

Extreme photography

CS 178, Spring 2009



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Extremes

- ◆ high resolution
- high speed
- low speed
- small aperture
- large aperture
- narrow field of view
- wide field of view
- high dynamic range
- low dynamic range



Sinar view camera
10,000 × 8,000 pixels



CRAYONS

Different Brilliant Colors

TOYS 'R' US
68 17 F
PRICE
X >> \$2.57





Graham Flint's gigapixel.org



- ◆ custom camera and lens
- ◆ 18" negative → drum scanner → printer
- ◆ 40,000 pixels × 25,000 pixels



Balboa Park, San Diego

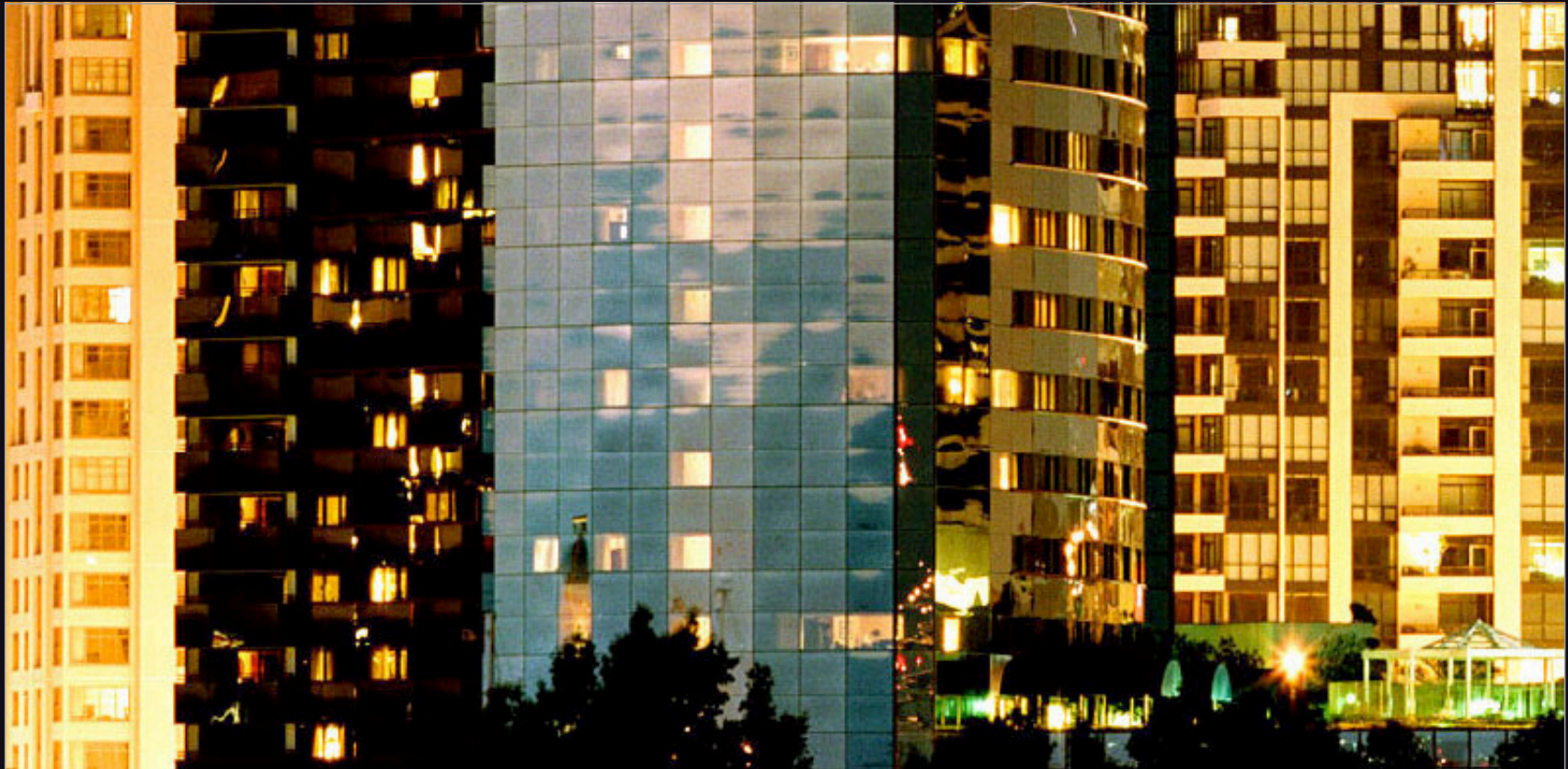
(full-resolution print in Gates Hall, 3rd floor, entrance to graphics wing)



San Diego Skyline



San Diego Skyline



San Diego Skyline



San Diego Skyline



xrez.com (also gigapixel resolution)



xrez.com (also gigapixel resolution)



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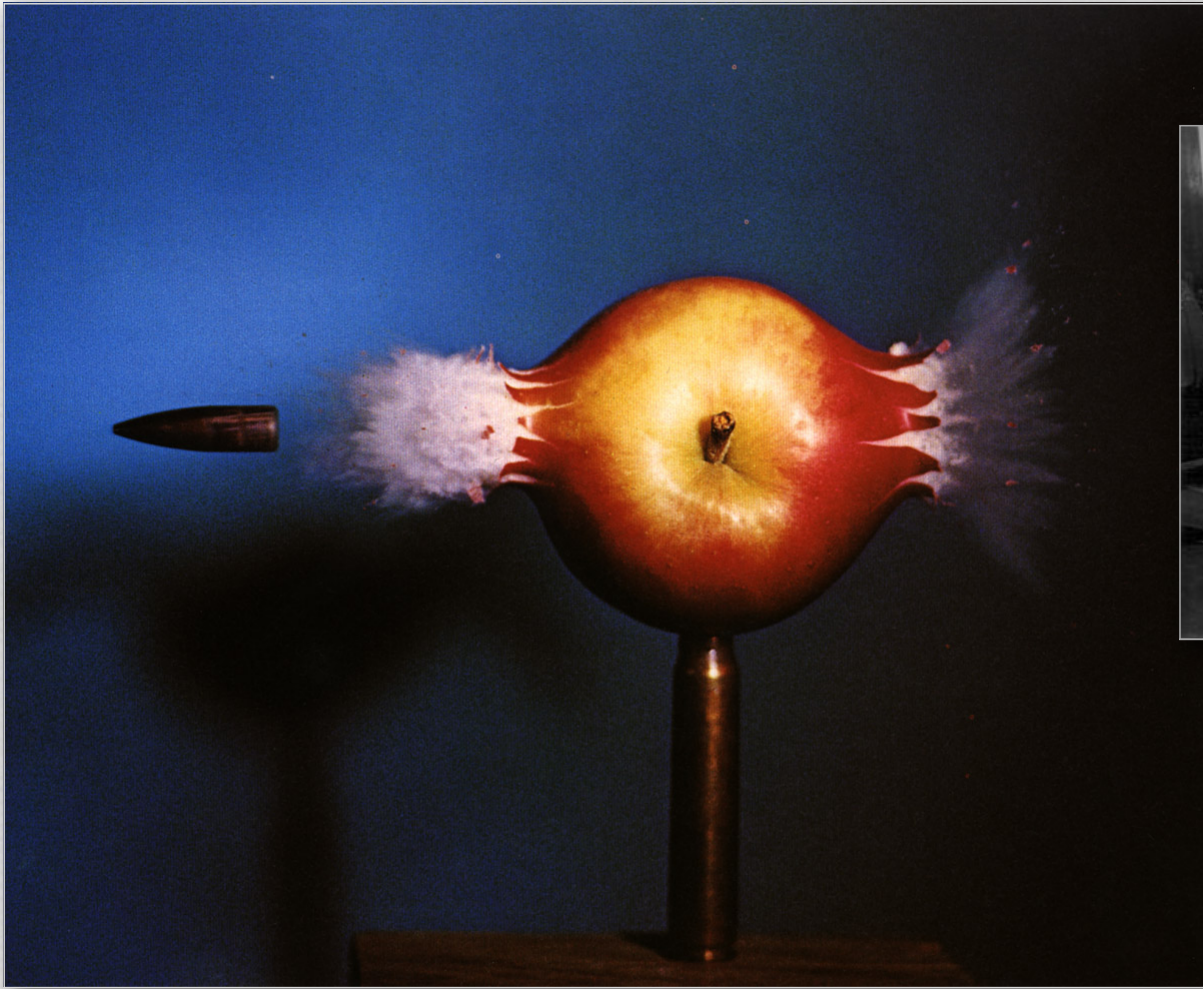


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Harold Edgerton:

