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**MASTER'S THESIS**

**INFRARED IMAGING AS ARTISTIC  
MEANS IN PHOTOGRAPHY**

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PROSTŘEDEK VE FOTOGRAFII**

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## **Abstract**

This thesis studies the impact of the adoption of infrared imaging as artistic means in photographic practice. Infrared imaging is represented by various technologies such as infrared films, digital infrared photography, and thermography. Every type of infrared imaging is examined through the analysis of various photographic projects in chronological order according to technology development. The main features of artistic borrowings of different imaging technologies are interpreted and summarized in each chapter, and major hallmarks and aspects are compared and analyzed in the conclusion. The thesis reveals that the infrared image, when adopted by photographers, provides unique visuality, profoundly modifies photographic practice, and enables new ways of creating, reading, and understanding of photographic works.

## **Abstrakt**

Tato práce se zabývá dopadem zavedení infračerveného zobrazování jako uměleckého prostředku do fotografické praxe. Infračervené zobrazování představují různé technologie, jako jsou infračervené filmy, digitální infračervená fotografie a termografie. Každý typ infračerveného zobrazování je zkoumán prostřednictvím analýzy různých fotografických projektů v chronologickém pořadí podle vývoje technologie. V každé kapitole jsou interpretovány a shrnuty hlavní rysy uměleckých výpůjček různých zobrazovacích technologií a v závěru jsou porovnány a analyzovány jejich hlavní znaky a aspekty. Práce ukazuje, že infračervený snímek, když jej přijmou fotografové, poskytuje jedinečnou vizualitu, zásadně mění fotografickou praxi a umožňuje nové způsoby vytváření, čtení a porozumění fotografickým dílům.

## Table of Contents

Introduction	9
Chapter 1. Early Infrared Photography	12
1.1 What is Infrared	12
1.2 Early History of the Infrared	12
1.3 Robert Wood's First Infrared Photographs	13
Chapter 2. Film-based Black and White Infrared Photography	17
2.1 Weegee's "Blackout Flash Photography"	17
2.2 Kohei Yoshiyuki's "The Park"	21
2.3 Chapter Conclusion	24
Chapter 3. Film-based Color Infrared Photography	28
3.1 Technical and Historical Details on Color Infrared Film	28
3.2 Psychedelic Photography	30
3.3 Claudia Andujar's Photographs of Indigenous People of Amazonia	36
3.4 Richard Mosse's "Infra" and "Enclave"	39
3.5 Popular Film-based Color Infrared Photography and "the Aerochrome Project"	44
3.6 Edward Thompson's "The Unseen — an Atlas of Infrared Plates"	49
3.7 Chapter Conclusion	55
Chapter 4. Digital Infrared Photography	60
4.1 Technical Introduction to Digital Infrared Photography	60
4.2 Popular Digital Infrared Photography	63
4.3 Kate Ballis' "Infra Realism"	66
4.4 Sanne De Wilde's "The Island of the Colorblind"	69
4.5 Chapter Conclusion	72
Chapter 5. Infrared Thermography (Algorithmic Infrared)	75
5.1 Technical Introduction to Infrared Thermography	75
5.2 Richard Mosse's "Incoming" and "Heat Maps"	77
5.3 Linda Alterwitz's "Signatures of Heat"	81
5.4 Giles Price's "Restricted Residence"	84
5.5 Grey Hutton's "Traces of Warmth"	87
5.6 Chapter Conclusion	89
Conclusion	92
List of Illustrations	96
References	100

## Introduction

My interest in infrared photography got sparked by my very first experiments with infrared film back in 2008. I tried color and black and white films, and digital photography, and since then I have been fascinated by the ambiguity of infrared images and their ability to reveal invisible — something that is not accessible by my own senses. My infrared photographs resembled reality but remained radically distinct in terms of colors and tonal relationships.

Nowadays, infrared-based technologies are ubiquitous. Starting from the remote control or bar-code reader to modern entertainment systems like Kinect or infrared-based machine vision systems for unmanned vehicles. The permeation of infrared imagery into visual culture has begun in the late 70s - early 80s with movies like "Westworld", "Predator" and "the Silence of the Lambs." Since then the general idea of the visual language of infrared thermography or infrared night vision devices has been present in cultural background. In 1991, during the Gulf war, TV audiences got to get acquainted with the footage made by infrared cameras of cruise missiles or recorded via military night-vision devices. It was the ascendance of infrared imaging technology. However, by that moment, different infrared visualization technologies had already been around for about a century. In this thesis, I will consider different types of infrared imaging technologies and the ways of their adoption in artistic practices of photographers and artists.

Each part of my thesis will be devoted to particular imaging technology. I will analyze why and how specifically the technology was adopted by artists and photographers. And what meaning and context infrared image brings and how it shapes the final outcome.

I will open every chapter with brief technical introduction in order to establish technical terminology and reveal some important details on specific technology. I will discuss every technology on the basis of the study of

works of relevant artists and photographers. I will focus primarily on professional work and developed projects. Amateur and popular photography will be considered in general in separate sub-chapters. Additionally to projects analysis, I will examine and discuss the use of infrared images from the perspective of photographic theory.

In the first chapter, I will provide a short excursion into the history of infrared photography — from the basic scientific and historical details to the emergence of infrared photography. I will describe the features of the first photographic technology, which is a black and white film, and the main areas of its application. In the following chapters, from the second to the fifth, I will consider the bodies of artistic works in accordance to the technology employed.

In “Film-based Black and White Infrared Photography,” I will analyze photographs by Weegee and Kohei Yoshiyuki’s “the Park.” In “Film-based Color Infrared Photography,” I will study psychedelic photography, photographs by Claudia Andujar, Richard Mosse’s “Enclave” and “Infra”, Edward Thompson’s “The Unseen — an Atlas of Infrared Plates,” and popular color infrared photography. In “Digital Infrared Photography,” I will examine popular digital infrared photography, Kate Ballis’ “Infra Realism” and Sanne De Wilde’s “The Island of the Colorblind.” In “Infrared Thermography,” I will analyze Richard Mosse’s “Incoming” and “Heatmaps”, Linda Alterwitz’s “Signatures of Heat”, Giles Price’s “Restricted Residence” and “Traces of Warmth” by Grey Hutton.

Considering each of the projects, I will display the peculiarities of adopting the technology, the importance of technology within the particular project, and how it puts the work into context and shapes the outcome. Each chapter will be completed with a theoretical conclusion in which I will analyze the features of the technology in general and how it affects photographic practice and the final image — its meaning, understanding, and

reading.

In “Film-based Black and White Infrared Photography,” I will investigate how the technological approach borrowed from the military influenced the appearance of photographs and what limitations and features it introduced into the photographic practice. I will analyze the context created by photographs and how it relates to the origins of technology and its initial purposes.

In “Film-based Color Infrared Photography,” I will analyze the nature of the medium from the perspective of its purpose — which is aerial photography, camouflage detection, and cartography. I will discuss how the combination of the indexical nature and its intrinsic symbolism converted the medium into an artistic means for the production of allegorical imagery.

In “Digital Infrared Photography,” I will address the paradigmatic shift from “photorealism” to “scientific realism” and I will show that Digital photography cannot be considered indexical, but iconic. I will discuss that digital infrared photography released from the indexicality and obligation to follow real, as well as from associations with science and military, becomes a means of emancipation of color.

In “Infrared Thermography,” I will show that infrared thermography, as a derivative and the result of the dominant regime of scientific realism, is a new class of information images. I will show that thermography’s demand for interpretation becomes an opportunity to understand images in a broader allegorical sense within the framework of the artistic process. I will demonstrate that the very nature of the thermographic image — statistical, generalized, and anonymous, — may be understood and used as a representation of socio-political processes and conditions.

# Chapter 1. Early Infrared Photography

## 1.1 What is Infrared

Infrared radiation is a part of the electromagnetic spectrum adjacent to the range of visible light. The infrared spectrum lies between 700nm and 1mm, while visible light falls between 400nm and 750nm. The infrared spectrum is normally divided into near, medium and far segments. Although infrared is absolutely invisible to the human eye, it can be visualized as a photograph or an image. Near-infrared is the subject of analog and digital photography, while medium and far-infrared (thermal infrared) are the subjects of thermography, which is complex technology based on computations and algorithmic data processing.

The subject of this thesis is the study of adopting of infrared imaging technologies for artistic and photographic purposes.

## 1.2 Early History of the Infrared

Sir John F.W. Herschel discovered infrared radiation in 1800. Herschel experimented with light dispersion to find out whether different colors transmit different amounts of energy. Measuring each color spot with a thermometer, Herschel noticed that outside the zone of visible light, adjacent to the red end of the spectrum, there was an area of invisible radiation. This radiation devoid of color or visible signs of presence was making the thermometer to show the highest values. That was infrared radiation.<sup>1</sup>

The very first technical means of detection of infrared radiation has emerged in the early 19th century, but that was not a visualization yet.<sup>2</sup>

In the 19th century, photography was expected to uncover and expose the most hidden secrets of nature and reality, and to translate processes

- 1 Robin Williams and Gigi Williams, "Frederick William Herschel, Pioneers of Invisible Radiation Photography," *Medical and Scientific Photography*. Accessed Dec 4, 2019, [http://medicalphotography.com.au/Article\\_04/03.html](http://medicalphotography.com.au/Article_04/03.html)
- 2 Antoni Rogalski, "History of Infrared Detectors." *Opto-Electronics Review*, vol. 20, no. 3 (Jan. 2012): 280. DOI: 10.2478/s11772-012-0037-7



previously unavailable for the mode of human vision into an observable and comprehensible form. This myth was backed by the success of chronophotography and the invention of X-ray imaging.

Photography seemed to be a suitable tool to fulfill the task of visualization of infrared. However, due to certain technical limitations, such as insufficient sensitivity of early emulsions and the inability to filter out the visible part of the spectrum, infrared photography was not available until the beginning of the 20th century.

### **1.3 Robert Wood's First Infrared Photographs**

The history of infrared photography began in 1910 with the illustrated lecture by professor Robert Wood, which took place at the Royal Photographic Society.<sup>3</sup> Wood was presenting two new inventions — two brand new patented technologies — a new photographic emulsion, having an extended red and infrared sensitivity, and a new type of optical glass, — the optical filter, subsequently named after Wood himself.<sup>4</sup> The technological breakthrough was in the combination of both — while the technology of selective sensitisation has been already invented, the keystone still was in the production of photographic filters, which would be capable of cutting out all visible light but infrared radiation. Wood's glass served as such a filter and the new photographic emulsion was designed with infrared photography in mind.

After the lecture Wood published a few papers on his inventions and discoveries, including the publication of photographs in the Illustrated London News in 1911.<sup>5</sup> His infrared and ultraviolet photographs were exhibited during an annual exhibition of the Royal Photographic Society. Each exhibited or published photograph was supported with Wood's commentary on

3 Robin Williams and Gigi Williams, "Prof. Robert Williams Wood, Pioneers of Invisible Radiation Photography," *Medical and Scientific Photography*. Accessed Dec 4, 2019, [http://medicalphotography.com.au/Article\\_04/06.html](http://medicalphotography.com.au/Article_04/06.html)

4 Ibid.

5 Ibid.



Figure 1. Infrared photographs by Robert Wood in the *Illustrated London News*, 1911.

details of making, name of the place it was taken, and its appearance. It is noteworthy that one photograph Wood has captured, depicts ruins of an ancient temple in Sicily. As far as it is known, that was the very first archaeological infrared photograph.<sup>6</sup>

Wood's photographs were mainly landscapes. It was a deliberate choice dictated by technological limitations. Even improved emulsion had sensitivity requiring extra long exposures, sometimes tens of minutes.<sup>7</sup> Wood's emulsion was sensitive to near-infrared radiation, beyond 700nm, therefore images were formed by reflected infrared light initially coming from the sun. These images, in general, looked very similar to ordinary photographs of that time, however, with some important exceptions. One of the most conspicuous details is how skies were rendered. Comparing with the standard photographic emulsion of that time — orthochromatic

6 Roger Balm, *Archaeology's Visual Culture: Digging and Desire* (Routledge, 2016), 218.

7 Williams and Williams, "Prof. Robert Williams Wood, Pioneers of Invisible Radiation Photography,"

emulsion,<sup>8</sup> the difference is quite noticeable. Orthochromatic emulsions had their peak of sensitivity in the blue-violet spectrum while staying almost blind to red and green. Thus, blue skies were rendered in bright greys and whites without any significant difference in tone between skies and clouds. On Wood's photographs, on the contrary, skies are dark, gradually getting darker from the horizon line to the zenith. Tonality and degree of darkness vary significantly depending on the position of the camera relative to the sun. The darkest skies, even pitch black, could be captured when the sun is situated behind the camera. Clouds, when photographed in infrared rays, always stand out against the sky, even if they are indistinguishable with the naked eye. Aerial perspective is lacking due to low or no scattering of infrared rays in the atmosphere. Thus, all distant objects on the horizon are clearly visible, distinguishable and retain contrast. All foliage and greens on photographs were rendered in a range of bright white tones. That brought a strong resemblance to a snowy landscape.<sup>9</sup> Unusual tone reproduction and unordinary patterns of reflectance might look like a special pictorial effect, but actually say a lot about the physical nature of infrared radiation — it's high penetration ability, low atmosphere scattering and a specific pattern of absorption by different materials. In order to dispel all doubts of the audience that photographs don't simply illustrate just a visual trick but visualize something that is invisible but present in physical reality, Wood states: "it is said that they are merely pictures obtained by the use of a screen which changes the appearance of things. But I must point out that these pictures show things as they really are quite as truly as our visible impressions of nature."<sup>10</sup> Wood concludes: "human optics yield only part of the visible

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8 Mark Osterman, "Introduction of Photographic Equipment, Processes, and Definitions of the 19th Century." In *The Focal Encyclopedia of Photography: Digital Imaging, Theory and Applications History and Science*. Edited by Michael R. Peres (4th ed, Elsevier, 2007), 99.

9 Robert Wood, "Photography by invisible rays." *Photographic Journal*, vol. 50 (Oct. 1910): 330.

10 Ibid., 336.

world.”<sup>11</sup>

These qualities were recognised and technology was almost immediately adopted by specialists from different fields. Medicine, science, cinematography and, first of all, the military. The military were interested in the ability of infrared rays to cut through the atmospheric haze.<sup>12</sup>

Medical scientists were quick to adopt infrared imaging as a means to record and analyze blood circulation patterns.<sup>13</sup>

Extremely dramatic look delivered by the infrared film stock — black skies and pale human skin — was not considered as a possible standard in cinematography but something that may come in handy for special cases. It was mainly used for “day as night” shoots between the 1930s and mid-1940s.<sup>14</sup> The only drawback that needed to be taken into consideration was the necessity to avoid foliage in the frame. “Wood effect” — bright whites of tree’s leaves or shining grass would have instantly destroyed the atmosphere of the scene.<sup>15</sup>

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11 Balm, *Archaeology’s Visual Culture: Digging and Desire*, 218.

12 Henry Louis Gibson and Walter Clark. *Photography by Infrared: Its Principles and Applications* (A 3d ed. of *Photography by infrared* by Walter Clark, Wiley, 1978), 287-290.

13 *ibid.*, 6.

14 *ibid.*, 310.

15 Federico Pierotti and Alessandra Ronetti, “Beyond human vision: Towards an archaeology of infrared images,” *Necsus*, Jul 31, 2018, [https://necsus-ejms.org/beyond-human-vision-towards-an-archaeology-of-infrared-images/#\\_edn31](https://necsus-ejms.org/beyond-human-vision-towards-an-archaeology-of-infrared-images/#_edn31)

## Chapter 2. Film-based Black and White Infrared Photography

### 2.1 Weegee's "Blackout Flash Photography"

Since the mid-30s, the commercially available infrared films have begun to gain popularity among amateur photographers.<sup>16</sup> These films have made a path to the market due to the high demand among scientists, cinematographers, but, mainly, the military. As has been mentioned, the military had a growing interest in the adoption of new technology. Along with reconnaissance, they discovered the benefits of using infrared light sources for covered communication<sup>17</sup>, signalling, and observation. They even established a new type of photography — "Blackout flash photography".<sup>18</sup> As it is noted in one of the military photography manuals: "Since infrared is invisible, the room that looks pitch black to us may actually be brilliantly illuminated with infrared "light."<sup>19</sup> That is, the core idea was in applying a new source of light — infrared flash,<sup>20</sup> which would provide enough "invisible" light for photography. It would allow taking pictures in the dark, at night or indoors, on Kodak Aero Film<sup>21</sup> initially designed for aerial photography. What is fundamentally important is that the filter is not applied to the lens, but filtering occurs at the level of the light source itself. Which makes the process invisible for outside observers.<sup>22</sup>

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16 Andy Finney, "Infrared Photography." In *The Focal Encyclopedia of Photography: Digital Imaging, Theory and Applications History and Science*. Edited by Michael R. Peres (4th ed, Elsevier, 2007), 559.

17 Esther Inglis-Arkell, "How Robert Wood's creepy invention helped the Allies win World War I." *Gizmodo*, Aug 30, 2013, <https://io9.gizmodo.com/how-robert-woods-creepy-invention-helped-the-allies-wi-1224038485>

18 *Photography volume 1. Navy training courses* (Navy Department, Washington D.C. 1947), 341. Accessed Jan 10, 2020. [https://play.google.com/books/reader?id=C1SKr2qt-RUC&hl=en\\_AU&pg=GBS.PA340](https://play.google.com/books/reader?id=C1SKr2qt-RUC&hl=en_AU&pg=GBS.PA340)

19 *Army Pictorial Techniques, Equipment and Systems, Still Photography* (Department of the Army, United States, 1969), 7-1. Accessed Jan 10, 2020. [https://play.google.com/books/reader?id=aBctfJyOTD8C&hl=en\\_AU&pg=GBS.SA7-PA1](https://play.google.com/books/reader?id=aBctfJyOTD8C&hl=en_AU&pg=GBS.SA7-PA1)

20 Ibid., 7-14.

21 *Photography volume 1. Navy training courses*, 336.

22 Many night vision systems are based on that principle. For instance, most of the tanks and combat vehicles are equipped with infrared searchlights.





Figure 2. *Weegee (Arthur Fellig). Lovers at the movies, Palace Theatre, New York. Infrared photograph, circa 1943.*

In the early 40s, a professional press photographer Arthur Fellig, better known as “Weegee,” adopted the same technology as the military but for artistic purposes. Arthur Fellig worked at night, covering New York’s life, following emergency services and documenting their activities or, even, competing with the police to be the first at a crime scene. His photographs of an unprecedented level of realism, depicting crime, death, and everyday life of the city made him famous and determined his signature style. Weegee’s style of work made use of flash inevitable. However, the wartime blackout drill made his professional activity not only potentially dangerous but also illegal. At the same time, new wartime limitations opened up new opportunities. Weegee started to use Infrared flashbulbs<sup>23</sup> with the infrared “Aero” film. While using his new setup on New York’s night streets he realized that he not just have avoided violating wartime restrictions but also could take photographs of his models and stay unnoticed. “It was a great medium for

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<sup>23</sup> Christopher Bonanos, *Flash: The Making of Weegee the Famous* (First edition, Henry Holt and Company, 2018), chap. 14. iBooks.

a voyeur who worked by night.”<sup>24</sup> New infrared flash granted him invisibility.

During the 1940s Weegee was repeatedly visiting movie theatres, opera houses and arenas for taking photos of the audience. Disguised as a snack vendor, armed with a press camera, infrared flash and film, Weegee was photographing people in the dark, while they were immersed into an experience of watching a movie or performance.<sup>25</sup> Most likely, most of them were not able to notice a faint red sparkle accompanying the triggering of the flash.

The emancipative darkness of the screening room of a cinema brings a false sense of security. That allowed Weegee to capture people behaving as they behave when they believe no one is watching — people pick their noses, yawn, sleep, take strange poses, sometimes inappropriate for public spaces, lovers kiss and touch each other. A full emotional gamut can be read on their faces — excitement, boredom, ecstasy, joy and shock. As the very atmosphere and cultural meaning of the cinema carries a potential for intimacy and intimate contact, lovers are frequent subjects on Weegee’s photographs. Besides, during the wartime, the cinema, perhaps, was the only opportunity for young soldiers on leave time to have an intimate moment with a girl. Some of these couples are just kissing, while other photographs could tell a whole dramatic story — the young woman is clearly unhappy with the annoying persistence of the young sailor. He embraces her while her body language demonstrates clear signs of insecurity and displeasure.

To emphasise the uniqueness of his photographs, their disarming realism, Weegee oftentimes presented his pictures saying “Made with invisible light”.<sup>26</sup> Appeal to the technology employed, indeed, makes a lot of sense — along with technical opportunities technology has brought unique aesthetic qualities, sometimes even with a political touch, if considered in a given

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24 *ibid.*

25 It is noteworthy that in the 1950s, US film and television companies used a similar approach to assess the reaction of the audience to shows.

