survey technology (photogrammetry) or in film technology, where the English term "photogram" or the French term "photogramme" refers to a frame (single image).[21] Bertolt Brecht [1898–1956] even called the word-image combination of photo and quatrains in his *War Primer* (1940–45) "Fotoepigramme" or "Fotogramme".[22]

The term must also be viewed critically because it is explicitly formulated by Moholy-Nagy in an artistic context. Moreover, the term has considerable vagueness in technical terms and is used by Moholy-Nagy analogously to the equally vague term "cameraless photography".[23] From a historical point of view, therefore, the methodological question arises as to whether this concept, which in Moholy-Nagy's work is based on a mixture of gnostic and constructivist ideas, is at all suitable to be projected back in time as a terminus technicus to serve other uses of the process, such as in a photohistorical and scientific context.[24]

German spelling of photography, now using "f" instead of "ph": Moholy-Nagy, László: Malerei – Fotografie – Film, Mainz (Kupferberg) 1967 (reprint of the edition from 1927). In the German edition of the present study the spelling "photogram" is used according to the first edition of 1925.

19 Cf. letter by Moholy-Nagy, László to Newhall, Baumont, 7 April 1937, in: Kostelanetz, Richard: Moholy-Nagy, London (Allen Lane) 1970, p. 57. See also the detailed discussion on Mohohly-Nagy in chapter 5.3.

20 Cf. Neusüss, Floris M.; Heyne, Reante (Ed.): Das Fotogramm in der Kunst des 20. Jahrhunderts. Die andere Seite der Bilder – Fotografie ohne Kamera, Köln (DuMont) 1990, p. 9. A search for the frequency of use of the term with the help of the N-gram analysis of Google Books reveals that in German the term "Photogramm" was already used disproportionately in the period from about 1890 to 1910. A first significant peak in the 1890s can also be seen in the distribution diagrams for the languages English (*photogram*) and French (*photogramme*).

21 Pierre, Sylvie: Eléments pour une théorie du photogramme, in: Cahiers du cinéma (January-February 1971) 226–227, pp. 75–83.

22 Brady, Philip V.: From Cave-painting to ‚Fotogramm' – Brecht, Photography, and the Arbeitsjournal, in: Forum for Modern Languages Studies 14 (July 1978), pp. 270–282, here p. 280.

23 Whereas in 1925 in his book *Malerei – Photographie – Film* the shadowgraphs were simply labelled "Photogramm", he added the designation "kameralose Fotografie" [cameraless photography] to the captions in the revised edition of 1927.

24 Thus, in 1937, Newhall adopts the expression for Wedgwood and Davy's approach to produce contact copies: "They were the first to describe the 'shadowgraph' or 'photogram' – a silhouette picture made without a camera." Cf. Newhall, Beaumont: Photography 1839–1937, New York (Museum of Modern Art) 1937, p. 15. The historians of science Daston and Galison consider a photogenic drawing of three leaves by Talbot to be "in fact, a photogram". Daston, Lorraine; Galison, Peter: Daston, Lorraine; Galison, Peter: Objectivity, New York, NY (Zone Books) 2007, fig. 3.5, p. 128. The French art and photo historian Chéroux classifies August Strindberg's works as photograms, in which he experimented with light-sensitive plates without a camera. Cf. Chéroux,

As the term photogram already suggests a conceptual proximity to photography on the phonetic level, it is not surprising that the shadowgraph in an artistic context has until recently been predominantly associated with photography as its "escapade" [Seitensprung] or "alter ego".[25] Thus, the photogram was previously considered an "artistic technique" [künstlerische Technik][26] of photography or an "experimental vision"[27] or "generative"[28] variation of photography, whose special feature lies in the apparative reduction. There is talk of photography "without a lens" or "without a camera", which is reflected not only in the specialist literature but also in exhibition titles such as *Lensless Photography* (Philadelphia 1983) or *Kamera los* (Salzburg 2006).[29] This negative reference to photography always leaves the concept of the photogram in the situation of a strange definitional indeterminacy or at least underdetermination. This has led to a wide variety of procedures labled as photograms that work experimentally with light-sensitive materials. The impact of this negative concept of camera-less photography is demonstrated by the fact that even the exhibition with the unmistakable title *Shadow Catchers* at the Victoria & Albert Museum (2010) was subtitled *camera-less photography*.[30]

The present study provides fresh impetus by not defining the shadowgraphs negatively as a photograph minus X, but positively, and consequently by classifying and thematising them beyond a photographic context. Moholy-Nagy already

Clément: L'expérience photographique d'August Strindberg – du naturalisme au sur-naturalisme, Arles (Actes Sud) 1994, p. 37 & p. 38.

25 Cf. Hajek-Halke, Heinz: Seitensprünge der Fotografie – das Fotogramm, in: Volk und Zeit, 12 (1930) 27, p. 210; Hagen, Charles: Photography's Alter Ego, in: Camera Arts 3 (Mai 1983) 5, pp. 22–32, 84 & 87.

26 Hülsewig-Johnen, Jutta; Münzberg, Diether: Künstlerische Techniken IV – die Fotografie, Bielefeld (Kunsthalle Bielefeld) 1989.

27 Neusüss, Floris M.; Hagen, Charles; Barrow, Thomas (Ed.): Experimental vision – the evolution of the photogram since 1919, Niwot, CO (Roberts Rinehart Publishers) 1994.

28 Jäger, Gottfried; Holzhäuser, Karl Martin: Generative Fotografie, Ravensburg (O. Maier) 1975.

29 Cf. the exhibition catalogues: The Franklin Institute Science Museum: Lensless Photography, Philadelphia 1983; Museum der Moderne: Kamera los – das Fotogramm, eine künstlerische Position von der Klassik bis zur Gegenwart, Salzburg (Pustet) 2006, and the article Andersson, Cecilia: Cameraless Photography, in: Katalog 13 (Summer 2001) 2, pp. 14–19. Other exhibitions that can be mentioned in this context are: Heaven's Embroidered Cloths, National Museum of Photography, Film & TV, Bradford, 13 June – 17 September 1995; Cameraless photography, Yokohama Museum of Art, 2–23 October 1994; Cameraless Wonders, Art Institute Chicago, 1 June – 5 November 2000. A workshop by Nino Migliori is intitled *Off Camera*: Migliori, Antonio: Off camera, Parma (Università di Parma) 1980. There is already a reference to a "photographie sans objectif" at: Bergeret, Albert; Drouin, Felix: Les récréations photographiques, Paris (C. Mendel) 1893, pp. 43–47.