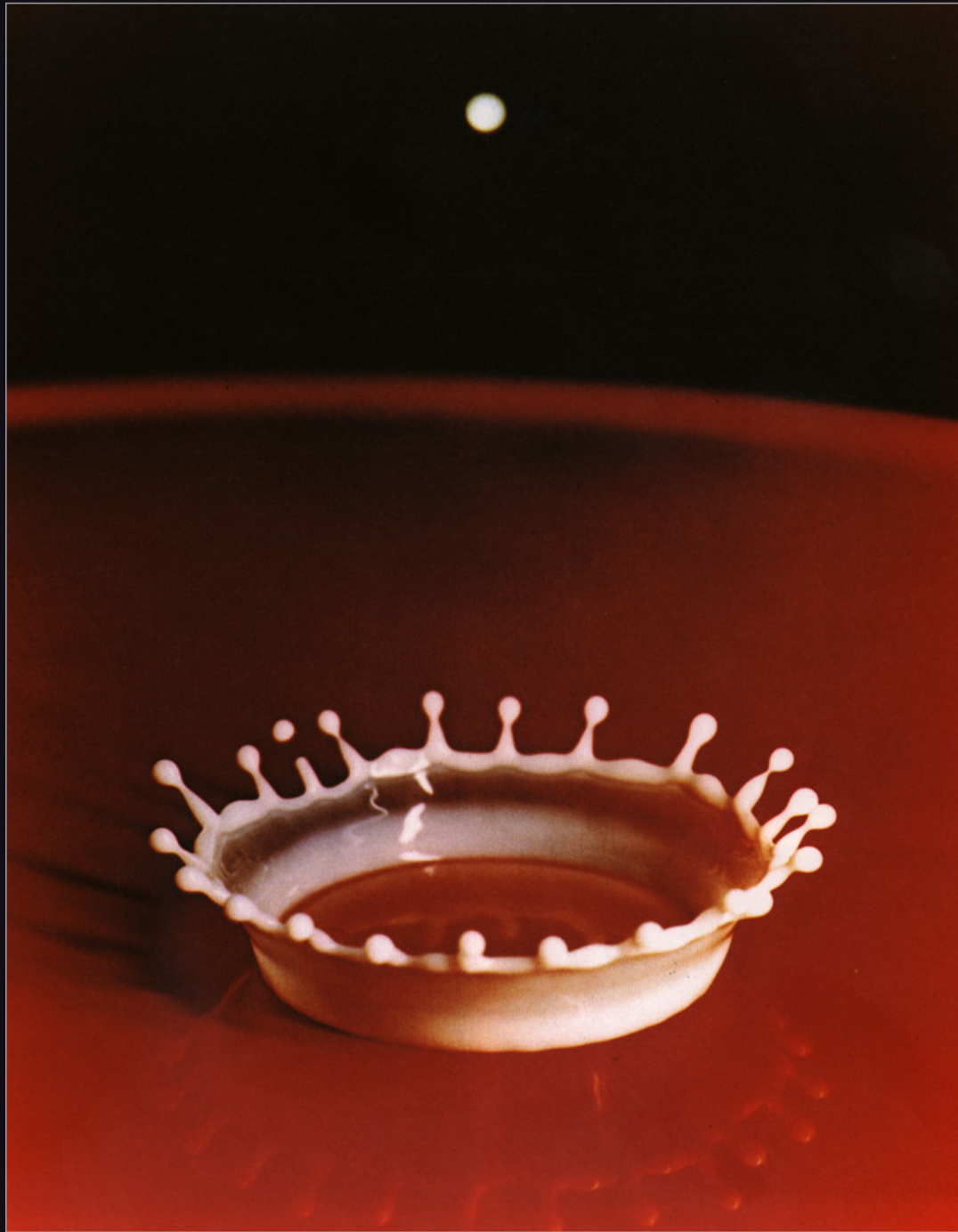
“father” of high-speed photography



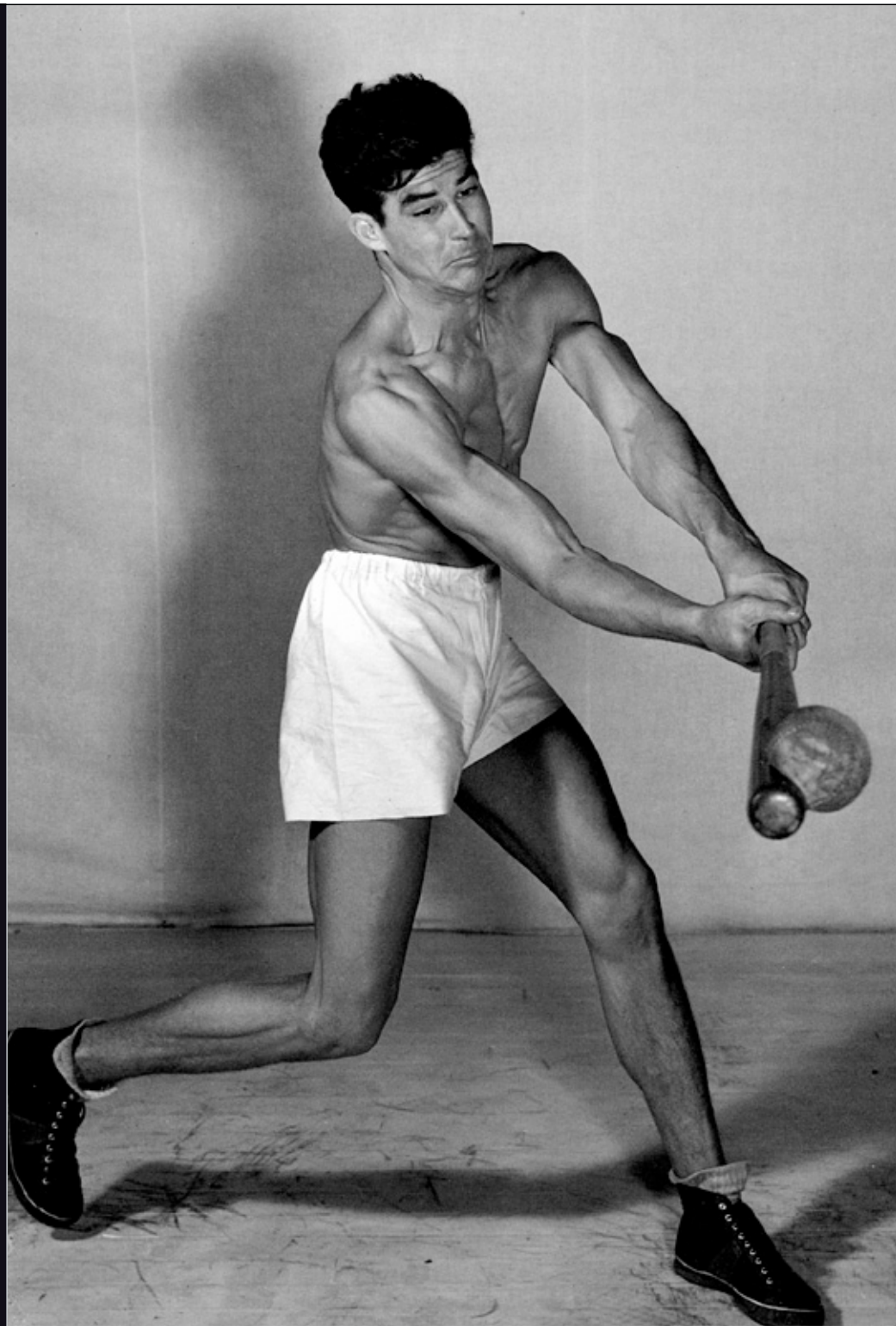
from Stopping Time, 1964

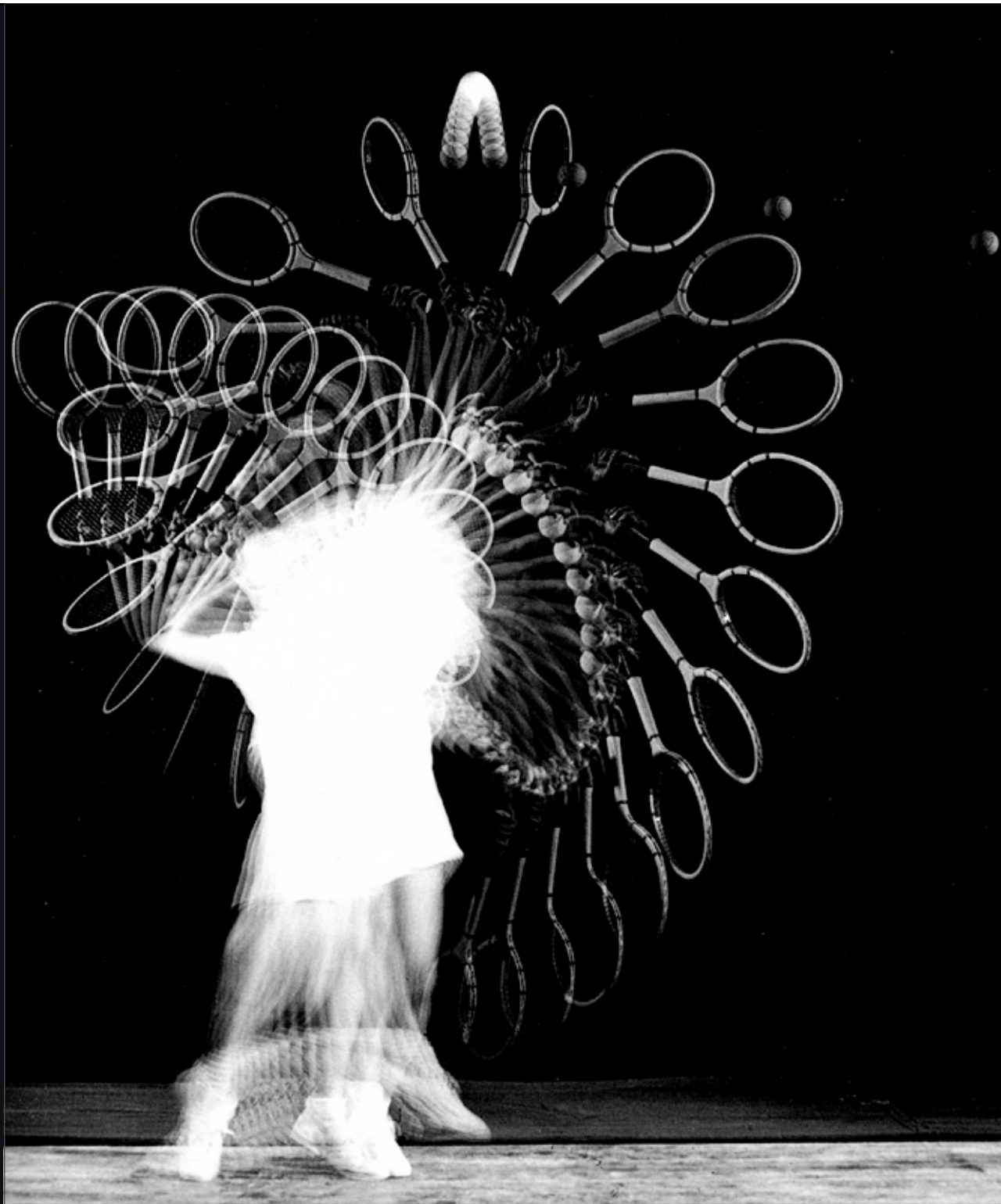


- no shutter
- electronic strobe
- microphone near gun

