

WEEK 6: EXPOSURE

DIGITAL MEDIA E-5

EXPLORING DIGITAL MEDIA

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Exposure

- Rendering a scene in a specific way using camera controls to interpret the amount of light in a given scene.

Exposure

- What is the goal of exposure?
 - To capture an intentional image by calibrating the camera to the light in a given scene.

How much light is in a scene?

- Foot Candles, Candela, Lumens, Lux
 - Measure the absolute amount of light in a given situation.
- We need to know how that relates to camera settings.
 - We need a relative measurement.

F-Stops

- We use the concept of stops to describe the amount of light in a scene relative to camera settings.
- A stop is a unit that halves or doubles the sensitivity of a camera to the given light in a scene.
- Doubling the sensitivity is +1 stop.
- Halving the sensitivity is -1 stop.



At exposure



1 stop overexposed



2 stops overexposed



3 stops overexposed



At exposure



1 stop underexposed



2 stops underexposed



3 stops underexposed

Measuring Light

- Light Meters
 - A device that measures the amount of light in a scene and interprets that data into camera settings.
 - They can be handheld or internal to a camera.
 - All light meters are calibrated to expose for 18% reflected grey. They just do so in different ways.



18% reflective grey

- Often called middle grey. Is a chroma neutral shade of grey that when exposed correctly yields a tone that is halfway in between full black and full white.
- Usually found on a grey card. Which has been printed with a tone of grey that reflects 18% of the light that strikes it.



Exposure suggested by the camera

Exposure increased by 1 stop

Exposure increased by 2 stops



Metered Exposure



Compensating by increasing exposure one stop

Exposure Controls

- Three main camera controls
- ISO – The sensitivity of the sensor to light
- Shutter Speed – How long the shutter is open for.
- Aperture – How large the diaphragm is open inside the lens.

ISO

ISO

- ISO measures the sensitivity of a medium to light.
 - In digital cameras this is the camera sensor.
- The sensitivity doubles and halves when the ISO value is doubled or halved.
 - 100, 125, 160, 200, 250, 320, 400, 500, 640, 800, 1000, 1250, 1600

Counting Stops

- From 200 ISO to 800 ISO 2 stops more sensitive
- From 1600 ISO to 50 ISO 5 stops less sensitive
- From 320 ISO to 400 ISO $\frac{1}{3}$ stop more sensitive
- From 500 ISO to 1000 ISO 1 stop more sensitive

Artifacts of ISO

- Increasing the sensitivity of a medium introduces noise.
- More sensitive ISO values have more noise and lower ISO Values have less noise.
- Noise manifests as random pixel values in your image.
 - Noise is more apparent in the shadows of an image.



400 ISO



3200 ISO



12800 ISO

400 ISO

3200 ISO



12800 ISO

Creative Uses

- Why would you ever accept more noise?
 - There is not enough light in the scene.
 - For aesthetic effect.
 - To mimic grainy footage.
 - For a textural effect.

STOPPING MOTION

SHUTTER SPEED



Shutter Speed

- Shutter speed is the amount of time the sensor is exposed to light.
- We measure in fractions of a second, though you may see them written on cameras as integer values. This is a space saving convention.
 - 1', 1/2, 1/4, 1/8, 1/15, 1/30, 1/60, 1/125, 1/250, 1/500, 1/1000
- Doubling the length of time the shutter is open doubles the amount of light entering the camera.

Counting Stops

- From $1/60$ to $1/15$ 2 stops more sensitive
- From $1/1000$ to $1/30$ 5 stops more sensitive
- From $1/500$ to $1/400$ $1/3$ stop more sensitive
- From $1/180$ to $1/90$ 1 stop more sensitive