30 The subtitle is possibly due to the fact that the exhibition also showed the chemical paintings on photographic paper by the Belgian artist Pierre Cordier [*1933], which have no procedural connection to "shadow catchers". Cf. Barnes, Martin: Shadow catchers – camera-less photography, London a.o. (Merrell) 2010. In an interview by the *Daily Telegraph* with Floris M. Neusüss, the artist participating in the exhibition rejects the conflation of shadowgraphy and photography: "For me making a photogram is almost the opposite of making photographs." Cf. Davies, Lucy: Floris Neususs – Interview, in: The Telegraph (8 October 2010), cited in: http://www.telegraph.co.uk /culture/photography/8051406/Floris-Neususs-Interview.html <12.10.2010>.

understood the photogram as the "fixation of a differentiated play of light and shadow"[31], so the relationship of these pictures to the shadow needs to be better elaborated. For this purpose, not only the works of artists and art-theoretical considerations are consulted, but also scientific images and their contextualisation within the framework of scientific research. Following Beaumont Newhall's original term "shadowgraph", but especially the definition of the brewing biologist Paul Lindner [1861–1945], for whom, recalling Wilhelm Scheffer [1871–?] "the process is simply the projection of the shadow of a spatial object onto a light-sensitive emulsion," [32] I will therefore refer to these pictures as shadowgraphs.

A shadowgraph can consequently be described as a category of shadow picture in which the shadow representation is realised by fixing a shadow by means of a photochemical or photoelectric recording process. Shadow pictures differ from shadow representations in a picture by the fact that only shadows are represented as the sole picture-structuring content. This is based on a concept of shadow that starts from the projection of a spatial object and thus understands projection as a translational process from a three-dimensional body into the two-dimensionality of a picture. This approach, which is inspired by projective geometry, is understood as a distinct counter-proposal to approaches that positively or negatively relate shadowgraphs to photography. A theoretical reappraisal of the history of shadowgraphs in particular and shadow pictures in general has yet to be undertaken.

Shadowgraphs in the arts – publications and exhibitions

As early as 1982, with his essay on the photogram entitled *Versuch über das Fotogramm* in the East German journal *Bildende Kunst*, Roland März [*1939] called attention to the fact that a history and theory of shadowgraphs was still lacking. He criticises this deficiency in particular because it makes it difficult to classify shadowgraphs by contemporary artists both historiographically and theoretically:

> The closer we get to the present, the more random these few examples of the photogram must appear. Are they representative at all? - A question that can hardly be answered conclusively as long as the history and theory of the photogram have not been written and the overview for the contemporary photogram is also almost completely lacking.[33]

[31] "Fixierung eines differenzierten Licht- und Schatten-Spiels", see: Moholy-Nagy, László: Malerei – Fotografie – Film, Mainz (Kupferberg) 1967, p. 30 [reprint of the edition from1927].

[32] "[...] das Verfahren einfach die Projektion des Schattens eines räumlichen Gegenstandes auf eine lichtempfindliche Schicht ist". Lindner speaks of "light-shadowgraphs" ("Hellschattenaufnahmen") and "half-light-shadowgraphs" ("Halbhellschattenaufnahmen"). The lighthened shadows refer to the tonal inversion of the shadows on the black and white photo emulsion. Scheffer,Wilhelm: Zur Technik der Hellschattenaufnahmen, in: Photographie für Alle 3 (1914) 22, pp. 482–484, here p. 484.

[33] "Je mehr wir uns der Gegenwart nähern, um so zufälliger müssen diese wenigen Beispiele des Fotogramms erscheinen. Sind sie überhaupt repräsentativ? – Eine Frage, die kaum schlüssig zu beantworten ist, so lange die Geschichte und Theorie des Fotogramms noch nicht geschrieben

The review by Roland März was the first of its kind in Germany.[34] Although art history subsequently started to deal with shadowgraphs in a more historiographical way, a theoretical discussion of shadow recordings has not yet taken place in relevant media and art theories. The only compendium *Das Fotogramm in der Kunst 20. Jahrhundert*[35] by Floris M. Neusüss [*1937–2020] and Renate Heyne [*1947] is a rather extensive collection of art historical material (500 pages) on what the subtitle describes as "photography without a camera" [Fotografie ohne Kamera]. The anthology, which in its subtitle also aims to draw attention to "another side of the pictures" [die andere Seite der Bilder], has, however, only been published in German and, with a print run of only 1000 copies, distribution has been comparatively low. The volume gathers images by over 150 artists and a few scientists together with biographical and bibliographical background information. Also included are numerous reprints of important texts, some of which are available as facsimiles or for the first time as German translations. As the title already suggests, the publication remains predominantly committed to purely artistic positions in the 20th century. The focus of the work is on the classical avant-garde, with which the discovery of the process for art is associated. By contrast, comparatively little space is given to more contemporary artistic positions up to the year of publication 1990.

The endeavour to consistently sharpen the concept of the photogram and to rid it of its "camouflage designations" [Tarnbezeichnungen][36] is, however, not only partially undermined by the fact that the book continues to speak of "photographic images", but that processes such as the cliché verre or the chemigram are also included.[37] Despite the meticulously researched abundance of material, the volume only rudimentarily undertakes a theoretical reappraisal. The textual reflections remain mostly text- and work-immanent. The essay by Ulrich Raulff [*1950], which

sind und auch der Überblick für das zeitgenössische Fotogramm nahezu gänzlich fehlt." Cf. März, Roland: Die Kunst der kameralosen Fotografie – Versuch über das Fotogram, in: Bildende Kunst 30 (1982) 6, pp. 279–283, here p. 283.

34 Einen kleinen, weit weniger akademischen Überblick mit einem französischen Schwerpunkt gibt 1977 bereits Guilpin in einer Photozeitschrift: Guilpin, Georges: Défense et illustration du photogramme, in: Photo-revue 89 (February 1977), p. 77.