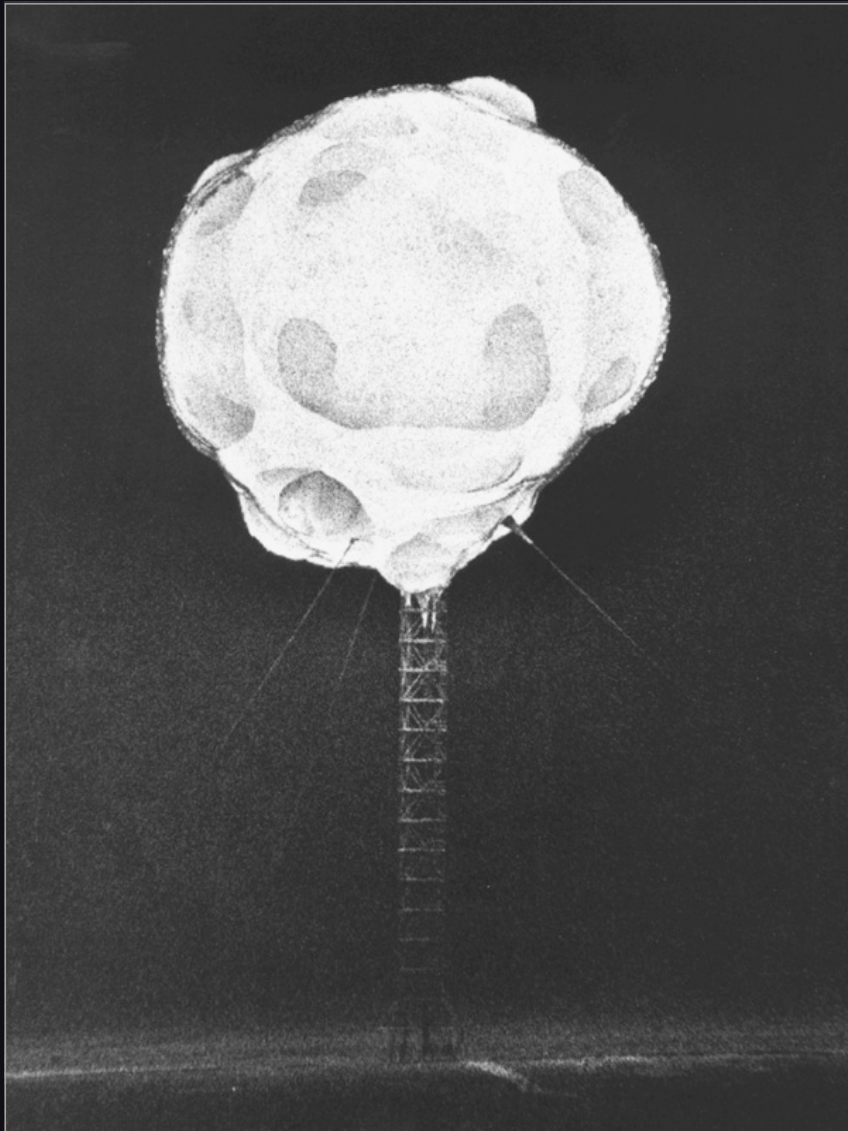




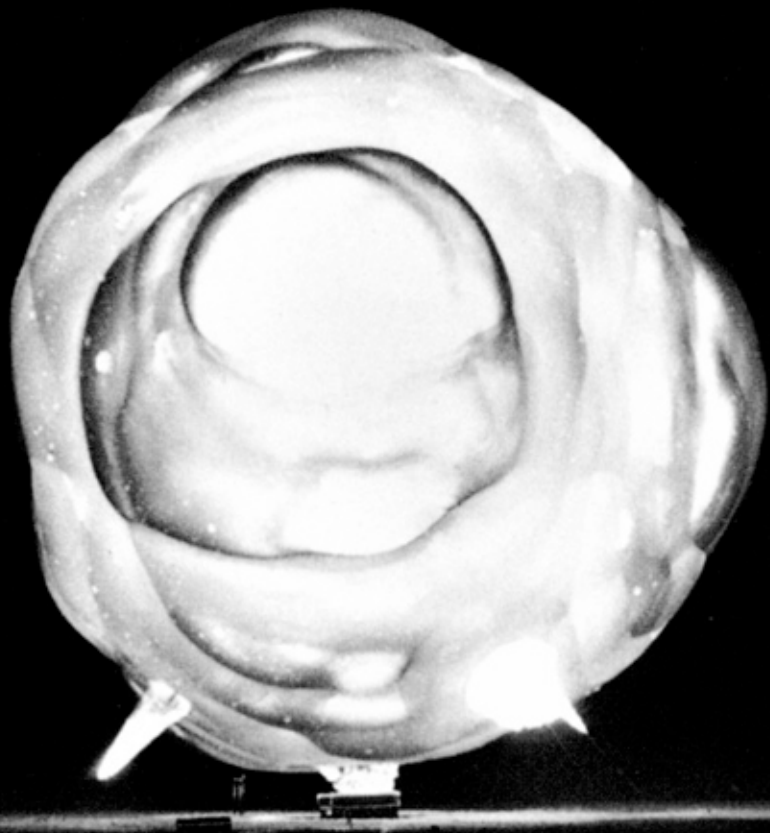


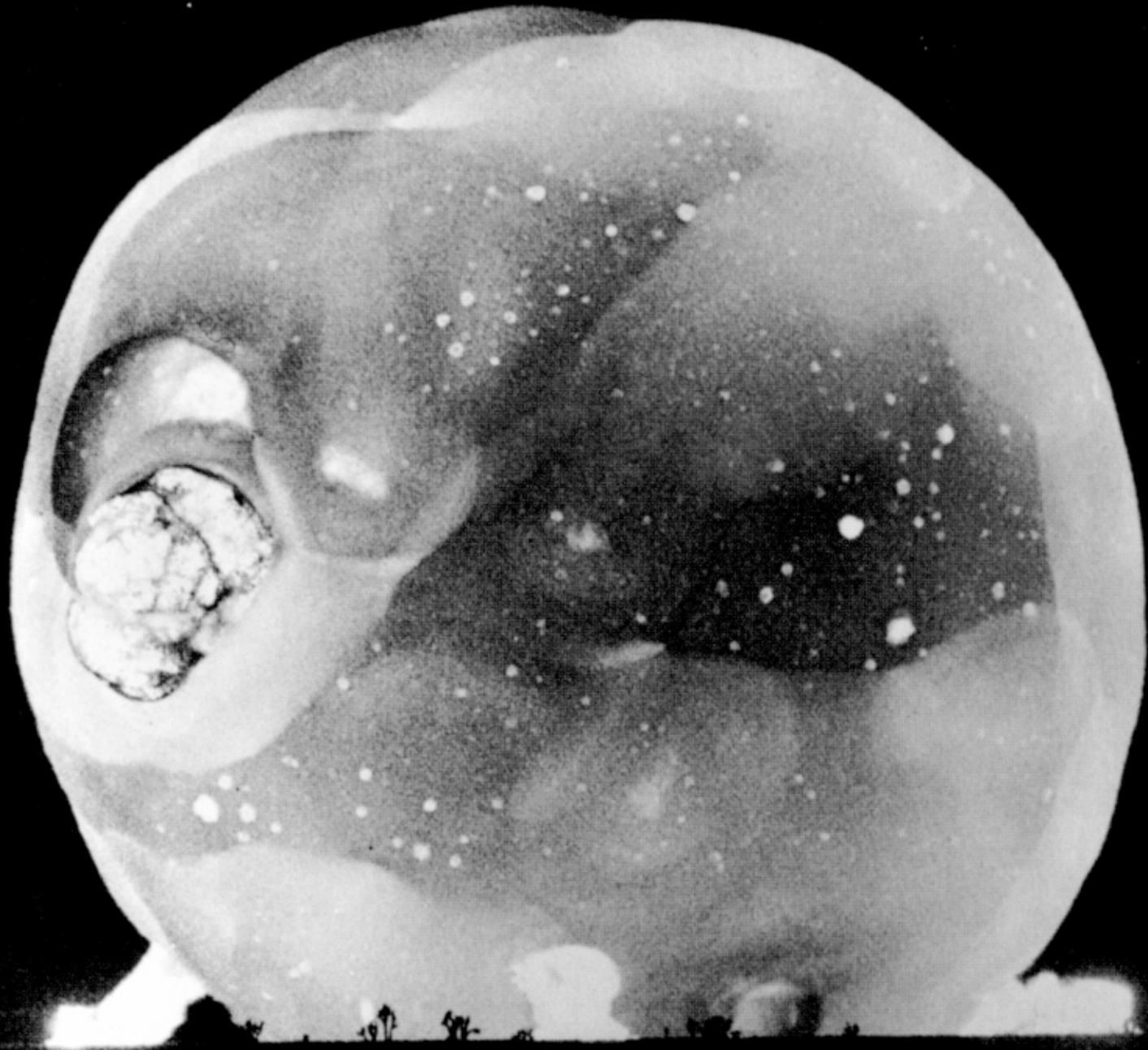


Ultra-high speed photography



- atomic explosion
- 1/100,000,000 second
- camera was 7 miles away
- telescopic lens





