M255 – From Photo to Deep Fakes

George Legrady © 2022
Experimental Visualization Lab
Media Arts & Technology
University of California, Santa Barbara

Interdisciplinary Overview

- **Historical**: A sampling of the history and evolution of the photographic image (from 1826 to present)
- **Social**: What are the critical issues and impact of how we perceive the technological image
- **Computational**: A sampling of ideas and methods related to the digital image - from image processing, and Information Theory to present neural-network applications
- **Artistic**: Examples of artistic projects to highlight the role of aesthetics in image design

Student Work

- **Short weekly reports**: Thoughts you may have about any of the materials covered in the weekly presentations

- **A course project**: Student defined – it can be project realized in computer code, or a project created not by code, or a research paper.

Analog-Optical Apparatus Fundamentals

Paleo-Camera

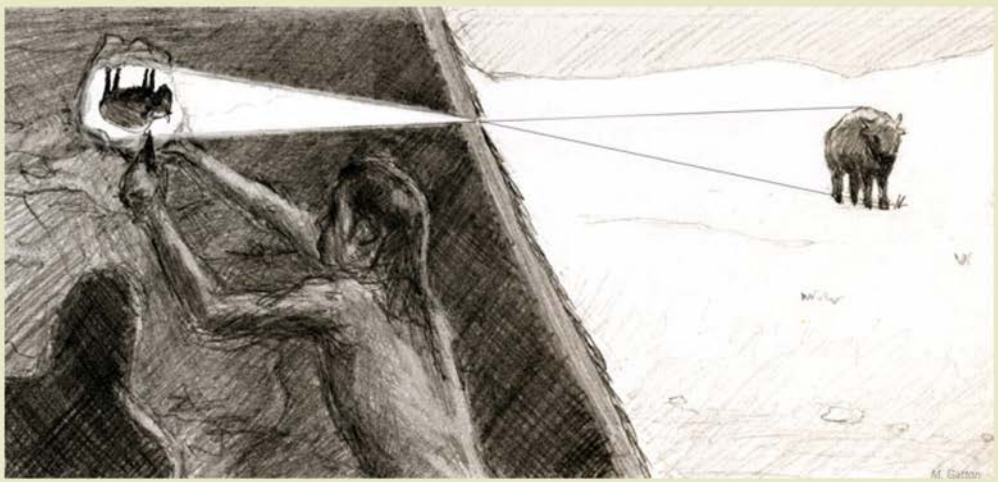
the Start of Art

Home | What is a camera obscura? | What were Paleo-dwellings? | What is Paleo-art?
Field Reconstructions | Drawing Experiments | Author | Bibliography | Contact

France
Deutsch
Español

The Paleo-Camera Theory

"Small random holes in Paleolithic hide tents coincidentally and occasionally created camera obscuras, which projected moving images inside the dwelling spaces, triggering profound spiritual, philosophical, and aesthetic advances."



Humans, as a species, are not anatomically adapted to many of the environments we inhabit. We have survived by means of the micro-climate strategy—clothing and shelter. The building of shelter has accidentally created camera obscuras throughout historic times, documented in written records back to the fifth century B.C. The micro-climate strategy, however, extends deep into prehistory. The archeological record shows that Paleolithic peoples fashioned hide tents in cave mouths, rock overhangs, and in the open. Our field reconstructions show the inevitability of camera obscura formation when using generally opaque but puncturable materials in these locales.

A camera obscura is a dim room (of any size) with a hole (or holes) that allow light to enter and project an upside-down image of the outside world onto an interior surface, the simplest of optical principles.

From the Literature

Mozi, social philosopher, Tengzhou, China (470-390 BC)

Aristotle, Greek philosopher, pinhole to study eclipse (384-322 BC)

Ḥasan Ibn al-Haytham , mathematician, astronomer, physicist, “father of modern optics”, Basra, Iraq (965-1039AD)

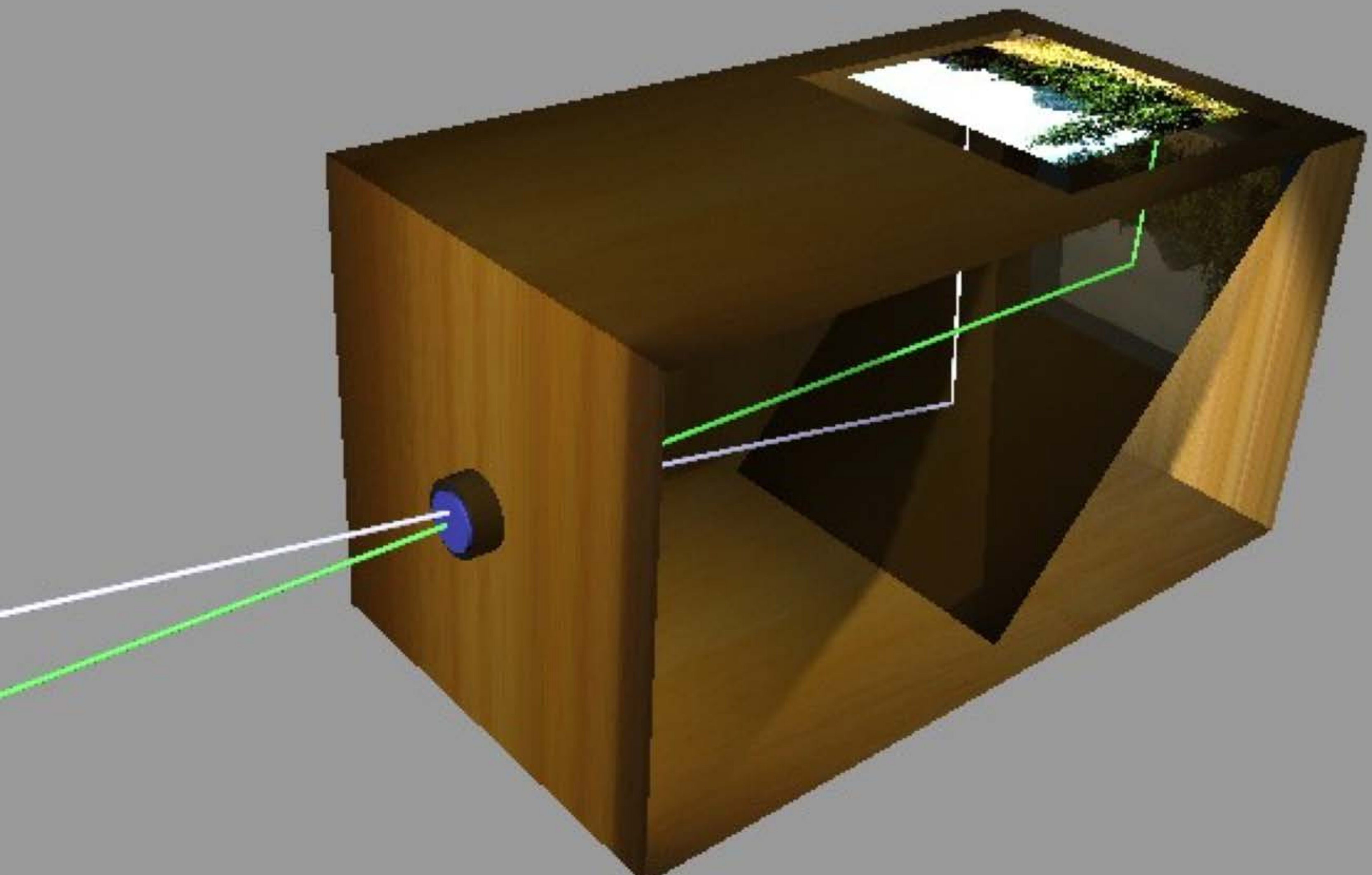
Roger Bacon, philosopher, scientist, England, (1219-1292 AD)

Leonardo da Vinci, artist, scientist describes pinhole camera (1452-1519 AD)

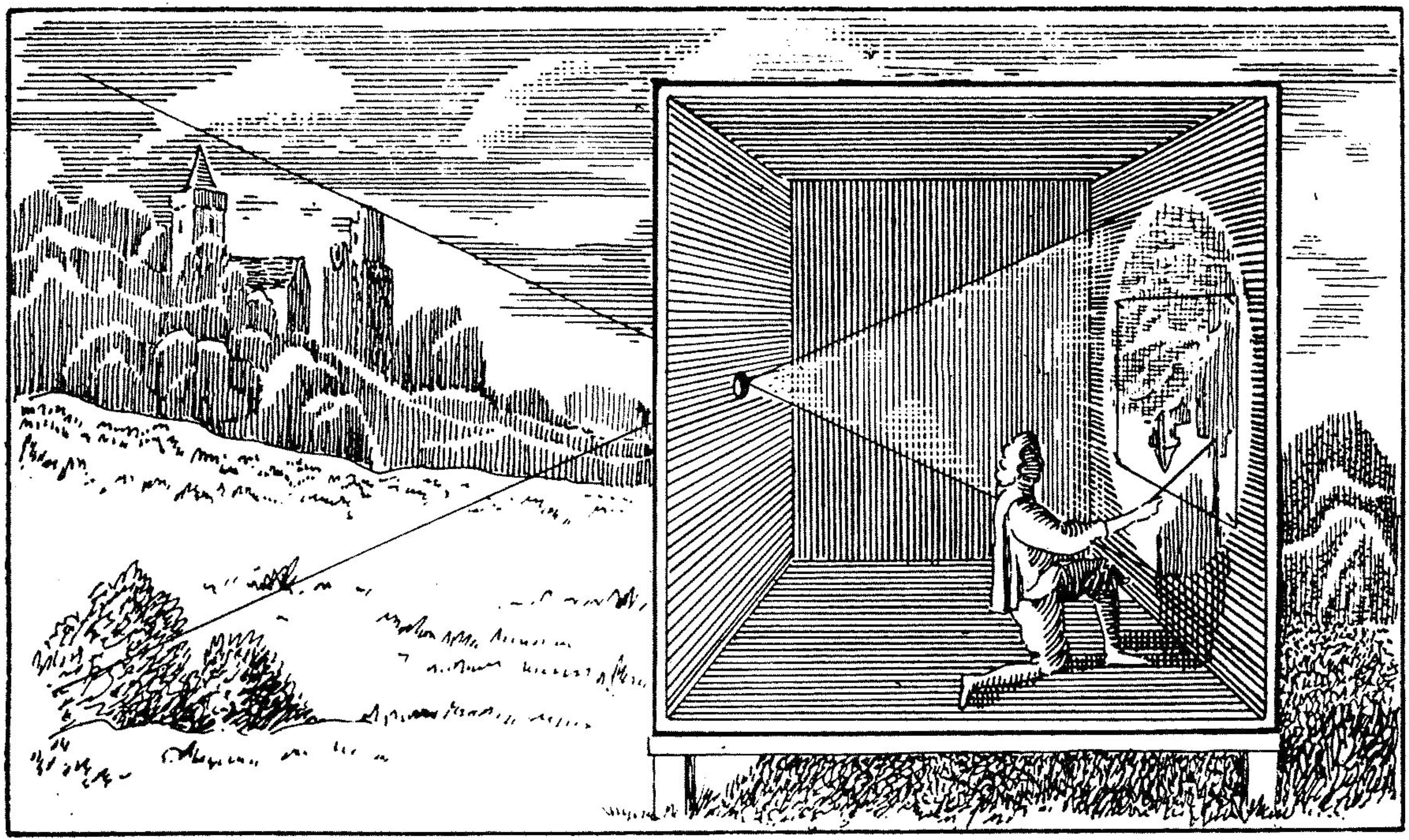
Johannes Kepler, astronomer, uses term “Camera Obscura” in 1604 (1571-1630)

http://www.photographyhistoryfacts.com/photography-development-history/camera-obscura-history/