35 Neusüss, Floris M.; Heyne, Renate: Das Fotogramm in der Kunst des 20. Jahrhunderts. Die andere Seite der Bilder – Fotografie ohne Kamera, Köln (DuMont) 1990. Hereafter abbreviated by: Neusüss & Heyne 1990.

36 Ibid., p. 9.

37 Ibid., p. 11, see also the mentioned processes on pp. 482–483. Helmut Gernsheim describes these processes as "purely chemical or optical techniques and so could not be objected to on photographic grounds." Cf. Gernsheim, Helmut: Creative photography – aesthetic trends 1839–1960, New York (Bonanza) 1962, p. 168. Pierre Cordier understands the process as a "chemical symbol" [chemisches Schriftzeichen]: "According to this, one could call every graphic symbol that appears as a result of a chemical reaction, e.g. a rust stain, verdigris on copper or crystallised salt, a chemigram."[Demnach könnte man jedes grafische Zeichen, das sich aufgrund einer chemischen Reaktion abbildet, z.B. eine Rostfleck, Grünspan an Kupfer oder kristallisiertes Salz, ein Chemigramm nennen.] Cf. Jäger, Gottfried; Holzhäuser, Karl Martin: Generative Fotografie, Ravensburg (O. Maier) 1975, p. 142.

opens up new ways of thinking with references to light-sensitive surfaces and skin, is one of the few exceptions.[38]

It is significant and quite advantageous that the anthology, with Floris M. Neusüss and Renate Heyne, was written by artists and thus visual practitioners who understand the process first-hand. It is therefore not surprising that in retrospect Floris M. Neusüss classifies the work as the work as "a kind of artist's book, similar to the *Book of New Artists* by Moholy-Nagy und Kassák".[39] Methodologically, it must be taken into account that the authors – as they state themselves – made their selection "according to personal-associative and not according to scientific or didactic points of view",[40] which does not make it easy to systematically access the publication.

Other anthologies on the photogram have so far been much more modest in scope and are usually published as a catalogue accompanying an exhibition. Floris M. Neusüss himself has also published a number of smaller works in collaboration with the Goethe-Institut, among others.[41] With the exhibition *Photogramme*, Norbert Nobis took a look back at the classical avant-garde in 1988 at the Sprengel Museum Hannover.[42] The exhibition *Anwesenheit bei Abwesenheit* [Presence in Absence] at the Zurich Kunsthaus, in which Floris M. Neusüss and Renate Heyne were also significantly involved, ventures a far more comprehensive view into the present.[43] In 1991, a special volume of the Spanish magazine *Photovision* entitled *Del pigmento a la luz – from pigment to light* focuses on shadowgraphs.[44] With *Experimental Vision* an exhibition in Denver in 1994 is explicitly dedicated to "the evolution of the photogram since 1919".[45] The quite extensive *Light Grammar* from 2001 by the Hungarian artist Dora Maurer [*1937][46] or catalogues such as those for the

38 Raulff, Ulrich: Ein Etwas oder ein Nichts, in: Neusüss & Heyne 1990, pp. 406–410. Raulff had already written the essay *Umbrische Figuren* in: Neusüss, Floris M. (Hrsg.): Fotogramme – die lichtreichen Schatten, Kassel (Fotoforum) 1983, pp. 11–17.

39 "eine Art Künstlerbuch, ähnlich wie das Buch Neuer Künstler von Moholy-Nagy und Kassák" See the transcription of the *evening talk with Floris M. Neusüss* in occasion of the symposium *Das Photogramm. Licht, Spur und Schatten* in April 2009 at the Center of Art & Media ZKM Karlsruhe [Transkription] on: http://www.photogram.org/symposium/neusuess.html <30.10.2009>.

40 "nach persönlich-assoziativen und nicht nach wissenschaftlichen oder didaktischen Gesichtspunkten", cf. Neusüss & Heyne 1990, p. 10.

41 Fotogramme – die lichtreichen Schatten, Kassel (Fotoforum) 1983; Fotogramme 1918 bis heute, München (Goethe-Institut) 1987; Photogrammes [Collection Photo poche 74], Paris (Nathan) 1998.

42 Nobis, Norbert (Ed.): Photogramme, Hannover (Sprengel Museum) 1988.

43 Binder, Walter (Ed.): Anwesenheit bei Abwesenheit – Fotogramme und die Kunst des 20. Jahrhunderts, Zürich (Schweizerische Stiftung für Photographie) 1990.

44 Photovision 12 (1991) 22.

45 Cf. Neusüss, Floris M.; Hagen, Charles; Barrow, Thomas (Ed.): Experimental vision – the evolution of the photogram since 1919, Niwot/CO (Roberts Rinehart Publishers) 1994.

46 Maurer, Dóra (Ed.): Fényelvtan – a fotogramról, Budapest (Balassi Kiadó) 2001.

Salzburg exhibition *Kamera los* (2006) and the Viennese show *Fotogramme 1920 > now* (2006)[47] focus on shadowgraphic works in their own country.

Most of the authors of the publications cited associate the beginning of an (art) history of the shadowgraph with the emergence of the so-called Schadographs by Christian Schad [1894–1982] after 1918.[48] Almost inevitably, this entails a reference back to positions of the classical avant-garde, in particular Man Ray [1890–1976] and László Moholy-Nagy [1895–1946]. In this context, the numerous publications of the Bielefeld photography professor Gottfried Jäger [*1937] also need to be mentioned. In the 1970s, he worked with Karl Martin Holzhäuser [*1944] on the concept of a "generative photography" to further structure the ideas of Moholy-Nagy, but also Herbert W. Franke's question "What can photography do?".[49] [50] Later, he refers to the photogram as a variant of an "imaging photograph" (1988) or a "concrete photograph" (2005).[51] Even if you do not necessarily have to follow Jäger's classification of shadowgraphs as a form of experimental photography, he deserves credit for having developed a technically based system.