High-speed video with a still camera: the Casio EX-F1



- 640 × 480 pixels
- 300 frames per second
- border collie



- 320 × 480 pixels
- 600 frames per second



- 160 × 480 pixels
- 1200 frames per second

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Low-light photography



Lee Frost, Santorini, Greece

- composite of two 30-second exposures

Time exposures in astronomy

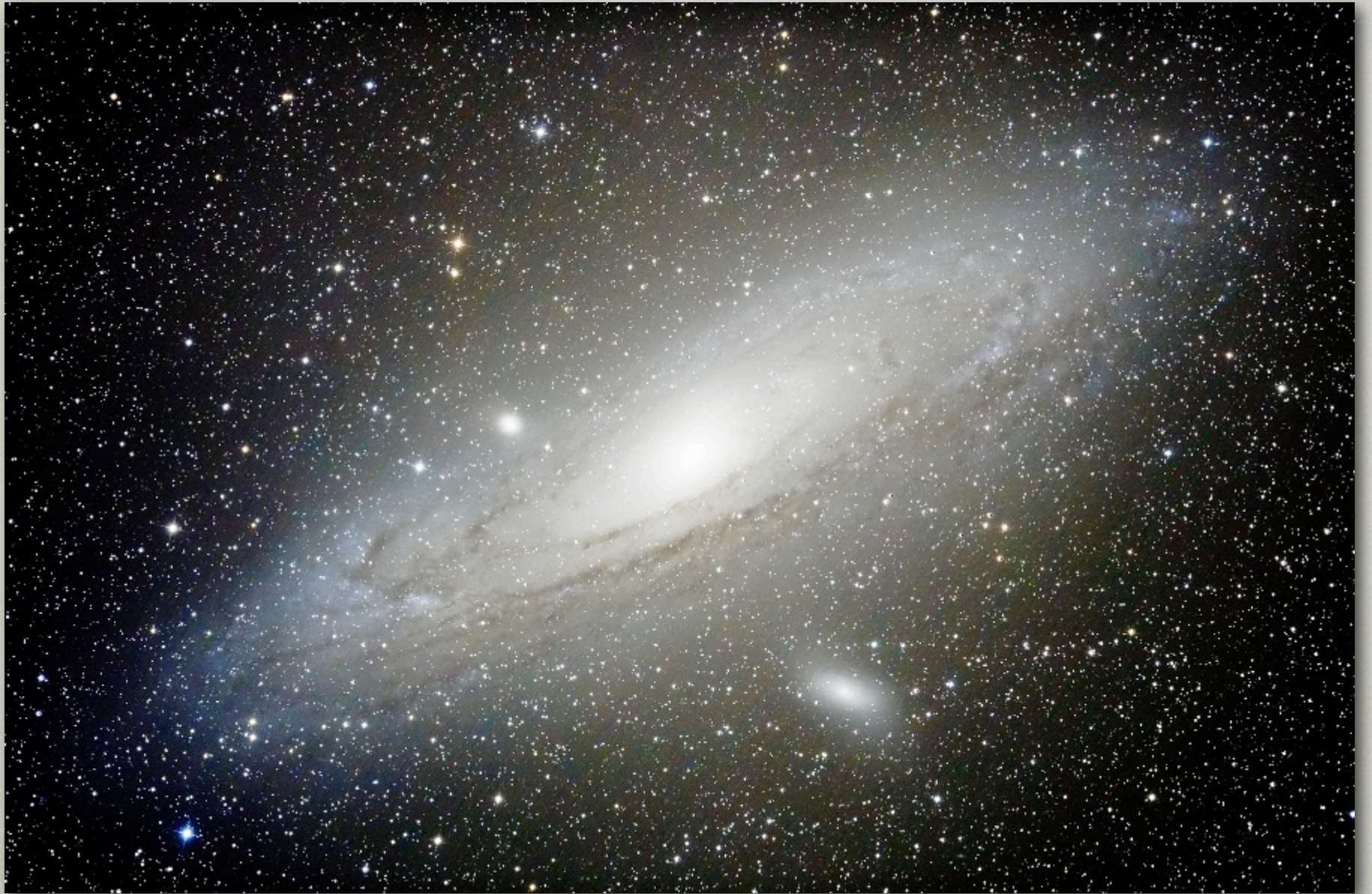


Lee Frost, star trails



(Palomar 200-inch)

- 30-minute exposure
- telescopes can rotate to avoid smearing stars
- What is the unmoving star in the middle?



Jesse Levinson, Andromeda

Painting with light



Lee Frost, railroad yard

- 30-second exposure
- multiple flashes
- Don't stand between the flashed part of the scene and the camera!

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Small aperture (large depth of field)



- the f/64 club

Ansel Adams, Mission San Xavier del Bac, Tucson

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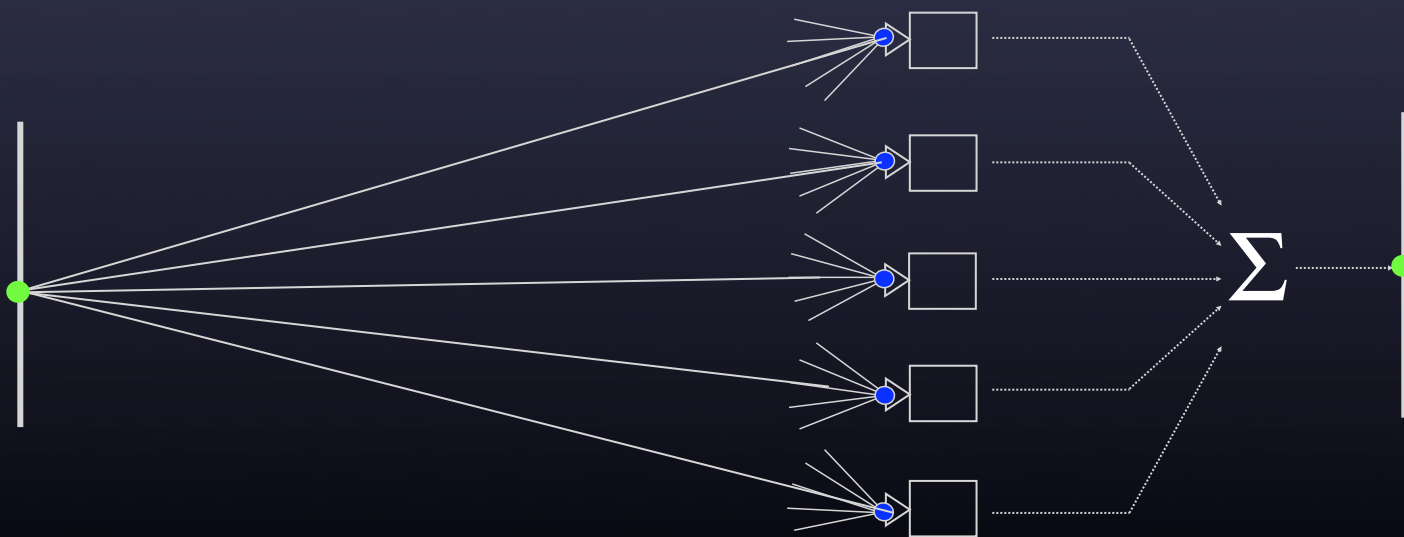
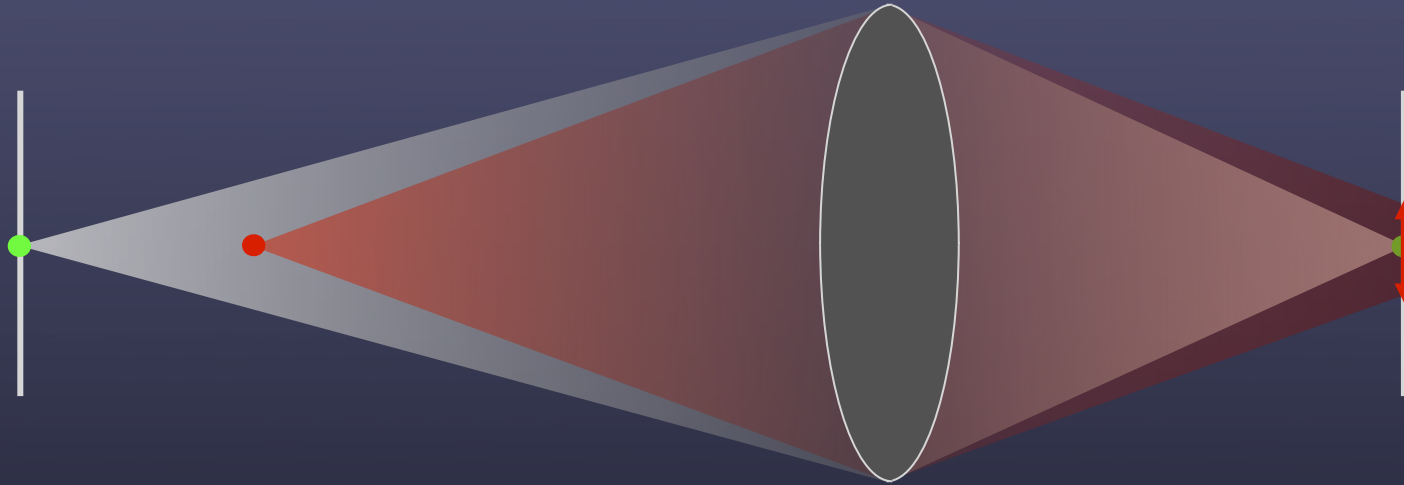
Large aperture (shallow depth of field)