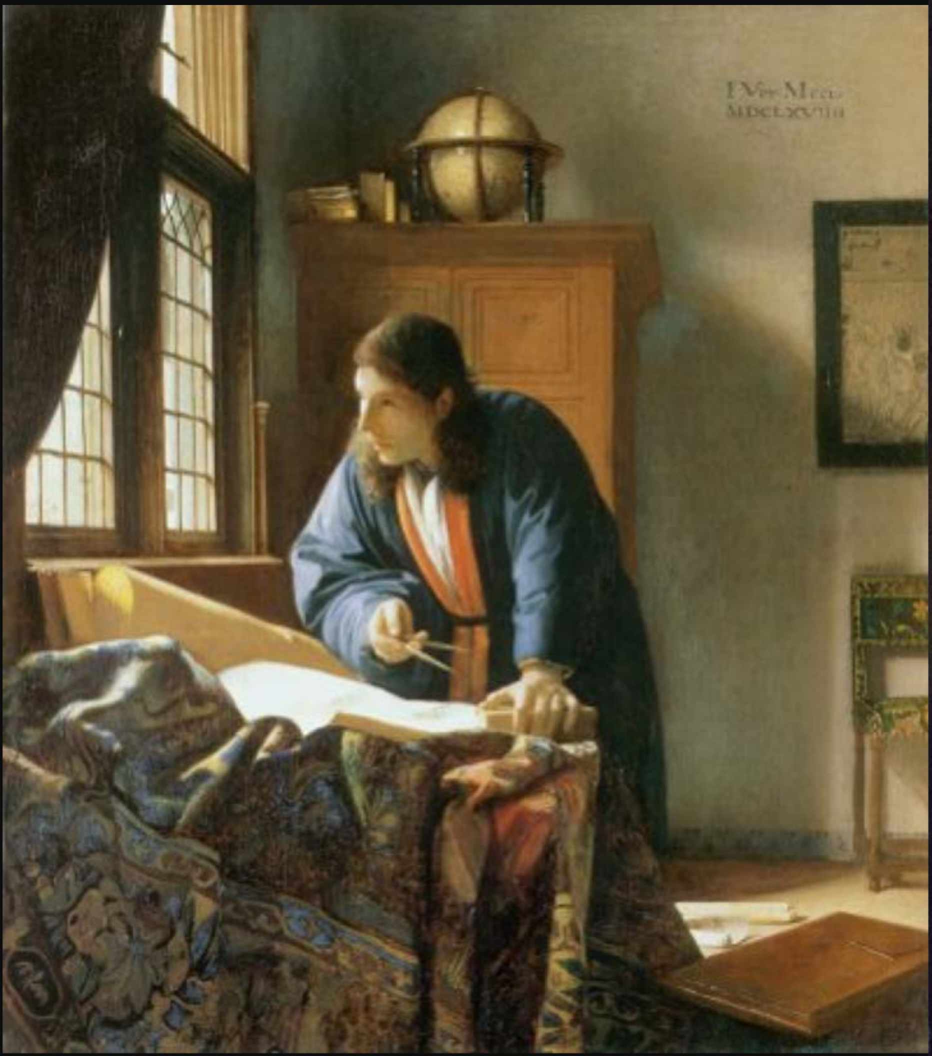
Dark chamber lets photons (lightbeams) thru pinhole/lens, then captured on receiving flat surface



Tracing the projection inside a Camera Obscura



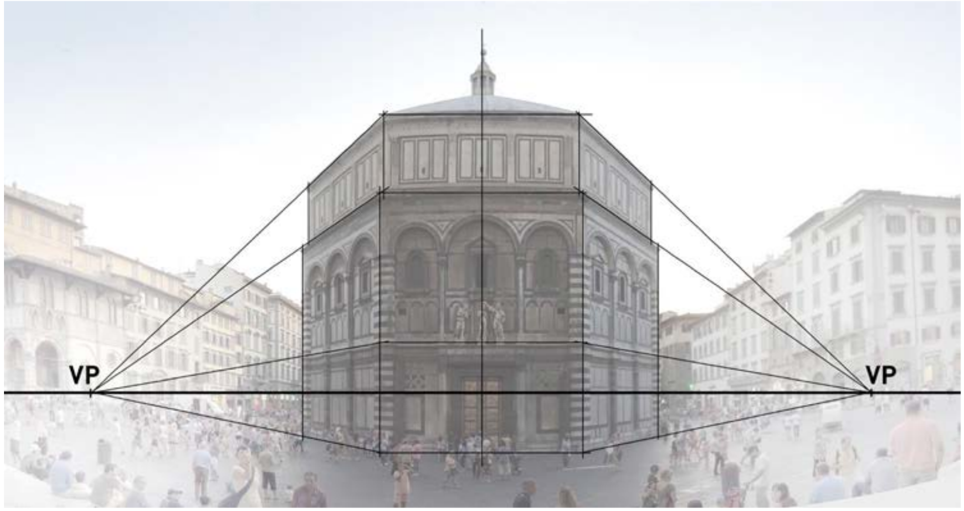
The **Hockney–Falco thesis** advanced by artist David Hockney and optics physicist Charles M. Falco: Advances in realism based on use of optical instruments



Johannes Vermeer, “The Geographer” (1668/1669), the “Astronomer” (1668)

Various Perspectives

Oblique*: Entrance and yard of a yamen*. Detail of scroll about Suzhou by Xu Yang, ordered by the Qianlong Emperor. 18th century



Brunelleschi 2 point perspective, 1415-1420 (video)

Albrecht Dürer, grid window (1525?) Right panels: Giotto (1310), Cimabue (1280-1285)

Staring Into the Soul of the Catskills Through a Pinhole

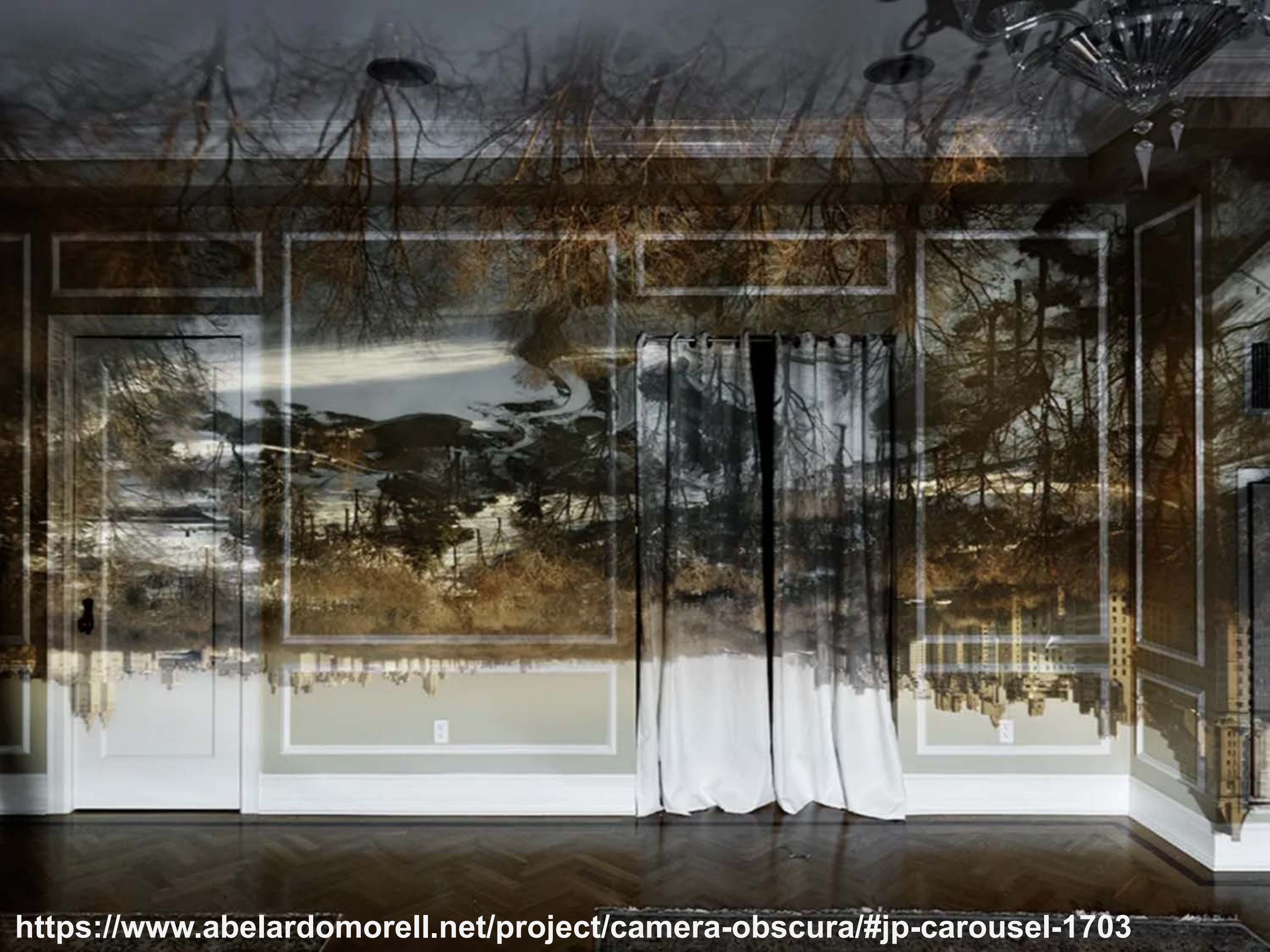
With his camera obscura, Shi Guorui reinterprets the landscapes of the Hudson River School painter Thomas Cole.

The artist Shi Guorui building his camera obscura out of a tent in a forest near Kaaterskill Falls, in the Hudson River Valley. He has transformed a weather station and even a watchtower at the Great Wall of China into pinhole cameras. Nathan Bajar for The New York Times

Mr. Shi was inspired by “Falls of the Kaaterskill,” an 1826 painting by Thomas Cole (1801-1848).

Mr. Shi's "On Catskill Creek, New York, June 25-26" (2019), a camera obscura gelatin silver print. Shi Guorui and Thomas Cole National Historic Site

https://www.nytimes.com/2019/10/24/arts/shi-guorui-catskills-photography.html



https://www.abelardomorell.net/project/camera-obscura/#jp-carousel-1703

Millenial Time Machine, Rodney Graham, University of British Columbia (2003)