Such systematics are missing in many recent publications on exhibitions featuring mainly shadowgraphs. The presentation concepts for relating the works are consequently of a rather associative nature. The exhibition *Under the Sun* in San Francisco (1996/97), for example, focuses on the "metaphysical possibilities of the medium"[52] as a unifying element of the presented "photographs". The technical and physical possibilities of the medium are not important to the artists, as it is said that they are not concerned about how the images are produced.[53] In the exhibition *Alchemy*, touring England in 2007, shadow photographs are interpreted as an expression of an

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47 Rupertinum Museum der Moderne: Kamera los – das Fotogramm. eine künstlerische Position von der Klassik bis zur Gegenwart, Salzburg (Pustet) 2006; Nevole, Inge (Ed.): Fotogramme 1920 > now, Passau (Klinger) 2007.

48 For a long time, these early works by Schad were wrongly dated to 1918. In fact, they were created in Geneva in 1919. Cf. the explanations in chapter 5.1.

49 "Was kann die Fotografie?". Cf. Franke, Herbert W.: Kunst und Konstruktion, München (Bruckmann) 1957, pp. 8-9. Together with him Gottfried Jäger wrote: Apparative Kunst – vom Kaleidoskop zum Computer, Köln (DuMont Schauberg) 1973.

50 In addition to X-ray images, the photogram is listed in the procedure category "penetration/overlay"[Durchdringung/Überlagerung] as well as under the procedures "contrast and contour formation"[Kontrast und Konturenbildung]. Jäger, Gottfried; Holzhäuser, Karl Martin: Generative Fotografie, Ravensburg (O. Maier) 1975, p. 40 & p. 74.

51 Jäger, Gottfried: Bildgebende Fotografie: Fotografik – Lichtgrafik – Lichtmalerei; Ursprünge, Konzepte und Spezifika einer Kunstform, Köln (DuMont) 1988; Jäger, Gottfried; Krauss, Rolf H.; Reese, Beate: Concrete Photography, Bielefeld (Kerber) 2005.

52 Fraenkel, Jeffrey: Introduction, in: ders. (Ed.): Under the sun – photographs by Christopher Bucklow, Susan Derges, Garry Fabian Miller, and Adam Fuss, San Francisco 1996, pp. 7–8, here p. 7. The title of the book is possibly an allusion to a 1960 exhibition of abstract photography or even a reminiscence of a nineteenth-century book title. Cf. Lyons, Nathan; Labrot, Syl; Chappell, Walter: Under the sun – the abstract art of camera vision, New York (G. Braziller) 1960; Gaffield, Thomas: Something new under the sun – Leaf and fern pictures, Boston 1869.

53 The *technical note* that precedes the picture section points to this: "[…] how their pictures were made does not matter." Cf. ibid., n.p.

alchemical approach to the world.[54] The exhibition *Abstrakte Photographie*. and an accompanying conference in Bielefeld thematise shadow recordings in the context of an "abstract photography".[55] While *ARTnews* proclaimed the "new abstract photo" in a cover story in 2008, the exhibition *Edge of Vision* at the Aperture Foundation in New York in 2009 embeds the contemporary works in a history of abstract photography that, for the author Lyle Rexer, already begins with Talbot's [1800–1877] photogenic drawings and the cyanotypes of Anna Atkins [1799–1871].[56]

Numerous monographic publications are now explicitly dedicated to the artistic examination of shadowgraphs. Extensive catalogues raisonnés have already appeared on Moholy-Nagy, Man Ray and Christian Schad.[57] For a long time, a reference to at least one of these three classics was considered almost to be mandatory for a catalogue contribution to a photogrammatical oeuvre, but since the 1990s a change has become apparent. Looking at the catalogues of Adam Fuss and Susan Derges, it is not only the colourfulness of the large-format shadowgraphs that catches the eye, but also the lack of references to classical modernism in the catalogue texts.[58]

Literature on shadows in pictures

The current research literature, which deals more closely with shadow phenomena and their history, does not yet offer a theoretical toolkit for shadowgraphs. Thus, the definition of shadow pictures is already insufficiently differentiated; the description of shadowgraphs does not appear at all or only marginally. This is due to the fact

54 Barron, Katy; Douglas, Anna: Alchemy – twelve contemporary artists exploring the essence of photography, London (Purdy Hicks Gallery) 2006.

55 Kellein, Thomas; Lampe, Angela (Hrsg.): Abstrakte Fotografie, Ostfildern-Ruit (Cantz) 2000; Jäger, Gottfried (Ed.): Die Kunst der abstrakten Fotografie, Stuttgart (Arnold) 2002.

56 Bryant, Eric: The indecisive image, in: ARTnews 101 (2008) 3, pp. 106–113; Rexer, Lyle: The edge of vision – the rise of abstraction in photography, New York (Aperture) 2009. In her dissertation, Kathrin Schönegg argues "that abstract depictions in photography follow a different logic than comparable pictures in abstract art" [dass abstrakte Darstellungen in der Fotografie einer anderen Logik folgen, als vergleichbare Bilder der abstrakten Kunst]. Cf. Schönegg, Kathrin: Nicht(s) zeigen – zur Abstraktion in der Fotografie, in: Fotogeschichte 32 (2012) 126, pp. 73–74, here p. 73. On the subject see also: Gyenes, Zsolt: Az absztrakt fotográfia a kortárs művészetben[Abstract photography in contemporary art], Pécs 2007 (PhD Thesis); Wiesing, Lambert; Jäger, Gottfried: Abstrakte Fotografie: Denkmöglichkeiten – What could 'Abstract photography' be?, Bielefeld (Teutloff) 2000. The photographer Erwin Quedenfeldt already advocated "abstract photography" in the 1920s. Cf. Quedenfeldt, Erwin: Das Lichtbild ohne Kamera, in: Photofreund 6 (1926) 5, pp. 83–84, here p. 84. See also the exhibition *Abstraction in Photography* (Nr. 476) at the Museum of Modern Art, New York, 1 May–4 July 1951.

57 Vgl. Heyne, Renate; Neusüss, Floris M.; Moholy-Nagy, Hattula (Hrsg.): Moholy-Nagy – the photograms. Catalogue raisonné, Ostfildern (Hatje Cantz) 2009. L'Ecotais, Emmanuelle de: Man Ray – Rayographies, Paris (Scheer) 2002. Christian-Schad-Stiftung Aschaffenburg (Ed.): Christian Schad – catalogue raisonné, Volume 3 Schadographs, Köln (Wienand) 2019.