Lewis Hine, Girl Worker in Cotton Mill, 1908

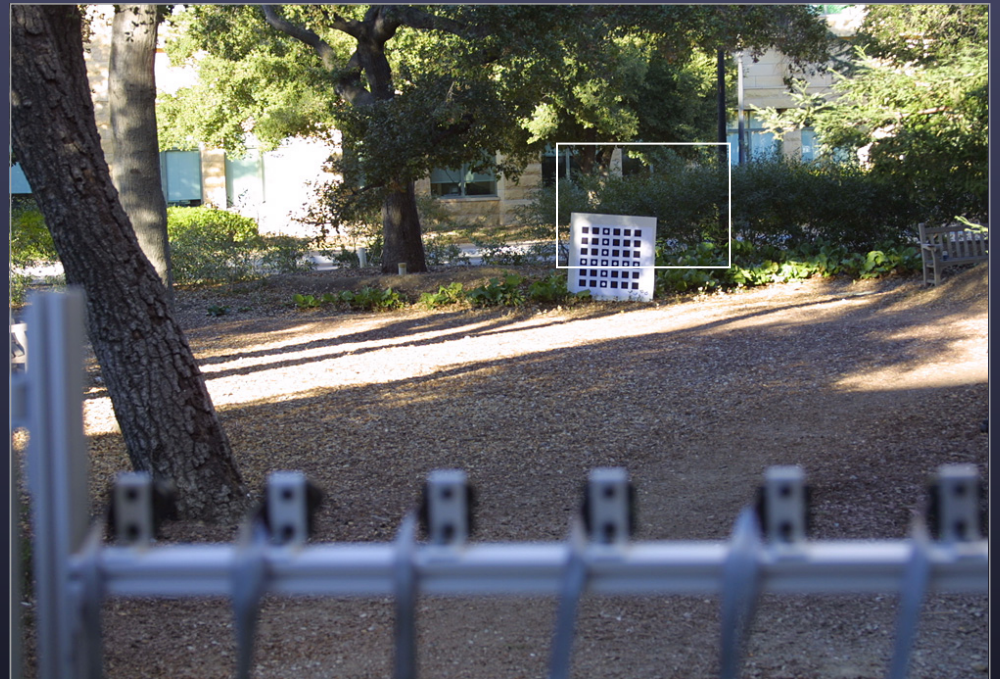
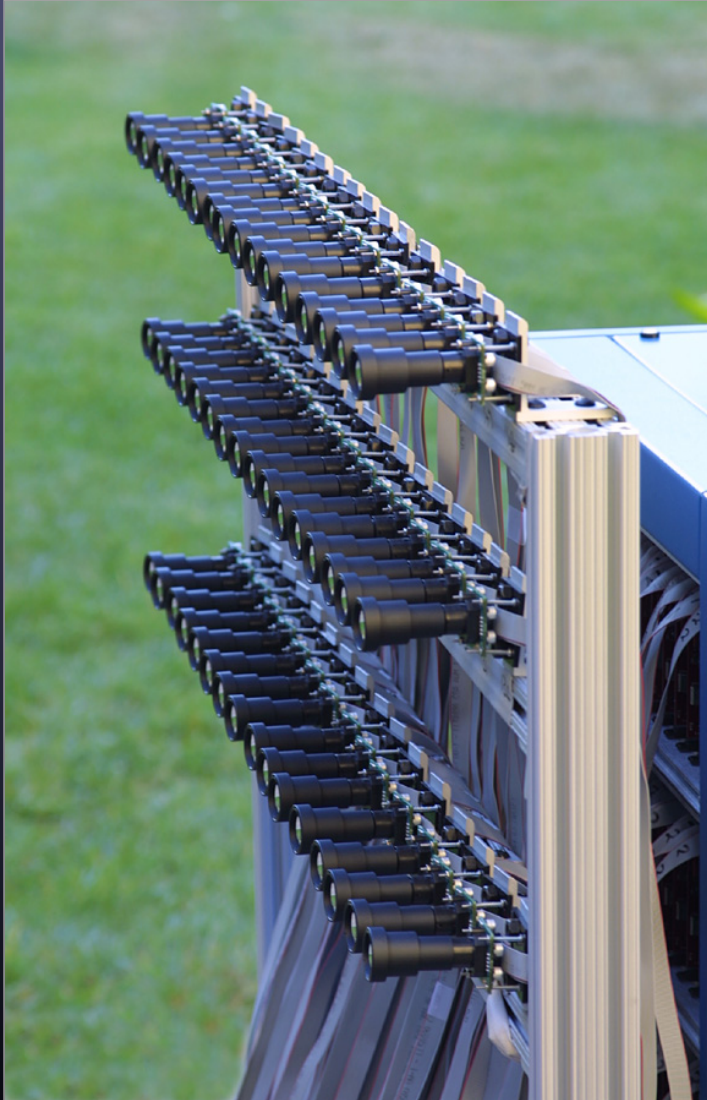


Synthetic aperture photography



Example using 45 cameras

[Vaish CVPR 2004]





(movie is available at <http://graphics.stanford.edu/projects/array>)

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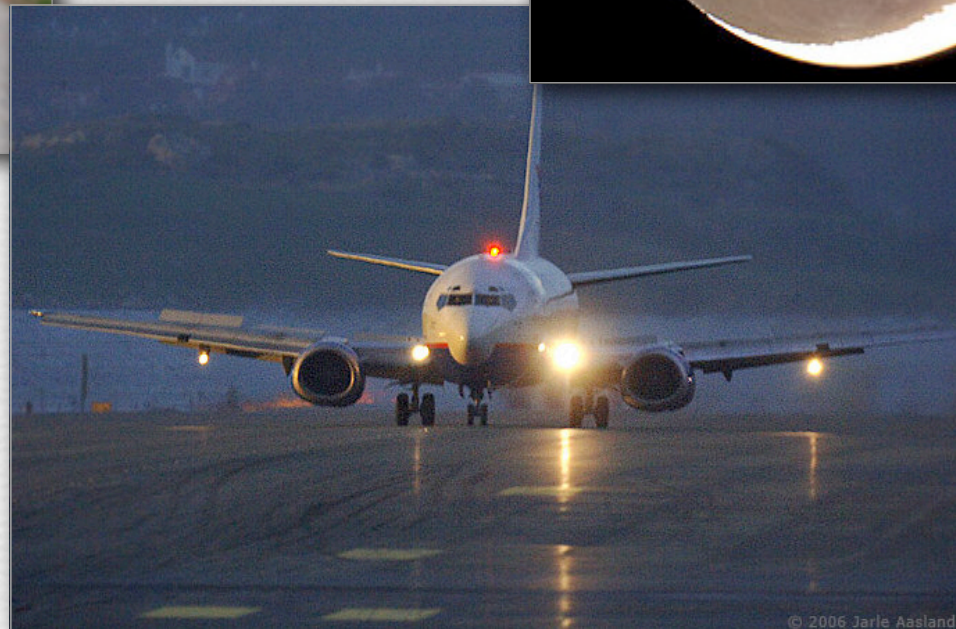
Narrow field of view: telephoto lens



- 300mm lens

Bryan Peterson, Golden Gate Bridge

Extreme telephoto



- Nikon 1540mm Cassegrain reflector

© 2006 Jarle Aasland

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Wide field of view: stitched panoramas