1/4000 s

1/2000 s

1/1000 s

1/500 s

1/250 s

1/125 s

1/60 s

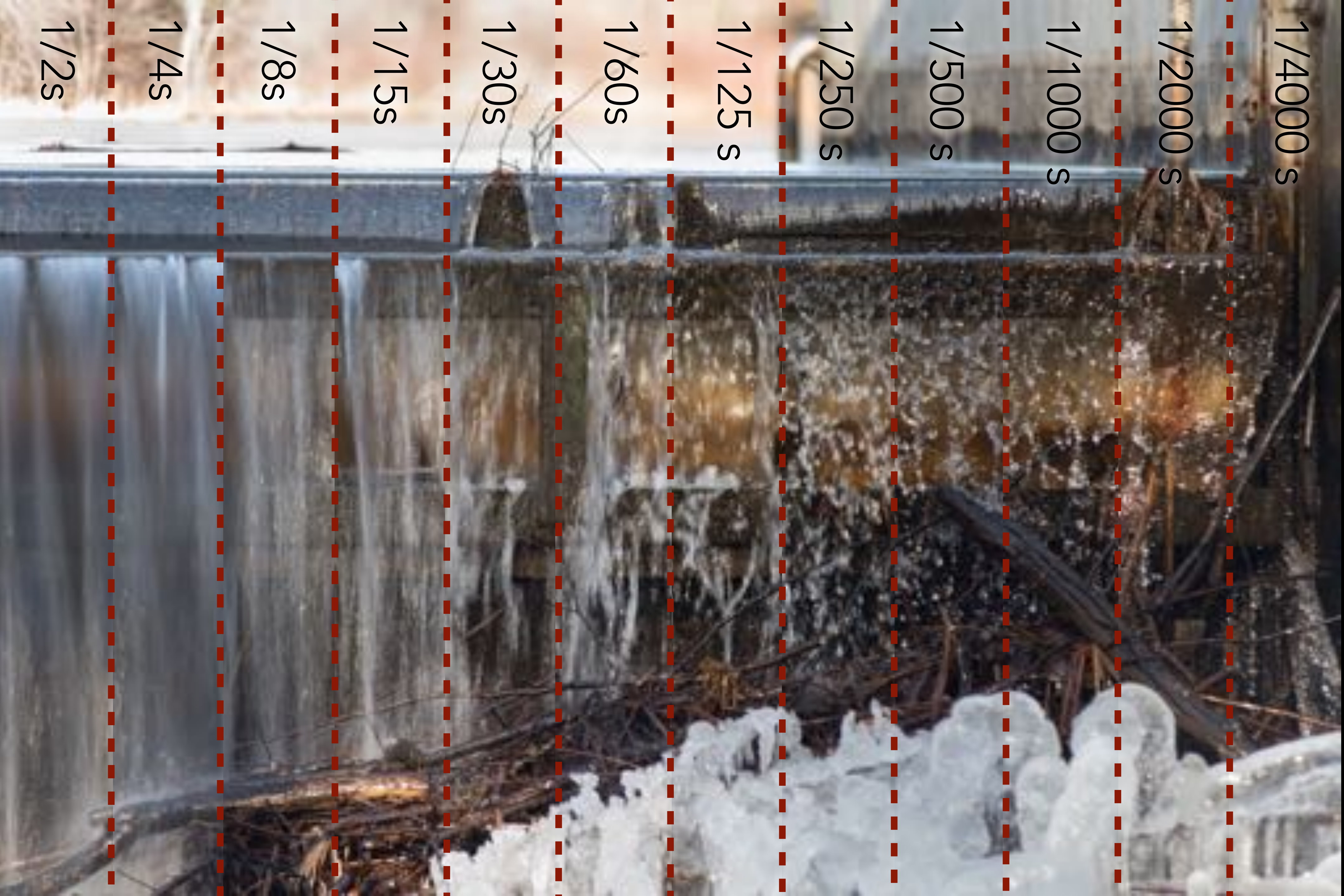
1/30 s

1/15 s

1/8 s

1/4 s

1/2 s









1/20s, f/14, ISO 100.
Ian Sexton, 2019

CAMERA SHAKE RULE OF THUMB

To minimize handheld camera shake set your shutter speed faster than
1 / focal length (mm)