58 Parry, Eugenia: Less of a test than earth, in: Fuss, Adam: Adam Fuss, Santa Fe, NM (Arena) 1997, pp. 1–28. Derges, Susan; Kemp, Martin: Liquid Form 1985–99, London (Michael Hue-Williams Fine Art) 1999.

that the shadow is always treated as a representation in the picture and thus as one pictorial element among others, but not as the sole pictorial object. Ernst H. Gombrich [1909–2001], for example, focuses his brief outline *Shadows – the depiction of cast shadows in western art* (1995) on representations of shadows in painting.[59]

Although Michael Baxandall not only addresses the shadow as an art historical theme in painting, but also reflects on it philosophically as an epistemological problem in his book *Shadows and Enlightenment* (1995) and even includes shadow simulation in the computer, the shadow as the sole pictorial actor is not discussed.[60] In Victor Stoichita's *A short history of the shadow* (1997), which deals with shadows in pictures from antiquity to contemporary photography, shadows are not mentioned either.[61] Thomas DaCosta Kaufmann is critical of such an approach: "legends and classical references could never lead to a systematic theory of shadow projection."[62] Instead, he looks more closely at how artists and scholars attempt to describe the phenomenon of the shadow and develop methods to represent it in a picture. However, his investigation is limited to the period from the Renaissance to the early modern era.

A few historical references to shadowgraphs can also be found in publications on shadows written by philosophers: In his popular science treatise *The Shadow Club* (2004) Roberto Casati discusses a contact copy of a foliage leaf by Talbot in a few lines.[63] In *Seeing Dark Things* (2008), Roy A. Sorensen is equally sparse in discussing John Herschel's early experiments with the blueprint process in 1839.[64] What Casati's and Sorensen's approaches have in common is not only that they are committed to analytical philosophy, but that no categorical distinction is made between shadows and their fixation in a shadow picture. Steffen Bogen's paper *Schattenriss und Sonnenuhr* [Silhouette and Sundial] is one of the few essays in the field of visual studies and picture theory that focuses on the shadow as an object of

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59 Gombrich, Ernst H.: Shadows – the depiction of cast shadows in western art, London (National Gallery) 1995.

60 Baxandall, Michael: Shadows and Enlightenment, New Haven and London (Yale Univ. Press) 1995.

61 This is all the more astonishing because in the chapter *Of Shadow and its Reproducibility during the Photographic Era* Stoichita shows a photograph of a shadow-casting object by Man Ray, but does not even mention his so-called rayographs. Stoichita, Victor I.: A short history of the shadow, London (Reaktion Books) 1997, p. 195. In the catalogue of the Madrid exhibition *La sombra* (2009), curated by Stoichita, only one rayograph, erroneously dated 1920, is included. Cf. Stoichita, Victor I.; Arburg, Hans-Georg von: La sombra, Madrid (Museo Thyssen-Bornemisza) 2009, p. 229.

62 Kaufmann, Thomas DaCosta: The perspective of shadows – the history of the theory of shadow projection, in: Journal of the Warburg and Courtauld Institutes 38 (1975), pp. 258–287, here p. 262.

63 In the English edition, Talbot's print is called a "shadowgraph". Casati, Roberto: The shadow club, New York, NY (Knopf) 2003, p. 15.

64 Roy A. Sorensen: Seeing dark things, Oxford (Oxford University Press US) 2008, p. 32.

study.[65] In his diagrammatic approach to the shadow, however, he only deals with the silhouette as a form of pictorial representation of a shadow. This is quite legitimate if the silhouette is not reduced to the only form of pictorial translation of a shadow.[66]

Shadows and shadow pictures on show

If we look at exhibitions that focus on the shadow in 20th century art, it tends to appear as an immaterial projection in an installation, as a painted silhouette and shadow outline or as a shadow within a photographic picture. Shadowgraphs, on the other hand, have so far hardly been shown in this exhibition context. Although painted shadows were represented in the Mannheim show *Der ausgesparte Mensch* (1975/76) no shadowgraphs were presented.[67] The Italian exhibition catalogue *L'ombra* (1979) is illustrated only in the introductory text by a shadowgraph: a Rayograph from 1922.[68] The exhibition *Schattenprojektionen* Werner Nekes realised 1993 in cooperation with the Academy of Media Arts Cologne at the Städtische Galerie Schloß Oberhausen also did not show any shadowgraphs.[69]

Looking at more recent publications, the situation has hardly changed. In the extensive catalogue of the exhibition *Shadow play* (2005), which made stops in Odense, Kiel and Linz, no shadowgraphs are listed.[70] In the publication accompanying the Basel exhibition *Schatten, Schatten* (2003), the authors are portrayed only in the short biographies in the form of a full-body shadow picture.[71] The publication accompanying the Neukölln exhibition *Schattenwelten* briefly refers to three positions of the classical avant-garde and the "Schattenaufnahmen" by Floris M. Neusüss.[72] The Munich exhibition catalogue *SchattenRisse* (2001) goes well

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65 Cf. Bogen, Steffen: Schattenriss und Sonnenuhr – Überlegungen zu einer kunsthistorischen Diagrammatik, in: Zeitschrift für Kunstgeschichte 68 (2005) 2, pp. 153–176. Hans Belting, among others, offers reflections on the relationship between shadow and picture in: Belting, Hans: An anthropology of images – picture, medium, body, Princeton (Princeton Univ. Press) 2011.

66 Hans Belting claims in his anthropoly of images that "a shadow without a body [...] could only be experienced in the empirical world as a fixation of a shadow in a silhouette". Translated by the author from the original German publication: Belting, Hans: Bild-Anthropologie – Entwürfe für eine Bildwissenschaft, München (Fink) 2001, p. 183.

67 Städtische Kunsthalle Mannheim: Der ausgesparte Mensch, Mannheim 1976.

68 In addition to Man Ray the text mentions also Christian Schad and Moholy-Nagy. Cf. Sinisi, Silvana: L'ombra, Mantova (Casa del Mantegna) 1979.

69 Nekes, Werner: Schattenprojektionen, Köln (Kunsthochschule für Medien a.o.) 1993 (postcard catalogue and video documentation on VHS).