26 Bonanos, *Flash: The Making of Weegee the Famous*, chap. 14.



Figure 3. *Weegee (Arthur Fellig). Infrared photograph, circa 1940.*

context of the 1940s in the United States. For instance, human skin, when photographed in reflected infrared rays, regardless of race and color always looks very light, pale, devoid of details and texture.<sup>27</sup>

Kodak "Aero" film (as well as many late types of infrared films) did not have a so-called antihalation layer,<sup>28</sup> the presence of which is necessary for sharply detailed photographs. Basically, it prevents light scattering and multiple reflections inside the film base. Lacking an antihalation layer leads to the emergence of something like a glowing halo surrounding brightly lit objects. Moreover, that effect may be amplified by the very nature of infrared rays — as we know, infrared radiation can penetrate through a thin layer of human skin, scattering inside.<sup>29</sup> Lit by an intense and focused flow of light from the flash, human faces look ghostly sharp and unsharp at the same time, as if the skin is liquid or was made of wax. In some photographs, mostly close-ups, paths of veins are clearly recognisable under the skin, that looks truly eerie when is spotted on children's faces. All people

<sup>27</sup> Walter Clark, *Photography by Infrared* (First edition, Wiley, 1939), 224.

<sup>28</sup> Finney, "Infrared Photography," 559.

<sup>29</sup> Clark, *Photography by Infrared*, 218.



have pitch-black eyes, with pupils fully dilated, since infrared radiation is not being registered by an eye's retina and does not cause pupil constriction.<sup>30</sup>

Scenes inhabited with liquid skinned, white, slightly glowing human beings attentively peering on something happening behind the frame or sitting with eyes closed as if they were sleeping or either dead, convey a feeling similar to the experience of the uncanny valley. Everything looks about right but something is clearly wrong and the brain responds to this unclear discrepancy with a strong sense of subconscious anxiety. This comes in contrast with scenes' content — people are laughing, smiling, sitting on cinema's seats, and wearing easy recognisable everyday clothes. Without such symbols connecting them to ordinary life, these photographs would be eternal, ethereal, and generalized images of human beings on the neutrally black background.

## **2.2 Kohei Yoshiyuki's "The Park"**

In the early 70s, Kohey Yoshiyuki, a commercial photographer from Tokyo, rediscovered the technique of blackout flash photography to document the hidden, underground aspect of Japanese society. Between 1971 and 1979 Yoshiyuki was photographing couples, both straight and gay, that were using public parks for intimate rendezvous and having sex. Besides, he discovered a whole community of voyeurs, professional peepers, being attracted by these couples and following them in the dark. As mentioned in the 1979 interview with Nobuyoshi Araki,<sup>31</sup> Yoshiyuki came across the phenomenon in 1971 while walking with his friend near Chuo Park in Shinjuku. They had spotted a couple having sex in the park and Yoshiyuki immediately decided that that has to be photographed. However, at that moment he couldn't take candid photographs in the dark with conventional film and a

30 Gibson and Clark, *Photography by Infrared: Its Principles and Applications*, 209.

31 "Nobuyoshi Araki In Conversation With Kohei Yoshiyuki (1979)," *American Suburb X*. Accessed Dec 27, 2019, <https://web.archive.org/web/20130123025543/http://www.americansuburbx.com/2012/02/interview-nobuyoshi-araki-in-conversation-with-kohei-yoshiyuki-1979.html>



Figure 4. Kohei Yoshiyuki. *Untitled*. Infrared photograph, 1973.

camera. The situation, context and lighting conditions required a special approach and eventually, Yoshiyuki equipped his 35mm camera with infrared film and infrared flashbulb. Now he could join peepers, pretending to be one of them, and take photographs in the total darkness without breaking his cover. The pale red light of the triggered infrared flashbulb could have been easily confused with the lights on a passing car.<sup>32</sup> Besides, the very idea of being photographed in the dark without being blinded by flash was quite improbable (and unthinkable) at that time, so it may have been somewhat an invisibility cloak for Yoshiyuki. On the other hand, the lack of light introduces an interesting aspect into his practice. He couldn't use a viewfinder to compose a frame, moreover, it is highly likely that he didn't know how many people were present at the scene and would have been captured. The only way to find it out was to develop film and produce prints. Only the print could tell him about the details of the scene he had witnessed. That time lag or delay in visual perception, dissection of senses, forced Yoshi-

<sup>32</sup> Ibid.

yuki, just like voyeurs surrounding him, to rely solely on his hearing and intuition. However, the practice of photographing while disoriented in the dark and following misleading sounds of somebody's motion actually was a necessary condition to capture the scene in its wholeness on every level of interaction. Although Initially wanted to document just people having sex in a public space, he managed to capture voyeurs as well. In some cases, these peepers are the main and only characters of photographs — we can see them sneaking or wandering chaotically among trees and bushes. While other photographs depict them crawling, pushing each other, crowding in close proximity to couples, even stretching out their hands trying to reach and touch couple's bodies. There is something deeply primal in that, or maybe, in a way, resembling Christian visions on purgatory or hell.<sup>33</sup> The whiteness of people's skin and clothes makes scenes even more unnatural. In Japanese culture white colour has a sacred sense and mostly associated with divine and joy, and is a major wedding color. That symbolical meaning of white comes in contradiction with the actual content of photographs — obscene scenes, sometimes on a border of a gangbang, look like perverted, turned upside down mating ritual. That whiteness and purity are brought by the nature of the infrared radiation itself. That is, infrared radiation reflects equally from cotton clothes of different colours (no matter of dyes used) and renders them on film in a range of whites.

Yoshiyuki's photographs carry something inhuman and alienated. Aesthetically they are close to the imagery from automatic trap cameras triggered by the infrared motion sensor during nighttime — images of wildlife taken without the disturbing presence of a human operator.<sup>34</sup> In that sense, Yoshiyuki himself played the role of an automat, a vehicle, and a living motion and sound sensor/trigger for a mechanical "trap camera." That makes it possible to consider Yoshiyuki's photographic practice as a sort of data

33 In the preface to a reprint of Yoshiyuki's book "The Park" (2007) photography critic Vince Aletti compares these scenes with Dante's "Inferno".

34 Gibson and Clark, *Photography by Infrared: Its Principles and Applications*, 255.





Figure 5. Kohei Yoshiyuki. *Untitled*. Infrared photograph, 1971.

collection by analog and biological means. That is why Yoshiyuki's work, mostly speaking about the post-war transformation of Japanese society and side-effects of "Japanese Economic Miracle", looks surprisingly fresh and topical today.

### 2.3 Chapter Conclusion

In both cases described, black and white film infrared photography was adopted to fulfill two ambitions — to take photographs in the dark (to be independent of light conditions) and remain invisible to those, who are being photographed. That seems a photojournalism dream-technology, allowing one to capture moments in their spontaneity and utter sincerity. That is what Susan Sontag describes in the essay "Regarding the Pain of Others": "We want the photographer to be a spy in the house of love and of death, and those being photographed to be unaware of the camera, "off guard." No sophisticated sense of what photography is or can be will ever weaken the satisfactions of a picture of an unexpected event seized in mid-action by an

alert photographer.”<sup>35</sup>

At the same time, the desire to secretly watch others is nothing but voyeurism. There is a popular notion that a photographer is a voyeur by nature. Semiotician Clive Scott agrees, pointing out that “voyeurism is looking through the camera,” as a photographer can be driven by voyeuristic motives since “the camera, one comes to believe, conceals the photographer.”<sup>36</sup>

Both Weegee and Yoshiyuki were not just concealed by their cameras but were hidden by the darkness, whether it was a night park or cinema hall. The same covering darkness deprived them of the ability to fully operate their cameras and make decisions about composition, angle, and focus point. Whereby, Clive Scott claims that photograph carries an indexical trace of photographers’ choices — it is, basically, a record of actions and decisions made before reality, rather than an objective record of reality.<sup>37</sup> That raises an interesting question — If Weegee and Yoshiyuki were not able to fully operate their mechanical cameras in the dark, they definitely had to pre-set all settings before the shooting. That is, they used the same settings for each case, and they could not properly analyze the scene before shooting and carefully select their subjects. Most likely, available images represent only a very minute part of all captured material, and photographers selected only “good” pictures from numerous “bad” ones. That means that we are dealing with an archive selected and organized according to some internal, cultural criteria of photographers.

Taking into consideration aforementioned aspects of Weegee’s and Yoshiyuki’s practice, the relevant question would be — could one say that significant limitation in choices reduces their artistic practice to a simple prescribed algorithm like in police or military photography? In other words, photographers have to use preset settings on their cameras, they are barely

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35 Susan Sontag, *Regarding the Pain of Others* (Farrar, Straus and Giroux, 2013), chap. 3. Kindle.

36 Clive Scott, *The Spoken Image: Photography and Language* (Reaktion, 1999), 31.

37 Ibid., 33.

able to see and frame the scene and they take pictures to cover the situation using their own light source. So, they work in a quite straightforward way. Art historian John Tagg<sup>38</sup> in his book "The Burden of Representation" gives an example of instructions for police photographers. These guidelines determine the qualities and ways of production of photographs that can be considered as evidence of truth. In fact, this is an algorithm for maximizing the elimination of photographer's interference with an image.

This problem could be approached from a different angle. Philosopher Vilém Flusser has introduced the term "apparatus," which has its own "program." According to Flusser, a photographer plays with a camera but always remains limited by preprogrammed rules determining the functioning of the device. The photographer may wrongly believe that the camera (apparatus) is just a simple tool. But in fact, the camera follows the program engendered by socio-cultural and political conventions. When the photographer wants to realize her concept, she "must translate those concepts into the camera program."<sup>39</sup> That implies the totality of artistic choices and camera settings. When both Weegee and Yoshiyuki are limited in their ability to translate their concepts into the camera's program, should their photographs be viewed as illustrating concepts by which the camera was programmed? Shall we consider these photographs not just as images covering some social phenomena, but, at the level of the second reading, also as a reflection on social and political institutions that engendered infrared imaging technology? "Blackout photography" originated in military and police fields and embodies the concept of surveillance and vision established by political and social infrastructures in the late 19th and early 20th centuries. Apparently, the technology exists in the shadow of the context and bears some certain features and qualities indicating its origins. Photographers were interested

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38 John Tagg, *The Burden of Representation: Essays on Photographies and Histories* (University of Minnesota Press, 1993), 97.

39 Vilém Flusser, *Towards a Philosophy of Photography* (European Photography, 1984), 36.

in invading into one's privacy and they employ voyeuristic tactics in the absence of consent from their models. Moreover, again, there is no awareness of being watched and photographed on the subject's side. One can say that this might be just a perverted interest of photographers, but one should not deny that the field of interest and possible themes are mainly shaped by current cultural and social situations. Therefore, considered photographs that were taken in the period of "hot" and "cold" wars might be a reflection of internal political and social processes repressed into the cultural field.

To conclude, black and white infrared film, if adopted and used by artists intentionally and because of its properties, inevitably exists in the context of its initial purpose.

## Chapter 3. Film-based Color Infrared Photography

### 3.1 Technical and Historical Details on Color Infrared Film

Color infrared film was introduced in 1943 by Kodak,<sup>40</sup> which had been producing different types of color infrared films until late 2009.<sup>41</sup> Assumably, Kodak was not the only producer of the infrared film for military purposes, but no doubt, the company was an exclusive supplier of infrared film for scientific, commercial, and artistic needs. From a technical point of view, color infrared film, later named Kodak Ektachrome Professional Infrared Film (Kodak EIR) or Kodak Aerochrome, shared the same basic design as all contemporary color films nowadays. That is, basically, a multilayered composition intended to record red, green, and blue light by respectively sensitized layers.<sup>42</sup> During the exposure time, the latent monochromatic image is being set on every layer according to its sensitization. On the development stage, “dye couplers” are being activated and form a color layer using the previously produced black and white image as a basis. Dye couplers, forming in a particular layer, may be not related to the wavelength to which this layer is sensitive. Therefore, one or more layers may be sensitized to invisible light. Since invisible radiation cannot be associated with any color, the particular hue is to be assigned. Such images, obtained by reconstructing informational layers representing invisible radiation solely or combined with visible light, are called false-color images. Kodak EIR film is a typical false-color film capable of recording visible light and infrared radiation up to 900nm.<sup>43</sup> It has three color layers forming a tri-color image. As seen in the figure, Red, Green and Blue channels of resulting image are being cre-

40 Finney, “Infrared Photography,” 559.

41 *Kodak News, Discontinued Product KODAK AEROCHROME III Infrared Film 1443*, Eastman Kodak Company. Accessed Jan 25, 2020, <http://www.astrum-ltd.com/images/stories/Product%20KODAK.pdf>

42 William H. Klein, *Understanding Color Infrared Photography* (eBooks. Book 4. 1984), 9. Accessed Jan 29, 2020, <http://scholarworks.sfasu.edu/ebooks/>

43 *KODAK AEROCHROME III Infrared Film 1443 • AS-77*, Eastman Kodak Company. Accessed Jan 25, 2020, [https://www.kodak.com/uploadedFiles/Corporate/Industrial\\_Materials\\_Group/ti2562.pdf](https://www.kodak.com/uploadedFiles/Corporate/Industrial_Materials_Group/ti2562.pdf)



## COLOR INFRARED FILM

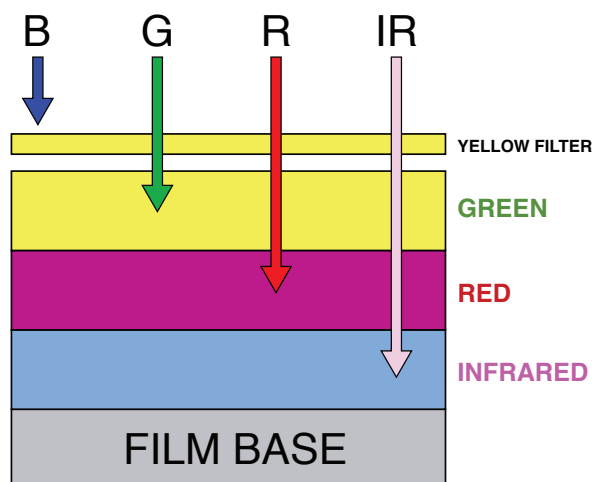


Figure 6. Structure of Color Infrared Film.

ated by Infrared radiation, Red and Green light respectively. Additionally, every layer, besides its major color or wavelength, is sensitive to blue light. Thus filtration is necessary and the yellow (minus blue) photo filter is recommended by Kodak.<sup>44</sup>

Since film records both visible and invisible radiation while typical exposure meters (external and in-camera) are calibrated to measure

the intensity of visible light only, aperture and shutter speed should be chosen according to special tables provided by Kodak.<sup>45</sup> An experienced user can take an educated guess if works in familiar conditions, or try bracketing — series of the same subject captures taken with different shutter speeds.

Near-infrared radiation behaves differently than visible light when it comes to patterns of reflection and absorption.<sup>46</sup> Metals, for instance, would absorb IR light, while foliage would intensively reflect it. Having an infrared-sensitive color layer grants color infrared film ability to emphasize the contrast between different objects which is barely perceivable while observed in visible light. In other words, to not just show objects but reveal their nature. This quality had determined two main applications for the color infrared film until the 1960s, which are aerial reconnaissance and camouflage detection. But camouflage detection, for some reason, has lost its significance relatively soon. Possibly due to the spread or emergence of similar technology in the USSR and the following development of new types of camouflage, materials, paints, and dyes having the same reflectance in infrared light as healthy foliage. Which would make detection quite prob-

<sup>44</sup> *ibid.*

<sup>45</sup> *ibid.*

<sup>46</sup> Klein, *Understanding Color Infrared Photography*, 9.

lematic.

Having become available on the market, the color infrared film followed the path of the black and white infrared film — it has become an intrinsic part of the arsenal of scientific tools. Mostly because of its unique qualities — ability to depict objects and scenes not just through their appearance but also through their physical qualities. Needless to mention infrared radiation's ability to penetrate a thin layer of photographed material.

According to the film data sheet, main applications of Kodak EIR film were: camouflage detection, pollution monitoring, forest survey, archaeology, and ice reconnaissance.<sup>47</sup>

### 3.2 Psychedelic Photography

The first photographer who got a chance to use color infrared film was photographer and designer Karl Ferris, famous for his photographs of British Rock musicians. His experience with the color infrared film made him also the founder of psychedelic photography. The offer to try color infrared film has come from one of Kodak's representatives in London, who had seen Ferris' experimental color photographs made for designers group "The Fool" and Marijke Koger.<sup>48</sup> Kodak provided Ferris with some specially pre-cut rolls of Kodak Aerochrome, which had not been available before in formats smaller than 4x5 inches. Had previously served in RAF as an aerial photographer,<sup>49</sup> Ferris must have been acquainted with Kodak Aerochrome film and may have had at least a vague vision on what kind of image to expect. At the same time Jimi Hendrix, being unhappy with the cover of his UK album "Are You Experienced?", asked Ferris if he could create a totally

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47 KODAK AEROCHROME III Infrared Film 1443 • AS-77.

48 "The Fool: The Dutch Artists Who Worked For The Beatles (And Made Their Own Freak Folk Masterpiece)," *Dangerous Minds*, Dec 6, 2018, [https://dangerousminds.net/comments/the\\_fool\\_the\\_dutch\\_artists\\_who\\_worked\\_for\\_the\\_beatles\\_and\\_made\\_their\\_own\\_fr](https://dangerousminds.net/comments/the_fool_the_dutch_artists_who_worked_for_the_beatles_and_made_their_own_fr)

49 "Hendrix, Cream, The Hollies – The Karl Ferris Psychedelic Experience," *NME*, Dec 12, 2012, <https://www.nme.com/photos/hendrix-cream-the-hollies-the-karl-ferris-psychedelic-experience-1435358>



Figure 7. Karl Ferris. Color infrared photograph for Jimi Hendrix's "Are You Experienced" album, 1967.

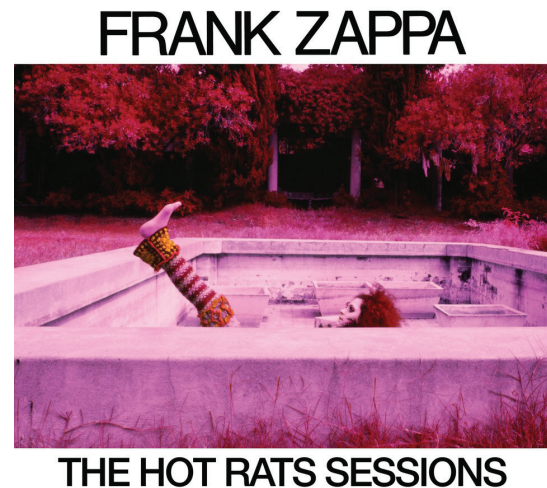


Figure 8. Andee Nathanson. Album cover for Frank Zappa's album "Hot Rats." Color infrared photograph, 1969.

new cover for the US release, which would express Hendrix's approach to making music.<sup>50</sup> Hendrix thought that Ferris is "the only photographer that is doing with photography what I am doing with music — knocking down barriers and going beyond limits."<sup>51</sup> Clearly, there was no better solution for that assignment than color infrared film. Besides Kodak Aerochrome film Ferris used a freshly-released Nikon fish-eye lens.<sup>52</sup> Hence, he distorted photographs in two ways — by introducing unnatural color shifts and hues, and by changing the perception of space geometry, which corresponds with a common vision on the effects of an "acid trip." Hendrix liked the result and photographs were used for his album cover.<sup>53</sup>

The aesthetic of psychedelic photography established by Ferris attracted other photographers and artists of that time. The most important names to mention are Andee Nathanson and Elliott Landy. Andee Nathanson created a set of humorous fairy-tale alike photographs for Frank Zappa's "Hot Rats" album cover in 1969. Those photographs were featuring Miss Chris-

50 "Cover Story - Jimi Hendrix Experience's "Are You Experienced?", with photography by Karl Ferris," *RockPop Gallery*, Feb 22, 2008, [https://rockpopgallery.typepad.com/rockpop\\_gallery\\_news/2008/02/cover-story---j.html](https://rockpopgallery.typepad.com/rockpop_gallery_news/2008/02/cover-story---j.html)

51 Ibid.

52 Ibid.

53 Ibid.

tine from girls group “The GTO” posing in the empty pond. Nathanson also took infrared pictures for “The GTOs” themselves and Captain Beefheart.<sup>54</sup>

In the late 1960s, Elliott Landy portrayed many cult musicians such as Bob Dylan, John Lee Hooker, and Ornette Coleman. Elliott Landy’s work deserves special attention. Unlike other mentioned photographers, Elliott Landy was interested in extensive experimenting with the medium. It becomes self-evident after the examination and juxtaposition of the photographs. But first of all, we need to consider some technical aspects related to color translation in infrared photography. The rendition of color with the color infrared film is determined by few factors: Firstly, it is a nature of the material — i.e. what amount of infrared radiation is being reflected by materials in the scene; Secondly, by the proportion between visible and infrared radiation in the overall scene lighting; Thirdly, by a type of photo filter or lacking it. In other words, the photographer must take into consideration multiple factors that are beyond his knowledge or barely measurable. She cannot measure the amount of present infrared radiation with any photographic lightmeter. She cannot reckon to guess a possible rendition of the color of the dyed fabric or other material. She neither can predict the overall tint of the scene if color filters are used. Thus, it is visible that Karl Ferris and Andy Nathanson were working with the so-called “classical Aerochrome look” achievable when the yellow filter (minus blue, as Kodak recommends) is used. While Landy’s photographs are quite different in look. In his portrait series of Ornette Coleman and his son colors vary from deep blue to saturated yellow — it is hard to guess, what exactly caused such color shifts. It might have been a specific ambient light in the shadow or particular photographic filter applied. We cannot even assume what was the real color of their clothes. Anyways, it only demonstrates that the photographer willingly played with a new film, accepting that the result is unforeseeable.