50mm lens (equivalent):
1/50th

100mm lens (equivalent):
1/100th

APERTURE



Aperture

Aperture

- Refers to the size of the diaphragm opening in the lens. It is a fractional relationship between the size of the opening and the length of the lens.
- The Major f-stops
 - 1, 1.4, 2, 2.8, 4, 5.6, 8, 11, 16, 22
- The smaller the number the larger the opening. The larger the number the smaller the opening.
 - They are actually fractions but written as integers to save space. (1/22 is smaller than 1/2)

Smaller f number

Larger f number



Larger Opening

Smaller Opening

Halves the amount of light with each major stop

Doubles the amount of light with each major stop

Artifacts of Aperture

- Changing the aperture directly affects the Depth of Field in an image.
- Depth of field is defined as the amount of an image in apparent focus.
 - In reality there is only a single plane of critical focus. The rest of the image is sharp enough to look in focus.

APERTURE



1/4000, f/1.4, ISO 400.
Dan Coffey, 2017

APERTURE



1/60, f/11, ISO 400.
Dan Coffey, 2017

APERTURE



1/4000, f/1.4, ISO 400
Dan Coffey, 2017

1/60, f/11, ISO 400
Dan Coffey, 2017

Exposure equivalencies

- We can expose for the same scene with different settings and yield an image that is at exposure.
- How does the image change?



ISO 100

f 5.6

1/100th



ISO 400

f 1.4

1/6400th



ISO 32000

f 11

1/6400th



ISO 640

f 1.4

1/8000



ISO 640

f 22

1/30th



ISO 100

f 5.6

1/100th



ISO 400

f 1.4

1/6400th



ISO 32000

f 11

1/6400th



ISO 640

f 1.4

1/8000



ISO 640

f 22

1/30th

Aperture

F5.6

**Available
Light**

ISO

400

Shutter Speed

1/60s



Equivalencies

Aperture	ISO	Shutter Speed
5.6	400	1/60
8	400	
1.4	400	
2.8		1/30
	800	1/8
	320	1/100

Equivalencies

Aperture	ISO	Shutter Speed
5.6	400	1/60
8	400	1/30
1.4	400	
2.8		1/30
	800	1/8
	320	1/100

Equivalencies

Aperture	ISO	Shutter Speed
5.6	400	1/60
8	400	1/30
1.4	400	1/1000
2.8		1/30
	800	1/8
	320	1/100

Equivalencies

Aperture	ISO	Shutter Speed
5.6	400	1/60
8	400	1/30
1.4	400	1/1000
2.8	50	1/30
	800	1/8
	320	1/100

Equivalencies

Aperture	ISO	Shutter Speed
5.6	400	1/60
8	400	1/30
1.4	400	1/1000
2.8	50	1/30
22	800	1/8
	320	1/100

Equivalencies

Aperture	ISO	Shutter Speed
5.6	400	1/60
8	400	1/30
1.4	400	1/1000
2.8	50	1/30
22	800	1/8
4	320	1/100











Depth Of Field

- Is the amount of an image that is in apparent focus.
 - There is only a single plane critical focus. However other parts of the image can appear to be sharp to the human eye.
- Of the exposure controls aperture is the only one that affects Depth of Field. However depth of field can be affected in other ways.

Diagram



Depth of Field

- We describe depth of field as being deep when there is much of an image in apparent focus
- Conversely if only a small area is in apparent focus we describe it as shallow.
- The three factors that control depth of field are Aperture, Focal length and the focusing distance of the lens.

Aperture

- The smaller the opening the deeper the depth of field.
- The larger the opening the shallower the depth of field.
- f1, f1.4, f2, f2.8, f4, f5.6, f8, f11, f16, f22
- Shallower ←————→ Deeper
- Rule of thumb doubling the size of the aperture halves the depth of field.