Niepce (1826), oldest chemically fixed image (outside his window)

https://www.hrc.utexas.edu/niepce-heliograph/

10 minute shutter exposure

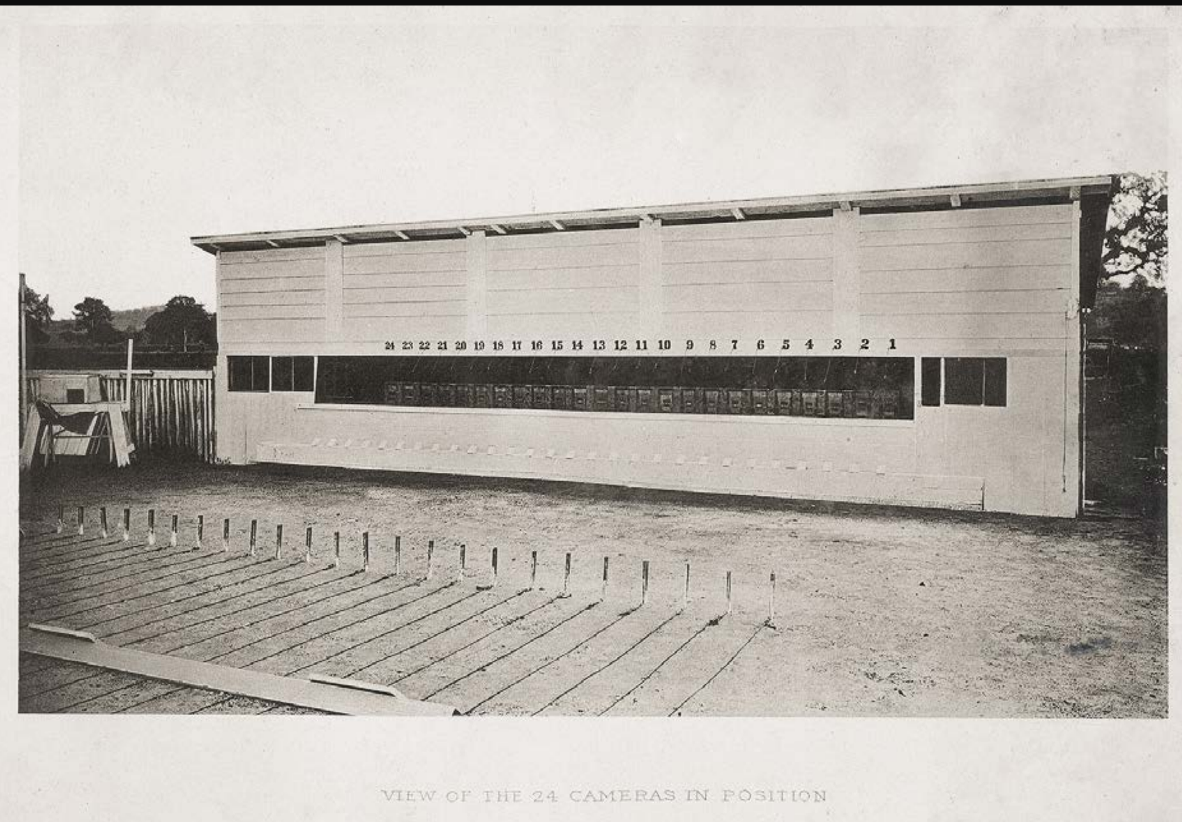
Louis Daguerre, first photograph of a person on a busy street, (1839)

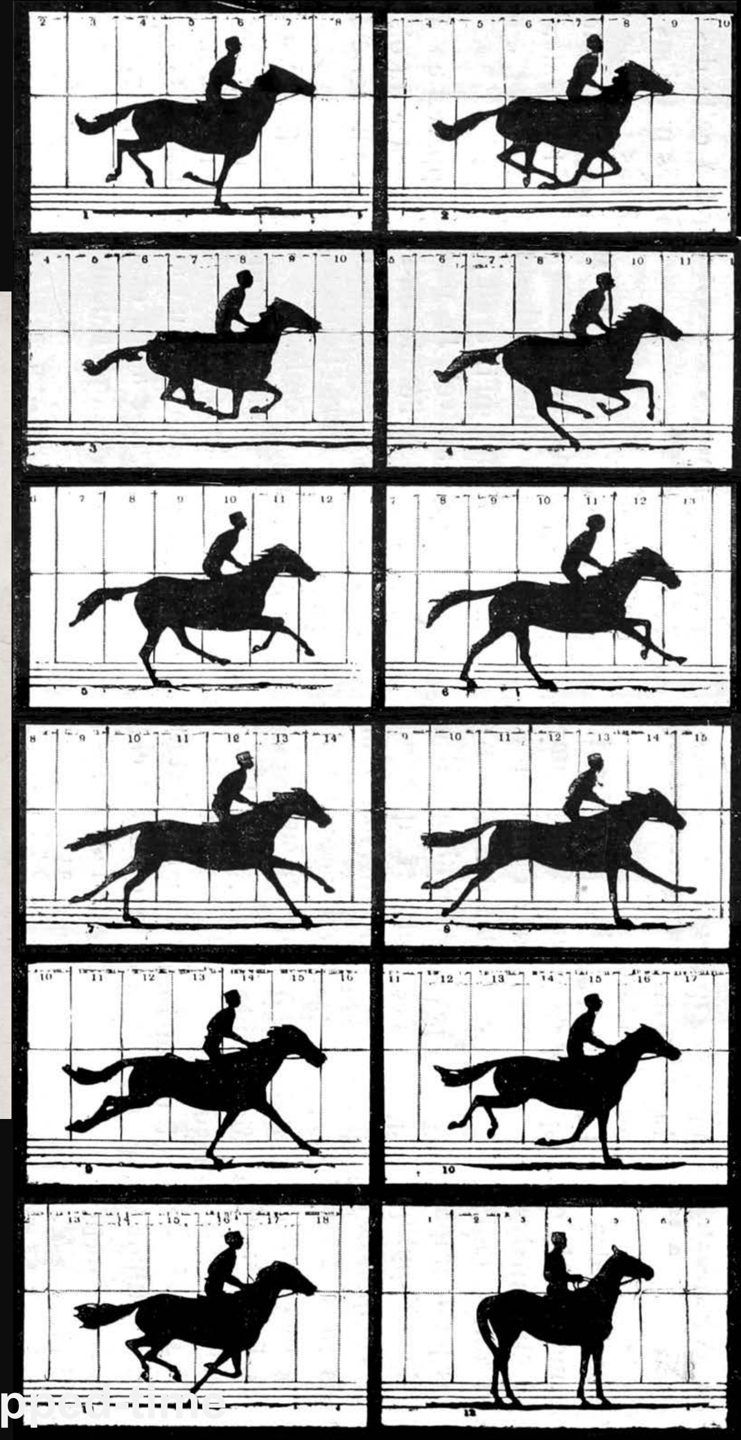
William Henry Fox Talbot – Studio 1853

Anna Atkins, botanist and photographer (1799-1871)