70 Kunsthallen Brandts Klædefabrik (Ed.): Shadow play – shadow and light in contemporary art, Heidelberg (Kehrer) 2005.

71 The shadows were photographed from a screen onto which the authors cast their shadows from behind. Götz, Matthias: Schatten, Schatten. Der Schatten – das älteste Medium der Welt, Basel (Schwabe a.o.) 2003, pp. 125–127.

72 Schad, Moholy-Nagy and Man Ray are discussed in addition to Neusüss. Binger, Lothar; Hellemann, Susann: Schattenwelten – zur Kulturgeschichte des Schattens, Berlin (Kramer) 2001, p. 162 &164.

beyond this and thematises shadow recordings in words and images in the fields of silhouette, photography and even old techniques such as nature printing.[73]

The 1985 exhibition *Mehr Licht* in Hamburg extended the field of references and presented shadowgraphs in the context of light art and holography.[74] In 1997, Georges Didi-Huberman presented a few shadowgraphs in his Paris exhibition *L'Empreinte*, which was dedicated to the phenomenon of the imprint. At the same time, he curated the small exhibition *Contemporary Photograms* in the neighbouring gallery Michèle Chomette, which featured shadow photographs exclusively by contemporary French artists.[75]

"This is not a photograph"

In recent years, there has been a boom in exhibitions that increasingly present contemporary shadowgraphs. The majority of these exhibitions and the publications accompanying them continue to locate them in the sphere of (camera-less) photography – sometimes without taking account of their relationship to the shadow. A growing number of artists have lately expressed dissatisfaction with this classification. This is partly due to the fact that they no longer necessarily have a photographic background, but as painters or sculptors also deliberately take up the medium of the shadowgraph.[76] A caesura in this respect is foreshadowed in the title of the show *This is not a photograph*, which toured several US university galleries in 2001 and 2002:[77]

> a show whose name comes from a mission-of-burma song, with a nod to rené magritte, it is intended to be a showcase of photographs that my grandfather would not recognize as such.[78]

These are the curator's introductory words Roger Sayre [*1963] in the accompanying catalogue. The works on show have in common that they were all made on light-sensitive materials without using a photo camera. Many of them were shadowgraphs.

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73 Ackermann, Marion: SchattenRisse – Silhouetten und Cutouts, hrsg. von Helmut Friedel, Ostfildern (Hatje Cantz) 2001. See here in particular: Pohlmann, Ulrich: Über die Kunst, einen Schatten zu fixieren – Photographie in Schattenfiguren von 1839 bis 1930, pp. 149–169.

74 Lipp, Achim (Hrsg.): Mehr Licht – Künstlerholographie und Lichtobjekte, Hamburg (Kabel) 1985.

75 Didi-Huberman, Georges: L'Empreinte, Paris (Centre Georges Pompidou) 1997. Gallery exhibition: Contemporary Photograms, Galerie Michèle Chomette, Paris, 18 March–24 May1997.

76 For example, the Italian painter Fabio Sandri or the German sculptor Jörg Wagner, who will be discussed in more detail in the last chapter.

77 University Art Gallery San Diego, La Jolla, 5 April–19 May 2001; Bayly Art Museum, University of Virginia, Charlotteville, 3 August–7 October 2001; University Art Gallery, De Paul University, Chicago IL, 18 January–10 March 2002. *Not photography show*, the title of a smaller exhibition at the Arts Club London sets a similar course (1 October 2012–31 January 2013).

78 Sayre, Roger: Introduction, in: Sayre, Roger (Ed.): This is not a photograph, New York (Pamela Auchincloss) 2001, n. p.

This is not a photograph as an exhibition title is thought-provoking in the sense that it suggests that, on the one hand, a picture made with light-sensitive material does not necessarily have to be called a photograph, and that, on the other hand, a photographic apparatus is necessary to call a picture photographic. It is also noteworthy that Sayre refers to a layman, his grandfather, as a key witness. Sayre thus implicitly formulates a conflict between the more or less intuitive perception of pictures by the layman's eye and a theoretically obscuring view on the part of photographic discourse.[79]

Structure of the study and methodology

The present study opens up the medial terrain of shadowgraphs significantly through various topics. The first chapter provides basic procedural considerations on shadowgraphs by dealing in detail with the phenomenon of shadows and the different ways of recording them. The concept of projection plays a key role here. That the spatial nature of the projected object is decisive becomes apparent in the second chapter, which explains, among other things, why a contact print is not a shadowgraph. Building on this, the following chapter presents the negative shadowgraphs ("Hellschattenaufnahmen") developed by the brewing biologist Paul Lindner in the 1910s as an example of a scientific application. In the fourth chapter, the discovery of X-rays is examined in more detail with regard to the two 'X-ray aesthetics' of plasticity and transparency. The examination focuses in particular on X-ray cinematography, which combines the X-ray process with the motion picture. The division into direct and indirect processes, as made by Robert Janker [1894–1964][80] and others, is the starting point here for examining parallels in artistic shadowgraphic movies in more detail. Only the two following chapters are more or less historically conceived. The fifth chapter contrasts the three very different positions that have so far been significantly associated with the introduction of the shadowgraph into art after the First World War: Christian Schad, Man Ray und László Moholy-Nagy. Just to distinguish the process from photography, their different relationship to (amateur) photography is examined in detail. Special attention is paid to Man Ray's artistic development in the United States, which reveals a very unique, projective approach to images as planar phenomena. The sixth chapter outlines various development trends after the Second World War until today. One caesura that needs to be elaborated here is the increasing use of colour positive processes since the 1980s. The human body is the focus of the seventh chapter: four works by the Graz-based artist Peter Gerwin Hoffmann [*1945] from

[79] The photohistorian A. D. Coleman vehemently contradicts the lay view of Sayer's grandfather in his introduction. I go into this in more detail in: Roth, Tim Otto: This is not a photograph – some remarks on the photogram as a picture, in: Auer, Anna; Schögl, Uwe (Ed.): Congress of Photography in Vienna, Salzburg 2008, pp. 464-469. *This is [not] a photograph* is also the title of a chapter in: Rexer, Lyle: The edge of vision, New York (Aperture) 2009, p. 179 ff.