Crater Lake, Oregon

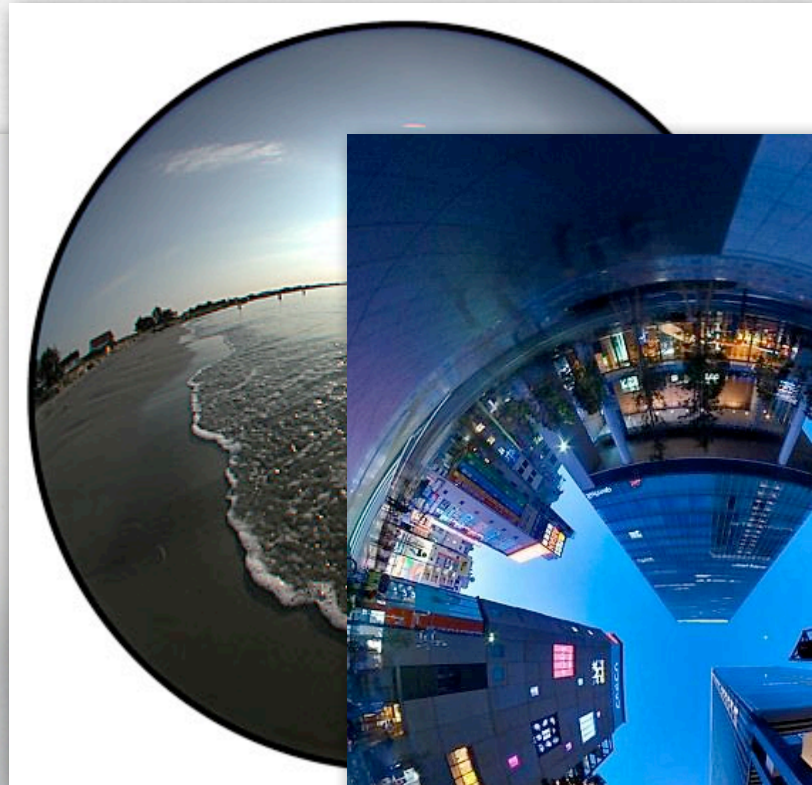
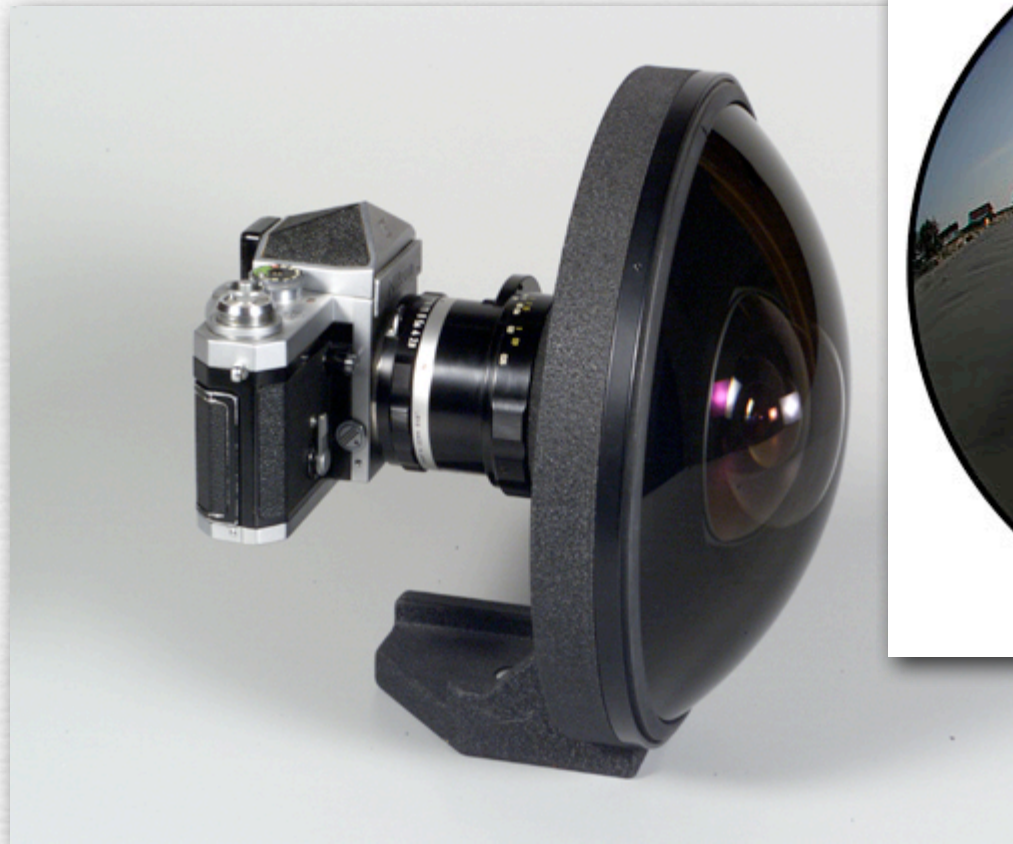
- 4 photos, total = 90° field of view
- Canon point-and-shoot camera, handheld
- stitched using Photoshop CS3

Games with stitched panoramas

- 5 shots, with camera aimed slightly downwards and rolled clockwise around its optical axis between shots left to right, producing a curved world effect when stitched using Photoshop with cylindrical projection



Nikon 6mm fisheye lens

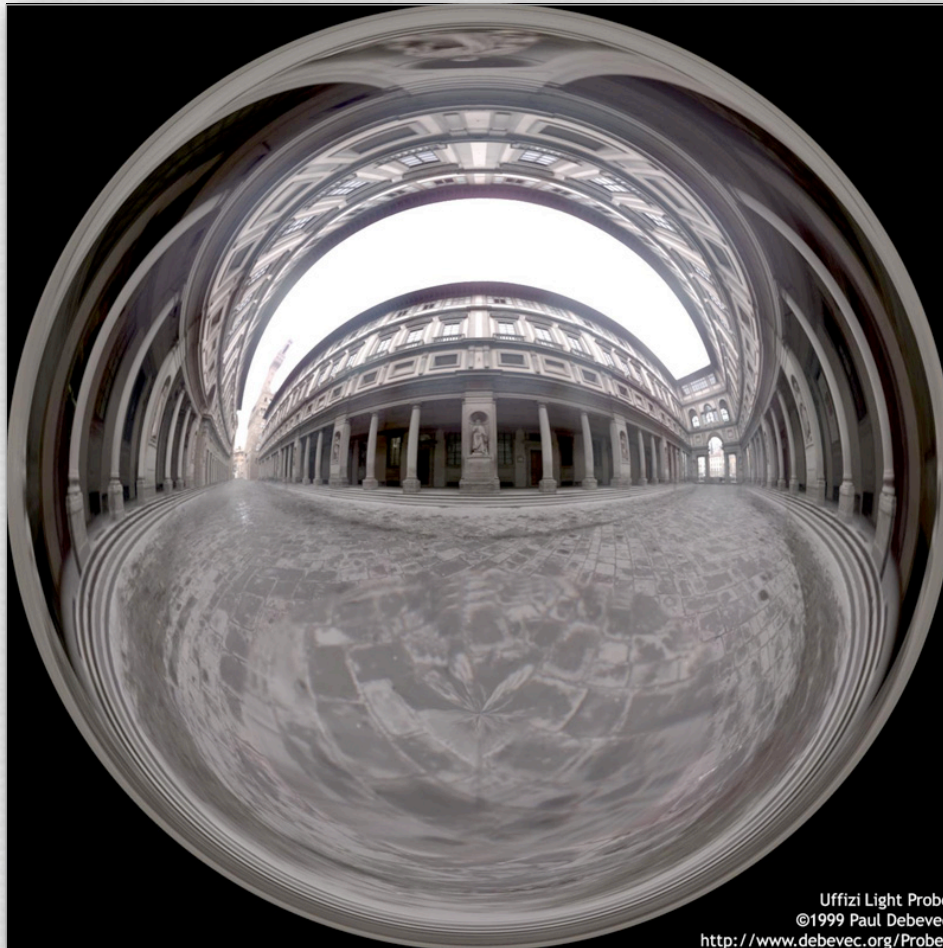


- 220° field of view measured diagonally
- 11.4 pounds

(DigitalFreak.net)

© 2009 Marc Levoy

360 x 360 panorama

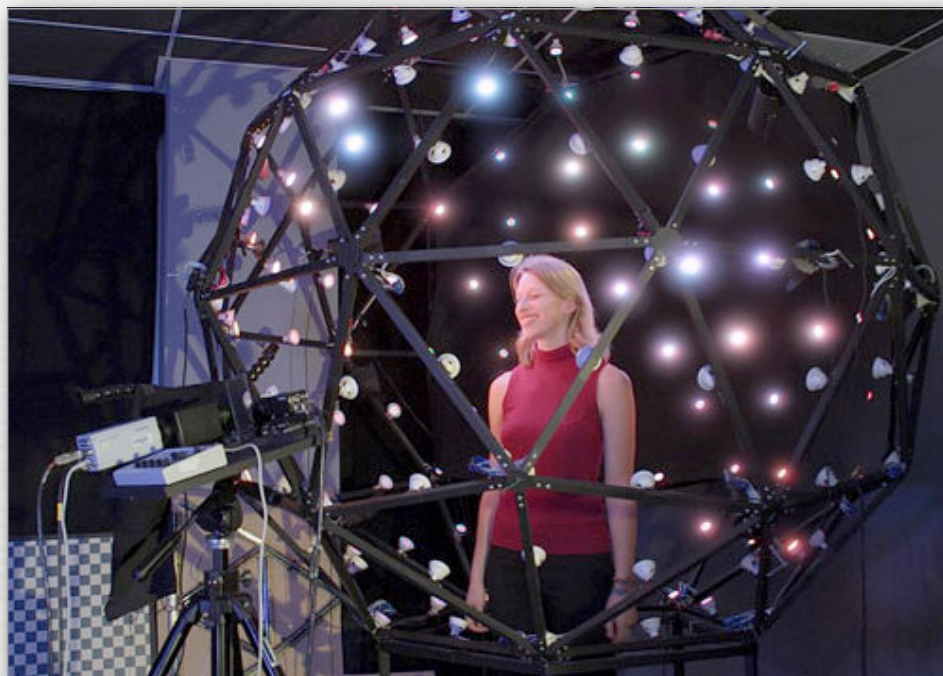


Paul Debevec, Uffizi Galleries, Florence

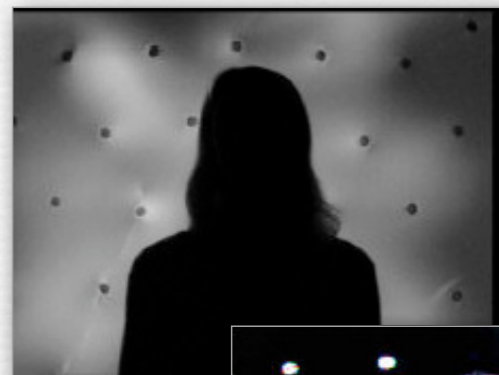
- point a camera at a chrome ball

Image-based relighting

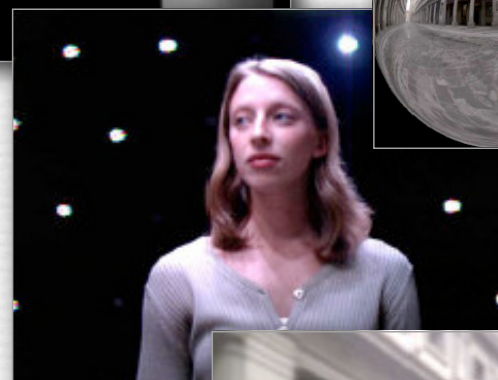
(Paul Debevec)