https://en.wikipedia.org/wiki/Anna_Atkins

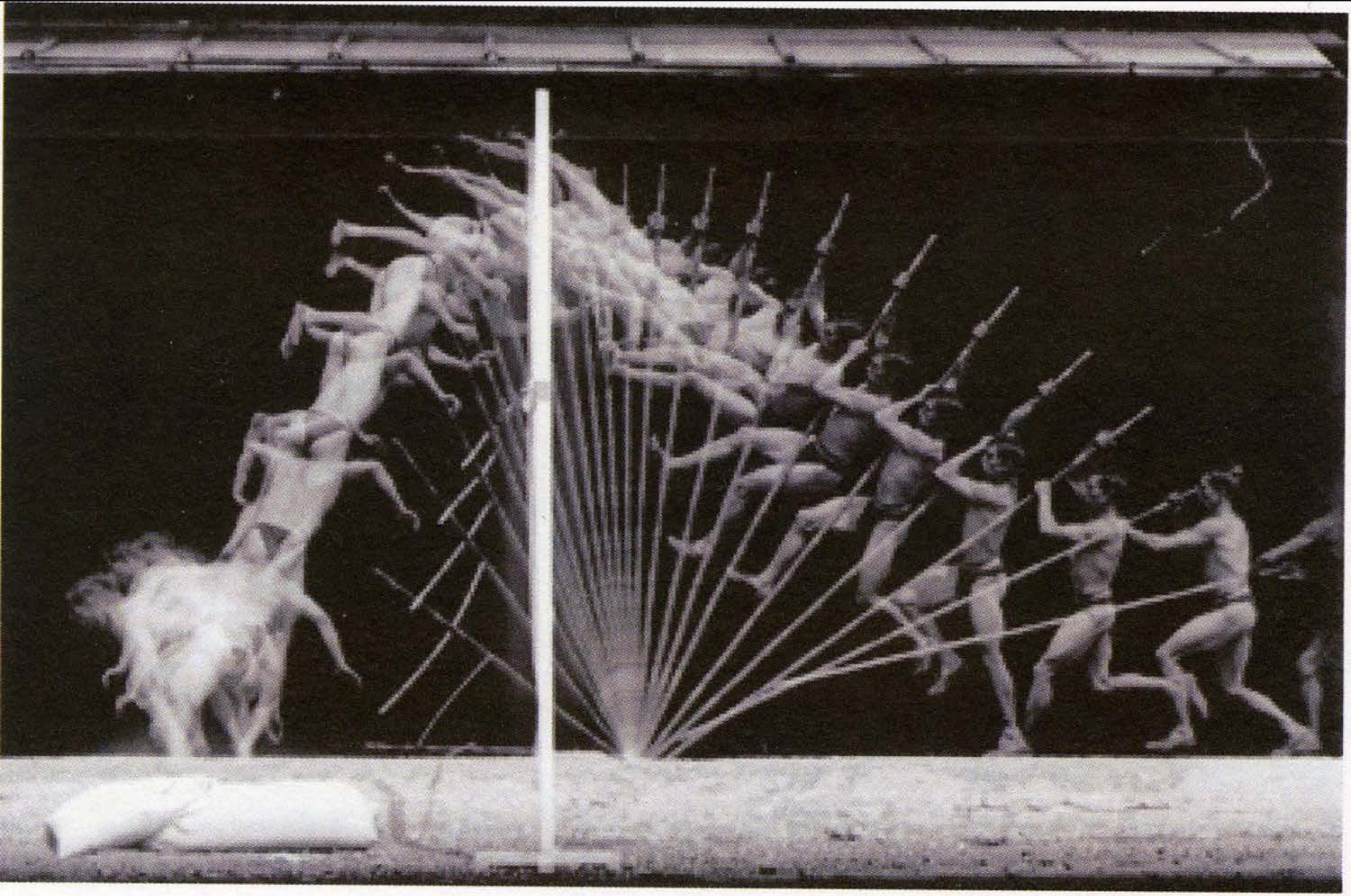
Animal Locomotion, 1872





https://stanfordmag.org/contents/the-man-who-stopped-time

Chrono-Photography

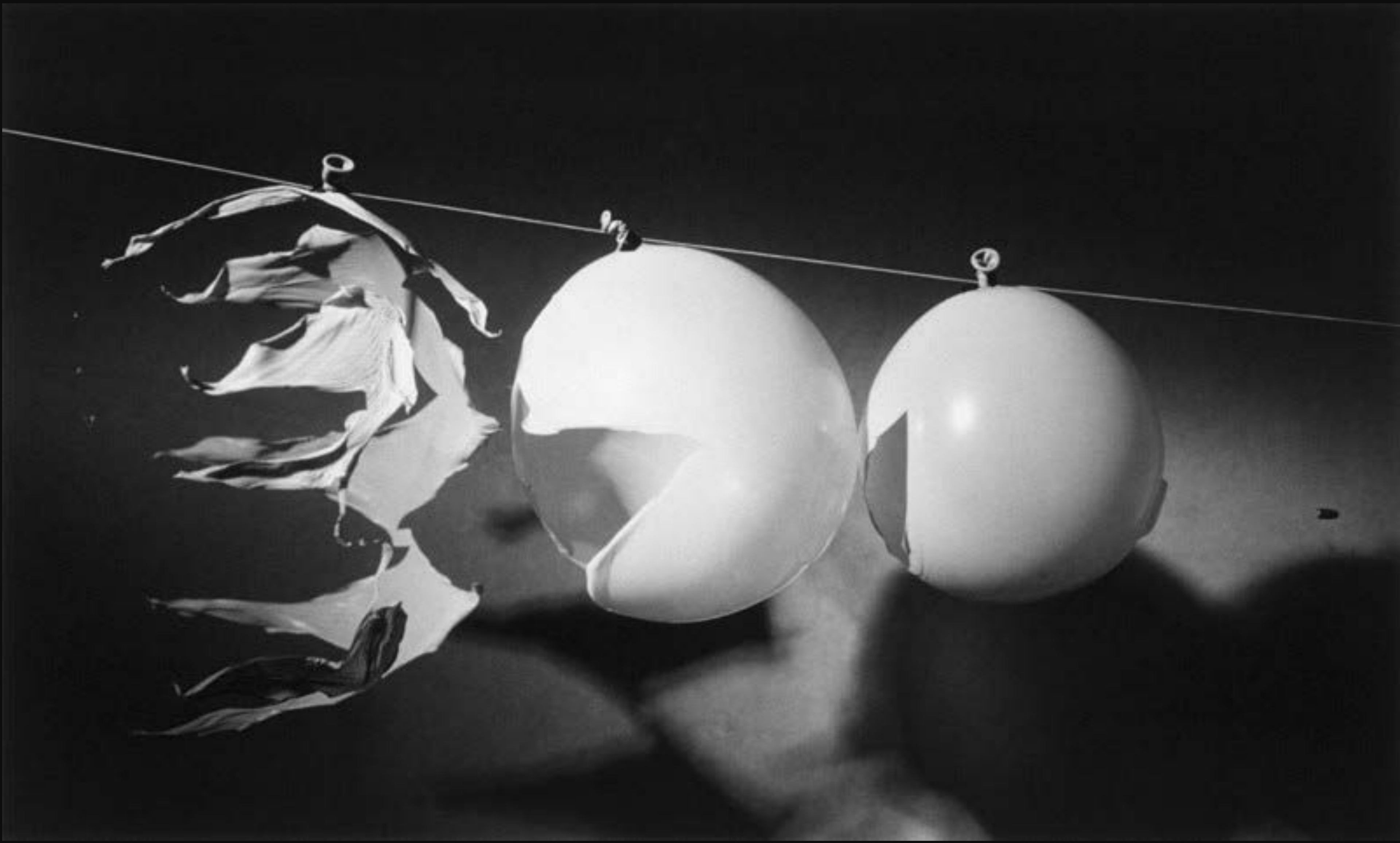


Etienne-Jules Marey, scientist, physiologist, 1880s

http://artcom.de/en/project/the-invisible-shape-of-things-past/

Camera Motion, *Grand Prix*, Jacques-Henri Lartique (1913)

High-speed photography



Harold Edgerton, MIT, “Bullet through Three Balloons” (1959)

Visualizing Photons in Motion at a trillion frames per second (2013)

Femto-Photography: Capturing and Visualizing the Propagation of Light

Andreas Velten[1*] Di Wu[1†] Adrian Jarabo[2] Belen Masia[1,2] Christopher Barsi[1]
Chinmaya Joshi[1‡] Everett Lawson[1] Moungi Bawendi[3] Diego Gutierrez[2] Ramesh Raskar[1]

[1] MIT Media Lab [2] Universidad de Zaragoza [3] MIT Department of Chemistry

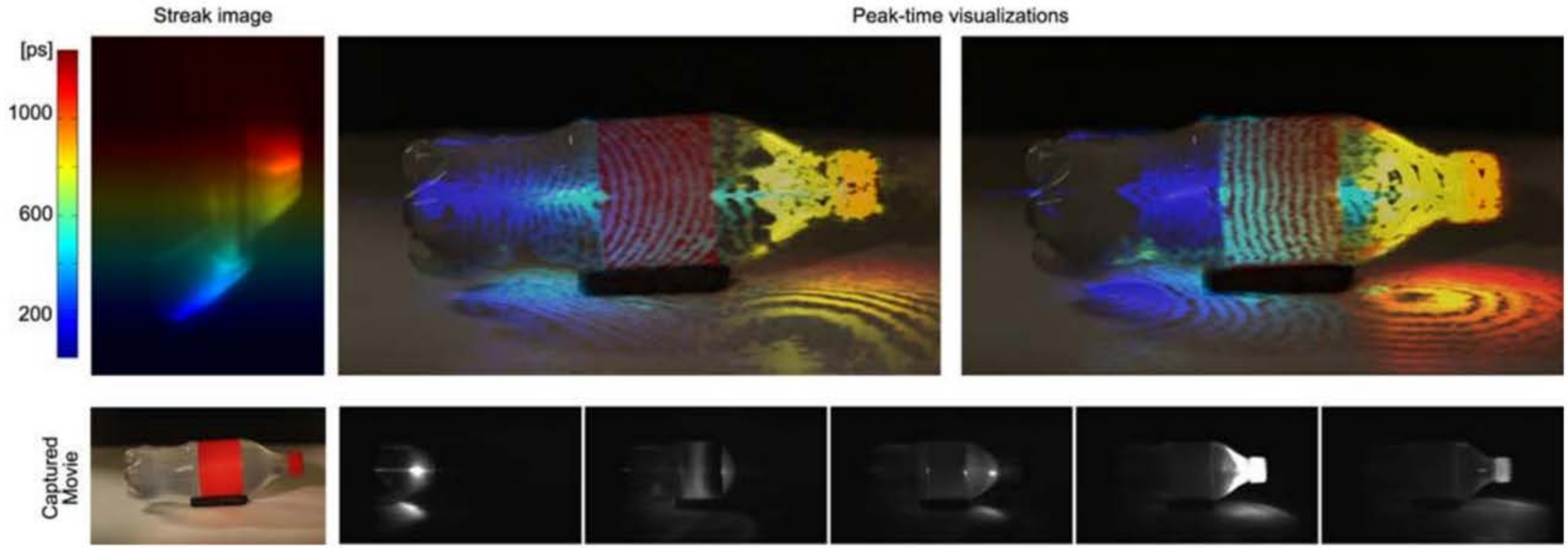
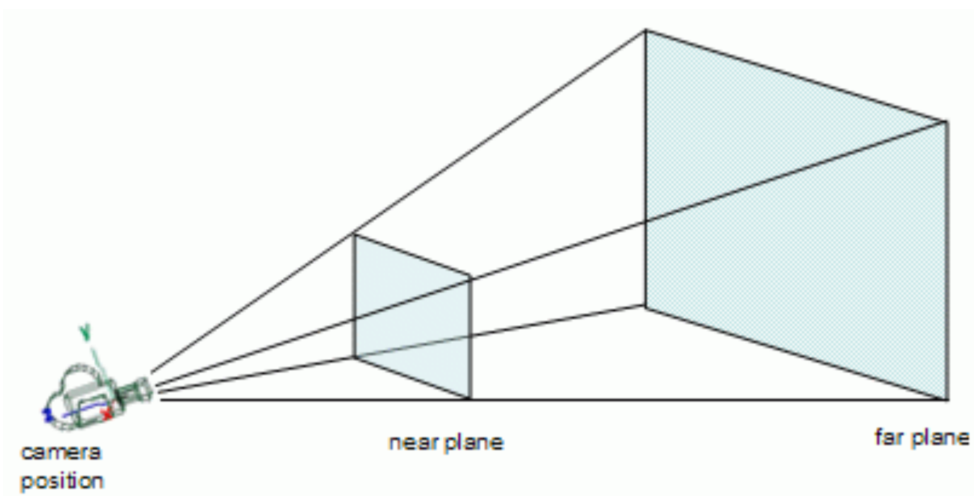
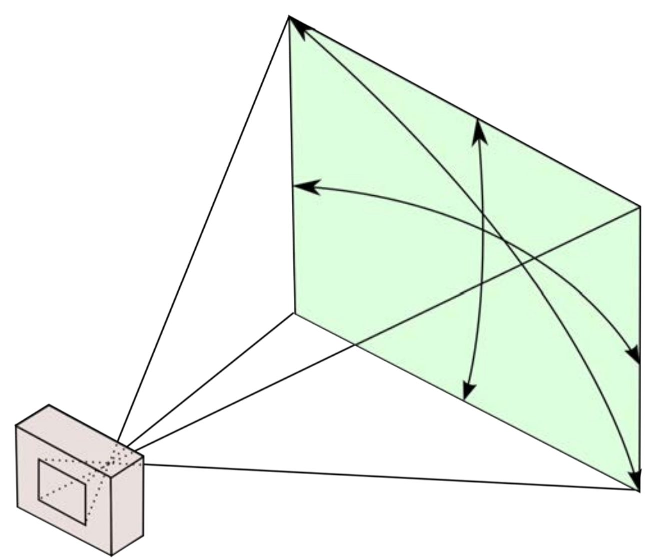


Figure 1: *What does the world look like at the speed of light? Our new computational photography technique allows us to visualize light in ultra-slow motion, as it travels and interacts with objects in table-top scenes. We capture photons with an effective temporal resolution of less than 2 picoseconds per frame. Top row, left: a false color, single streak image from our sensor. Middle: time lapse visualization of the bottle scene, as directly reconstructed from sensor data. Right: time-unwarped visualization, taking into account the fact that the speed of light can no longer be considered infinite (see the main text for details). Bottom row: original scene through which a laser pulse propagates, followed by different frames of the complete reconstructed video. For this and other results in the paper, we refer the reader to the video included in the supplementary material.*

Ramesh Raskar, MIT Media Lab, https://web.media.mit.edu/~raskar/trillionfps/

- **Field-of-View**: What is seen at a given moment
- **Angle of view**: Angular extent of a scene imaged by a camera
- **Vantage point**: The location where the photo is taken from
- **Frustum**: 3D region viewed on the screen