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54 Andee Cohen Nathanson was occasionally using infrared film for her personal work as well. Some of her infrared photographs can be found at [www.andee-eye.com](http://www.andee-eye.com)



Figure 9. Elliott Landy. Ornette Coleman & son, Aero infrared film, Central Park, NYC, 1969.

He played with the camera in an attempt to obtain a new, still unexplored, visual experience.<sup>55</sup>

In the essay “The Doors of Perception”, Aldous Huxley reflects on his experience with hallucinogens.<sup>56</sup> He argues that the human brain might be having an eliminative function, not productive. That is, in a way, it may have a hardwired biologically-based processing function performing the reduction of data, very similar by principle to digital image processing algorithms. Thus, if LSD and other hallucinogenic substances interfere with the processing of data coming from an optical nerve, resulting in a new vivid perception of reality, a photo camera loaded with color infrared film may be considered as an optical prosthetic device delivering a similar visual experience. It mechanically produces imagery of reality painted in vivid, unusual hues, based on the everchanging proportion between visible and invisible light. However, it reveals reality as it is, — the imagery is a purely indexical result of chemical reactions in the emulsion caused by absorption of electromagnetic waves, no matter of visible or invisible nature, — but since it is

<sup>55</sup> or as Vilém Flusser puts it — to “discover the tricks hidden there”.

<sup>56</sup> Aldous Huxley, “The Doors of Perception.” In *Colour*, edited by David Batchelor (MIT Press, 2008), 115.



rendered in deliberately assigned hues it is symbolic as well. The symbolism of this imagery derives from the way it was designed and supposed to be read and decoded by professionals.

Speaking about photographers and their audiences — it was a pure fluke, — the adoption of the film made happen due to cultural expectations driven by the rise of the 1960s' counterculture. Furthermore, in a way, it was a somewhat result of the establishment of post-war consumerism culture and expansion of new mass visual cul-



Figure 10. Elliott Landy. Ornette Coleman & son, Aero infrared film, NYC, 1969.

ture followed the development of new synthetic dyes and colors, and color film.<sup>57</sup> Thus, color infrared photographs were read, mainly, through their unique color palette applied to familiar everyday objects, unintentionally mimicking psychedelic visual art. At the same time, speaking about colors, we cannot oppose the infrared color film to a “normal” color film. It should be taken into consideration that “natural” or “correct” color is a non-existent category in photography. It is always an approximation in endless aspiration to reach a “desired” color. Producers of photographic film (as well as digital sensors and software) follow not just cultural agreements inherited from art history but always face the obligation to meet certain requirements of their customers.

In other words, it is an exercise of application of preexisting practices

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<sup>57</sup> Carolyn L. Kane, *Chromatic Algorithms: Synthetic Color, Computer Art, and Aesthetics after Code* (The University of Chicago Press, 2014), 58.

and principles of visual culture to technological means and available possibilities according to the current demand. A good example of this would be the development of color film for cinematography in the 40s and 50s. Kodak was developing their film keeping in mind that, first of all, it was intended to render white skin. That is, to render white skin with good contrast and tonal depth, which made it significantly less suitable for brown and black skin.<sup>58</sup>

As for the color infrared film, whose main purpose was aerial photography for military reconnaissance — the whole complexity of technology and logic backing up the design is completely opaque for ordinary photographers. To explain such complexity of the imaging system philosopher Vilém Flusser uses the term “apparatus.” In his book “Towards a philosophy of photography,” Flusser describes it as a “complex toy, opaque for its user.”<sup>59</sup> and compares it with a complex entangled bureaucratic system operated by unknown “software.” However, a photographer doesn’t have to know how the apparatus works, she needs only to learn how to operate it, to play with it. In most cases, it means pushing the release button or making minor decisions about the shutter speed or framing.<sup>60</sup>

Although this statement is a generalization, in the case of the color infrared film it remains true. Shutter speed for technically correct exposure is unpredictable and lies in the field of pure guessing. As well as color rendition. So, to sum up, the infrared film is a variable that turns the whole imaging system into the black box delivering unpredictable results. The photographer can only play<sup>61</sup> with it or make some educated guesses based on her previous experience. So, as Flusser puts it — photographer works/ plays against apparatus. The psychedelic photographer works against the nature and purpose of the infrared film itself. Artistically misuses technolo-

58 Yvette Granata, “False color/real life: Chromo-politics and François Laruelle’s photo-fiction.” *Necsus*, May 29, 2017, <https://necsus-ejms.org/false-colorreal-life-chromo-politics-and-francois-laruelles-photo-fiction/>

59 Flusser, *Towards a Philosophy of Photography*, 22.

60 The whole Kodak empire was built upon the words “You Press the Button, We Do the Rest”.

61 Flusser, *Towards a Philosophy of Photography*, 19.

gy. Again, following Huxley<sup>62</sup> and Flusser,<sup>63</sup> it is possible to say that the apparatus (the tandem of camera and infrared film) works against the biological function of the brain as a funneling device, which reduces the amount of information the mind to operate. Or, in a way, works as an outsourcing mechanism for a psychological function, eventually delivering imagery that may induce psychedelic experience.

### **3.3 Claudia Andujar's Photographs of Indigenous People of Amazonia**

Claudia Andujar (Claudine Haas) is a Brazilian photographer and activist. She was born in Switzerland in 1931 and grew up in Transilvania, but because of her jewish ancestry, she and her mother had to flee to the USA before WWII. Her father and his part of the family perished at Auschwitz and Dachau concentration camps. In 1955 she settled down in São Paulo, Brazil, where she started her career as a photojournalist. In 1971 while working on material for Realidade magazine she visited a remote area in



*Figure 11. Claudia Andujar. Collective house near the Catholic mission on the Catrimani River. Color infrared photograph, 1976.*

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62 Huxley, "The Doors of Perception," 116.

63 Flusser, *Towards a Philosophy of Photography*, 16.



Brazilian Amazonia where she met Yanomami people. Subsequently, she has spent almost five decades photographing and protecting the Yanomami indigenous community. During the 1970s and 1980s she traveled back and forth to document Yanomami's everyday life, cultural rituals and changes being brought by civilization. Infrared photographs constitute just a small part of Andujar's photographic legacy but are of some interest to this study.

In her work, Andujar combines experimental and documentary photography. Images, she has made, color or black and white, demonstrate a number of different effects and visual distortions. She applies various techniques — petroleum jelly on lenses, multiple exposures, flash, color infrared film. Andujar interferes with the photographic process—she mixes up visible and invisible, sharp and blurred by manipulating the path of light. She introduces something foreign in the course of photographic practice, something that stays between the final image and the scene — literally, like petroleum jelly or symbolically, as ungovernable logic of the color infrared film, which transforms and re-code the picture.<sup>64</sup> Andujar's photographs are not "straight photographs" so common for photojournalism.<sup>65</sup> Images have gone through altering and enhancements. But it is hard to say if these modifications were intended to make photographs more aesthetically pleasing. Even the vivid colors of infrared images do not seem to be an enhancement, but rather a degradation. The Amazon rainforest cannot be considered as a place that suffers from a lack of color. The hues of color infrared film, over-saturated, alien to reality, seem an inappropriate substitute for rich genuine colors of Amazonia's nature and rather emphasize the distance between the spectator and the locus of reality where photographs were taken.

The color infrared film seems to be a very interesting choice if considered from the position of its purpose. As was pointed out, the color infrared

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<sup>64</sup> as was shown in "Psychedelic Photography" subchapter.

<sup>65</sup> the border between photojournalism and documentary is rather vague and depends on consideration of particular cases. Besides, at that moment Andujar worked on a photographic essay for the *"Realidade"* magazine.



*Figure 12. Claudia Andujar. Youth Wakatha victim of measles is treated by shamans and paramedics from the Catholic mission, Catrimani, Roraima. Color infrared photograph, 1972-1976.*

film was used for remote sensing, cartography, forestry, pollution detection. Indeed, aerial color infrared photography makes it easy to recognize which part of the forest is healthy and which is not, simply by the tint of the foliage's color. The decline or increase in the forest area is also immediately visible. Surely, infrared aerial photography had been used during the planning and construction of the Trans-Amazonian Highway which was introduced in late 1972. The Highway has become a determining condition for following deforestation of Amazonia rainforests and caused a huge impact on local communities like Yanomami people. To document such consequences was one of Andujar's initial intentions. Unquestionably, deforestation or transformation of the landscape would have been perfectly recorded on aerial color infrared film. However, Andujar, despite using film accurately in the environment it was intended for, radically changed two important conditions — the focus and the distance. Instead of capturing the environment, she shifts focus to the local people, while remote sensing is replaced by a close gaze.<sup>66</sup>

<sup>66</sup> sometimes even inappropriately close in modern view.

Andujar exploits the blindsight of a cartographic/observational instrument against its design and nature. She registers reality directly, visible and invisible, but speaks about her feelings, her personal experience, her own perception — "...I wanted to observe, absorb, in order to recreate in the form of images what I was feeling."<sup>67</sup>

Just like psychedelic photographers, Andujar cannot anticipate the final result. She doesn't know what color infrared film will record in every particular case, but intentionally uses it to remap colors and, consequently, to remap reality, or as Flusser put it — to change the meaning of the reality. Andujar uses a scientific visual language of aerial infrared film which is to be misread and misinterpreted by spectators in order to create a vision of new reality. In other words, her experiments highlight the cultural gap, emphasizing the difference in way of living between western society and the shamanic culture of the indigenous community. Visual distortions and twisted colors are symbols indicating the presence of unrecordable feelings of the western photographer and invisible entities Yanomami believe in.

### **3.4 Richard Mosse's "Infra" and "Enclave"**

Richard Mosse's projects are, perhaps, the most important for this study. Not just because infrared imaging is at the very heart of each work, but also because the infrared is the main point of intersection of visual, contextual, humanitarian and political aspects of projects.

Richard Mosse is an Irish documentary photographer based in New-York, USA. This part of the thesis is devoted to his work with color infrared film. In fact, we are going to consider two tightly intertwined projects: the first one, "Infra" is the series of still images and "Enclave" — is a further development, a multimedia project built around documentary footage

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<sup>67</sup> Hannah Abel-Hirsch, "Claudia Andujar's ongoing commitment to a community under continual threat," *British Journal of Photography*, Jan 31, 2020, <https://www.bjp-online.com/2020/01/claudia-andujars-ongoing-commitment-to-a-community-under-continual-threat/>



Figure 13. Richard Mosse. "Vintage violence", North Kivu, Eastern Congo. Color infrared photograph, 2011.

filmed on 16mm film. Both projects are complementary pieces of a long-term project on which Mosse had been working between 2010 and 2013. In 2013, Mosse was representing Ireland at 55th Venetian Biennale with his "Enclave" installation. Subsequently, In 2014, Mosse's "Enclave" was nominated for Deutsche Börse Photography Prize.

It is a little-known fact that the "Infra" project has begun with a mistake, but a beautiful one. During his first visit to Africa, Richard Mosse used a 8x10 inches large-format camera and Kodak Aerochrome film. Upon return, it turned out that almost all photographs were exposed twice. Nevertheless, these double exposures were exhibited as the separate "Debris" series.<sup>68</sup> During further visits to Congo, Mosse was using a medium format camera. He proceeded with a "fluid" photography-based approach — project "Infra" has been under continuous modification, and different versions of it have been exhibited several times as work in progress.

At a certain point, Mosse got interested in employing a moving im-

<sup>68</sup> James Pomerantz, "Great Mistakes: Richard Mosse." *The New Yorker*, Oct 31, 2011, <https://www.newyorker.com/culture/photo-booth/great-mistakes-richard-mosse>





Figure 14. Richard Mosse. *Platon, Farm near Bihambwe, Masisi Territory, North Kivu*. Color infrared photograph, 2012.

age, but to perform it practically was quite problematic. Kodak Aerochrome film stock was not available at that moment. It won't be available anymore in the foreseeable future since the film was discontinued in 2009. It took Mosse a couple of years to find the 16 mm film at a second-hand market. The "Enclave" is a result of the unique multilateral collaboration of Richard Mosse, musician Ben Frost, cinematographer Trevor Tweeten, and writer John Holten.

Both projects were shot in the regions of North and South Kivu in Eastern Congo during the "extremely intense series of journeys to Congo."<sup>69</sup> At the center of both projects is the ongoing civil war in the region. The changing landscape of conflict between the Congolese army and paramilitary groups led by warlords. This conflict has engendered a complex system of dynamically evolving relationships between numerous groups of militants. This arrangement of competing political forces, rooted in overlapping conflicts of interests, is barely visible for the outsider.

69 "The Venice Questionnaire #5: Richard Mosse," *Art Review*. Accessed Feb 10, 2020 [https://artreview.com/previews/5\\_venice\\_richard\\_mosse/](https://artreview.com/previews/5_venice_richard_mosse/)

Mosse's interest in the region was sparked by many various reasons. He often explains his motivation by speculating on Congo's representation dominating in the western popular imagination. The image shaped by myths, fiction, and misinterpretation and often having been associated with madness, horror, and wickedness. The most famous example of it would be Joseph Conrad's "Heart of Darkness."<sup>70</sup> Nowadays, that image is fueled by media reports on outrageous gangs, endless civil war, and ineffective actions of UN forces in the region. In combination with the entangled nature of ongoing conflict itself, reality becomes totally opaque to the observer as if it was camouflaged by many layers of misrepresentation. Mosse explains: "Congo's conflict is really very hidden in this respect. It's a huge humanitarian disaster that people don't really see anymore;"<sup>71</sup> Besides, in his interview related to the Venice Biennale, he mentioned personal connections — his best friend's father was shot to death in Congo while worked for the UN.<sup>72</sup> In 1896 two English missionaries, Alice Seeley and John Harris, depicted brutal atrocities that was committed by the colonial administration in Congo. In the same period, photography had its rise in mass media. Photographs were published and that, subsequently, has undermined the king's Leopold control over Congo.<sup>73</sup>

To sum up, Mosse tried to connect multiple issues and viewpoints under one project. The color infrared film seems a relevant choice, funneling all perspectives into one clear path. Moss employed color infrared photography as a tool that theoretically capable of breaking through the curtain of false representation, and designating reality buried under a heap of fiction.

The film with military origin intended for reconnaissance<sup>74</sup> — for the

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70 Jörg Colberg, "Interview With Richard Mosse," *GUP Magazine*, Feb 8, 2011, <http://www.gupmagazine.com/articles/interview-with-richard-mosse>

71 "Interview: Richard Mosse on his Moving Images of Congolese Rebels," *Artsy*, May 30, 2013, <https://www.artsy.net/article/editorial-interview-richard-mosse-on-his-moving-images>

72 "The Venice Questionnaire #5: Richard Mosse".

73 Colberg, "Interview With Richard Mosse".

74 The word reconnaissance is derived from the French word reconnaître, to recognize.



Figure 15. Richard Mosse. *The "Enclave,"* installation view at the Venice Biennale, 2013.

recognition of camouflaged objects and people — is being used as a means of examining the nature of photojournalism being in the deep crisis. Mosse argues that nowadays photojournalism is more likely to affirm our beliefs than to give an objective view of things.<sup>75</sup> Photographs delivered by the color infrared film turn out to be more objective than conventional photography. Astonishing landscapes of Congo rendered in vivid hues of pink, crimson, and lavender, rather resemble imaginary sci-fi illustrations depicting outer worlds, than the existing reality. However, that alienation resets mode of perception. Moss turns to the local context in order to recognize and capture traces and consequences of never ending conflict and a complex network of invisible connections hidden in the landscape. He shows reality camouflaged as fiction, in an attempt to neutralize numerous myths wrapping Congo, disguising as reality.<sup>76</sup>

Mosse's still photographs are very similar to ones that may be found in many other documentary projects shot in military zones and covering

<sup>75</sup> Din Heagney, "ELUSIVE ENCLAVES, Interview with Richard Mosse," *Din Heagney*, Aug 2011. <https://www.dinheagney.com/elusive-enclaves>

<sup>76</sup> Ibid.



humanitarian catastrophes. Aerial photographs, photographs depicting militants carrying weapons, units maneuvering in the field, villages, portraits, and peaceful landscapes. But in Mosse's case they look startlingly fresh. Mismatch of visuality and context of depicted events highlights the subject matter of photographs. The color infrared film, which is still can be associated with psychedelic culture and anti-war movements of the 60ss, is superimposed upon images of armed conflict.

Moss recontextualizes the use of infrared film, turning it into a kind of multi-tool for cross-examination of matters unrelated at first glance. Challenging attempts to depict social issues that are impossible to see, are turning into critical meditation about the genre of documentary photography.

### **3.5 Popular Film-based Color Infrared Photography and "the Aerochrome Project"**

Undoubtedly, the main reason why Kodak has abandoned its color infrared film was the decline in demand. The military and scientists have moved to more flexible and reliable digital technology. At the same time, amateur and professional photography markets couldn't deliver sufficient demand to support the struggling analog film industry. In popular consciousness, the color infrared film was tightly bound to hot pink of swinging sixties, and as the epoch slowly faded away, curiosity regarding the medium has declined. The color infrared film remained a matter of interest to a small number of connoisseurs and photography enthusiasts.<sup>77</sup> However, after Richard Mosse's projects "Infra" and "Enclave" had enjoyed wide success, the interest in infrared film got sparkled again. The unique look of the medium, its analog nature and rarity made it even more attractive for amateur photographers of the digital age.

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By 2011, when Richard Mosse exhibited his first versions of "Infra",

<sup>77</sup> The same cannot be said about black and white infrared film which was respected by landscape photographers due to its "dramatic" look, see chapter 1, "Robert Wood's First Infrared Photographs".

Kodak Aerochrome film had already been discontinued. The only remaining source of film was a second-hand market. Online auctions like eBay, websites trading second-hand photography equipment, and individuals were selling and reselling color infrared films, mostly in big rolls supposed to be used in aerial cameras and unsuitable for general photography. Dean Bennici was one of enthusiasts who had got interested in dying out medium and founded "the Aerochrome Project" in 2007, two years before the film was discontinued. He started out with buying industrial rolls of film and developing the technology of manual cutting those rolls into smaller pieces. Subsequently, he has developed a technology of preparing films for large format photography (in any standard size) and even medium format rollfilms. Bennici is still selling medium format films rolled up manually. Exactly these rolls of infrared films were used by Richard Moss in Congo<sup>78</sup> and by Edward Thompson for his book "Unseen," and still available at Bennici's website.<sup>79</sup>

Eventually, "the Aerochrome Project" has become the main supplier of Kodak color infrared films of various formats. "The Aerochrome project" made the film achievable, albeit very expensive. Nevertheless, a photographer interested in relatively longterm work, requiring more than few rolls of the film, could rely on Bennici supplies.

The major part of the Kodak EIR film consumers is amateur photographers, looking for something new and unusual. Buying just a couple of rollfilms, the photographer explores the world around her, challenging familiar subjects in an attempt to discover something shockingly new about the visuality of everyday life. Such photographs, taken on expired Kodak EIR film, are still being published on Instagram or other platforms. For example, in the Flickr "Aerochrome group,"<sup>80</sup> snapshots of daily life, unsophisticated landscapes and photographs from trips and vacations are prevailing. One

78 According to Bennici's webpage.

79 The film is still available (march 2020) at the Aerochrome Project internet shop: <https://www.aerochrome.shop/product-page/aerochrome-120-color-infrared-film>

80 "Kodak Aerochrome group," Flickr, Accessed Jan 12, 2020, <https://www.flickr.com/groups/1776903@N21/pool/>

can safely assume that authors were driven by simple curiosity to see a familiar world with new eyes.

The important feature here is that the film reveals reality (or at least the film's indexical nature makes its user convinced that this statement is true). Even though it provides a vision of real infrared light, a final user is not educated about algorithms behind the translation of invisible radiation to visualized form. The user deals with images visually striking and fresh.

Russian literary theorist Viktor Shklovsky, in his essay "Art as Technique" (1917), coined the term "ostranenie" which is usually being translated as "defamiliarization" or "estrangement."<sup>81</sup> Shklovsky defines the term as the process of creation of special conditions for the perception of the subject. These conditions should prevent instant recognition but stimulate the active "seeing" of the subject as if it was observed the very first time ever. In other words, to make it unfamiliar and novel. The visual representation of familiar reality, when interpreted by infrared film's "program," looks alienated and thereby attractive.

It is highly likely that the most popular subject for the color infrared photography would be landscape. The landscape intersects with travel photography, popular genre among professional photobloggers, and amateur photographers.

Photographs made during vacations and trips have migrated from a personal or family album to a public (virtual) space and ceased to be an index of private memories and experiences. Bits of memory shared with millions of followers via Instagram or Facebook in exchange for such valuables as new followers and likes. In this exchange, the most unusual content takes the highest reward. A travel photographer, like an amateur photographer, cannot be satisfied with imagery repeating itself. She looks for something new. Even exotic remote place doesn't look attractive enough if it has

<sup>81</sup> Viktor Shklovsky, *Art as Technique* (1917). The University of Warwick. Accessed Apr 23, 2020, <https://warwick.ac.uk/fac/arts/english/currentstudents/undergraduate/modules/fulllist/first/en122/lecturelist-2015-16-2/shklovsky.pdf>

been photographed a thousand times.