APERTURE

f/2
f/2.8
f/4
f/5.6
f/8
f/11
f/16

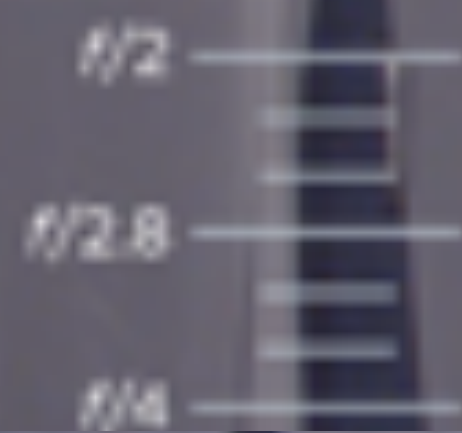
LIGHT (STOPS)

+6
+5
+4
+3
+2
+1
0



Start

APERTURE

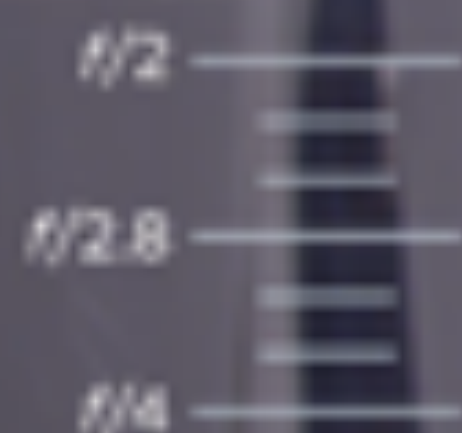


LIGHT (STOPS)

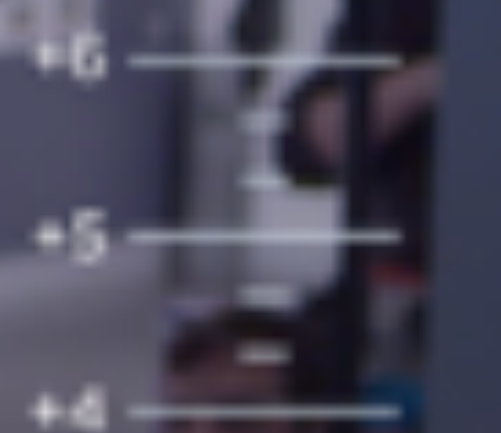


End

APERTURE



LIGHT (STOPS)



APERTURE

f/2
f/2.8
f/4
f/5.6
f/8
f/11
f/16



LIGHT

+6
+5
+4
+3
+2
+1
0



Start



End



APERTURE

f/2
f/2.8
f/4
f/5.6
f/8
f/11
f/16



LIGHT (STOPS)

+6
+5
+4
+3
+2
+1
0



Start APERTURE

f/2
f/2.8
f/4
f/5.6
f/8
f/11

LIGHT (STOPS)

+6
+5
+4
+3
+2
+1



End

APERTURE

f/2
f/2.8
f/4
f/5.6
f/8
f/11

LIGHT (STOPS)

+6
+5
+4
+3
+2
+1



Distance to subject

- Depth of field is shallower when a lens is focused to a closer distance than to a further distance.
- The closer the critical plane of focus = Shallower depth of field
- The farther the critical plane of focus = Deeper depth of field
- Rule of thumb doubling the distance quadruples the depth of field

DISTANCE (FT)

4
5
6
7
8
9
10
11
12
13
14



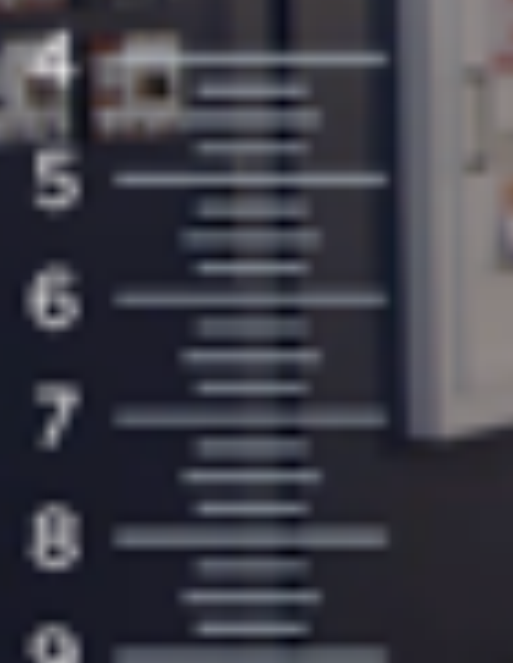
Start

DISTANCE (FT)