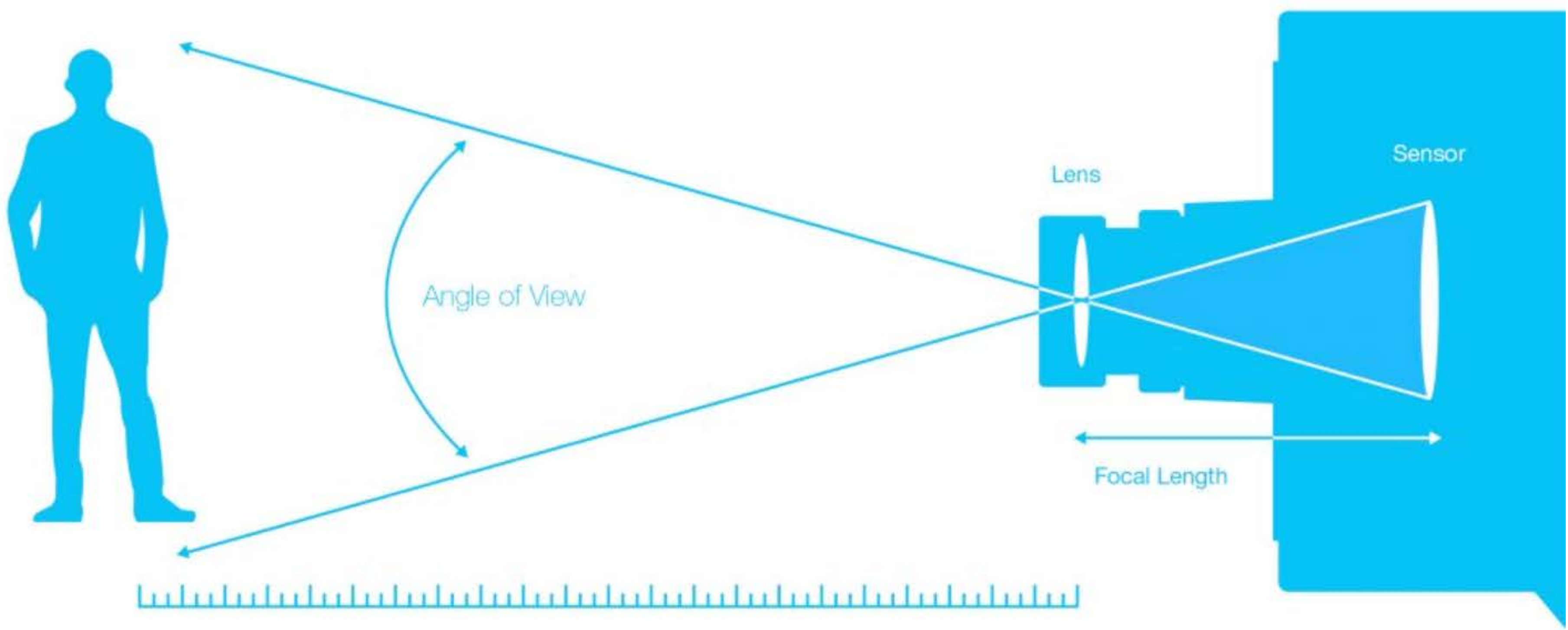




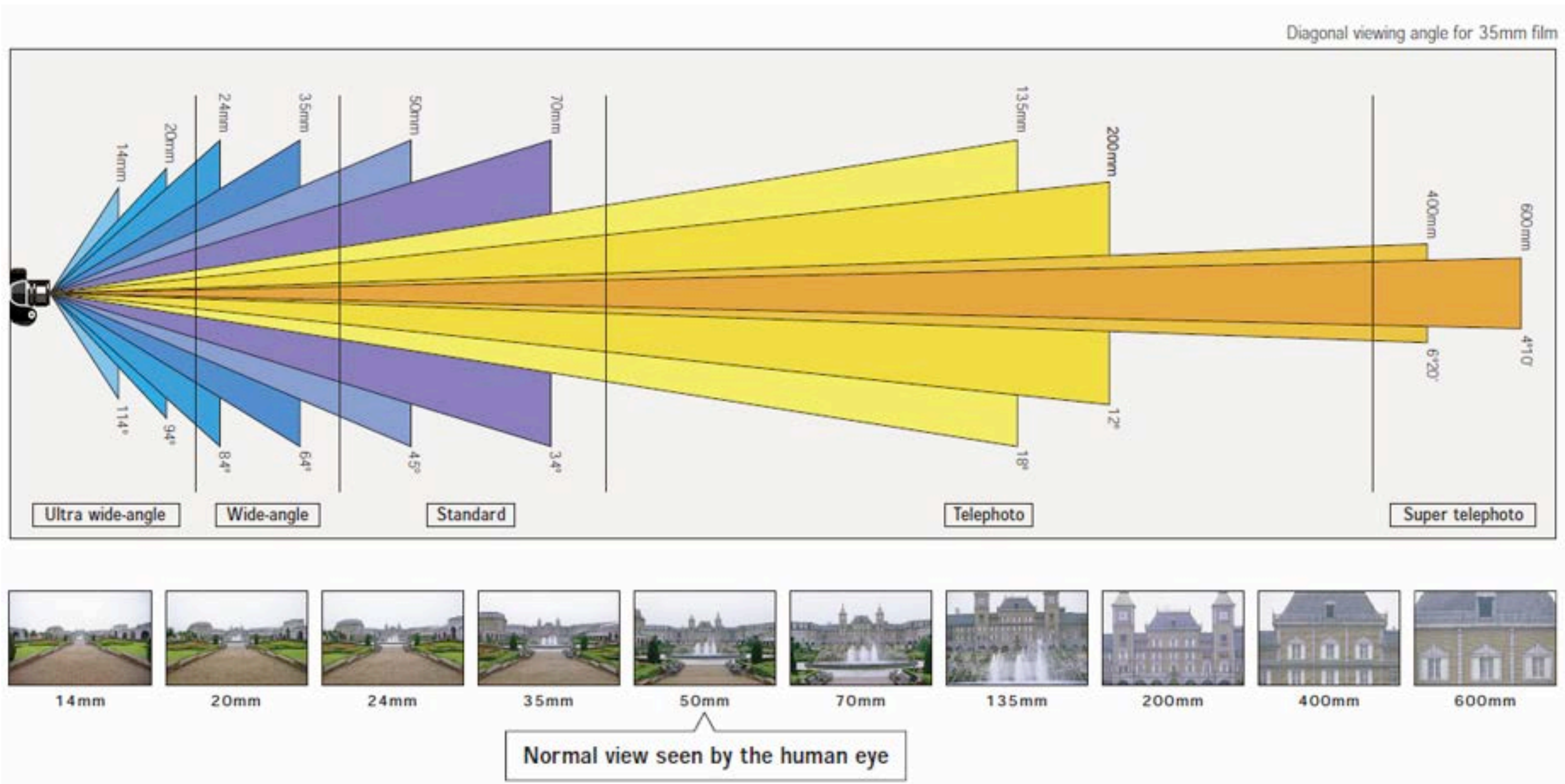
Basic optical-mechanical camera format

Focal Length and Angle of View

Longer focal length = NARROWER angle of view
Shorter focal length = WIDER angle of view

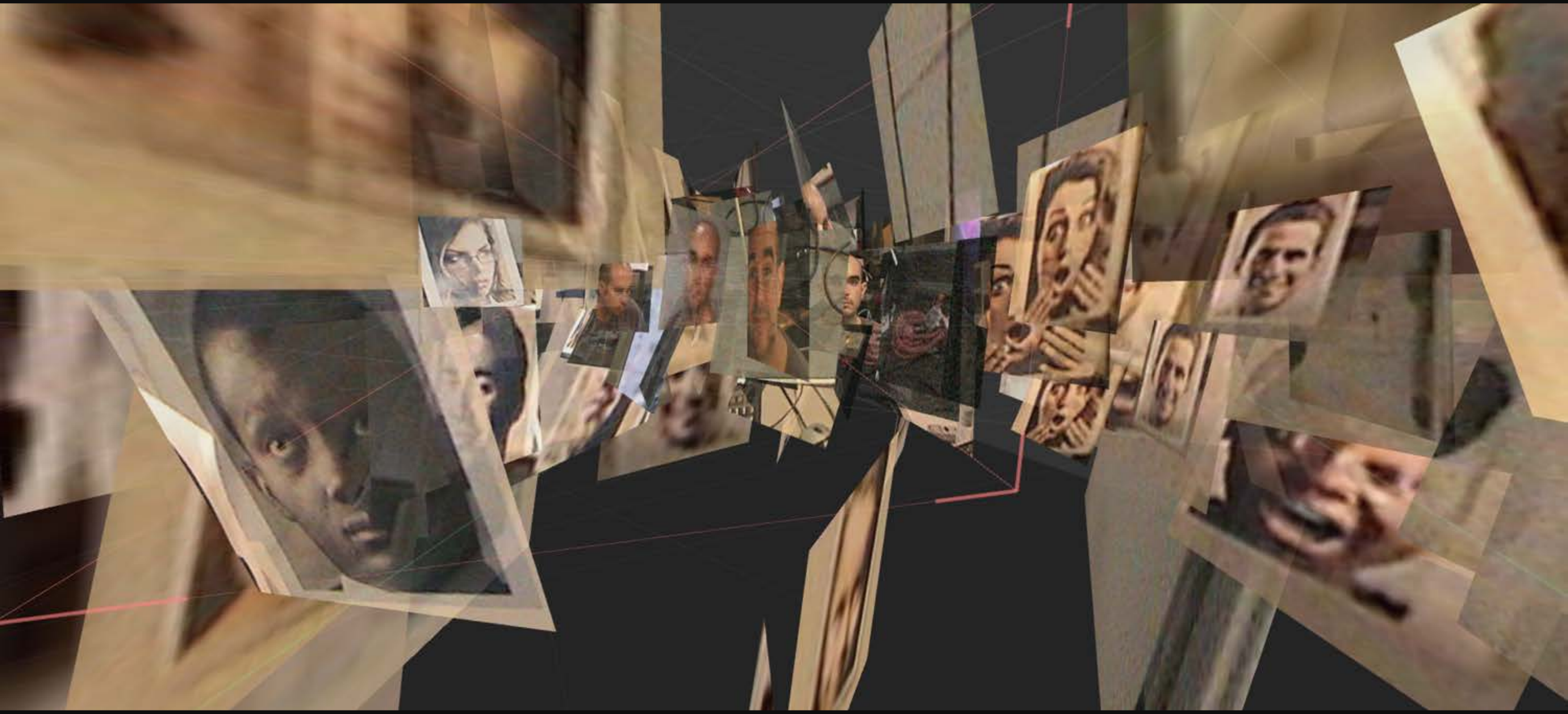


Focal lens – the distance between the lens and the image sensor



Play of balance with Point-of-View, *Knoxville, Tennessee*, (1971) Lee Friedlander

The screen as camera / point-of-view



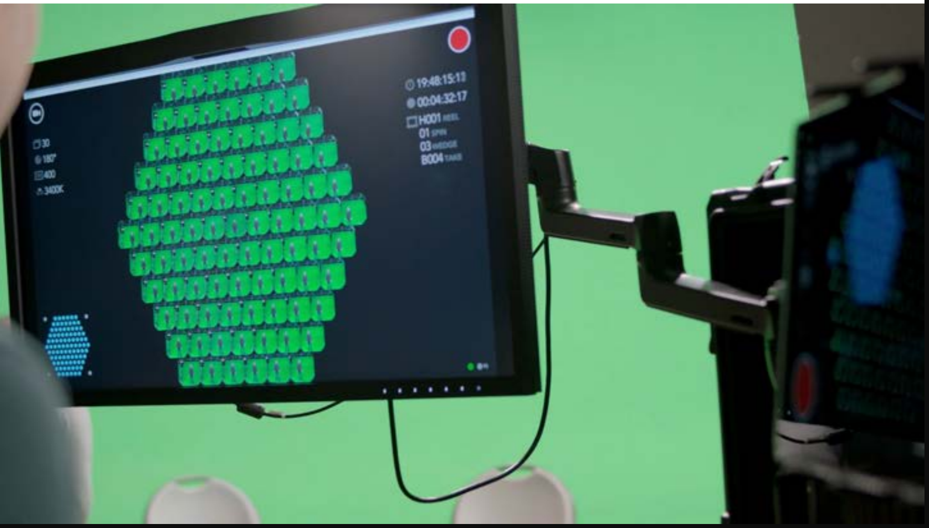
The Metaphorical Camera: Automation and Embodiment in Visual Narrative
Daniel Bazo, PhD thesis 2015

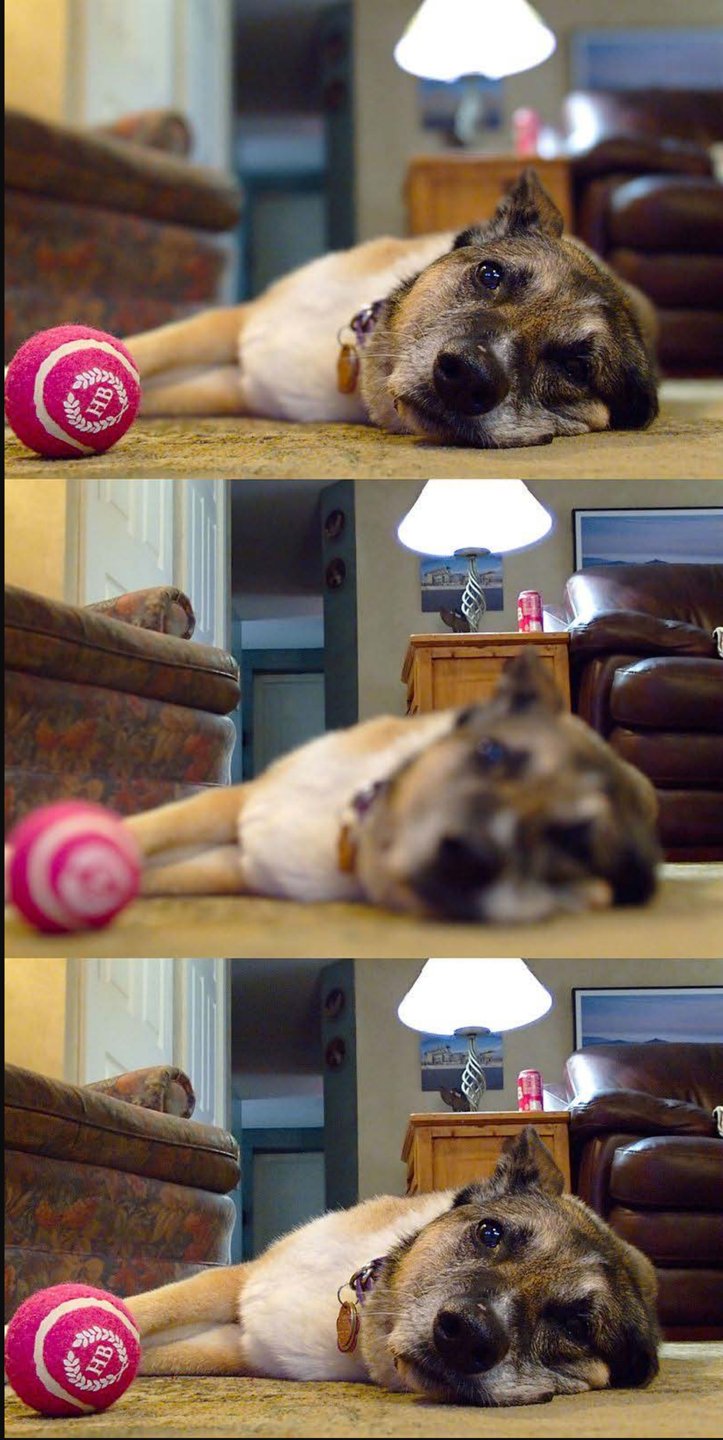
This dissertation examines the process of automation of real and virtual cameras, drawing on insights from artificial intelligence, robotics, narrative theory, virtual and interactive systems design, and presents two contributions: an analysis of automation in camera systems, and a prototype software tool for virtual camera control.