[80] Janker, Robert: Die Röntgenkinematographie, Stuttgart u.a. (Kohlhammer) 1939.

1974 are taken as an example to show the different ways a human being can leave pictorial traces on a light-sensitive material. It becomes clear how important the performative context is for many artists when they expose the human body – often their own – on light-sensitive material. A comparison of works by the painter Fabio Sandri [*1964] and the sculptor Jörg Wagner [*1967] is taken as a starting point in the eighth and final chapter to demonstrate how artists relate shadow and space pictorially and capture entire spaces in large format on light-sensitive material. The comparison with processes that do not necessarily work with a light-sensitive recording medium will reveal the differences between understanding these images as (light) impressions or as spatial translations as projections.

The work is primarily an examination of pictures. For example, detailed pictorial descriptions of Christian's early shadowgraphs and the reconstruction of how he made them reveal the density and complexity of the miniature works. The illustrations used in the context of this study are therefore not always to be understood merely as pictorial evidence. Rather, the illustrations are used to build up their own strands of argumentation complementary to the text.

The shadowgraphic oeuvre of artists and scientists, on whom the study places particular emphasis, is not considered in isolation, but biographical references are made in order to better understand the context in which it was created, but also to illustrate the richness of facets and the complexity of a personality that is sometimes perceived in a highly contradictory manner in different contexts. The methodological approach to text sources varies. For example, the classification of the shadowgraphs of the brewing biologist Paul Lindner and the artist László Moholy-Nagy is based on their own numerous publications. With this monographically oriented approach, publication strategies become clear and it can be demonstrated how the view of one's own work changes over time. In contrast, the reception of X-ray images is treated in a discourse-analytical way. The evaluations of the new technique in various journals of photographic associations in Austria, Germany, Switzerland, Italy, England and France are compared. The reception of Man Ray's shadowgraphs is also examined in terms of discourse analysis by comparing early journal articles on his work. In addition to tracing an early history of reception, the aim is also to draw a picture of the artistic production processes on the basis of contemporary sources, which sometimes differs considerably from the recollections in autobiographies published decades later, such as those by Christian Schad and Man Ray.

Projection as (shadow-)picture-theoretical approach

The study pursues a picture-theoretical approach that specifies the "iconic difference"[81] of shadow pictures under procedural premises. The primary aim is to clarify the

[81] Boehm, Gottfried: Die Wiederkehr der Bilder, in: ibid. (Ed.): Was ist ein Bild?, München 1994, pp. 11–38, here p. 29 ff. By "iconic difference" I do not, like Boehm, refer exclusively to the

relationship between shadows and shadow pictures and to differentiate between shadow pictures and shadows in pictures with the help of a concept of the picture developed by Konrad Fiedler and Edmund Husserl, among others, and to which more recent philosophers such as Lambert Wiesing refer significantly.[82] It is crucial for this approach that the procedural step of structuring the picture through shadow projection is clearly distinguished from its fixation. In terms of media theory, it is necessary to specify to what extent the shadowgraph as a shadow picture fixed on light-sensitive material can be distinguished from other types of shadow pictures, such as Jiro Takamatsu's [1936–1998] painted shadows or Claudio Parmiggiani's [*1943] smoke projections of entire rooms (chapter 8).

In contrast to a semiotic approach that focuses on the step of fixation, the temporal relationship between presence and absence plays less of a role in this picture-theoretical approach echoing phenomenology. The crucial factor is rather the type of representation and the physical process of translation from a spatial body into a two-dimensional picture. What needs to be clarified is whether, from this point of view of spatial translation in projection, contact copies of flat originals can still be called shadowgraphs at all.

For a better understanding of both picture production and pictorial perception, the first chapter takes a closer look at the concept of projection as developed by projective geometry and, building on this, by descriptive geometry. Projection can serve as a model here in a double sense. Understanding pictures as fixed projections allows to differentiate between various types of pictures to the extent that they constitute different ways of spatial translation into the pictorial plane. Conversely, this concept of projection as translation can also be applied to the perception and interpretation of pictures. Thus, a surface is recognised as a picture if it is possible to translate the surface imaginarily back into a spatial scenario. Consequently, producing and interpreting pictures means performing geometry by means of a practised or imagined physics.

The concept of projection is conceived as an alternative to approaches that try to explain the relationship between picture and depicted object by means of an iconic similarity. Such an understanding of a picture proves to be inadequate, since a shadow picture does not have to necessarily resemble the object it represents. In general, using iconic similarity as an explanatory model for pictures proves problematic because, as Nelson Goodman points out, similarity relations are conventional

highly coded experience of a work of art, but I also include the judgement of a layman such as Roger Sayre's grandfather, who, for example, would not intuitively understand an X-ray as a photograph. See also the critical remarks by Hans Ulrich Reck on the problem of picture theory [bildwissenschaftliches Problem], in: Reck, Hans Ulrich: Eigensinn der Bilder – Bildtheorie oder Kunstphilosophie?, München (Fink) 2007, p. 45.

82 Cf. Wiesing, Lambert: Phänomene im Bild, München 2000; ibid.: Artifizielle Präsenz – Studien zur Philosophie des Bildes, Frankfurt a. M. (Suhrkamp) 2005.

and thus ultimately arbitrary.[83] This does not apply to a projection model derived from projective geometry: here, a flat structure can only be related to an object as a pictorial representation if a projective relationship can be established. The only conventional aspect of projection is the choice of projection model. Once you have decided to use a certain method of projection, it consequently sets a limited geometric framework of interpretation. With this in mind, the study takes a look back at the history of projective and descriptive geometry and points to the central role of projection in the pictorial concepts of Edmund Husserl [1859–1938] and Ludwig Wittgenstein [1889–1951]. In Edmund Husserl's work in particular, a new reading of the concept of similarity emerges, which can be understood projectively rather than iconically on the basis of mathematical references, especially to the *Ausdehnungslehre* by German polymath Hermann Graßmann [1809–1877].