End

DISTANCE (FT)



DISTANCE (FT)

4

5

6

7

8

9

10

11

12

13

14



Start

DISTANCE (m)

4

5

6

7

8

9

10



End

DISTANCE (m)

4





DISTANCE (FT)

4

5

6

7

8

9

10

11

12

13

14



Start



DISTANCE (FT)

4

5

6

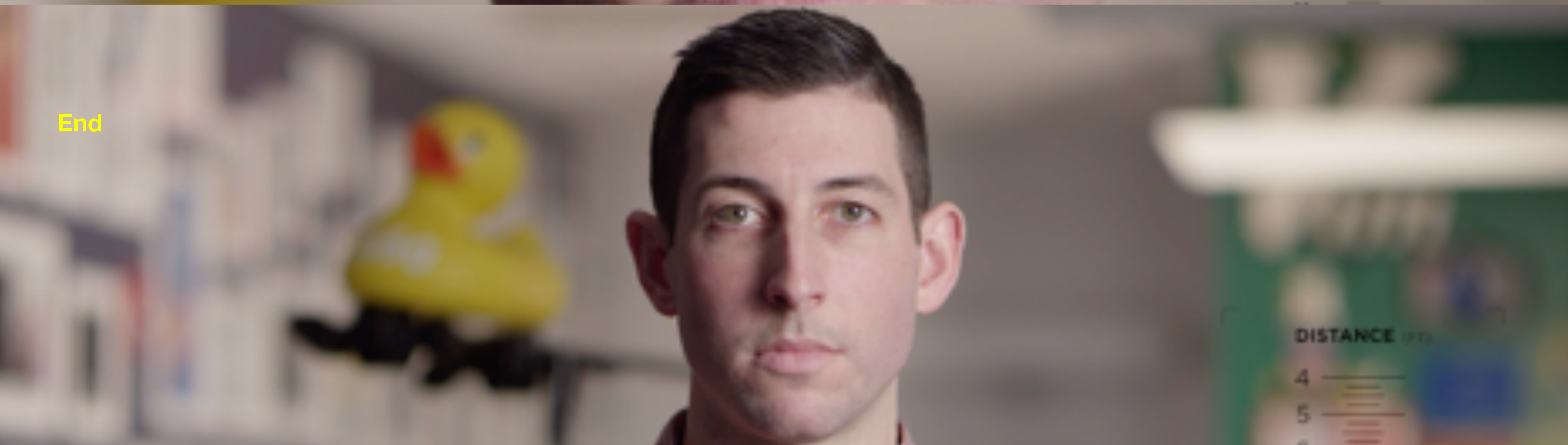
7

8

9

10

End



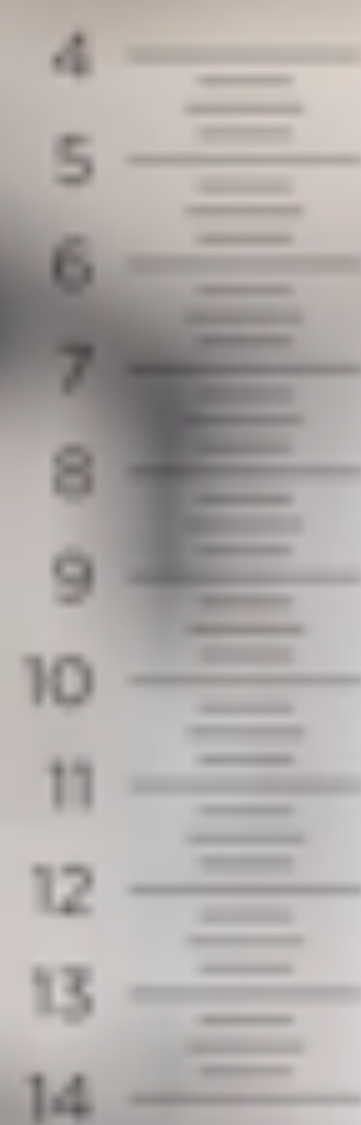
DISTANCE (FT)