Photographers such as Daniel Zvereff, Sean Lynch, Karim Sahai, Vicente Munoz, and others used Kodak EIR film to document their journeys or short projects.

Karim Sahai took a few rolls of Kodak EIR film on his trip to North Korea.<sup>82</sup> He came back with a set of tourist road trip shots but taken on infrared film. The redness of Infrared, supposedly, stands for the “red ideology” of the state. Daniel Zvereff used color infrared to document his journeys to the Arctic

and across Russia.<sup>83</sup> Sean Lynch uses infrared film for the same purpose and for his everyday photographic experiments and portraits.<sup>84</sup> Ecuadorian photographer Vicente Muñoz studies relationships between nature and city through taking infrared landscapes of Guayaquil.<sup>85</sup>

Another part of the audience for Kodak color infrared film was the Lomography community — people who are keen on the simplest, often primitive, analog photographic equipment and practicing “wrong photography.” In the heart of Lomography philosophy are images accumulating defects, traces of misuse of the camera, and incorrect processing. In other words, the photograph that points out to its nature and origins. That is, that Thom-



Figure 16. Vicente Muñoz. “Sublimes.” Color infrared photograph.

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82 Jessica Stewart, “Interview: Stunning Infrared Photos of North Korea Using Kodak Aerochrome Film,” *My Modern Met*, Apr 2, 2018, <https://mymodernmet.com/karim-sahai-kodak-aerochrome-north-korea/>

83 Janna Dotschkal, “Musings: Daniel Zvereff’s Infrared Introspective,” *National Geographic*, Feb 10, 2014, <https://www.nationalgeographic.com/photography/proof/2014/02/10/musings-daniel-zvereffs-infrared-introspective/>

84 Sean Lynch, “Dorialisium,” Accessed Jan 12, 2020, <https://dorialusium.com>

85 Eleanor Gibson, “Vicente Muñoz’s infrared photos highlight the battle between city and nature,” *Dezeen*, Sep 8, 2018, <https://www.dezeen.com/2018/09/08/sublimis-vicente-munoz-urbanism-infrared-photography-guayaquil-ecuador/>





Figure 17. Karim Sahai. Army officers walk up a hill leading to the Revolutionary Martyrs' Cemetery in Pyongyang, North Korea. Color infrared photograph.

as Mitchell in his book "Picture Theory" titles as "metapicture."<sup>86</sup> This visual construct, created inside the discourse of Lomography, refers to the spontaneity of the act of photographing, and to the very essence of the medium and its self-manifestation through defects. In this context, an infrared film, completely unpredictable in its behavior, becomes a holy grail. The demand for the film was so great that the Lomographic society (which is a commercial company) has released a film supposed to replace Kodak Aerochrome. "Lomochrome Purple," supposedly, is a false-color negative film with mismatched or swapped dye-couplers in color layers. Instead of hot pinks of Kodak Aerochrome, this film produces pictures rendered in incorrect colors with prevailing violet-magenta hues.

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86 Thomas W.J. Mitchell, *Picture Theory: Essays on Verbal and Visual Representation* (University of Chicago Press, 1994), 42.

### 3.6 Edward Thompson's "The Unseen — an Atlas of Infrared Plates"

Edward Thompson is a British documentary photographer. He is focused, as he explains in his biography, on covering environmental issues, socio-political movements, subcultures and consequences of war. His book "The Unseen — an Atlas of Infrared Plates", consisting solely of infrared photographs, covers all of these matters. Thompson had been developing the project from 2010 to 2016. Subsequently, the book was published in 2016 after a Kickstarter fundraising campaign.<sup>87</sup>

In 2010, Edward Thompson went to the "haunted village" of Pluckley to photograph ghosts. Shortly before that, he bought some rolls of Kodak EIR film and during his research on possible applications, he stumbled upon articles claiming that ghosts could be captured by infrared photography.<sup>88</sup> In his interview for the podcast "a small voice,"<sup>89</sup> he says that from the very childhood he has been captivated by ghost stories and the role they played in the development of England's cultural landscape. Equipped with a medium format camera with color Infrared film, Thompson had followed the path of popular myths and visited every "ghost" site in Pluckley village. Unfortunately, he never captured anything supernatural. However, he was quite impressed with the aesthetic qualities of color infrared film. "These red landscapes are very reminiscent of H.G. Wells' *The War of the Worlds*. It's very sci-fiesque and dystopian," he says.<sup>90</sup>

Delighted by the first outcomes, Thompson decides to proceed with his exploration of the medium. While searching for a film manual, Kodak

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87 "THE UNSEEN: An Atlas of Infrared Plates," Kickstarter. Accessed Feb 14, 2020, <https://www.kickstarter.com/projects/1092524383/the-unseen-an-atlas-of-infrared-plates?ref=card>

88 unfortunately, he doesn't specify his sources.

89 Ben Smith, host, "027 - Edward Thompson," *A Small Voice: Conversations with photographers* (podcast), n.d. Accessed Feb 15, 2020, <https://bensmithphoto.com/asmallvoice/edward-thompson>

90 Emiko Jozuka, "This Photographer Captures the World in Infrared," *Vice*, Apr 8, 2015, [https://www.vice.com/en\\_us/article/ypw4z7/this-photographer-captures-the-world-in-infrared](https://www.vice.com/en_us/article/ypw4z7/this-photographer-captures-the-world-in-infrared)



Figure 18. Edward Thompson. *The Village of Zalissja* from "the Red Forest." Color infrared photograph, 2012.

Aerochrome III data sheet, he discovers that film was recently discontinued by Kodak and available only from a limited number of dealers or on the second-hand market. Subsequently, it has become one of his major recurrent motifs — the last rolls of the obsolete, discontinued film.

He also undertakes research on the medium and turns to the book "Photography by infrared"<sup>91</sup> — the major and most fundamental compendium of material on infrared photography. Although "Photography by infrared" is mainly devoted to scientific and technical applications, it has become an inspiration for Thompson's work. He followed chapter by chapter in order to apply described procedures and techniques to contemporary issues under "...a long-term project that sat firmly within the boundary of art and science."<sup>92</sup> Simultaneously, he highlights his focus on aesthetical qualities and social background of his work "My work is aspiring to scientific photographs,

91 Gibson, Henry Louis, and Walter Clark. *Photography by Infrared: Its Principles and Applications* (A 3d ed. of *Photography by infrared* by Walter Clark, Wiley, 1978).

92 Jessica McQueen, "The Evolved Documentary Photography of Ed Thompson," *Canvas*, Sep 8, 2018, <https://canvas.saatchiart.com/art/one-to-watch/ed-thompson>



but the scientists taking those photographs were scientists, and they'll have had different desires for their work to me. I'm a documentary photographer, so my aesthetic and social impulses are stronger."<sup>93</sup> Nevertheless, the very fact of naming his book as "an Atlas of Infrared Plates" refers to 19th-century scientific or experimental photography, rather than to an album of "scifisque" landscapes or typical documentary series.<sup>94</sup>

For every chapter of the "Atlas" Thompson had chosen one of the original applications of the film and matched it with a particular problem. He visited Chernobyl's Exclusion zone for "The Red Forest" (2012). "After the Flood, after the Red River Valley" (2012) covers the social consequences of the flood. "The Vein" (2014) and "The Gross Specimen" (2015) explore medical photography. In "The City" (2014), Thompson tries to register the pollution in London. In "The War" (2015) he photographed military paintings to reveal the underlying sketch, playing with the idea of uncovering the military camouflage. He experimented with Astrophotography at "The Beginning and the End" (2015). In 2016 he photographed aurora Borealis for "The Northern Lights and Anomaly" and melting glacier Hellir for "Hellir." In "The Apiary" (2015) Thompson documented beekeeping practices in the context of global warming and insect extinction. The opening project, The Village (2012) is a stand-alone project, irrelevant to the actual use of the material.

As evident from the brief description, projects are mostly focused on environmental issues and scientific photography. In his rare interviews, Thompson underscores the importance of every particular case but names the idea of photographing of "invisible" as a uniting motive and common ground for all of them.<sup>95</sup> Invisibility is understood in 2 ways: literally — as radioactive pollution in Chernobyl, and hidden veins underneath human

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93 Jozuka, "This Photographer Captures the World in Infrared".

94 Atlas is a collection of maps bound in one book. May be geographical, anatomical, astronomical, etc..

95 Smith, "027 - Edward Thompson".



Figure 19. Edward Thompson. Photograph from "After the Flood, after the Red River Valley." Color infrared photograph, 2012.

skin. Allegorically — as the hidden presence of global warming causing glaciers melting, and lack of public attention in case of struggling flood victims. Nevertheless, again, while Thompson stresses the importance of drawing attention to involved matters, this gesture seems somewhat redundant. The very subject of the book is the medium itself.

Thompson plays with the aura of the obsolete, discontinued military film<sup>96</sup> — he describes his work as the "Odyssey to the dead stock film".<sup>97</sup> The photographer appeals to the intrinsic objectivity of the medium and inherited authenticity of photographs — "There is much debate in contemporary photojournalism and documentary photography about manipulations, both in the construction and post-production of photographic imagery. Although the infrared photographs in "The Unseen" look strangely sensational, they

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96 It is noteworthy that Thompson regularly mentions that he uses "the very last rolls of infrared film." The number of "the latest films ever" has been steadily increasing from interview to interview — 6, 12, 48, 56... The mention of using something so rare and difficult to get is, presumably, supposed to amplify the aura of exclusiveness. Nevertheless, the film is still available at "the Aerochrome project" on-line shop.

97 Smith, "027 - Edward Thompson".

are not constructed or manipulated. This is documentary.”<sup>98</sup>

To expand on this statement it is important to remind, that the photographer cannot foresee the exact appearance of the final photograph. The visual gap between observable reality and the image clearly illustrates Moholy-Nagy’s conclusion that the photographic camera is an extension of the human eye<sup>99</sup> and supposed to augment human optics. Since infrared photography is not a visual trick it unveils some truth about reality, indeed. Thompson’s statement about documentary nature of his photographs might be understood in the context of 19th-century scientific photography — he employs objective blindsight of the camera not interfered by emotions or intelligence (that is quite a bold assumption since Thompson still chooses the subject and the composition, but he still takes pictures in a “blind mode,” not seeing the result). In other words — he had chosen social and environmental issues to cover and photographed them in the lack of knowledge if it could work out. This may explain the inconsistency between the stated problem and the result in some projects.

For instance, in the case of “the Red Forest”, Thompson points out that he was most interested in the pollution (podcast). Although it is quite clear that color infrared film could register radioactive pollution only when it is unthinkably, unrealistically high. The only defect Thompson mentions is the appearance of tiny black dots on his positives (that must have been dust, which is a common problem in the case of hand-rolled medium format films).<sup>100</sup> Evidently, it is a failure of the instrument to perform its task. Whereby photographs produce strong estrangement effects supported by symbolism of the red color in the context of the location name and post-

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98 Lisa der Weduwe, “Revealing the world in Infrared – Edward Thompson,” *Silverlake Voice*, May 11, 2016, <http://www.silverlakevoice.com/photography/edward-thompson/>

99 Laszlo Moholy-Nagy, *Painting, Photography, Film* (London, Lund Humphries, 1969), 28.

100 project Aerochrome, which highly likely is Thompson’s supplier, sells hand-rolled films.



*Figure 20. Edward Thompson. Hellir #4 from "Hellir." Iceland. Color infrared photograph, 2016.*

USSR heritage.<sup>101</sup> Project "the City" demonstrates a similar outcome. Supposed to be a study on pollution in London, it shows nothing but just aerial photographs. Despite the fact that "pollution monitoring" can be found in the film manual, it is hardly possible to record chemical contamination of Themes or air pollution by means of simple film-based aerial photography. Rather, it would be only possible to register the growth of algae in places with temperatures higher than normal. It could have been much more interesting if it was a study on city parks. The color infrared film would highlight every green plant in the city. For instance, Ecuadorian artist Vicente Muñoz made a project exploring the ceaseless clash between city and nature.<sup>102</sup> "The Veins" project devoted to the medical application of infrared photography. As known, infrared photography can reveal and capture underskin

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101 The interesting aspect of this case is that the real "Red Forest" is not red at all, and Thompson didn't take pictures of the exact "Red Forest" — he has taken photographs in some other place. So, he created some sort of simulacra of the "Red Forest."

102 Gibson, "Vicente Muñoz's infrared photos highlight the battle between city and nature".



blood vessels. In some cases, a developing condition can change the number of vessels or reroute them, so the disease can be diagnosed before its manifestation. Thompson's photographs of human bodies copy photographs from the book "Photography by Infrared," which in turn illustrate the course of illnesses. In the lack of particular cases of the disease, it is not entirely clear what these photographs are saying — probably, they should tell us that the human body looks like that too. Besides, it might be a photographer's astonishment with his discovery of the new trick in apparatus' program enabling new ways of seeing. "If we just viewed the world a little differently, it would be radically altered. If our visual spectrum of light was changed slightly, then we'd see in a very different way."<sup>103</sup>

In the case of "Hellir", melting glacier, the color infrared photograph failed to reveal anything about global warming. The very dark almost spectral blue mass is depicted in the photograph, but it doesn't show any signs of change in average temperature. It gains meaning only in the context.

As seen, technical or scientific infrared image is misused in order to create an allegorical fiction landscape. "Although alluding to the interplay between art and science, the work also dwells within the realm of science fiction. We live in a time when art photographers are working to make fake documentary fictions, but here the real seems unreal."<sup>104</sup>

### **3.7 Chapter Conclusion**

Infrared film is usually perceived as a means of authentic scientific representation of reality. It is supposed to reveal the truth about invisible, unseeable by the human eye. Doubtless, these expectations and suppositions derive from the indexical nature of the film. A negative or positive image (both negative films and transparencies) are direct imprints of reality

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<sup>103</sup> Jozuka, "This Photographer Captures the World in Infrared".

<sup>104</sup> "EDWARD THOMPSON / The Unseen: An Atlas of Infrared Plates," Edward Thompson. Accessed 16 Feb, 2020, <https://edwardthompson.co.uk/The-Unseen-An-Atlas-of-Infrared-Plates>

manifested in chemical reactions.<sup>105</sup>

However, John Tagg argues that idea that film-based photography can be seen as evidence of truth not originated solely in its indexical nature, but rather is based on the perception of photography in the context of institutional use. In particular, in police and scientific practice or as a concept of the photographic archive established in the 19th century<sup>106</sup> Therefore, photography inherits its power to be considered as evidence of truth from the concept of photographic document. This aura of authenticity was also fueled by the spreading of photography in mass media and the ascendance of photojournalism and documentary photography. Hence, photography has traditionally been understood as showing real facts and, thus, related to truth. Moreover, David Campany elaborates on this idea, arguing that photography's properties and significance always depend on the institutions using it. — "The definition of a medium, particularly photography, is not autonomous or self-governing, but heteronymous, dependent on other media. It derives less from what it is technologically than what it is culturally. Photography is what we do with it."<sup>107</sup>

The color infrared film is, first of all, an aerial film, which means that it is intended for high altitude photography of landscapes, and mapping territories for different purposes, including reconnaissance and cartography. By its nature, aerial infrared image is highly saturated with information and deeply symbolic. Information about the structure of space and objects is encoded in colors that must be deciphered by trained professionals.

Analyzing aerial photographs of World War I, art historian Bernd Hüppauf indicates that "aerial photographs of the front demonstrate pointedly the new perception and experience of a "landscape" hitherto unknown" ... "landscape, emptied of its traditional points of orientation, and its potential

<sup>105</sup> Scott, *The Spoken Image*, 28.

<sup>106</sup> Tagg, *The Burden of Representation: Essays on Photographies and Histories*, 5-11.

<sup>107</sup> David Campany, "Safety in Numbness: Some Remarks on Problems of 'Late Photography.'" In *The Cinematic*, edited by David Campany (Whitechapel ; MIT Press, 2007), 190.

for experience visibly reduced to barren functional space."<sup>108</sup> Hüppauf points out that aerial images are not emotional or sensual, they are purely informative. If the war had destroyed landscape and turned it into abstraction, aerial photographs have created a new meta-level of abstraction. This new abstraction is defined by the fact that these photographs were taken from above and at high altitude i.e. from a great distance.<sup>109</sup>

Color infrared photography elaborates this effect even further — the abstractness of aerial photographs is enhanced by unnatural and misleading false-colors. One can say that the very visuality of the color infrared film contradicts expectations that photography reflects reality. Nevertheless, according to Scott, photography can remain realistic even when it is not realistic in relation to the human eye. "Realism is something our perceptual culture has educated, or persuaded, us into."<sup>110</sup>

Thus, we are dealing with a medium that is perceived as truthful, authentic, but simultaneously delivering abstract and highly informative images, requiring educated decryption. The medium that is being associated with institutions that had engendered and utilized it. And the medium that is tightly connected to the concept of photographing "invisible", that enables the allegorical level of reading. Considering projects and art practice involving infrared photography, it can be concluded that artists operate precisely with these aspects of color infrared film-based photography.

Psychedelic photography and photographs by Claudia Andujar are perfect examples of using the allegorical level of reading. The film's feature to capture "unseeable" accompanied by vivid colors, obviously non-present in the initial scene, has allowed addressing the invisible subjective experiences. Moreover, photographers reframed the symbolic level of images. Photographs lost their immediate associative connection with the military-in-

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108 Bernd Hüppauf, "Experiences of Modern Warfare and the Crisis of Representation," *New German Critique*, no. 59 (1993): 56-57. DOI:10.2307/488223.

109 Ibid., 57.

110 Scott, *The Spoken Image*, 9.



dustrial complex, and from that point, they should have been related to the individual psychedelic experiences of Amazonian indigenous people or American youth in the 60s.

In his projects, Richard Mosse addresses all aspects of the medium. Examining the essence and structure of documentary photography, Mosse employs a visual ambivalence engendered by superimposing unnatural colors on documentary projects covering the military conflict. Mosse provokes the spectator to close scrutiny and questioning - Is this a true story and What exactly is true here? At the allegorical level, Moss discusses the feasibility of detecting camouflaged conflicts of interests and hidden processes in the region. He brought the medium that is immediately associated with military power to the battlefield, in order to tell about the tragedy and suffering of others via cold and informative images. One may assume that enveloping someone's suffering into the spectacular might look questionable. However, Susan Sontag points out that "the spectacular is very much part of the religious narratives by which suffering, throughout most of Western history, has been understood."<sup>111</sup>

Edward Thompson addressed the scientific aspect of using color infra-red film. But his approach is quite far from scientific, it is rather a treasure hunt. Evidently, Thompson was captivated by the viscosity of the film — to speak precisely, by the gap between the indexicality of film and colorful unnatural results. Vilém Flusser explains the act of photographing as "... is to search for undiscovered possibilities within the camera program — in other words, to search for images as yet unseen, for informative, improbable images."<sup>112</sup> In other words, Thompson examines reality in the hope of discovering novel visual experiences. Vilém Flusser compares the photographer with the hunter, who merges with the camera and becomes a united function. He claims that this chimerical hunter is after the information as

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<sup>111</sup> Sontag, *Regarding the Pain of Others*, chap. 5.

<sup>112</sup> Flusser, *Towards a Philosophy of Photography*, 26.

such, not for its meaning. He does not decrypt it, he just collects it.<sup>113</sup> Formally, Thompson followed the Kodak manual and tried to use the film for its intended purpose. For instance, when the manual says that the film is supposed to detect and control the ice or icebergs, Thompson travels and takes photographs of the glacier. It is not totally clear what exactly Thompson expects to see upon returning to England. Most likely, as a player and a hunter for the new visual experience, he would accept any result.

Seemingly, amateur photographers' motivation for using color infrared film is the same one as Edward Thompson's. Those are essentially an element of play, experimentation, and magic. In other words — striking chromas, the inability to accurately predict the result or calculate the exposure,<sup>114</sup> and the lack of instant feedback. That is, if the exposure is incorrect, then this cannot be known until the film is developed.<sup>115</sup> Additionally, the very fact that it is the film chemically registering the invisible radiation, and exhibiting the invisible layer of reality, makes color infrared film irresistibly attractive plaything.

In sum, the main and key aspects of the artistic use of the color infrared film would be its non-standard visuality and its indexical nature in association with its perception as an objective scientific tool. The connection with science and the military-industrial complex unquestionably endows images with objectivity in spite of unusual colors. Whereas the notion of "invisible, but objectively present light" enables the use of film as a gesture pointing to an allegorical reading.

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113 Ibid., 28.

114 as it explained in the technical introduction to the chapter, there is no way to measure the proper exposure for color infrared film.

115 this inevitable gap between action and outcome is illustrated by Mosse's project "Debris." Film technology does not forgive mistakes. In the lack of possibility to see and evaluate the result instantly, and therefore without a chance to adjust one's decisions and actions, one must rely just on luck and experience.