Consequently, this procedural approach does not focus on a history of concepts, but rather on a differentiated examination of the ways in which, on the one hand, a picture surface is structured by means of various projection methods and, on the other hand, the means by which this projection is recorded as a picture. With this technical focus, the aim is not to classify shadow pictures in terms of their history of ideas, but rather to take as a starting point the material pictures as technical artefacts in order to develop a new reading of the discourses and narratives that unfold around these pictures. The study has neither a primarily historiographical nor an anthological orientation, but rather selects pictures and textual sources on the basis of conceptual questions. The crucial point is not to cover everything, but to clarify the possibilities of knowledge associated with this pictorial form by elaborating the motives that drive a scientist or artist to work with shadow pictures, how they perceive and describe them and how a certain understanding of shadow pictures is thus implicitly or explicitly articulated in distinctions from other pictorial forms and visual phenomena. As an example of this, the last two chapters address how artists react to the representation of the human body and entire rooms as shadowgraphs in juxtaposition with other processes.

The basic findability in archives and their accessibility, but also linguistic barriers, have a decisive influence on the exploration of the potential source material. Precisely because there is comparatively little art historical literature, the development of the online database *www.photogram.org* proved to be a decisive stimulus for the author. Since 2001, the platform has been collecting keyworded records on the internet on artists who have worked on shadowgraphs or related fields. The text corpus of the work is largely based on Central European and US-American sources with a focus on the German-speaking world. With the in-depth examination of Jiro Takamatsu's oeuvre, the topic is also examined from a non-Western perspective.

83 Goodman, Nelson: Languages of art – an approach to a theory of symbols, Indianapolis et al. (Bobbs-Merrill) 1968.

Material culture of shadowgraphs – shadow picture criticism in science and technology

The fact that the picture as projection is not an abstracted postulate of picture theory, but is immanently present in the pictorial practices of artists and scientists who produce shadow recordings, is at the core of this study. In doing so, the shadowgraph is not examined in technical isolation. In fact, shadowgraphy is considered as a "material culture"[84] incorporating the whole context of the apparatus into the pictorial practice. This includes the nature of the laboratory, technical sources of interference, climatic and seasonal factors, but also the socio-cultural environment in which the actors operate. Crucial to the understanding of this material culture is also the practical re-enactment, which occasionally involves the reconstruction of procedures – for example, one must have seen the spatial impression of a stereo X-ray in an appropriate stereo viewer in order to understand the discussion from the time. As far as the artistic appropriation of the process is concerned, it is essential to bear in mind the profound procedural transformation that accompanied the darkroom-based enlargement technology that increasingly replaced the contact printing processes based on daylight printing out and gaslight papers in the 1920s. This not only allows to reconstruct the technical genesis of many works,[85] but also to critically confront established doctrines or statements by image producers (especially artists prone to self-stylization), thus also counteracting historical mythmaking.

By including an examination particularly from the perspective of the history of technology and science, the study finally reveals the actual caesura constituted by shadowgraphs. The examination of the hitherto hardly noticed contact printing process and nature prints in botany helps to refine the concept of shadowgraphs and to reposition it in terms of media technology. When Henry Fox Talbot already characterises his photogenic drawings of flattened botanical specimen in his *Pencil of Nature* as "effected by quite a different process", it is important to explore this procedural difference in more detail.[86] In that context, the differences between a contact print by means of light, a physical imprint and the projection of shadows by a spatial object are elaborated, which become noticeable in various practices of scientific observation and documentation. The separation of the recording process and the imaging process helps to work out changes in the handling and

84 Galison, Peter: Image and logic – a material culture of microphysics, Chicago (Univ. of Chicago Press) 1997.

85 On the reconstructive re-enactment of experiments as a methodological element in the history of science, see: Heering, Peter; Falk, Rieß; Sichau, Christian (Eds.): Im Labor der Physikgeschichte – zur Untersuchung historischer Experimentalpraxis, Oldenburg (BIS-Verlag) 2000; Breidbach, Olaf; Heering, Peter; Müller, Matthias; Weber, Heiko (Eds.): Experimentelle Wissenschaftsgeschichte, Paderborn (Fink) 2010.

86 Talbot, William Henry Fox: The pencil of nature, London 1844 [Reprint: New York 1969], Plate VII.

evaluation of pictures as an object of knowledge. Furthermore, this differentiation also clarifies the essential differences with regard to camera-based photography. One focus is the detailed examination of Paul Lindner [1861–1944] in the third chapter, who developed with his "Hellschattenaufnahmen" in the years 1911–1915 a shadowgraphic visualisation technique that has hardly been taken into account so far.

The scientific application of shadowgraphs in the form of the X-ray process was, as Thomas Kuhn pointed out in *The Structure of Scientific Revolutions*, "greeted not only with surprise but with shock".[87] After all, the technical procedure constituted a disruption of previous paradigms of vision and image production, which the Swiss historian Monika Dommann described as follows: "One difficulty in viewing X-rays is that traditional depiction conventions, such as those used in art, mislead the viewer."[88] These difficulties of reception are not only rooted in the new invisible radiation, but ultimately also in the new way of pictorial representation of a shadow projection, which constitutes a break with the central-perspective photographic paradigm. Consequently, understanding X-rays means for Vera Dünkel to pursue "shadow-picture critique" as "shadow-reading learning".[89]

87 Kuhn, Thomas: The Structure of Scientific Revolutions, Chicago (Univ. of Chicago Press) 1970, p. 56..

88 "Eine Schwierigkeit bei der Betrachtung von Röntgenbildern liegt darin, daß tradierte Abbildungsgewohnheiten, wie sie beispielsweise in der Kunst zur Anwendung kommen, den Betrachter in die Irre führen." See: Dommann, Monika: Durchleuchtete Körper – die materielle Kultur der Radiographie 1896 bis 1930, in: Fotogeschichte 21 (2001) 80, pp. 41–58, here p. 47.

89 "Schattenbildkritik", "Schatten-Lesen-Lernen". Cf. Dünkel, Vera: Röntgenblick und Schattenbild – zur Spezifik der frühen Röntgenbilder und ihrer Deutung um 1900, in: Bredekamp, Horst; Schneider, Birgit; Dünkel, Vera (Ed.): Das technische Bild – Kompendium für eine Stilgeschichte wissenschaftlicher Bilder, Berlin (Akademie Verlag) 2008, pp. 136–147, here p. 143.