4

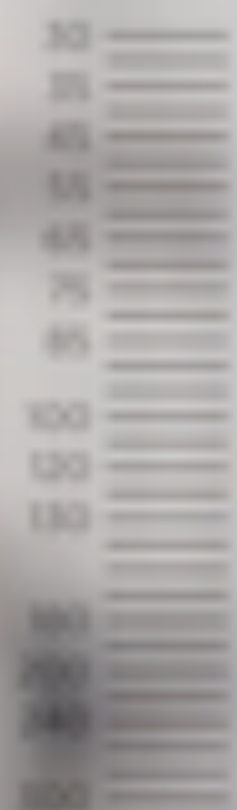
5

6

DISTANCE (FT)



FOCAL LENGTH (MM)

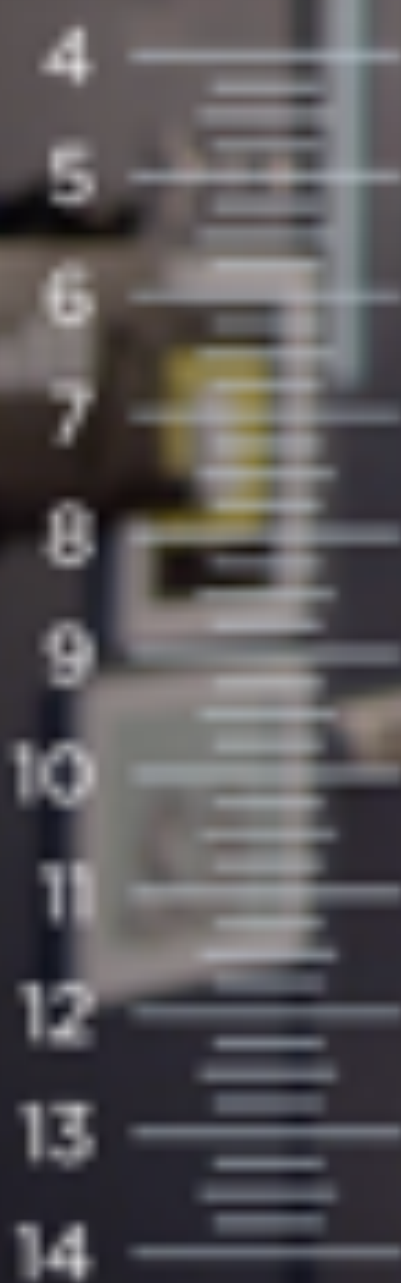


Focal length

- Longer focal lengths yield shallower depth of field
 - Shorter focal lengths yield deeper depth of field.
-
- Rule of thumb doubling the focal length quadruples the depth of field

Start

DISTANCE (ft)



Start

DISTANCE (cm)

4

5

6

7

8

9

10

11

12

13

14

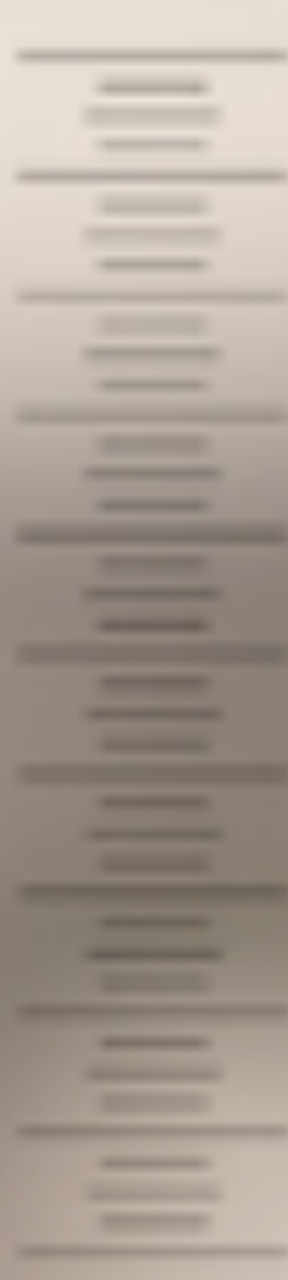


Start



DISTANCE (FT)