Light Stage



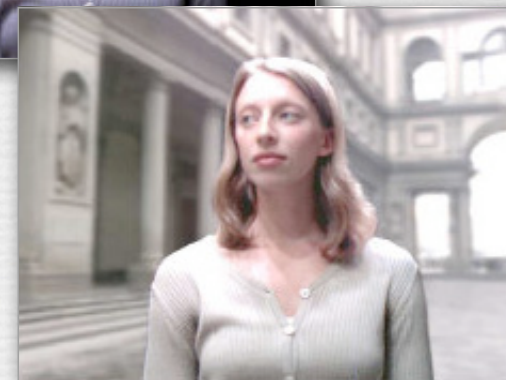
infrared



color



color and infrared LEDs



composite

Stanford CityBlock Project (now Google StreetView)

- ◆ capture video while driving
- ◆ extract middle column from each frame
- ◆ stack them to create a panorama



Stanford CityBlock Project



Stanford CityBlock Project

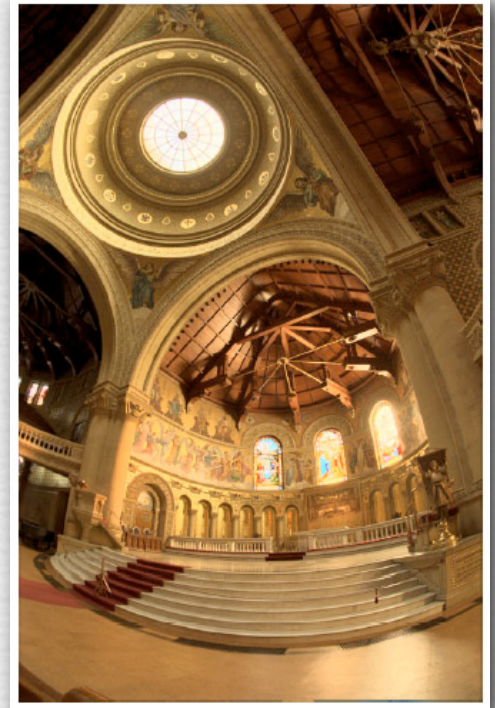
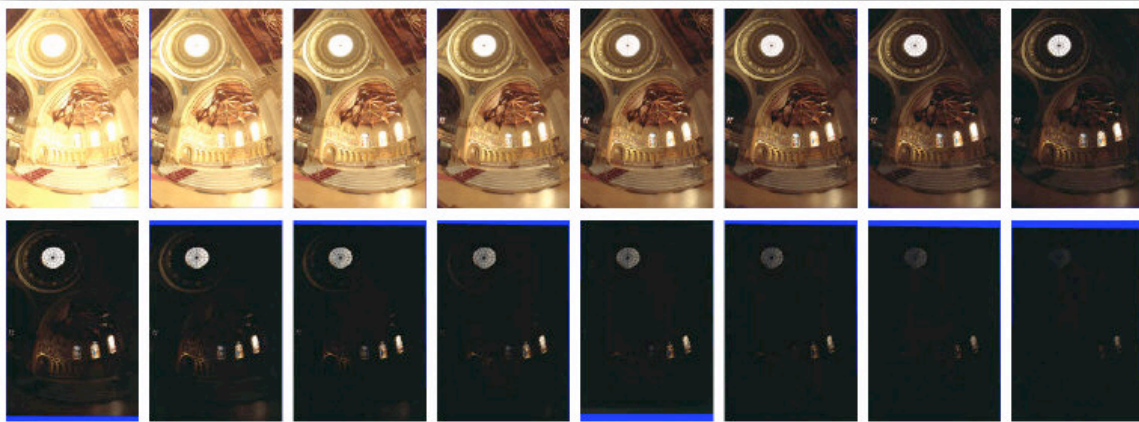


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High dynamic range (HDR)

- ◆ one of photography's key limitations
 - negative film = 250:1 (8 stops)
 - paper prints = 50:1
 - example below = 250,000:1 (18 stops)



(Paul Debevec)

DIY HDR



- 2 shots
- Photoshop CS4

Early morning in Zurich

DIY HDR



- 2 shots
- Photoshop CS4

Early morning in Zurich

DIY HDR



- 2 shots
- Photoshop CS4

Early morning in Zurich

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Atmospheric perspective according to Leonardo

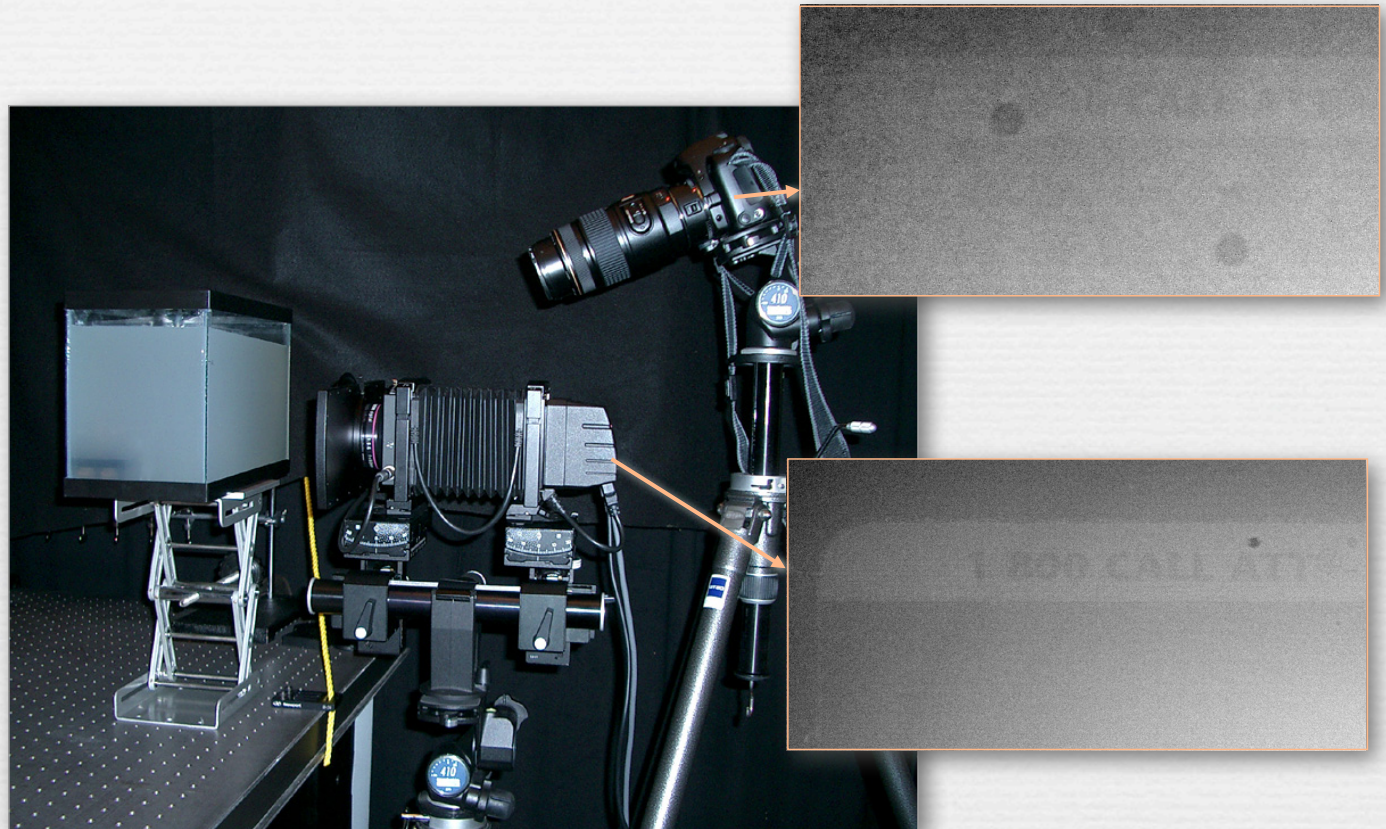


Virgin and child with St. Anne

“ the nearest objects will be bounded by evident and sharp boundaries, while those more distant will be... more blurred”