## Chapter 4. Digital Infrared Photography

### 4.1 Technical Introduction to Digital Infrared Photography

Infrared radiation can be detected by image sensors of any digital photographic camera. Contemporary CMOS and CCD image sensors that can be found in digital cameras are based on silicon semiconductor technology. Every pixel of the final image stands for one photodiode in the sensor's array. Photodiodes convert photons of light into electric signals.<sup>116</sup> Silicon-based photodiodes can be designed to be sensitive to different wavelengths, but digital cameras' image sensors are mostly sensitive to near-ultraviolet, visible light, and near-infrared. This range is much wider than human eyes are able to see.<sup>117</sup>

In conventional photography, such a wideness of perception can be somewhat problematic. To avoid the interference of the photographic image with invisible infrared or ultraviolet radiation, a so-called "hot mirror" filter is placed in front of the sensor. Basically, the "hot mirror" is a special colorless photo filter that cuts off everything except visible light.<sup>118</sup>

Since all photodiodes making the sensor's array are capable of registering light waves related to any color, it would be impossible to obtain the color image. In order to collect information about the scene's color, each sensor's photodiode is assigned to a specific color. It is made by covering the sensor with a multicolored Bayer filter (Bayer mask). Bayer filter is an array of microfilters colored with red, green and blue. Each of the colored microfilters covers one photodiode. Colored microfilters are distributed in an array in the following proportion — quarter is red, another quarter is blue and half is green.<sup>119</sup> This arrangement reproduces the quality of the human eye, the peak sensitivity of which lies in the green sector of the spectrum.

<sup>116</sup> Ulrich Teubner, *Optical Imaging and Photography: Introduction to Science and Technology of Optics, Sensors and Systems* (1st edition, De Gruyter, 2018), 211.

<sup>117</sup> Ibid., 218.

<sup>118</sup> Ibid., 242.

<sup>119</sup> Ibid., 243.

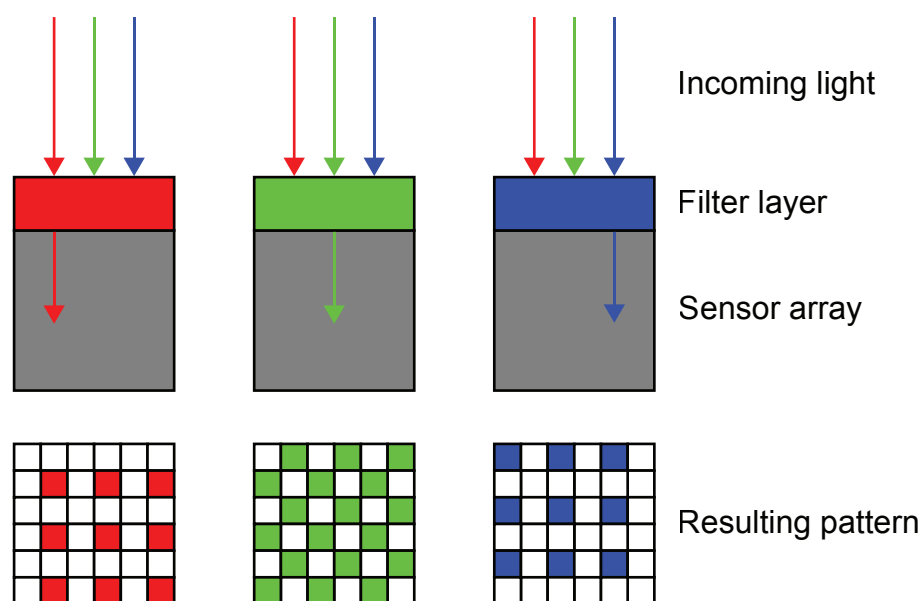


Figure 21. The Bayer arrangement of color filters on the pixel array of an image sensor.

This technology enables the registration of individual values of red, green and blue colors for subsequent processing.

As was pointed above, infrared photography is possible with any digital camera. To obtain an infrared image photographer has to mount the special infrared filter on the lens. There is a whole family of infrared filters, and every filter cuts off everything, but infrared radiation. The difference between filters is bandwidth — usually, filters are named with a specific number marking the threshold wavelength to which all other wavelengths will be cut off.

Infrared filters are completely opaque to the human eye. When it is mounted on the lens, there is no image visible in the optical viewfinder of the camera. If the camera has a “live view” mode or an electronic viewfinder, it might be a solution. Otherwise, a photographer must compose the frame without a filter first.

Furthermore, every conventional camera is equipped with the aforementioned “hot mirror.” Hence, the major part of the infrared radiation would be absorbed by this filter. It would be a clear obstacle for the photographer who wants to practice infrared photography. The presence of the

“hot mirror” leads to exceptionally long exposures (minutes) and makes the tripod essential.

There is a technology that can liberate the photographer from the burden of a tripod and extra-long shutter speeds. The camera can be physically modified. This procedure is called the “infrared conversion.” Usually, the conversion is carried out by third-party companies and, basically, it is the procedure of “hot mirror” removal.<sup>120</sup> The “hot mirror” may be replaced with an infrared filter or transparent protective glass.

A converted camera in which a hot mirror was replaced with an infrared filter is capable of capturing only infrared radiation. Depending on the installed filter type, the result varies.<sup>121</sup> Filter types that are being installed instead of the “hot mirror” are identical to the photo filters that are intended to be mounted on the lens.

A converted camera in which a hot mirror was replaced with a transparent protective glass is called a full-spectrum camera.<sup>122</sup> This camera is capable of capturing the whole range of radiation available to the sensor — usually from near-ultraviolet to near-infrared. The user can manipulate the information registered by the sensor by applying a variety of lens mounted photo filters — colored, infrared, ultraviolet.

To understand how digital camera produces color in photographs made in infrared radiation, which by nature has no color, one needs to understand how digital camera understands and processes colors in general. Again, as was explained above, the sensor is covered with a Bayer mask. Each photodiode in the array is covered by the colored filter. After exposure, data is being collected from each photodiode for further processing in accordance with the color of the Bayer filter. This data is used for the calculation of color

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120 Ilija Melentijevic, “Why Get An Infrared Conversion?,” Jan 04, 2018, <https://kolarivision.com/why-get-an-infrared-conversion/>

121 “Choosing an Infrared Filter,” Kolar Vision. Accessed on Mar 1, 2020, <https://kolarivision.com/articles/choosing-a-filter/>

122 “What is a full spectrum conversion?,” Kolar Vision. Accessed on Mar 1, 2020, [https://kolarivision.com/articles/full\\_spectrum\\_conversion/](https://kolarivision.com/articles/full_spectrum_conversion/)



values in RGB color space. These values are being assigned to appropriate pixels in photographs. In other words, each pixel in the photograph is the result of the interpolation of data obtained from neighboring pixels on the sensor according to a special algorithm. As a result, each pixel is assigned with RGB color value.<sup>123</sup>

In infrared photography, despite the presence of Bayer mask filters, photodiodes are still able to register a certain amount of infrared radiation. Hence, even if infrared radiation does not have a color as such, it can be assigned with color deliberately. The sensor of a full-spectrum camera would register the entire available spectrum of radiation — from near-UV to near-infrared. A color palette of the photograph can be altered by using various color filters: yellow, red, blue, green, etc.. Each filter cuts off a specific part of the spectrum, changing the bandwidth of light falling on the image sensor. Besides, a photographer may tweak the white balance settings to manipulate the color in the camera or during shooting. Changing the white balance redistributes information among color channels and so changes the overall color scheme of the photograph.

## **4.2 Popular Digital Infrared Photography**

From the very beginning of popular digital photography, digital cameras were known as a device capable of infrared photography. Nevertheless, digital infrared photography had a marginal status because infrared capturing was not on the list of camera's documented functions. Besides, due to the extremely low sensitivity to infrared (more precisely, due to the efficiency of a "hot mirror" filter), early digital infrared photography was limited to subjects that allowed only long exposures. Namely landscapes. For other genres and subjects, it could not have competed with Kodak infrared film, both color, and black and white. However, when Kodak infrared films had

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<sup>123</sup> Teubner, *Optical Imaging and Photography: Introduction to Science and Technology of Optics, Sensors and Systems*, 245.

been discontinued, just black and white pseudo-infrared film remained on the market. These films demanded the same long exposures as digital infrared, thus tripod was essential. However, the niche of the high sensitivity infrared film was immediately taken by infrared-converted digital cameras, that are fitted to handheld photography.

Black and white digital infrared photographs mostly mimic the visual tropes of film-based black and white photography. Most of the dramatic effects inherent in the infrared film can be easily imitated during post-processing, except so-called Wood-effect.

Color in digital infrared photography is, to some extent, a challenge. As shown in the technical introduction to this chapter, color is the result of the interpolation of brightness values recorded by photodiodes. Subsequently, interpolation results make color information which is distributed among the picture's color channels. In fact, for infrared range, a purely monochrome image would be the most authentic. Digital color does not have a firm foundation in the form of cultural visual standards describing infrared photographs. The photographer must autonomously decide which color palette to assign to infrared photographs at the post-processing stage. The only guide she has is her cultural background and visual experience.

On the other hand, Kodak Aerochrome film had been around for decades and some photographers tried to imitate the film's color profile. False colors of Aerochrome film have never been correct or authentic — the color profile was defined mainly by technical aspects and visual representativeness, so to say a compromise between convenience and feasibility. However, attempts to simulate the film hues have been undertaken regularly. It can be assumed that the success of Richard Mosse's "Infra" and "Enclave" projects played a significant role in setting this "Aerochrome look" as a visual standard for infrared photography. Yet imitation of the "film look" is not straightforward, due to the difference in technology. There are multiple

strategies, but all are based on two basic ideas — creating a composite image of multiple photographs or extensive post-processing and remapping of colors.

One option is to take two exposures — infrared one and a conventional photograph. Then, to merge photographs into one composite image with swapped channels. That means that the monochrome infrared image is placed in the red channel of the new photograph. While red and green channels of the conventional photograph are placed in green and blue channels of the new image, respectively.

Manipulations with one infrared photograph to recreate “Aerochrome look” seem challenging. With an unconverted camera, since it is impossible to control the ratios of infrared radiation and visible light, there may be no sufficient color information to manipulate. With a converted camera, it is possible to adjust visible and invisible radiation by applying lens-mounted color filters. The culmination of this approach might be a recently released Kolari Vision IRchrome photo filter.<sup>124</sup> The manufacturer claims that with properly set white balance, a full-spectrum camera would deliver imagery very alike to the canonical “Kodak Aerochrome look.” The filter they sell is a variant of basic blue photographic filter,<sup>125</sup> presumably, with additional UV filtration.

Amateur infrared photography is represented mainly by one-time experiments or advanced amateur photographer’s practice with converted cameras. The most popular genres are wedding photography, portraits, nudes, and landscapes. Indeed, public groups at social resources like, for instance, Flickr, make it self-evident. Most of these Flickr groups were founded around 2007 and still have active members. And one can observe that

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124 Yann Philippe, “The Irchrome Infrared Photography Filter – Our Digital Version Of Kodak Aerochrome,” Jan 29, 2019 Kolari Vision. <https://kolarivision.com/the-irchrome-infrared-photography-filter-our-digital-version-of-kodak-aerochrome/>

125 I experimented with different color filters and I have to admit that blue filter works very well with a full-spectrum camera. The result is quite similar to Aerochrome color scheme

landscapes, both color and black and white, have been the most dominant motif for infrared photography.<sup>126</sup>

To sum up, amateur photographers use digital infrared photography in two ways — as an experimental technique or a visual trick. The very fact that there is no established visual standard for infrared images releases photographers from a necessity to seek semblance and authenticity. Hence, photographic practice transforms from capturing (taking) of real into its interpretation.

#### **4.3 Kate Ballis' "Infra Realism"**

Kate Ballis is a Melbourne-based Australian photographer. Ballis belongs to a growing cohort of traveling photographers, — an occupation making the essence of contemporary popular view on photographer and photographer's practice. Her work balancing between decorative photography, photo stock, and social media-oriented travel photography. In 2018 Ballis published the book "Infra Realism." The book consists of infrared landscapes taken in Palm Springs, Southern California. Palm Springs is a desert resort city in South California famous for its modernist architecture. Fashionable resort in the 1900s, in the 1930s it became popular among Hollywood stars. In the 1950s it turned into a fertile environment for innovative architectural experiments.

Ballis has visited Palm Springs numerous times since 2013, each time photographing architecture, city and desert landscapes beyond city limits. However, Ballis confesses that she was never satisfied — photographs seemed dull, common and mundane to her.<sup>127</sup> — "I had to find way to reinterpret it, to show another side. I desperately wanted to make it unfamiliar."<sup>128</sup>

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126 "Digital Infrared Group", Flickr. Accessed Mar 01, 2020, <https://www.flickr.com/groups/55027594@N00/>

127 Jessica Klingelfuss, "Infra Realism," *Wallpaper*. Accessed on Mar 18, 2020, <https://www.wallpaper.com/art/kate-ballis-infrared-california-modernism>

128 "Infra Realism by Kate Ballis," *Palm Springs Style*, Jul 12, 2018, <https://>

At some point, she decided to give infrared photography a try. (in one of the book reviews, reviewer refers to an interview, not available anymore, in which Ballis mentions Richard Mosse's "Infra" as a source of inspiration). Under her project, Ballis worked with a full-format full-spectrum digital camera and a set of color filters. According to Ballis, she had experimented with color filters quite a lot until she found a desirable color scheme.<sup>129</sup>



Figure 22. Kate Ballis. *Untitled work from the project "Infra Realism."* Digital color infrared photograph, 2018.

At the focus of the Ballis' project is the Palm Springs architecture and the city itself, which she perceives as an oasis in the middle of the "martian desert." At the same time, Ballis states that despite the exceptional architectural beauty, the building's colors usually mimic the hues of the desert, so it makes oasis inexpressive.<sup>130</sup> In order to fight this monochromacy, she used the unique color palette she found. Additionally, Ballis noticed that

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palmspringsstyle.com/art-entertainment/infra-realism-kate-ballis/

129 Nina Azzarello, "Palm springs packs a punch in these infrared shots of modernist architecture eye-candy," *Designboom*, Feb 21, 2018, <https://www.designboom.com/art/kate-ballis-infrared-architecture-palm-springs-california-12-21-2018/>

130 Felicity Carter, "Kate Ballis Showcases A Hypercolor Fantasy In Her Latest Exhibition, *Infra Realism*," *Forbes*, Aug 4, 2018, <https://www.forbes.com/sites/felicitycarter/2018/08/04/kate-ballis-showcases-a-hypercolor-fantasy-in-her-latest-exhibition-infra-realism/>



false unnatural colors applied to the cityscape generate a strong feeling of confusion and ambiguity. Ballis mentions the use of infrared allowed her to highlight vegetation, to unveil and illuminate how alive muted landscapes are. Moreover, infrared reveals the real nature of things — for instance, the lawn can be immediately identified as synthetic or natural.

In interviews, Ballis characterizes her work as transformation of desert landscapes into some fantastic scenes of parallel universes or the process of opening windows to a new world.<sup>131</sup> New worlds that arise at the junction of science and magic, daily landscape and synthetic colors. Ballis explains the choice of the color palette by connecting place's contexts that are Southern California archetypes and the popular view on Hollywood lifestyle, to the visual style of the 80s, which influenced her in childhood — “the hyper color dream that was marketed to us.”

Ballis is interested in credibility that infrared gives, and opportunity to cross the border of the visible world. She uses infrared photography as a plaything, as a visual trick, as a technique to entertain herself and others by transforming familiar and tedious into unfamiliar and novel by technical means.

For Ballis, choosing a particular color palette means referring to an era. Hyper saturated colors stand for visual culture of 80s. The landscape *is colored* by Ballis' memories of childhood impressions. At the same time, we can say that the post-war “old-fashioned” American dream embodied in Palm Springs architecture and lifestyle, *has been colored* by contemporary synthetic colors, having no analogy beyond a computer screen. Edward Branigan describes a similar approach of using color as a system of allegories and references in the book “Tracking Color in Cinema and Art.”<sup>132</sup> In other words, the color scheme simultaneously indicates two things. Color is a symbol of the visual language of the 80s and the index of Ballis' memories.

<sup>131</sup> *ibid.*

<sup>132</sup> Edward Branigan, *Tracking Color in Cinema and Art: Philosophy and Aesthetics* (Routledge, 2017), 67-70.

Furthermore, the dominant tint of color, or key color, as cinematographers call it, can be read as a signifier of presence of an invisible coloring layer — not only in the sense of infrared radiation but also as cultural influence of the present, transforming the cultural landscape of the past.

#### **4.4 Sanne De Wilde's "The Island of the Colorblind"**

In 2017 Flemish photographer Sanne De Wilde presented her book and project "The Island of the Colorblind." The project covers a unique case of colorblindness in the Micronesia population. Pingelap Island has an unusually high percentage of people suffering from achromatopsia, — a rare genetic condition that makes a person unable to perceive and distinguish colors and gives extreme sensitivity to bright light. The usual distribution of achromatopsia in the population is no more than 1 person per 30 000, while on the island it is about 5% of the population. This anomaly is the result of a genetic bottleneck the population has passed through in the 18th century, when a disastrous typhoon and following famine had eliminated a significant part of the population. The project inherited its name from the book by neurologist Oliver Sacks "The Island of the Colorblind", covering the islanders' case.

While working on the project, De Wilde used both conventional and infrared converted cameras.<sup>133</sup> Pictures taken with a conventional camera were converted into monochrome photographs while infrared photographs have remained in color. Infrared imagery plays a key conceptual role, despite the fact that they consist only part of the project. De Wilde uses infrared in order to create "imaginary image of how world look like if color has no meaning"<sup>134</sup> Since people with achromatopsia cannot distinguish colors, and color as a category is not applicable to infrared light, in the overlapping of these two phenomena a new color reality can be yielded.

<sup>133</sup> LensCulture, "The Island of the Colorblind - Sanne de Wilde | LensCulture," Jan 26, 2018, Video, 5:12, <https://www.youtube.com/watch?v=dz7iX4XuF1Q>

<sup>134</sup> Ibid.



Figure 23. Sanne De Wilde. Untitled work from the project "The Island of the Colorblind." Digital color infrared photograph, 2017.

The visual strategy of De Wilde was to "to experiment with the infrared converted camera to rediscover color."<sup>135</sup> De Wilde emphasizes that she did not try to consciously control the color palette of pictures obtained, rather, she wanted to completely lose control over image appearance — "it was a surprise and a part of the process to let go of control of the color and allow a coincidence to come in."<sup>136</sup> That is, she did not try to document reality by reformatting it to meet some cultural expectations, but to explore the space with her camera. As known, the camera reads light differently and it enables the possibility to liberate color from cultural conventions, to rethink the nature of color perception. "The idea is to help people open up to the whole new reality and this freedom of color that you get if you let go the conventional way of looking at it"<sup>137</sup>

De Wilde's photographs look somewhat desaturated and have a clear dominant tint. This may occur due to the fact that the camera was presumably converted to an infrared camera, not full-spectrum. That is, it had

135 Nikon Europe, "Exploring the 'Island of the Colour Blind' with Sanne De Wilde." Jun 1, 2018, Video, 3:13, <https://www.youtube.com/watch?v=6mczZ73fMQI>

136 LensCulture, "The Island of the Colorblind - Sanne de Wilde | LensCulture".

137 Nikon Europe, "Exploring the 'Island of the Colour Blind' with Sanne De Wilde".



Figure 24. Sanne De Wilde. Untitled work from the project "The Island of the Colorblind." Digital color infrared photograph, 2017.

some type of infrared filter right in front of the sensor. Unfortunately, De Wilde does not specify the type of conversion. Nevertheless, the evident presence of an infrared filter in front of the sensor indicates two important aspects. Firstly, De Wilde was able to photograph using the viewfinder as with a conventional camera and was able to see the scene undistorted. That is, she did not know what result she would get after the shutter was released. Secondly, the dominant tint caused by the disproportion in the composition of visible and invisible light falling on the sensor may be viewed as a signifier of a condition limiting human perception. That is, we cannot even imagine what exactly achromats see — their eyes cannot recognize colors, but it doesn't strictly mean that they perceive everything in shades of black and white.

In De Wilde's project, photographing in infrared light is a gesture. Pictures indicate the impossibility of perception at a number of levels. That is, De Wilde travels to the Pingelap island and documents everyday life using an infrared camera in order to show and investigate reality of these people who are unable to see and distinguish colors. De Wilde tries to demonstrate



the incomprehensibility of their ways of perception for an ordinary person. Since we do not know how colorblind people perceive reality, their reality might be painted with a certain hue, just like infrared photographs. But deprived of the ability to determine and identify colors, achromats cannot describe what exactly they see. Therefore, De Wilde's infrared photographs indicate the incomprehensible and pluralism of ways of seeing.

#### **4.5 Chapter Conclusion**

Art critic Rosalind Krauss argues that, in contrast to the indexical film-based image, digital image is iconic. The film-based image is "a trace is causally registered on film." While in digital imaging technology, there is no direct causal connection between an event and its imprint — an artifact-image.<sup>138</sup>

Indeed, as noted in the technical introduction, the digital image is the result of transcoding and interpolation carried out according to the set of instructions — by the algorithm. That transition from indexicality to iconicity has brought up many questions about the nature of the digital image and its credibility. However, it is obvious that even indexical mediums are just as malleable and easy to manipulate as digital ones. As already discussed, authenticity of photography is determined not solely by the nature of the image itself but mostly by discourse — a system of cultural conventions and professional and institutional practices.