Depth of Field

László Moholy-Nagy, *Photograph (Self-Portrait with Hand)*, 1925/29, printed 1940/49

Lytro – variable depth-of-field





https://en.wikipedia.org/wiki/Lytro

Vexierbild – Erhard Schön, 1530

Nexus Netw J (2015) 17:253–285
DOI 10.1007/s00004-014-0225-5

NEXUS NETWORK JOURNAL
Architecture and Mathematics

RESEARCH

Anamorphic Projection: Analogical/Digital Algorithms

Francesco Di Paola · Pietro Pedone ·
Laura Inzerillo · Cettina Santagati

Published online: 27 November 2014

Abstract The study presents the first results of a wider research project dealing with the theme of "anamorphosis", a specific technique of geometric projection of a shape on a surface. Here we investigate how new digital techniques make it possible to simplify the anamorphic applications even in cases of projections on complex surfaces. After a short excursus of the most famous historical and contemporary applications, we propose several possible approaches for managing the geometry of anamorphic curves both in the field of descriptive geometry (by using interactive tools such as Cabrì and GeoGebra) and during the complex surfaces realization process, from concept design to manufacture, through CNC systems (by adopting generative procedural algorithms elaborated in Grasshopper).

Keywords Anamorphosis Anamorphic technique Descriptive geometry Architectural geometry Generative algorithms Free form surfaces

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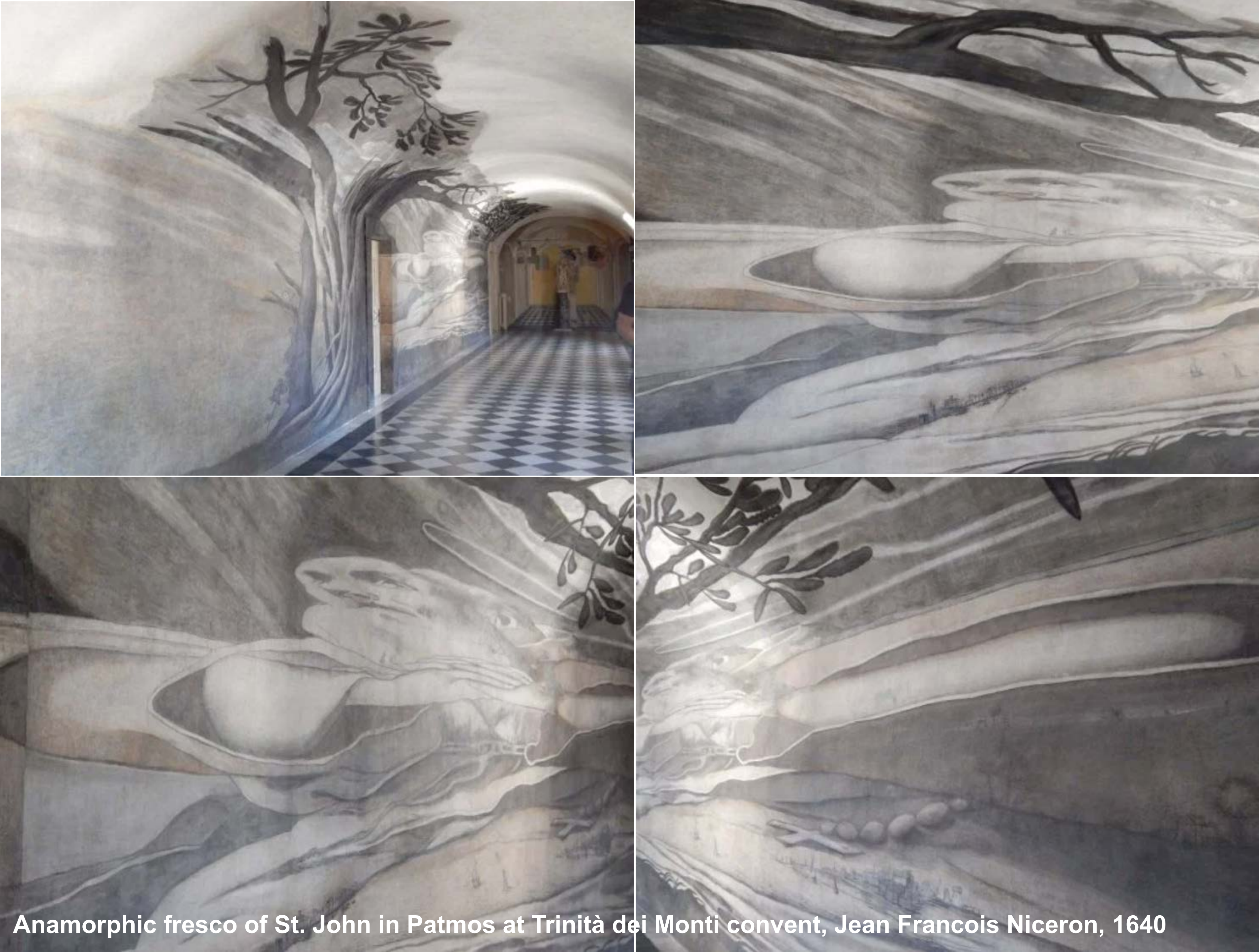
Fig. 4 *Center, right The Ambassadors* by Hans Holbein the Younger, National Gallery, London, 1533. The anamorphic skull on the floor becomes recognizable only observing the painting from the left side according to an oblique point of view. http://www.it.wikipedia.org/wiki/Gli_ambasciatori (Holbein_il_Giovane) Author: Lisby, licenza Creative Commons Attribution 2.0 Generic. https://creativecommons.org/licenses/by/2.0/legalcode, no change to the figure, https://flic.kr/p/6VsvNa

Fig. 5 Jean François Nicéron, anamorphic fresco of the Gallery of the Monastery of Trinità dei Monti in Rome, 1640. On the *left*, the *figure* shows the central part of the fresco as it appears walking through the corridor. On the *right*, there is the image of Saint John the Evangelist as appears from the privileged point of view (De Rosa and Cristian 2012, p. 597)

The painters used the concepts of anamorphosis in the creation of their works, with extreme skill and mastery, creating wonderful examples on the curved surfaces of apses and niches, over large areas of aristocratic salons or on the articulated vaults of churches.

We can cite, among the examples of anamorphosis on large scale, the apse of the church of Santa Maria in San Satiro in Milan created by Donato Bramante (1483), the corridors of Palazzo Spada in Rome by Francesco Borromini (1540), and the trompe-l'oeil scenography of Palladio's Teatro Olimpico in Vicenza designed by Vincenzo Scamozzi (1584).

The architect and painter Andrea Pozzo was one of the greatest exponents of illusory architecture as well as a theorist of perspective. The frescos on the ceiling of



Anamorphic fresco of St. John in Patmos at Trinità dei Monti convent, Jean Francois Niceron, 1640

Anamorph Transformation

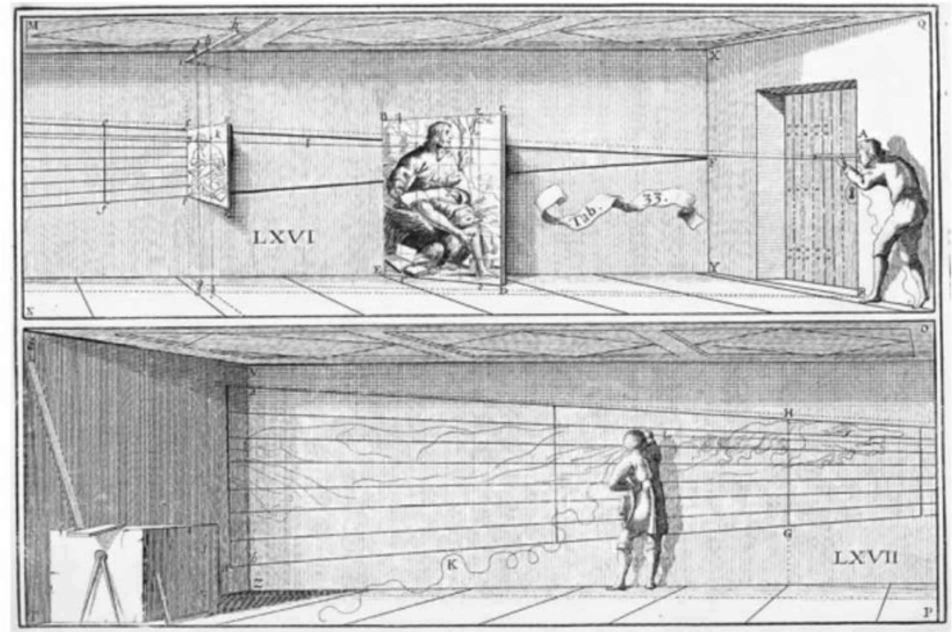
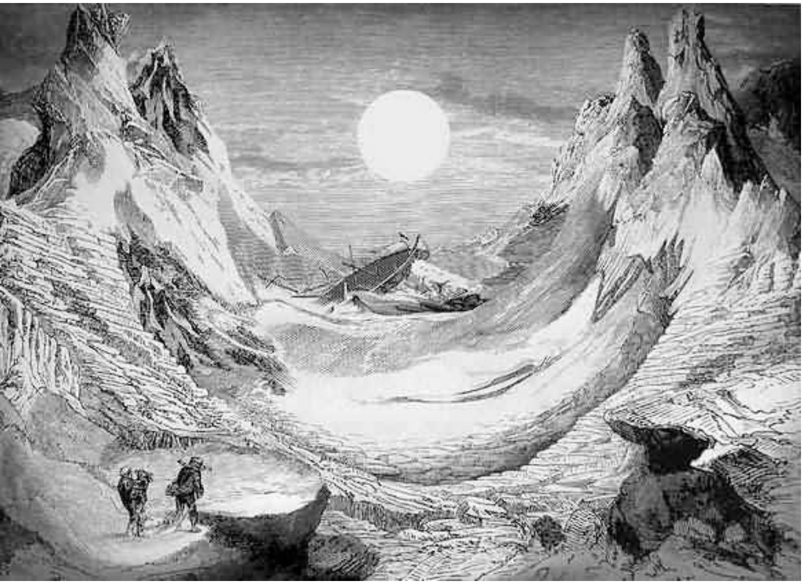


FIG. 5 – Anamorphic structure by J.F. Niceron, Thaumaturgus Opticus (Tab. 33, Fig. LXVI and LXVII), Paris, 1646.