– *On Painting*

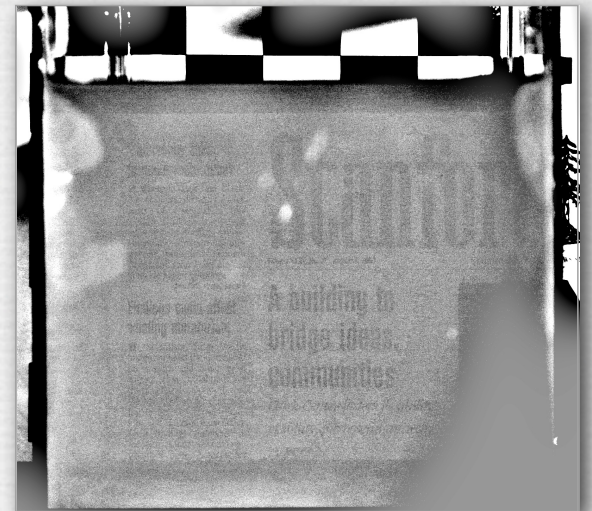
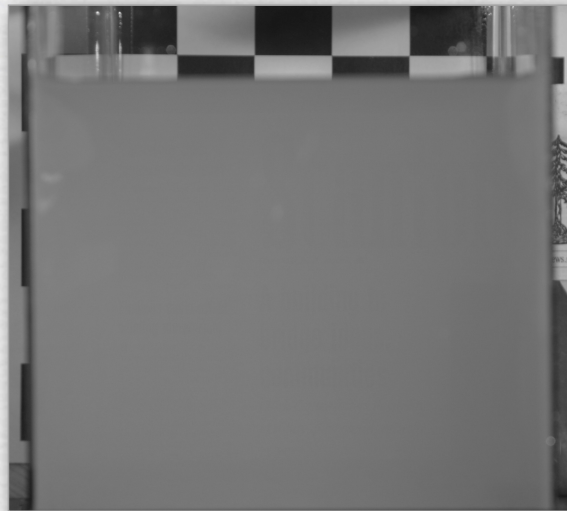
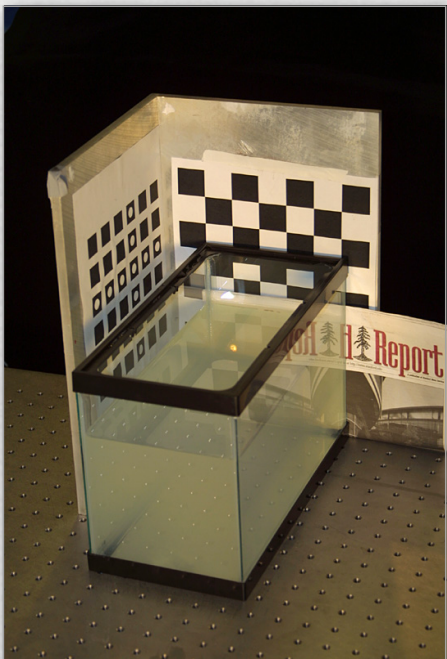
Sinar P3 view camera with 54H digital back



- ◆ $2\frac{1}{4} \times 2\frac{1}{4}$ sensor, actively cooled, 14 real bits

Seeing through murky water

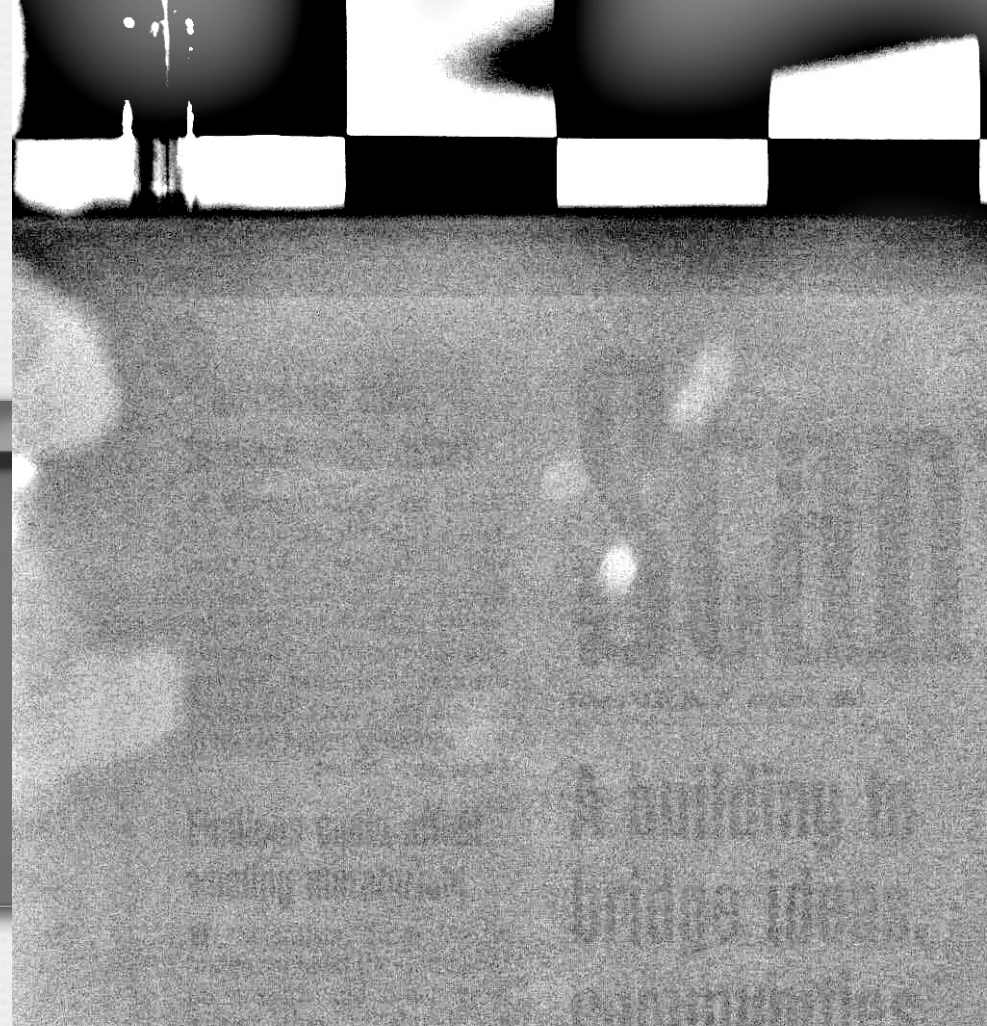
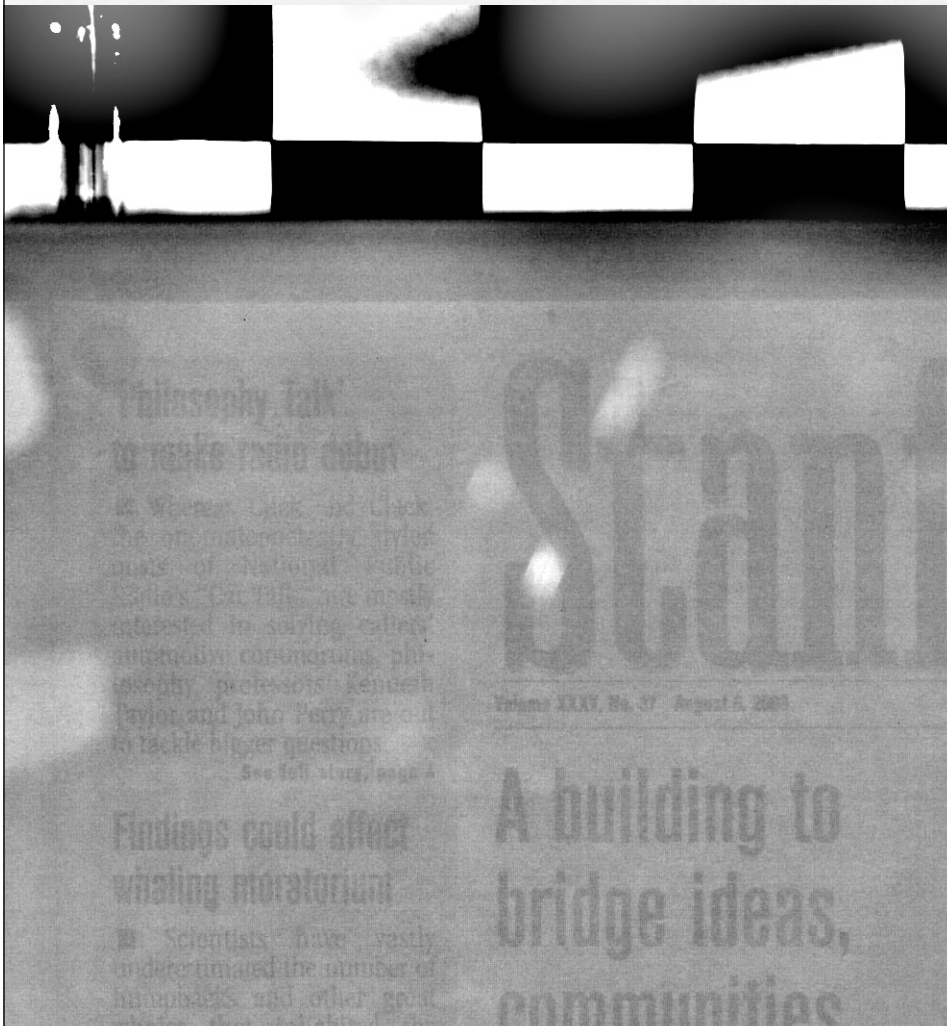
- ◆ scattering decreases contrast
- ◆ you can stretch the contrast, but...
- ◆ stretching is limited by imaging noise



Seeing through murky water

16 images

1 image



Coral reefs and shipwrecks



Slide credits

(in addition to individually credited images)

- ◆ Kayafas, G., Jussim, E., *Stopping Time: The Photographs of Harold Edgerton*, Harry Abrams Inc., 1987.
- ◆ Frost, L., *Night & Low-Light Photography*, Watson-Guptill, 1999.
- ◆ Peterson, B., *Learning to See Creatively*, Watson-Guptill, 1988.
- ◆ Kemp, M., *Leonardo On Painting*, Yale University, 1989.
- ◆ <http://gigapixl.org>
- ◆ <http://xrez.com>