In the context of infrared images, perhaps, the most important detail would be that we must decide on something that we cannot perceive immediately but only in its interpreted form. This marks a paradigm shift in defining and understanding "real." According to the media historian and philosopher Sean Cubitt, the previously dominant regime of photorealism, assuming similarity of the camera and the human eye, was replaced by a new regime of scientific realism. The essence of this transition is that the

<sup>138</sup> Rosalind. E. Krauss, "Frame by Frame," *Artforum* (September 2012): 416.



human sensorium is no longer a measure for reality.<sup>139</sup>

Reflecting on Color Photography, Flusser argues that the appearance of color photography made photos more true. However, practically, the appearance of color photography draws us into a long chain of interpretations — chemical (film) or algorithmic (digital), which leads to formation of color that represents the color that was present at the moment the photograph was taken.<sup>140</sup> That is, the hue informing us about the color that, allegedly, was there. Registration of color always implies processing and translation of the registered hue into available dyes in film or values recorded in form supported by digital cameras.<sup>141</sup> Thus, in the digital world, color converts into a generated number, which can be modified and modulated into different color-numbers and transferred to other devices, which, however, would display it differently.<sup>142</sup> It is important to take into account that in Western culture, color has traditionally been perceived as something subjective and associated with spiritual, and religious meanings, as something that should not be quantified.<sup>143</sup> These representations are primarily associated with the early technical realization of color.

Cubitt points out that natural pigments that had been used in paints had associated colors with their natural origins. Besides, colors were hardly reproducible due to the inevitable reduction and technological limitations of that time. With the advent of synthetic dyes, color has lost not exclusively its connection to natural origins, but also unrepeatability. Synthetic pigments are reproducible, standardized, and do not derive from natural sources. Moreover, new colors may not have analogs in nature.<sup>144</sup> Throughout this transition from natural to synthetic, colors have lost their spiritual and symbolic meaning. I would like to draw an analogy with the advent of

139 Sean Cubitt, *The Practice of Light: A Genealogy of Visual Technologies from Prints to Pixels* (The MIT Press, 2014), 108.

140 Flusser, *Towards a Philosophy of Photography*, 31.

141 Cubitt, *The Practice of Light*, 113.

142 Ibid., 145.

143 Kane, *Chromatic Algorithms*, 114.

144 Cubitt, *The Practice of Light*, 114, 115, 132.

digital post-processing — a synthetic digital color was freed from the restraints of film dyes but still tied to the cultural agreement on human vision and color perception. But gets finally liberated when it comes to infrared images, for the description of which there is no cultural consensus. The only compromise is that infrared radiation is colored by the language — it bears the name of the color adjacent to it in the spectrum. But the infrared image does not have a describing scheme of hues, except, perhaps, the so-called “Kodak Aerochrome look.”

The projects described in the chapter may be reconsidered through the prism of the liberation of digital color. That is, the use of infrared as a key factor freeing the photographer from the burden of imitation — the color can be anything and is no longer tied to reality. Color can be freely assigned and interpreted. Color no longer has a meaning, spiritual, cultural or other. This idea is in the heart of both projects analyzed in this chapter. De Wilde shows the subjectivity of color perception through the employment of infrared while Ballis enjoyed the color as a spectacle.

In conclusion, the digital infrared image free of the dictate of contextual connection with legitimizing institutions as science or military becomes a means of liberation of color. Digital photography is no longer an imprint of reality, but an interpretation — then how to imitate something that you have never seen? By whichever way you want.

## Chapter 5. Infrared Thermography (Algorithmic Infrared)

### 5.1 Technical Introduction to Infrared Thermography

Imaging of mid and far-infrared electromagnetic waves is called thermography. Thermal imaging implies recording of waves that lie between 1,000 nm (1  $\mu\text{m}$ ) and 14,000 nm (14  $\mu\text{m}$ ). Like near-infrared, thermal radiation is not visible by the naked eye. Moreover, it cannot be photographed like near-infrared, since there is no emulsion sensitive to the spectrum and no optics to pass the radiation (glass is opaque for thermal infrared). Fundamentally, this type of radiation is created by thermal motion of particles of matter. Every type of matter having a temperature higher than absolute zero emits thermal radiation. The higher the temperature, the more radiation matter emits.

Successful attempts to detect infrared radiation were made as early as in the mid 19th century,<sup>145</sup> but just the cold war advent of semiconductor technology, cybernetics, and computers made visualization become possible. In a technological sense, thermography is the heir of military night-vision devices (that still relies on near-infrared radiation), development and implementation of which had begun in the 1930s.<sup>146</sup> Naturally, in the late 1940s, the development of means of detecting and visualizing thermal infrared was primarily driven by military demands.<sup>147</sup> Even nowadays thermographic imaging equipment is oftentimes labeled as “dual–use technology” and controlled by International Traffic in Arms Regulations.<sup>148</sup>

The technology is presented by numerous types and families of devices and its understanding requires a fundamental knowledge of physics and electronic engineering, which puts it far beyond the purpose of this thesis. However, there are some important aspects of technology to be

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<sup>145</sup> Rogalski, *History of Infrared Detectors*, 280.

<sup>146</sup> Ibid., 282.

<sup>147</sup> Ibid., 284.

<sup>148</sup> Ibid., 282.

mentioned. The common among all devices is that registered radiation has to be translated into data for further algorithmic processing. Outcomes of which are to be transcoded into visual information, an image. The meaning of that image is to provide significant information to be read by an operator. The purpose of thermography is, obviously, to detect, measure, and compare temperatures of objects, and to present information in a visual form. Thermography usually, but still depending on the device, provides an image showing the contours of objects and tonal information in grayscale or color. In other words, roughly speaking, it resembles an oversimplified low-resolution photograph rendered in black and white or color. Tonal relationships in this image have nothing to do with light and shadows in the traditional sense. The range of tones from brightest to darkest — from white to black, denotes the temperature of areas in the scene. White usually stands for the hottest spot while black stands for the coolest. The thermographic image is accompanied by a scale, usually embedded into the image by an algorithm, — a grayscale gradient with numerical values marking temperatures of white, black, and middle points. Colored thermal images are usually generated from black and white images in order to improve their readability. The only difference is that instead of shades of gray, the limited number of colors are being assigned to different temperature values. For example, the hottest, warm and coolest areas may be indexed as bright yellow, red and deep blue respectively. The color scheme and number of colors depend on the device, but the rule of thumb is to assign “warm” colors to hot areas and “cool” colors to cold areas.

There are some true color infrared devices, having a composition of sensors sensitive to multiple bandwidths of radiation, but these complex, rare and expensive devices are not the subject matter of this thesis.

Currently, in addition to military applications — searching, tracking, and targeting — thermography is used in construction, astronomy, pollution

detection, as a medical diagnostic tool, and other areas.<sup>149</sup>

## 5.2 Richard Mosse's "Incoming" and "Heat Maps"

After the success of "Enclave" and "Infra" projects, Richard Moss has continued exploring infrared imaging technology. He abandoned an unstable infrared film and turned to a completely new instrument — military-grade camera for long-distance thermal radiation detection. This class of cameras is commonly used to monitor borders or on a battlefield for target tracking and artillery targeting. The camera is able to register thermal signatures, including heat of the human body, over a distance up to 30 km at any time of the day.<sup>150</sup> These cameras, because of their native application, are considered as an advanced weapons system and are being controlled under the International Traffic in Arms Regulations. Basically, it is a weapon. But still, it is an imaging device as well. In simple words, it is a huge and bulky complex hi-tech piece of military equipment serving as an extreme telephoto thermal video recorder/camera.

From 2014 till 2018, Mosse had been working on several projects dedicated to the refugee crisis as the most large-scale migration of people since the Second World War. "Incoming" (2014-2017) is a film, usually being exhibited as a three-part video installation. The book "Incoming" (2017) is a collection of stills captured from the "Incoming" film. "Heat Maps" (2016-2018) — exhibition project, a series of large scale still images. "The Castle" (2018) — a book based on "Heat Maps" and stills from "Incoming." The military thermal camera had been used under every project.

Project "Incoming" traces the process of migration, and follows migration routes to Europe from Syria, Iraq, Afghanistan, Senegal, and So-

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149 Ted Kinsman, "Technical Photography." In *The Focal Encyclopedia of Photography: Digital Imaging, Theory and Applications History and Science*. Edited by Michael R. Peres (4th ed, Elsevier, 2007), 621.

150 "Kunstforeningen GL STRAND. Richard Mosse. Incoming," *e-flux*, Jul 3, 2019, <https://www.e-flux.com/announcements/261559/richard-mosseincoming/>





Figure 25. Richard Mosse. Still frame from "Incoming," three-screen video installation. Refugees from sub-Saharan Africa nations travelling north on the back of a lorry crossing the Saharian Desert bound for Libya.

malia.<sup>151</sup> While "Heat Maps" and "The Castle" are covering life conditions in refugee camps in Greece, Bulgaria, Germany, and Lebanon.<sup>152</sup>

"Incoming", like "Enclave" previously, was created in close collaboration with musician Ben Frost and cinematographer Trevor Tweeten. It is important to note that Mosse extensively uses still images from the footage. These stills were collected as the book "Incoming" and make a part of the book "The Castle." Furthermore, Mosse regularly use stills to complement "Heat Maps" during exhibitions.

Project "Heat Maps" requires special consideration in terms of the technology employed. "Heat Maps" are monumental panoramic images densely saturated with countless small details. Taken from an elevated position, these high-resolution thermal images depict daily life in refugee camps. They resemble large scale paintings by Pieter Bruegel or high-detailed pieces of military art. The richness in details is enabled by technological method

<sup>151</sup> Ibid.

<sup>152</sup> Sean O'Hagan, "Richard Mosse: Incoming review – shows the white-hot misery of the migrant crisis," *The Guardian*, Feb 15, 2017, <https://www.theguardian.com/artanddesign/2017/feb/15/richard-mosse-incoming-review-barbican-curve-migrant-crisis>

— images are composite, they are stitched from hundreds of individual images. Mosse developed a motorized tripod connected to the camera to scan a space piece by piece. Every image had its place inside the virtual “grid,” and subsequently, all images were merged in Photoshop. Consequently, each panorama is the result of the scrupulous work of stitching numerous images. Noteworthy, since the camera does not provide wide-angle shot options, all source images were taken in a telephoto mode, hence every image brings its own perspective. Mosse describes: “The final images are multi-perspective photographs. Some would have 900 cells, each with its own distinct perspective.”<sup>153</sup>

Both projects show everything that we have seen before: refugees rescued from a sinking boat, an overcrowded camp, military ships lifting people aboard, people wrapping in thermal blankets, hospitals — we have seen it many times in the media or as photographic projects but haven’t seen anything like that before. The same stories are rendered in a strange gamut of grays with “wrong” tonal relationships. Mosse’s world seems familiar and unknown. The camera does not assign colors, images remain monochrome. Warm areas look bright, cold areas are dark. Objects seem recognizable, people’s bodies look as glowing silhouettes. The camera dehumanizes people.<sup>154</sup> Their skin glows, their bodies are covered with patterns and ornaments — indications of uneven temperature — those may be traces of sweat, blood circulation, breath or just clothing. People resemble monsters, ghosts, humanoid dolls.

“Incoming’s” imagery has a very unique perspective, shots are zoomed onto groups of people, separate figures, and sometimes even portraits or close-ups. Meanwhile, the distance is clearly present and palpable. Mosse says that in some cases the camera was miles away from the actual events — “We often shot at night, from miles and miles away, so we were shooting

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<sup>153</sup> “Richard Mosse – Incoming,” *British Journal of Photography*, Feb 15, 2017, <https://www.bjp-online.com/2017/02/mosse/>

<sup>154</sup> Ibid.

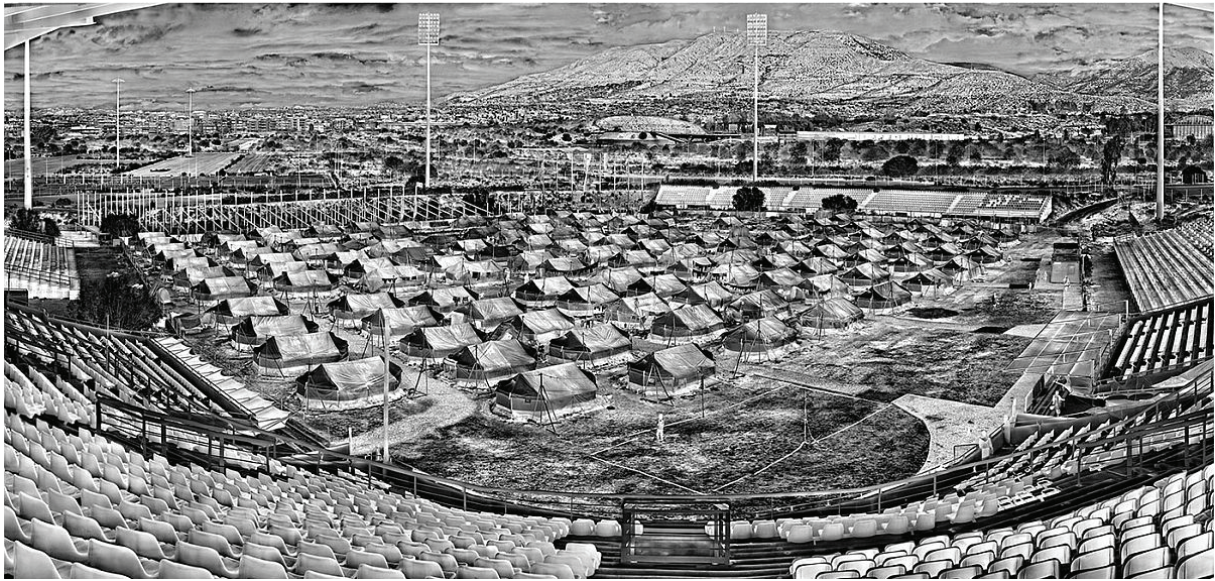


Figure 26. Richard Mosse. "Helliniko," 2016.

people who were not aware of being filmed.<sup>155</sup> That brings up an important question about conventions in photojournalism — the old slogan "I have been there, I have seen it with my own eyes" can no longer be applied.

Had taken from high eye-point "Heat Maps" evoke an ambiguous feeling. On the one hand, an all-seeing gaze embracing the entire space and watching everyone, record public and intimate moments without preference. Its dehumanizing gaze is turning bodies into luminous outlines, reducing them to the level of depersonalized objects that have no personal features and differences. On the other hand, like in "Incoming", even simple shapes and silhouettes are readable by spectators. Moreover, simplistic outlines are capable of expressing very personal and touching — people are embracing each other, talking, praying, sleeping. These common human activities while observed through the machine's blindsight elicit strong emotions and the feeling of fragility. Meanwhile, in the very act of observing the multiplicity of lives occurring simultaneously, there is something sinister and predatory. That simultaneity draws attention to another important feature — the aspect of time. "Heat Maps" are made up of multiple pictures taken one after another, that is, this is not a single moment, but a frozen continuity. In a sense, the device empowers its operator by providing unbi-

<sup>155</sup> Ibid.



ased knowledge about time besides information about space.

“Incoming” and “Heat Maps” obviously have the same core idea as which stays behind Mosse’s “Enclave.” The idea of misusing the military reconnaissance technology against its purpose. In other words, to use what is considered as a weapon or a part of the weapon, to solve humanitarian and artistic problems. In artistic terms, the gesture of using military technology in context exposes the crisis in documentary photography. Meanwhile, in a humanitarian sense, it draws attention to refugees and migrants issue, which is “seen but overlooked, and ignored by many.”<sup>156</sup>

The military reconnaissance technology makes visible what we don’t want to see and what we don’t want to know. Moreover, each thermal photograph obtained via algorithmic processing reduces the displayed event to the basic elements. It can be said that there is a dissection of human drama — every picture carries many levels of possible reading and contextual connections. Thermography denies skin color and individual differences but exposes and emphasizes universal human features — both from biological and social points of view. Scenes turn into a general outline or set of archetypal images of humanity. On the other hand, the encoded indication of the distance between spectator and events in every image expresses the alienation in relation to the problem. Moreover, it embodies a cold and indifferent gaze of the state on humanitarian issues.

### **5.3 Linda Alterwitz’s “Signatures of Heat”**

Linda Alterwitz is an American visual artist with a background in painting. She works with photography and scientific imagery such as MRI scans, sonography, and thermography. Alterwitz became interested in thermography after a tv show when some footage from a police thermographic camera was broadcasted. A police helicopter equipped with thermographic equipment was coordinating ground forces during the pursuit of a criminal.

<sup>156</sup> Ibid.



Figure 27. Linda Alterwitz. *Untitled #13* from the series *Creature 2*, Project "Signatures of Heat" (2012-2017). Infrared thermographic image.

The thermal camera was used to monitor that person's movement. Alterwitz was struck by the visuality of infrared imagery — by the glowing shape of a human being running in the darkness.<sup>157</sup> Alterwitz, wanting to push in some way the boundaries in her photographic practice, decided to try thermal infrared. Comparing the conventional photographic process with thermography, she argues that with an ordinary camera it's relatively easy to get a "perfect picture" while thermography is rather about chance and lack of control.<sup>158</sup>

For "Signatures of Heat" project Alterwitz used a high-resolution thermal camera. The project consists of 6 parts filled with images of plants, people, dogs, other animals, likely filmed in a zoo, and textural close-ups of

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157 Katharine Trendacosta, "Ghostly Thermal Imaging Portraits are Eerie and Fascinating." *Gizmodo*, Oct 13, 2013, <https://io9.gizmodo.com/ghostly-thermal-imaging-portraits-are-eerie-and-fascina-1444500714>

158 Ibid.



human bodies. There are images of common outdoor places, ponds, grasslands, and dunes — presumably, these places are situated in the closest neighborhood from her home or workshop.

The choice of subjects gives her artistic strategy away — Alterwitz explores the world with utmost naivety, she is fascinated by “the invisible.” According to her, a passion for “invisible” has emerged when she encountered MRI scans during a medical examination.<sup>159</sup> Like an amateur scientist or child that tries to taste everything, she looks for and collects images of the world surrounding her — geometric ornaments created by under skin blood vessel routes or uneven temperature patterns on sandy dunes. She compares different species, the living and dead matter. She examines reality — is it possible to capture a thermal infrared image of the reflection in the mirror? What would grass look like in thermal infrared? Do human bodies look the same or are there variations?

Images are almost abstract, monochromatic. Sometimes it’s difficult to understand what exactly is portrayed, because of the unnatural tonal palette representing the temperature instead of the appearance of objects. Close-ups of human bodies are rich in bizarre textures and only familiar outlines make them recognizable. Alterwitz is captivated by the freshness of imagery and the very fact that the image is not carefully designed fantasy, but the result of encounter with reality. The emphasis in her artistic practice shifts from inventing a novel visual language to examination and discovery of the yet unknown in the surrounding world. She uses technical means for visual scrutiny of reality. Alterwitz discovers that signs of individuality and personality are dissolved in thermal images. Only the presence or absence of heat is visible, and “heat” is the universal concept, binding, and uniting everything.<sup>160</sup>

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159 Chantal Corcoran, “The courage to look at my brain,” *Nevada PublicRadio*. Jan 1, 2014, <https://knpr.org/desert-companion/courage-look-my-brain>

160 Linda Alterwitz, “Signatures of Heat. Artist’s Statement,” Linda Alterwitz, Accessed Apr 9, 2020, <http://lindaalterwitz.com/project/signatures-of-heat/>

Alterwitz uses thermography as a “black box,” a mysterious device capable of the magical transformation of the ordinary into the unusual and to discover the enigmatic in the everyday.

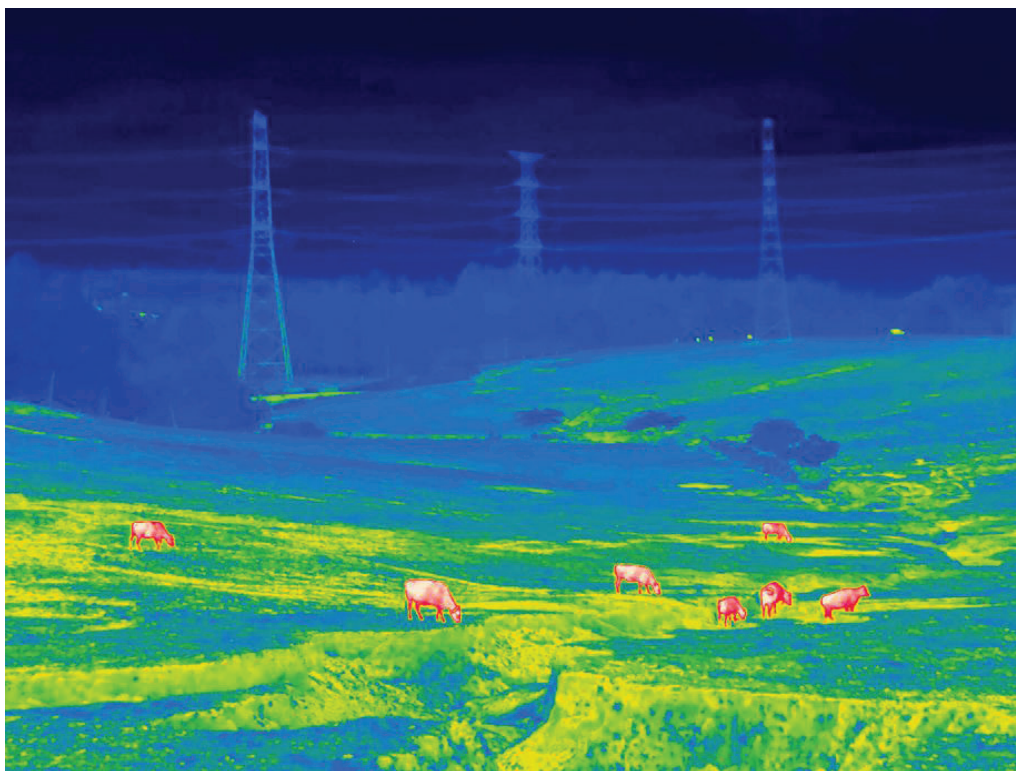
#### **5.4 Giles Price’s “Restricted Residence”**

The book “Restricted Residence” (2018) by British photographer Giles Price consists of thermal images taken in the closest neighborhood of a nuclear power plant in the Fukushima region, towns of Namie and Iitate in particular. Until recently, these cities were part of the exclusion zone established around the nuclear power plant after the nuclear accident of 2011. After a devastating earthquake, tsunami, and nuclear disaster followed, Japanese government resettled approximately 160,000 people. Today, most of these people have returned homes, only settlements nearest to the station remain uninhabited. Japanese government offers financial and social aid as a motivation for people to return. But still, most of the places stay partially abandoned, mainly because of the intimidating sense of the potential presence of invisible contamination.<sup>161</sup> Namie and Iitate are two towns that are only at the very beginning of recovering after many years of desolation. Despite the fact that restrictions were lifted in April 2017, people do not seek to return to their former homes. Towns are still partially populated and look deserted.