Fig. 3. Hans Holbein, 1533, The Ambassadors, oil on panel with an anamorphic image of a skull in the bottom of the image

Fig. 4. The Skull – visualisation of the **flat surface** anamorph from *The Ambassadors*

Catoptric anamorphic images – Istvan Orosz, William Kentridge
(*Catoptric – phenomena of reflected light as in mirrors*)

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Spatial Transfiguration: Anamorphic *Mixed-Reality* in the Virtual Reality Panorama

Abstract

Spatial illusion and immersion was achieved in Renaissance painting through the manipulation of linear perspective's pictorial conventions and painterly technique. The perceptual success of a painted trompe l'œil, its ability to fool the observer into believing they were viewing a real three-dimensional scene, was constrained by the limited immersive capacity of the two-dimensional painted canvas. During the baroque period however, artists began to experiment with the amalgamation of the 'real' space occupied by the observer together with the pictorial space enveloped by the painting's picture plane: real and pictorial space combined into one pictorial composition resulting in a hybridised 'mixed-reality'.[1] Today, the way architects, and designers generally, use the QuickTime Virtual Reality panorama to represent spaces of increasing visual density have much to learn from the way in which Renaissance and baroque artists manipulated the three-dimensional characteristics of the picture plane in order to offer more convincing spatial illusions. This paper outlines the conceptual development of the QuickTime VR panorama by Ken Turkowski and the Apple Advanced Technology Group during the late 1980s. Further, it charts the technical methods of the Virtual Reality panorama's creation in order to reflect upon the VR panorama's geometric construction and range and effectiveness of spatial illusion. Finally, through a brief analysis of Hans Holbein's Ambassadors [1533] and Andrea Pozzo's nave painting in Sant 'Ignazio [1691-94] this paper proposes an alternative conceptual model for the pictorial construction of the VR panorama that is innovatively based upon an anamorphic 'mixed-reality'.

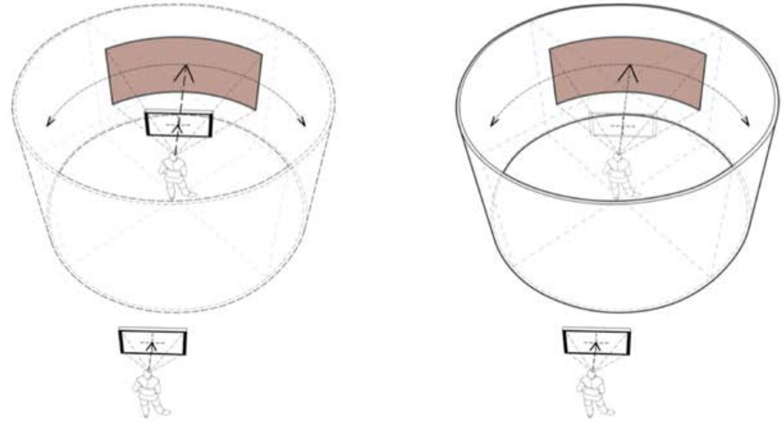


Fig.01 [above]
Cylindrical VR panorama interactivity diagram illustrating the panning of the drum around the observer, and their tele-present location at the drum's centre.

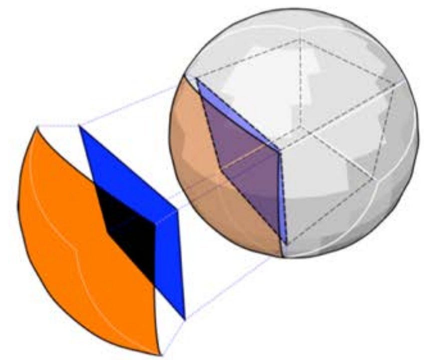


Fig.02 [right]
Diagram representing the translation of sptial information through anamorphosis, from the cube-based typological state to the sphere-based VR panorama.

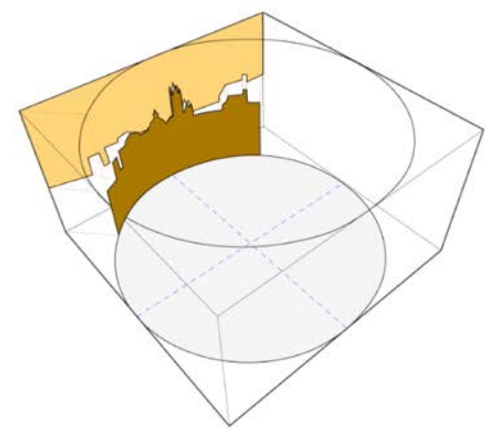


Fig.03 [right]
Diagram representing the anamorphic translation from the cyclinder-based typology to the cube-based typology. This diagram also represent the change in displacement from the central viewing position in the drum & cube's centre, to the outer surface fo the panorama's geometry.

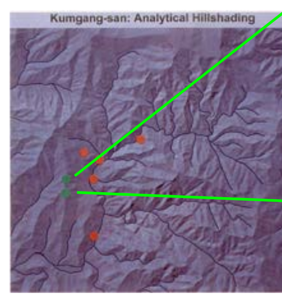
Intae Hwang thesis to transfer Jeon Seon's traditional paintings into virtual environments

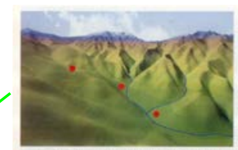
St. Ottilien's Six "True View Landscapes" by Chông Sôn (1676-1759) *3

Kay E. Black and Eckart Dege

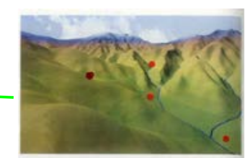
Jeong Seon, *The Complete View of the Diamond Mountains*, deep color on silk, 33.3 x 54.8cm.

Fig. 15. **1954 USAMS map detail** used for digitised elevation model. Courtesy Eckart Dege.

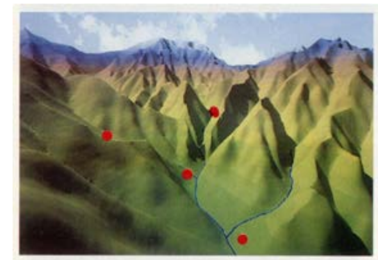




Printout 3. Neither Changan-sa nor Podŏk-am is visible from vantage point 930. Courtesy Eckart Dege.



Printout 4. All the landmarks are visible from Peak 3 except Changan-sa which is hidden deep in the valley. Courtesy Eckart Dege.