Price’s major focus is on everyday life in reviving towns and reclaiming of surrounding lands. His images portray residents, builders, doctors, public and sports events. This visual body is completed by thermal photographs of abandoned territories or deserted streets. In photographs taken with a contemporary thermographic camera, an algorithm usually highlights objects whose temperature is higher than the average of the given environment.

Cityscapes and abandoned spaces look odd and unnatural, like snapshots

<sup>161</sup> Marigold Warner, “Documenting the invisible effects of a nuclear disaster.” *British Journal of Photography*, Jan 16, 2020. <https://www.bjp-online.com/2020/01/giles-price-restricted-residence/>



*Figure 28. Giles Price. Untitled work from the project "Restricted Residence." Infrared thermographic image, 2018.*

from a computer game or simulation — the monotony of the color gamut that indicates the lack of living (warmth) objects in the scene, enhances the effect; The spectator does not just look at the deserted seascape, captured at the moment when there were no people in the frame, — the absence of living bodies is indicated by image qualities and encoded in the body of the image itself. Color functions as a denotation of what exactly is depicted, acting on an allegorical level as a symbol of the living or warmth.

The usage of thermography constitutes the conceptual basis in Price's project. The choice made was determined by the desire to indicate the presence of overlapping invisible aspects. First of all, it is Radiophobia, ceaseless exhausting anxiety caused by the inaccessibility of knowledge, and inability to identify and see the potential danger. Secondly, it is the invisibility of radioactive contamination topography. There is always a risk that during cleaning up procedures the hotspot was missed it might be somewhere in your garden or home. (Price was carrying Geiger counter and noticed that

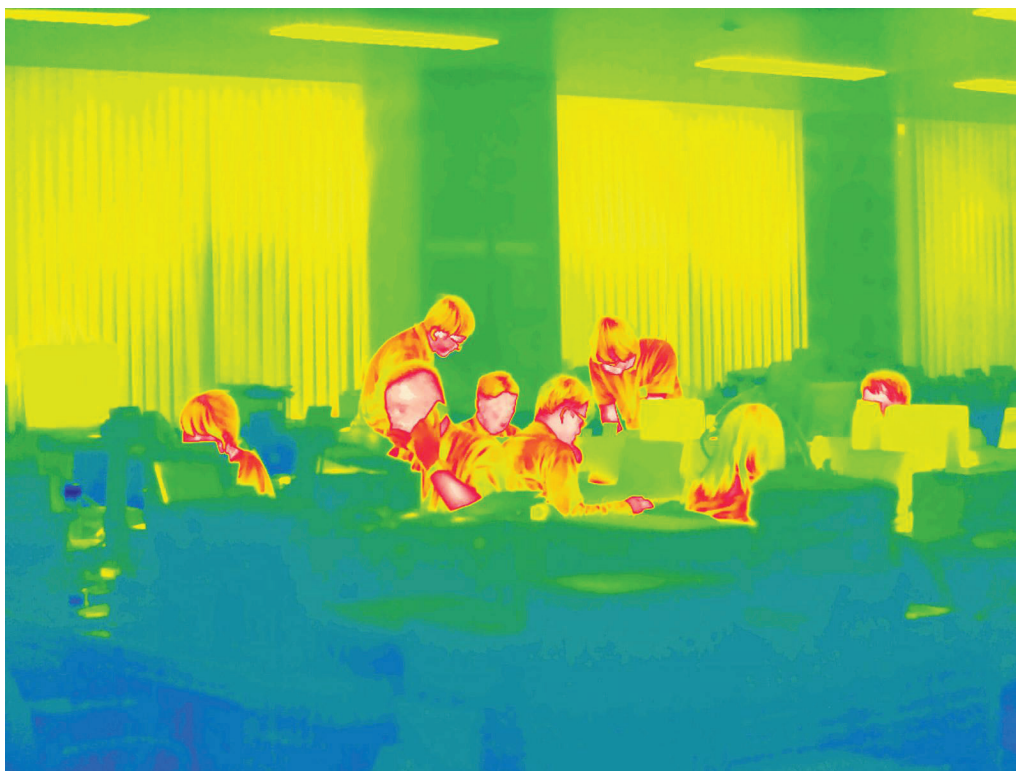


Figure 29. Giles Price. *Untitled work from the project "Restricted Residence."* Infrared thermographic image, 2018.

"the radiation started jumping all over the place.")<sup>162</sup> Thirdly, at the psychological level it is the cumulative emotional effect of living on a potentially dangerous territory multiplied by the psychologically challenging experience of residing in a half-abandoned city. Giles summarizes: "The tension between the mundanity of daily life, the colors and knowing that these people are living in an environment which is potentially harmful, I find very emotive,"<sup>163</sup> At the same time, speaking about people's emotions and their experiences, Price preserves their anonymity since thermography does not convey personal features and does not make a person recognizable in a conventional sense.

Like many other photographers, whose projects are considered in this thesis, Price is looking for a method for resetting the viewer's modes of perception. In order to do that Price wraps a documentary project with aesthet-

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<sup>162</sup> Ibid.

<sup>163</sup> Ayla Angelos, "Using thermal technology, Giles Price photographs the aftermath of the Fukushima nuclear disaster." *It's Nice That*, Jan 13, 2020. <https://www.itsnicethat.com/articles/giles-price-restricted-residence-photography-130120>

ics and contexts of thermographic imaging. In other words, Price utilizes thermography as a vehicle to deliver the narrative, and also to signify the presence of invisible layers of context enveloping the story.

## **5.5 Grey Hutton's "Traces of Warmth"**

British photographer Gray Hutton uses thermography to draw attention to social issues. During winters of 2017 and 2018, Hutton was photographing homeless people in London and Berlin with a technical thermographic camera that is being used for heat leakage examination.

Project "Traces of Warmth" centers on homeless people's struggle with life on the street, especially during winters. Hutton's work follows common documentary tropes — he spent days with homeless people, and covered their daily activities and typical daily situations. That results in pretty common visual flow — portraits of homeless, shelters, fights, begging, photographs of people sleeping in the street. The only difference is that instead of conventional photography spectator is faced with thermography.

All pictures are accompanied by Hutton's comments.<sup>164</sup> Usually, those are names, people's short stories, places photographer met them. Sometimes Hutton makes some remarks on temperature and weather conditions. Images are not modified, the color scheme is accepted as is, which means as it was intended by the camera manufacturer. The unusual color scheme of thermal images draws attention by its inappropriateness. But this striking uncommonness helps to concentrate on the subject of the picture. When the image has not been read at first glance there is no other way than to examine it carefully. The coldness of winter conditions makes the environment indistinguishably uniform when rendered by thermography, although still readable. Whereby, solid monotonous background emphasizes the glow of the bright warm bodies when juxtaposed with the surrounding world.

<sup>164</sup> Grey Hutton, "Traces of warmth: thermal images of London's homeless." *The Guardian*, Feb 27, 2018, <https://www.theguardian.com/uk-news/gallery/2018/feb/27/traces-of-warmth-thermal-images-of-londons-homeless>



Like many authors working with infrared radiation, Hutton stresses that thermography serves not just as a new means of image-making but rather as allegory or an indicator that the photographer addresses “invisible.” In Hutton’s project, “invisible” is that homeless people are overlooked by society.<sup>165</sup>

The “Traces of warmth” demonstrates that photojournalism and documentary photography is in deep crisis. The redundancy of visual information on the suffering of others has caused blindness and insensitivity. The genre requires new modes of operation and perception. Infrared thermography brings a new vivid aesthetic while appealing to personal experience through universal emotions. Freezing cold, the warmth of the human body — concepts that are open and clear to everyone on an intuitive and sensual level.



Figure 30. Grey Hutton. Untitled work from the project “Traces of Warmth.” Infrared thermographic image, 2017-2018.

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165 Michael Zhang, “Photographer Shoots Thermal Photos of the Homeless in the Winter.” *PetaPixel*, Apr 24, 2018, <https://petapixel.com/2018/04/24/photographer-shoots-thermal-photos-of-the-homeless-in-the-winter/>

## 5.6 Chapter Conclusion

Similar to color infrared film, thermography is being associated with science and military applications and delivers abstract and purely informative imagery. It inherits major qualities of color infrared film and digital imaging.

Describing first aerial photographs as informational images, Bernd Hüppauf states that film-based aerial photography has created “the aesthetics of its own.”<sup>166</sup> Hüppauf further emphasizes that military aerial photographs are deeply symbolic. He compares them with primitive art, in a sense that deciphering colors and shapes in these photographs is comparable to the reading signs and marks in order to comprehend the complex system of political, spiritual, and environmental relations in tribal society.<sup>167</sup> By transition into the digital realm the infrared image lost its indexicality and has become iconic. Infrared thermography pushes it even further. Inheriting and blending features of aerial film and digital image, it is an apparatus for the production of abstract imagery densely saturated with information. Like digital photography, it relies on semiconductor-based sensors converting absorbed infrared radiation into electric charges and then numbers. Researcher Carolyn Kane underlines the importance of understanding that visualization of thermal infrared involves the process of translating numerical values into “another language or system (code),” in order to subsequently generate a “Heat map.” At the same time, in spite of the fact that thermal images are the result of data visualization, that is, the result of calculations carried out by mathematical procedures, according to Kane, they support and strengthen “the primacy of visual evidence.”<sup>168</sup> To describe this imagery Kane uses the term “algorithmic image.” Algorithmic image is symbolic and iconic because it utilizes interpretational strategies like painting does, but it also implies a system of codes-symbols explaining to the observer what

166 Hüppauf, “Experiences of Modern Warfare and the Crisis of Representation,” 57.

167 Ibid., 58.

168 Kane, *Chromatic Algorithms*, 215.

she is looking at. Whereby, without knowledge about rules governing this code-symbol system, the image is unreadable.<sup>169</sup>

As explained, information is being encoded by brightness in grayscale or by a definite hierarchy of colors, that are being assigned intentionally and designate the temperature of objects. Thus, thermal infrared uses an allegory to represent reality. Furthermore, since the display of thermal values in the scene is the main purpose of such imagery, the rest of the information can be eliminated as irrelevant. In other words, in the very heart of the thermal infrared imaging lies statistical computations and generalization, that is, data reduction. Such images do not speak about specific objects or subjects, they are deeply anonymous. They operate with categories and their purpose is to inform, not to tell stories.

Thermal photographs of homeless people or inhabitants of the exclusion zone are completely anonymous — they may become meaningless without an accompanying text revealing the details. Admittedly, the visuality of thermography itself indicates the presence of invisible context — that is, the informing image indicates the presence of implied information. At the same time, Linda Alterwitz doesn't compliment her pictures with texts, leaving the decoding of images to the viewer. In Richard Mosse's "Incoming" case, images could have been just as misleading as anonymous and mysterious Giles Price's thermal images. However, they carry easy recognizable visual signs, such as inflatable boats, tents, etc., ubiquitous in mass media environment.

Another interesting aspect is that thermal imaging devices are designed to deliver a live stream infrared vision, while artists have chosen to work with stills. Although Richard Mosse uses the video, nonetheless, he uses stills for books and exhibition projects. Supposedly, still images seem more natural as a way to communicate with the spectator. David Campani argues that the power of the "freeze-frame" is in its relative primitivism and

<sup>169</sup> Ibid., 224.

nostalgic wish to see it as more comprehensible and accessible within the modern abundance of information.<sup>170</sup>

Another important question would be — Why is thermography being used to capture people's struggle and suffering? There is a notion that bearing of individual features is what may induce genuine empathy and compassion, while thermographic images lack it. Perhaps, the reason originated in the phenomenon is which Susan Sontag explains as life in a world that is "hyper-saturated" with visual information that ultimately creates a "diminishing effect: we become callous."<sup>171</sup> Thermography and its outstanding incomprehensible visuality may somehow provoke people to read images and learn about contexts. In other words, it may be a response to oversaturation by omnipresent images of suffering, indistinguishable from each other. On the other hand, it may also be an appropriation of the toolkit of the age of big data — thermography examines issues with cold maximized efficiency without distraction over details.

The other important issue is that in some projects the thermal image is being adopted as if it was optical, while it is not. Carolyn Kane states that algorithmic image cannot be approached as a conventional image and is rather the expansion of the optical regime, with further "narrowing of truth and phenomenological experience."<sup>172</sup> Explaining this transition, Kane refers to Giles Deleuze's "society of control." According to Deleuze, "society of control" emerged from the post-war development of cybernetics and information systems, and implies continuous collection and algorithmic processing of data. This data and corresponding informational infrastructure serve to control and management of society and its functioning.<sup>173</sup> Admittedly, thermal infrared imaging is firmly linked to the idea of control and the political and information infrastructure that implements it.

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170 Campany, "Safety in Numbness," 187.

171 Sontag, *Regarding the Pain of Others*, chap. 7.

172 Kane, *Chromatic Algorithms*, 215.

173 Kane, *Chromatic Algorithms*, 212-213.

## Conclusion

In this thesis, I examined strategies of adoption of the infrared image in photographic and artistic practices. I studied and analyzed various projects, according to the technology employed. In the chapter “Film-based Black and White Infrared Photography,” I investigated features and limitations imposed by technological aspects of the medium and voyeuristic tone of projects. It has been shown that “blackout infrared photography” limits photographers’ choices and therefore, according to Scott, images cannot carry the index of photographers’ choices in its wholeness.

Applying Flusser’s concept of the apparatus I explained that this kind of photography exhibits rather the program embedded in the apparatus, than a photographers’ concept. That is, in this case, blackout infrared photography inherits features and properties of military and police photography. In other words, it exists in the shadow of institutional practices that engendered it. Besides, it has been pointed out that ethical issues raised by Weegee and Yoshiyuki’s works could be addressed not only to photographers as voyeurs but also to the cultural and political environment in the period of the ascendance of surveillance and data collection practice.

In the third chapter I examined the color infrared film. It has been shown that color infrared film is perceived primarily as a technical and scientific tool, and supposed to reveal objective truth. Discussing the study of the first aerial photographs by Hüppauf, I explained the intrinsic quality of color infrared film to produce abstract information-saturated images that require decoding. Elaborating on this point, I showed that the very symbolicity of these images — the presence of embedded information — opens up opportunities for a wider interpretation of such photographs. This view was supported by an analysis of projects that led to the conclusion that the indexicality of the medium in combination with objective fact of the recording invisible radiation, enables new levels of reading. In other words, in each



case considered, the use of color infrared film implies not just a direct but also an allegorical reading of photographs.

In the fourth chapter, I investigated the phenomenon of digital color infrared photography. It has been shown that digital photography is not the indexical medium neither is associated with scientific or military institutions. Moreover, according to Cubitt, it exists in the new paradigm of scientific realism and not based on the human sensorium. I studied the phenomenon of color in digital infrared imaging and applied Sean Cubitt's analysis of the concept of color and its transformation and the transition from natural dyes to synthetic, and then to digital color. Based on this, I came to the conclusion that digital color can be modulated unobstructedly through mathematical procedures, and it is not bound to cultural meaning either to dyes and technological procedures. At the same time, infrared has no color and therefore any color can be assigned to visualization. Thus, the combination of digital photography and infrared imaging allows photographers to freely interpret reality.

In other words, digital infrared imaging could be considered as a way of further emancipation of color. That is, in addition to the allegorical reading inherited from infrared film technology, digital technology also gives unlimited possibilities for color interpretation.

In the fifth chapter, I investigated specific features of the infrared thermography in photographic practice. Compared to previously discussed types of infrared imaging, the thermographic image has little resemblance to reality. This image is statistical, abstract, and anonymous, and is intended to inform, not to tell stories. Thermographic image is a result of extensive algorithmic computations and information reductions and carries mainly temperature information coded by colors or brightness. When applied to photographic or artistic work, this alienness to the human gaze creates a significant visual impact, which overloads the spectator's perception and

may encourage her for a closer look. It also inherits features of color infrared film such as an “aura” of objective sight. Additionally, it has been pointed out that infrared thermography is the product of ubiquitous optimization and the penetration of high-performance algorithms into all aspects of life.

To conclude, infrared photography is not just a set of technical means — it is rather a complex system of relationships and technological features operating in the context. That means, that infrared image exists in a system of agreements created by institutions that employ it. In both cases, whether it is the indexical film or algorithmic infrared thermography, the medium inherits “aura” of objectivity from its scientific, technical or military origin. At the same time, digital infrared photography exists on its own and is free from externally imposed meanings and expectations. Nevertheless, the very knowledge that the device or photographic material registers invisible but existing light, becomes a key aspect of its application. Essentially, the inappropriate use of technical colors of the false-color infrared film is a form of liberating of synthetic color from binding to technical procedures and applications. In other words, scientific concepts and data that are hidden behind artificially assigned colors and expected to be read by the operator, virtually, gain the freedom to be read in a different context. That is, if the color is a representation of data, then it ceases to be. In fact, the technology of collecting data on the structure of photographed matter is appropriated by an artist looking for new visual forms. Moreover, in digital photography, infrared’s invisibility and lack of associated color, paradoxically, emancipates the color from rules of human perception. From now on color can be freely interpreted and modulated by the photographer. It is noteworthy that these aspects of use are not applicable to black-and-white infrared film since black-and-white images made in near-infrared are very similar to ordinary black-and-white photographs. Indeed, analyzed projects focus solely on photographing in “invisible mode,” i.e. surveillance mode. That

makes photographs taken by Weegee and Yoshiyuki very similar to Mosse's "Incoming" and "Heat Maps" — they are established in the discourse of power, that is, efficient observation and data collection without consent and knowledge on the subjects' side.

To sum up, again, the infrared image is a complex system of associations, contexts, and features, allowing the reading and interpretation of images at multiple levels.