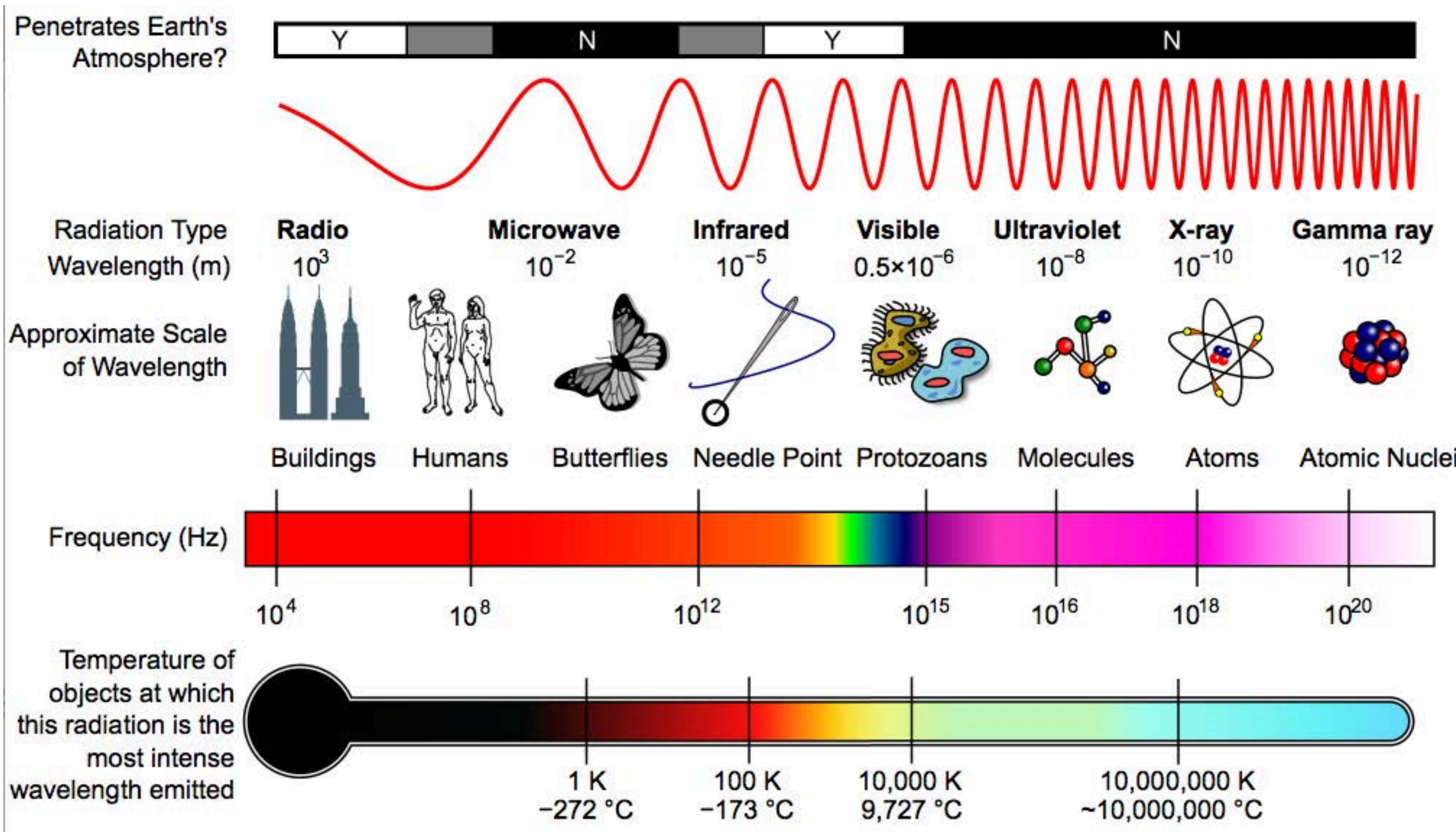


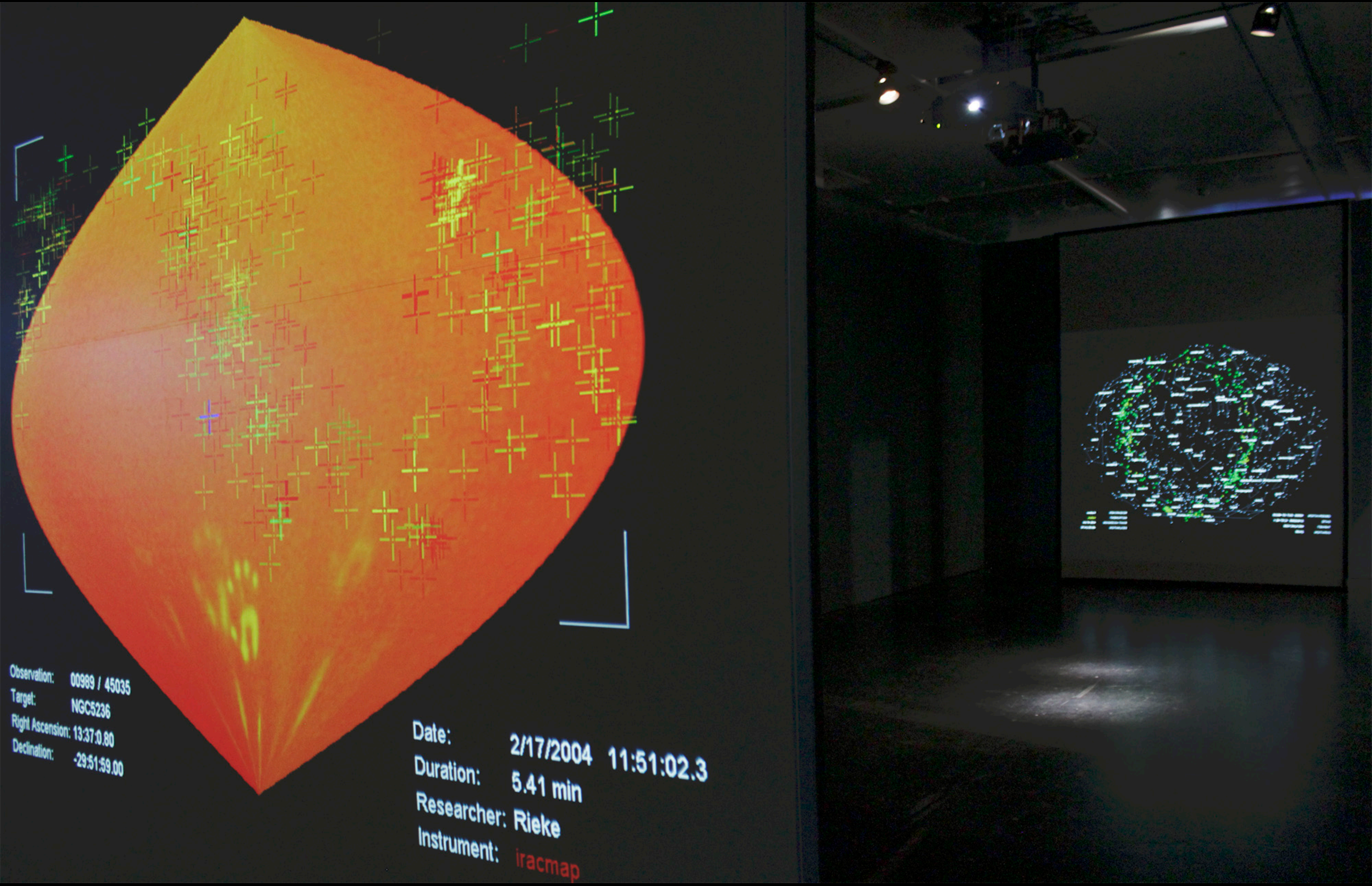
Printout 5. A virtual landscape as seen from vantage point Peak 3, with vertical exaggeration. Courtesy Eckart Dege.

[Kay E. Black, Eckart Dege, 1999]

Andrea Pozzo, church of St.Ignazio, Rome, 1690. 3D illusion on flat surface

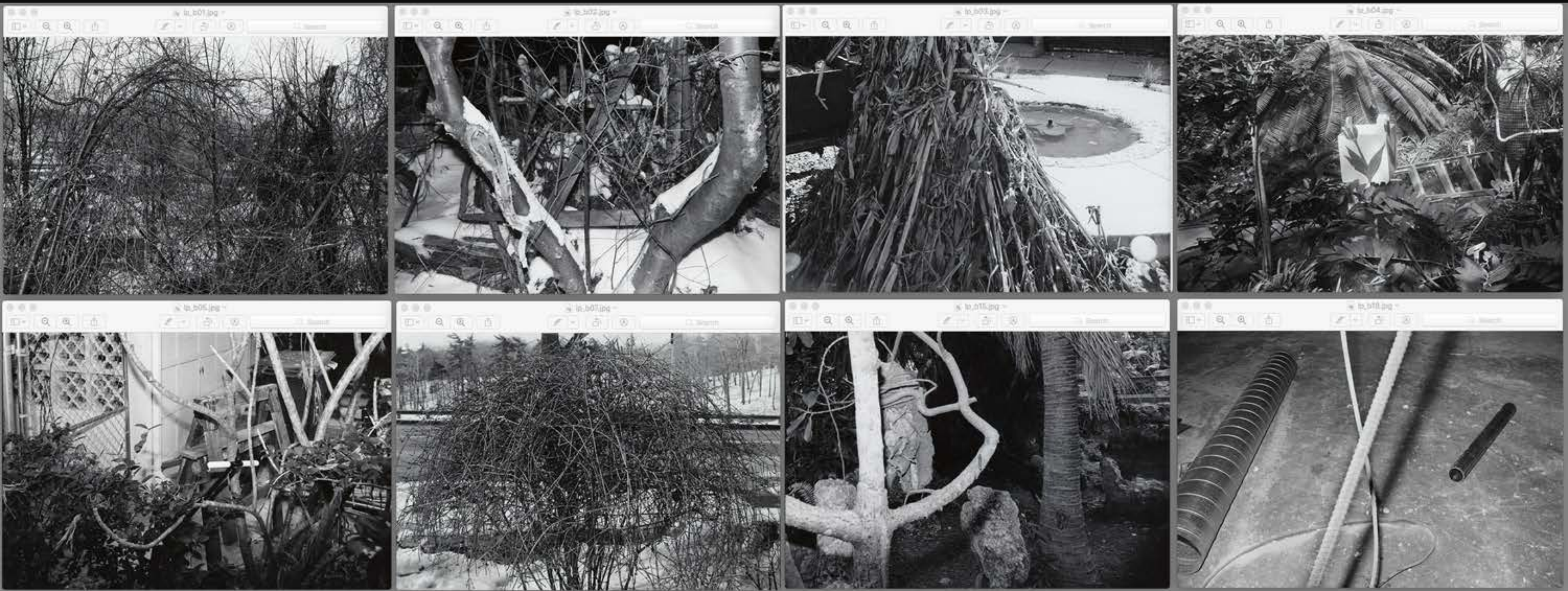
The Electromagnetic Spectrum

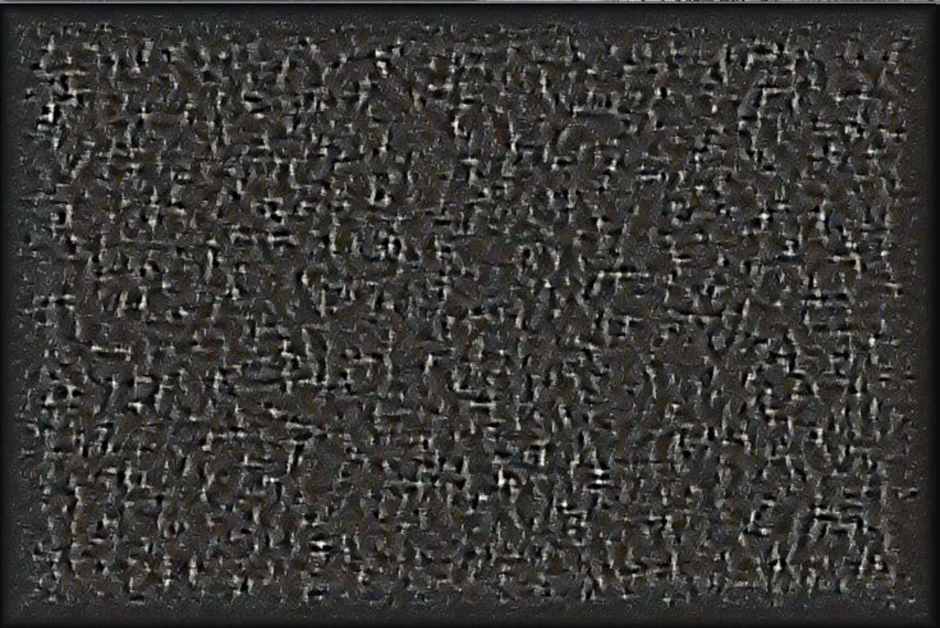




We Are Stardust, 2 screen installation in *InfoSphere* ZKM, Karlsruhe, 2015

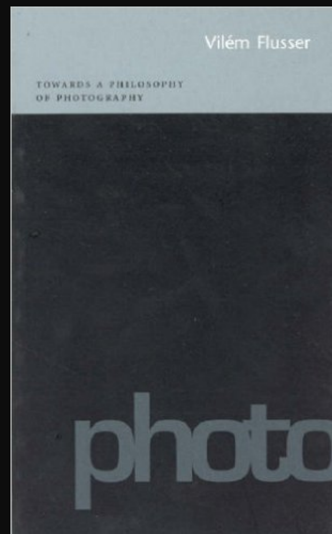
Software Generated images using Neural Texture Synthesis (Snelgrove)

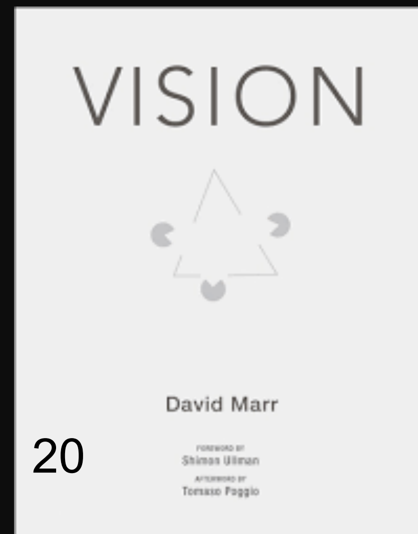




Software Generated Images – statistical derived

Some classical references (1970s-2000)





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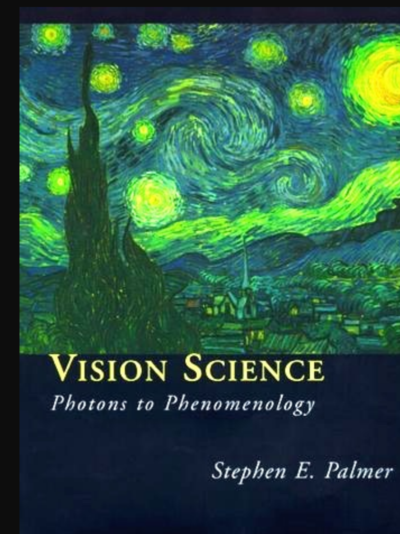

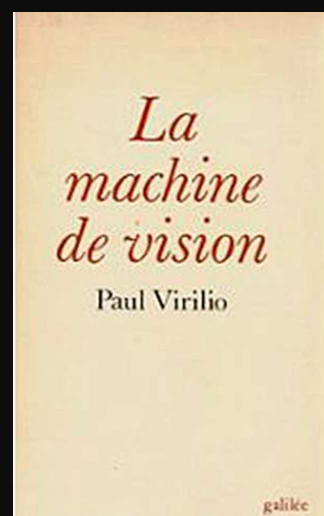

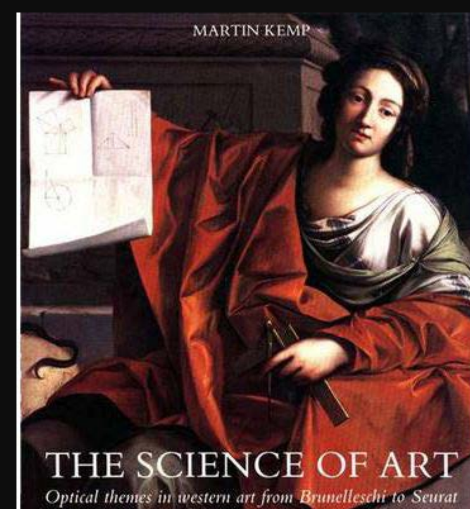

To be continued…