## List of Illustrations

1. Infrared photographs by Robert Wood in the Illustrated London News, 1911. Accessed Dec 20, 2019, <https://www.bbc.co.uk/blogs/photoblog/2010/01>
2. Weegee (Arthur Fellig). Lovers at the movies, Palace Theatre, New York. Infrared photograph, circa 1943. Accessed Jan 19, 2020, <https://timeline.com/weegee-photos-infrared-movie-ec9734a9d63e>
3. Weegee (Arthur Fellig). Infrared photograph, circa 1940. Accessed Jan 19, 2020, <https://timeline.com/weegee-photos-infrared-movie-ec9734a9d63e>
4. Kohei Yoshiyuki. Untitled. Infrared photograph, 1973. Accessed Jan 19, 2020, [https://www.moma.org/collection/works/108901?artist\\_id=32560&locale=en&page=1&sov\\_referrer=artist](https://www.moma.org/collection/works/108901?artist_id=32560&locale=en&page=1&sov_referrer=artist)
5. Kohei Yoshiyuki. Untitled. Infrared photograph, 1971. Accessed Jan 19, 2020, [https://www.moma.org/collection/works/108902?artist\\_id=32560&locale=en&page=1&sov\\_referrer=artist](https://www.moma.org/collection/works/108902?artist_id=32560&locale=en&page=1&sov_referrer=artist)
6. Structure of Color Infrared Film.
7. Karl Ferris. Color infrared photograph and design for an alternative cover of Jimi Hendrix's "Are You Experienced" album. 1967. Accessed Feb 15, 2020, [https://cs.wikipedia.org/wiki/Are\\_You\\_Experienced#/media/Soubor:Are\\_You\\_Experienced\\_-\\_US\\_cover-edit.jpg](https://cs.wikipedia.org/wiki/Are_You_Experienced#/media/Soubor:Are_You_Experienced_-_US_cover-edit.jpg)
8. Andee Nathanson. Album cover for Frank Zappa's album "Hot Rats", Color infrared photograph, 1969. Accessed Feb 15, 2020, <http://www.umusic.ca/press-releases/frank-zappas-legendary-1969-first-solo-album-hot-rats-celebrated-with-massive-50th-anniversary-six-disc-collection-exploring-his-groundbreaking-work/>
9. Elliott Landy. Ornette Coleman & son, Aero infrared film, Central Park, NYC, 1969. Accessed Feb 15, 2020, <https://www.elliottlandy.com/portfolio-items/infrared-music-photos/#gallery/ae9cbf16bd09cc1a7fe83478be1405a0/2600>
10. Elliott Landy. Ornette Coleman & son, Aero infrared film, NYC, 1969. Accessed Feb 15, 2020, <https://www.elliottlandy.com/portfolio-items/infrared-music-photos/#gallery/ae9cbf16bd09cc1a7fe83478be1405a0/2600>

11. Claudia Andujar. Collective house near the Catholic mission on the Catrimani River. Color infrared photograph, 1976. Accessed Mar 14, 2020, <https://www.bjp-online.com/2020/01/claudia-andujars-ongoing-commitment-to-a-community-under-continual-threat/>
12. Claudia Andujar. Youth Wakatha victim of measles is treated by shamans and paramedics from the Catholic mission, Catrimani, Roraima. Color infrared photograph, 1972-1976. Accessed Mar 14, 2020, <https://metalmagazine.eu/en/post/article/claudia-andujar>
13. Richard Mosse. "Vintage violence," North Kivu, Eastern Congo. Color infrared photograph, 2011. Accessed Mar 14, 2020, <https://www.businessinsider.com.au/amazing-photos-of-the-congo-2013-6#the-congo-is-africas-second-largest-country-and-boasts-untapped-raw-mineral-deposits-estimated-to-be-worth-in-excess-of--24-trillion-1>
14. Richard Mosse. Platon, Farm near Bihambwe, Masisi Territory, North Kivu. Color infrared photograph, 2012. Accessed Mar 14, 2020, <https://www.wired.com/2013/07/mosse-infrared/>
15. Richard Mosse. The "Enclave," installation view at the Venice Biennale, 2013. Accessed Mar 14, 2020, <https://www.bjp-online.com/2017/02/mosse/>
16. Vicente Muñoz. "Sublimes." Color infrared photograph. Accessed Mar 14, 2020, <http://www.vicentemunoz.xyz/#/sublimis>
17. Karim Sahai. Army officers walk up a hill leading to the Revolutionary Martyrs' Cemetery in Pyongyang, North Korea. Color infrared photograph. Accessed Mar 14, 2020, <https://mymodernmet.com/karim-sahai-kodak-aerochrome-north-korea/>
18. Edward Thompson. The Village of Zalissja from "the Red Forest." Color infrared photograph, 2012. Accessed Mar 14, 2020, <http://www.silverlakevoice.com/photography/edward-thompson/>
19. Edward Thompson. Photograph from "After the Flood, after the Red River Valley." Color infrared photograph, 2010. Accessed Mar 14, 2020, <https://www.yatzer.com/the-unseen-infrared-photography-edward-thompson>
20. Edward Thompson. Hellir #4 from "Hellir." Iceland. Color infrared photograph, 2016. Accessed Mar 14, 2020, <https://www.yatzer.com>



com/the-unseen-infrared-photography-edward-thompson

21. The Bayer arrangement of color filters on the pixel array of an image sensor. Accessed Mar 14, 2020, [https://en.wikipedia.org/wiki/Bayer\\_filter#/media/File:Bayer\\_pattern\\_on\\_sensor\\_profile.svg](https://en.wikipedia.org/wiki/Bayer_filter#/media/File:Bayer_pattern_on_sensor_profile.svg)
22. Kate Ballis. Untitled work from the project "Infra Realism." Digital color infrared photograph, 2018. Accessed Mar 14, 2020, <https://www.wallpaper.com/art/kate-ballis-infrared-california-modernism>
23. Sanne De Wilde. Untitled work from the project "The Island of the Colorblind". Digital color infrared photograph, 2017. Accessed Mar 14, 2020, <https://www.wired.com/story/explore-a-tropical-paradise-through-the-eyes-of-the-colorblind/>
24. Sanne De Wilde. Untitled work from the project "The Island of the Colorblind." Digital color infrared photograph, 2017. Accessed Mar 14, 2020, <https://www.wired.com/story/explore-a-tropical-paradise-through-the-eyes-of-the-colorblind/>
25. Richard Mosse. Still frame from "Incoming," three-screen video installation, 52 mins 10 sec, with 7.1 surround sound. Refugees from sub-Saharan Africa nations travelling north on the back of a lorry crossing the Saharian Desert bound for Libya. Accessed Mar 26, 2020, <http://www.richardmosse.com/projects/incoming#home>
26. Richard Mosse. "Helliniko," 2016. Accessed Mar 26, 2020, <https://monovisions.com/richard-mosse-heat-maps/>
27. Linda Alterwitz. Untitled #13 from the series Creature 2, Project "Signatures of Heat" (2012-2017). Infrared thermographic image. Accessed Mar 26, 2020, <http://lindaalterwitz.com/project/creature-2/>
28. Giles Price. Untitled work from the project "Restricted Residence." Infrared thermographic image, 2018. Accessed Mar 26, 2020, [https://cdn.wallpaper.com/main/styles/wp\\_extra\\_large/s3/giles-price-restricted-residence-05.jpg](https://cdn.wallpaper.com/main/styles/wp_extra_large/s3/giles-price-restricted-residence-05.jpg)
29. Giles Price. Untitled work from the project "Restricted Residence." Infrared thermographic image, 2018. Accessed Mar 26, 2020, [https://cdn.wallpaper.com/main/styles/wp\\_extra\\_large/s3/giles-price-restricted-residence-05.jpg](https://cdn.wallpaper.com/main/styles/wp_extra_large/s3/giles-price-restricted-residence-05.jpg)
30. Grey Hutton. Untitled work from the project "Traces of Warmth."

Infrared thermographic image, 2017-2018. Accessed Mar 26, 2020, <https://www.theguardian.com/uk-news/gallery/2018/feb/27/traces-of-warmth-thermal-images-of-londons-homeless>

## References

### Literature

1. Balm, Roger. *Archaeology's Visual Culture: Digging and Desire*. Routledge, 2016.
2. Bonanos, Christopher. *Flash: The Making of Weegee the Famous*. First edition, Henry Holt and Company, 2018. iBooks.
3. Branigan, Edward. *Tracking Color in Cinema and Art: Philosophy and Aesthetics*. Routledge, 2017.
4. Company, David. "Safety in Numbness: Some Remarks on Problems of 'Late Photography.'" In *The Cinematic*, edited by David Company, 185-195. Whitechapel; MIT Press, 2007.
5. Cubitt, Sean. *The Practice of Light: A Genealogy of Visual Technologies from Prints to Pixels*. The MIT Press, 2014.
6. Clark, Walter. *Photography by Infrared*. First edition, Wiley, 1939.
7. Finney, Andy. "Infrared Photography." In *The Focal Encyclopedia of Photography: Digital Imaging, Theory and Applications History and Science*. Edited by Michael R. Peres, 556-562. 4th ed, Elsevier, 2007.
8. Flusser, Vilém. *Towards a Philosophy of Photography*. European Photography, 1984.
9. Gibson, Henry Louis, and Walter Clark. *Photography by Infrared: Its Principles and Applications*. A 3d ed. of *Photography by infrared* by Walter Clark, Wiley, 1978.
10. Huxley, Auldos. "The Doors of Perception." In *Colour*, edited by David Batchelor, 115-116. MIT Press, 2008.
11. Kane, Carolyn L. *Chromatic Algorithms: Synthetic Color, Computer Art, and Aesthetics after Code*. The University of Chicago Press, 2014.
12. Kinsman, Ted. "Technical Photography." In *The Focal Encyclopedia of Photography: Digital Imaging, Theory and Applications History and Science*. Edited by Michael R. Peres, 620-622. 4th ed, Elsevier, 2007.
13. Mitchell, W. J. T. *Picture Theory: Essays on Verbal and Visual*

- Representation*. University of Chicago Press, 1994.
14. Moholy-Nagy, Laszlo. *Painting, Photography, Film*. London, Lund Humphries, 1969.
  15. Osterman, Mark. "Introduction of Photographic Equipment, Processes, and Definitions of the 19th Century." In *The Focal Encyclopedia of Photography: Digital Imaging, Theory and Applications History and Science*. Edited by Michael R. Peres, 36-123. 4th ed, Elsevier, 2007.
  16. Scott, Clive. *The Spoken Image: Photography and Language*. Reaktion, 1999.
  17. Sontag, Susan. *Regarding the Pain of Others*. Farrar, Straus and Giroux, 2013. Kindle.
  18. Tagg, John. *The Burden of Representation: Essays on Photographies and Histories*. University of Minnesota Press, 1993.
  19. Teubner, Ulrich. *Optical Imaging and Photography: Introduction to Science and Technology of Optics, Sensors and Systems*. 1st edition, De Gruyter, 2018.

## Articles

1. Huppauf, Bernd. "Experiences of Modern Warfare and the Crisis of Representation." *New German Critique*, no. 59 (1993):41-76. DOI:10.2307/488223.
2. Krauss, Rosalind. E. "Frame by Frame." *Artforum* (September 2012): 416–19. <https://www.artforum.com/print/201207/rosalind-e-krauss-on-tacita-dean-s-film-31941>
3. Rogalski, Antoni. "History of Infrared Detectors." *Opto-Electronics Review*, vol. 20, no. 3 (Jan. 2012): 279-308. DOI:10.2478/s11772–012–0037–7.
4. Wood, Robert. "Photography by invisible rays." *Photographic Journal*, vol. 50 (Oct. 1910): 329-338.

## Online Resources

1. Abel-Hirsch, Hannah. "Claudia Andujar's ongoing commitment to a community under continual threat." *British Journal of Photography*, Jan 31, 2020. <https://www.bjp-online.com/2020/01/claudia-andujars-ongoing-commitment-to-a-community-under-continual-threat/>
2. Alterwitz, Linda. "Signatures of Heat. Artist's Statement." Linda Alterwitz. Accessed Apr 9, 2020. <http://lindaalterwitz.com/project/signatures-of-heat/>
3. Angelos, Ayla. "Using thermal technology, Giles Price photographs the aftermath of the Fukushima nuclear disaster." *It's Nice That*, Jan 13, 2020. <https://www.itsnicethat.com/articles/giles-price-restricted-residence-photography-130120>
4. *Army Pictorial Techniques, Equipment and Systems, Still Photography*. Department of the Army, United States, 1969. Accessed Jan 10, 2020. [https://play.google.com/books/reader?id=aBctfJyOTD8C&hl=en\\_AU&pg=GBS.SA7-PA1](https://play.google.com/books/reader?id=aBctfJyOTD8C&hl=en_AU&pg=GBS.SA7-PA1)
5. Azzarello, Nina. "Palm springs packs a punch in these infrared shots of modernist architecture eye-candy." *Designboom*, Feb 21, 2018. <https://www.designboom.com/art/kate-ballis-infrared-architecture-palm-springs-california-12-21-2018/>
6. Carter, Felicity. "Kate Ballis Showcases A Hypercolor Fantasy In Her Latest Exhibition, Infra Realism." *Forbes*, Aug 4, 2018. <https://www.forbes.com/sites/felicitycarter/2018/08/04/kate-ballis-showcases-a-hypercolor-fantasy-in-her-latest-exhibition-infra-realism/>
7. Colberg, Jörg. "Interview With Richard Mosse." *GUP Magazine*, Feb 8, 2011. <http://www.gupmagazine.com/articles/interview-with-richard-mosse>
8. Corcoran, Chantal. "The courage to look at my brain." *Nevada PublicRadio*. Jan 01, 2014. <https://knpr.org/desert-companion/courage-look-my-brain>
9. "Cover Story - Jimi Hendrix Experience's "Are You Experienced?", with photography by Karl Ferris." *RockPop Gallery*, Feb 22, 2008. <https://rockpopgallery.typepad.com/>



rockpop\_gallery\_news/2008/02/cover-story---j.html

10. Dotschkal, Janna. "Musings: Daniel Zvereff's Infrared Introspective." *National Geographic*, Feb 10, 2014. <https://www.nationalgeographic.com/photography/proof/2014/02/10/musings-daniel-zvereffs-infrared-introspective/>
11. Gibson, Eleanor. "Vicente Muñoz's infrared photos highlight the battle between city and nature." *Dezeen*, Sep 8, 2018. <https://www.dezeen.com/2018/09/08/sublimis-vicente-munoz-urbanism-infrared-photography-guayaquil-ecuador/>
12. "EDWARD THOMPSON / The Unseen: An Atlas of Infrared Plates." Edward Thompson. Accessed Feb 16, 2020. <https://edwardthompson.co.uk/The-Unseen-An-Atlas-of-Infrared-Plates>
13. Granata, Yvette. "False color/real life: Chromo-politics and François Laruelle's photo-fiction." *Necsus*, May 29, 2017. <https://necsus-ejms.org/false-colorreal-life-chromo-politics-and-francois-laruelles-photo-fiction/>
14. Heagney, Din. "ELUSIVE ENCLAVES, Interview with Richard Mosse." *Din Heagney*, Aug 2011. <https://www.dinheagney.com/elusive-enclaves>
15. "Hendrix, Cream, The Hollies – The Karl Ferris Psychedelic Experience." *NME*, Dec 12, 2012. <https://www.nme.com/photos/hendrix-cream-the-hollies-the-karl-ferris-psychedelic-experience-1435358>
16. Hutton, Grey. "Traces of warmth: thermal images of London's homeless." *The Guardian*, Feb 27, 2018. <https://www.theguardian.com/uk-news/gallery/2018/feb/27/traces-of-warmth-thermal-images-of-londons-homeless>
17. "Infra Realism by Kate Ballis." *Palm Springs Style*, Jul 12, 2018. <https://palmspringsstyle.com/art-entertainment/infra-realism-kate-ballis/>
18. Inglis-Arkell, Esther. "How Robert Wood's creepy invention helped the Allies win World War I." *Gizmodo*, Aug 30, 2013. <https://io9.gizmodo.com/how-robert-woods-creepy-invention-helped-the-allies-wi-1224038485>

19. "Interview: Richard Mosse on his Moving Images of Congolese Rebels." *Artsy*, May 30, 2013. Retrieved 10 Feb 2020 from <https://www.artsy.net/article/editorial-interview-richard-mosse-on-his-moving-images>
20. Jozuka, Emiko. "This Photographer Captures the World in Infrared." *Vice*, Apr 8, 2015. [https://www.vice.com/en\\_us/article/ypw4z7/this-photographer-captures-the-world-in-infrared](https://www.vice.com/en_us/article/ypw4z7/this-photographer-captures-the-world-in-infrared)
21. *KODAK AEROCHROME III Infrared Film 1443 • AS-77*, Eastman Kodak Company. Accessed Jan 25, 2020. [https://www.kodak.com/uploadedFiles/Corporate/Industrial\\_Materials\\_Group/ti2562.pdf](https://www.kodak.com/uploadedFiles/Corporate/Industrial_Materials_Group/ti2562.pdf)
22. "Kodak Aerochrome group." Flickr. Accessed Jan 12, 2020. <https://www.flickr.com/groups/1776903@N21/pool/>
23. *Kodak News, Discontinued Product KODAK AEROCHROME III Infrared Film 1443*, Eastman Kodak Company. Accessed Jan 25, 2020. <http://www.astrum-ltd.com/images/stories/Product%20KODAK.pdf>
24. Klein, William H. *Understanding Color Infrared Photography*. eBooks. Book 4. 1984. Accessed Jan 29, 2020. <http://scholarworks.sfasu.edu/ebooks/>
25. Klingelfuss, Jessica. "Infra Realism." *Wallpaper*. Accessed Mar 18, 2020. <https://www.wallpaper.com/art/kate-ballis-infrared-california-modernism>
26. "Kunstforeningen GL STRAND. Richard Mosse. Incoming." *e-flux*, Jul 3, 2019. <https://www.e-flux.com/announcements/261559/richard-mosseincoming/>
27. Lynch, Sean. "Dorialusium." Accessed Jan 12, 2020. <https://dorialusium.com>
28. McQueen, Jessica. "The Evolved Documentary Photography of Ed Thompson." *Canvas*, Sep 8, 2018. <https://canvas.saatchiart.com/art/one-to-watch/ed-thompson>
29. "Nobuyoshi Araki In Conversation With Kohei Yoshiyuki (1979)." *American Suburb X*. Accessed Dec 27, 2019. <https://web.archive.org/web/20130123025543/http://www.americansuburbx.com/2012/02/interview-nobuyoshi-araki-in-conversation-with-kohei-yoshiyuki-1979.html>

30. O'Hagan, Sean. "Richard Mosse: Incoming review – shows the white-hot misery of the migrant crisis." *The Guardian*, Feb 15, 2017. <https://www.theguardian.com/artanddesign/2017/feb/15/richard-mosse-incoming-review-barbican-curve-migrant-crisis>
31. *Photography volume 1. Navy training courses*. Navy Department, Washington D.C. 1947. Accessed Jan 10, 2020. [https://play.google.com/books/reader?id=C1SKr2qt-RUC&hl=en\\_AU&pg=GBS.PA340](https://play.google.com/books/reader?id=C1SKr2qt-RUC&hl=en_AU&pg=GBS.PA340)
32. Pierotti, Federico, and Alessandra Ronetti. "Beyond human vision: Towards an archaeology of infrared images." *Necsus*, Jul 31, 2018. [https://necsus-ejms.org/beyond-human-vision-towards-an-archaeology-of-infrared-images/#\\_edn31](https://necsus-ejms.org/beyond-human-vision-towards-an-archaeology-of-infrared-images/#_edn31)
33. Pomerantz, James. "Great Mistakes: Richard Mosse." *The New Yorker*, Oct 31, 2011. <https://www.newyorker.com/culture/photo-booth/great-mistakes-richard-mosse>
34. "Richard Mosse – Incoming." *British Journal of Photography*, Feb 15, 2017. <https://www.bjp-online.com/2017/02/mosse/>
35. Shklovsky, Viktor. *Art as Technique (1917)*. The University of Warwick. Accessed Apr 23, 2020. <https://warwick.ac.uk/fac/arts/english/currentstudents/undergraduate/modules/fulllist/first/en122/lecturelist-2015-16-2/shklovsky.pdf>
36. Smith, Ben, host. "027 - Edward Thompson." *A Small Voice: Conversations with photographers* (podcast), n.d. Accessed Feb 15, 2020. <https://bensmithphoto.com/asmallvoice/edward-thompson>
37. Stewart, Jessica. "Interview: Stunning Infrared Photos of North Korea Using Kodak Aerochrome Film." *My Modern Met*, Apr 2, 2018. <https://mymodernmet.com/karim-sahai-kodak-aerochrome-north-korea/>
38. "The Fool: The Dutch Artists Who Worked For The Beatles (And Made Their Own Freak Folk Masterpiece)." *Dangerous Minds*, Dec 6, 2018. [https://dangerousminds.net/comments/the\\_fool\\_the\\_dutch\\_artists\\_who\\_worked\\_for\\_the\\_beatles\\_and\\_made\\_their\\_own\\_fr](https://dangerousminds.net/comments/the_fool_the_dutch_artists_who_worked_for_the_beatles_and_made_their_own_fr)
39. "The Venice Questionnaire #5: Richard Mosse." *Art Review*. Accessed Feb 10, 2020 [https://artreview.com/previews/5\\_venice\\_richard\\_mosse/](https://artreview.com/previews/5_venice_richard_mosse/)

40. Trendacosta, Katharine. "Ghostly Thermal Imaging Portraits are Eerie and Fascinating." *Gizmodo*, Oct 13, 2013. <https://io9.gizmodo.com/ghostly-thermal-imaging-portraits-are-eerie-and-fascina-1444500714>
41. Warner, Marigold. "Documenting the invisible effects of a nuclear disaster." *British Journal of Photography*, Jan 16, 2020. <https://www.bjp-online.com/2020/01/giles-price-restricted-residence/>
42. der Weduwe, Lisa. "Revealing the world in Infrared – Edward Thompson." *Silverlake Voice*, May 11, 2016. <http://www.silverlakevoice.com/photography/edward-thompson/>
43. Williams, Robin, and Gigi Williams. "Frederick William Herschel, Pioneers of Invisible Radiation Photography." *Medical and Scientific Photography*. Accessed Dec 4, 2019. [http://medicalphotography.com.au/Article\\_04/03.html](http://medicalphotography.com.au/Article_04/03.html)
44. Williams, Robin, and Gigi Williams. "Prof. Robert Williams Wood, Pioneers of Invisible Radiation Photography." *Medical and Scientific Photography*. Accessed Dec 4, 2019. [http://medicalphotography.com.au/Article\\_04/06.html](http://medicalphotography.com.au/Article_04/06.html)
45. Zhang, Michael. "Photographer Shoots Thermal Photos of the Homeless in the Winter." *PetaPixel*, Apr 24, 2018. <https://petapixel.com/2018/04/24/photographer-shoots-thermal-photos-of-the-homeless-in-the-winter/>

## Videos

1. LensCulture. "The Island of the Colorblind - Sanne de Wilde | LensCulture." Jan 26, 2018. Video, 5:12. <https://www.youtube.com/watch?v=dz7iX4XuF1Q>
2. Nikon Europe. "Exploring the 'Island of the Colour Blind' with Sanne De Wilde." Jun 1, 2018. Video, 3:13. <https://www.youtube.com/watch?v=6mczZ73fMQI>