4
5
6
7
8
9
10
11
12
13
14

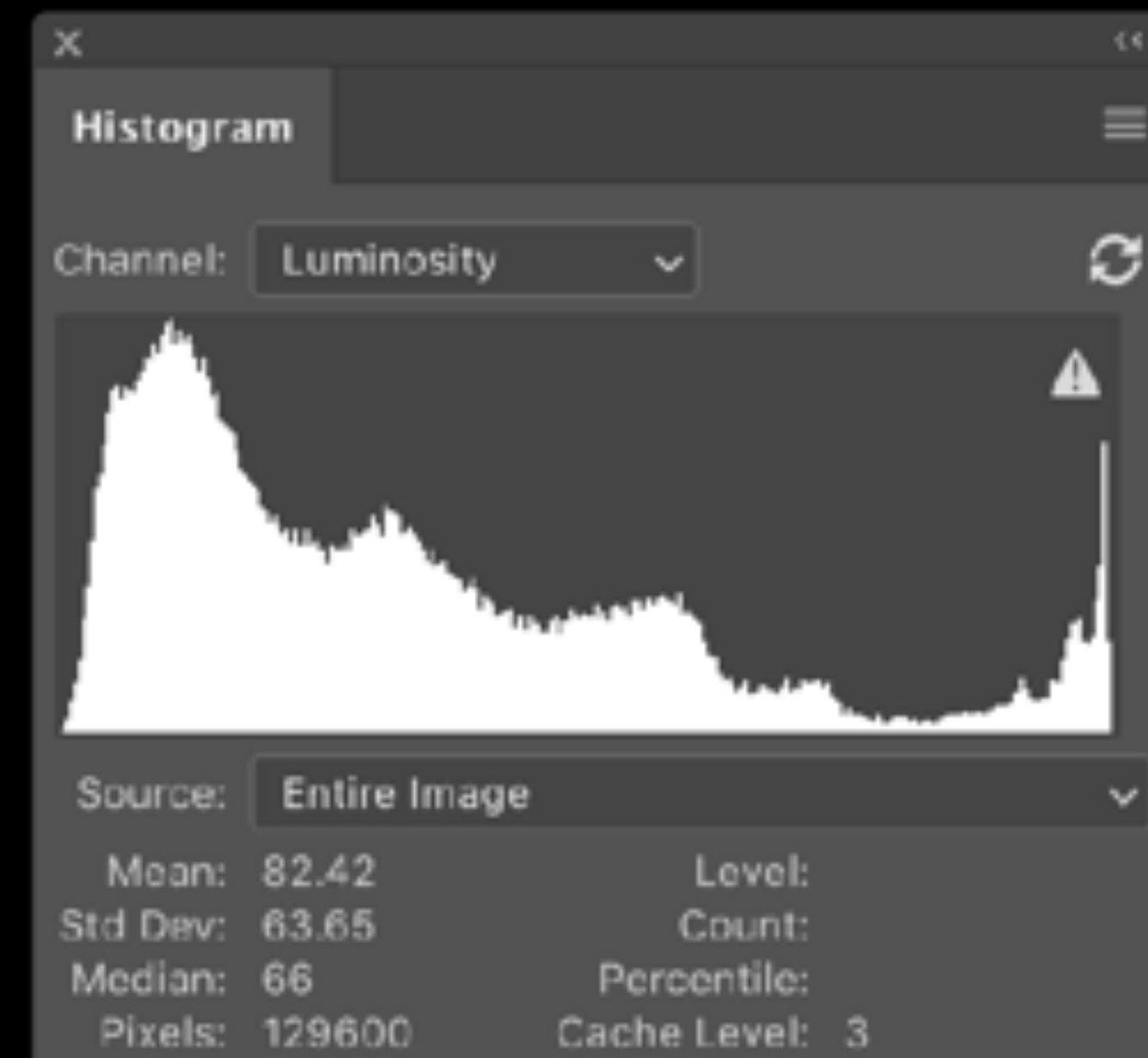


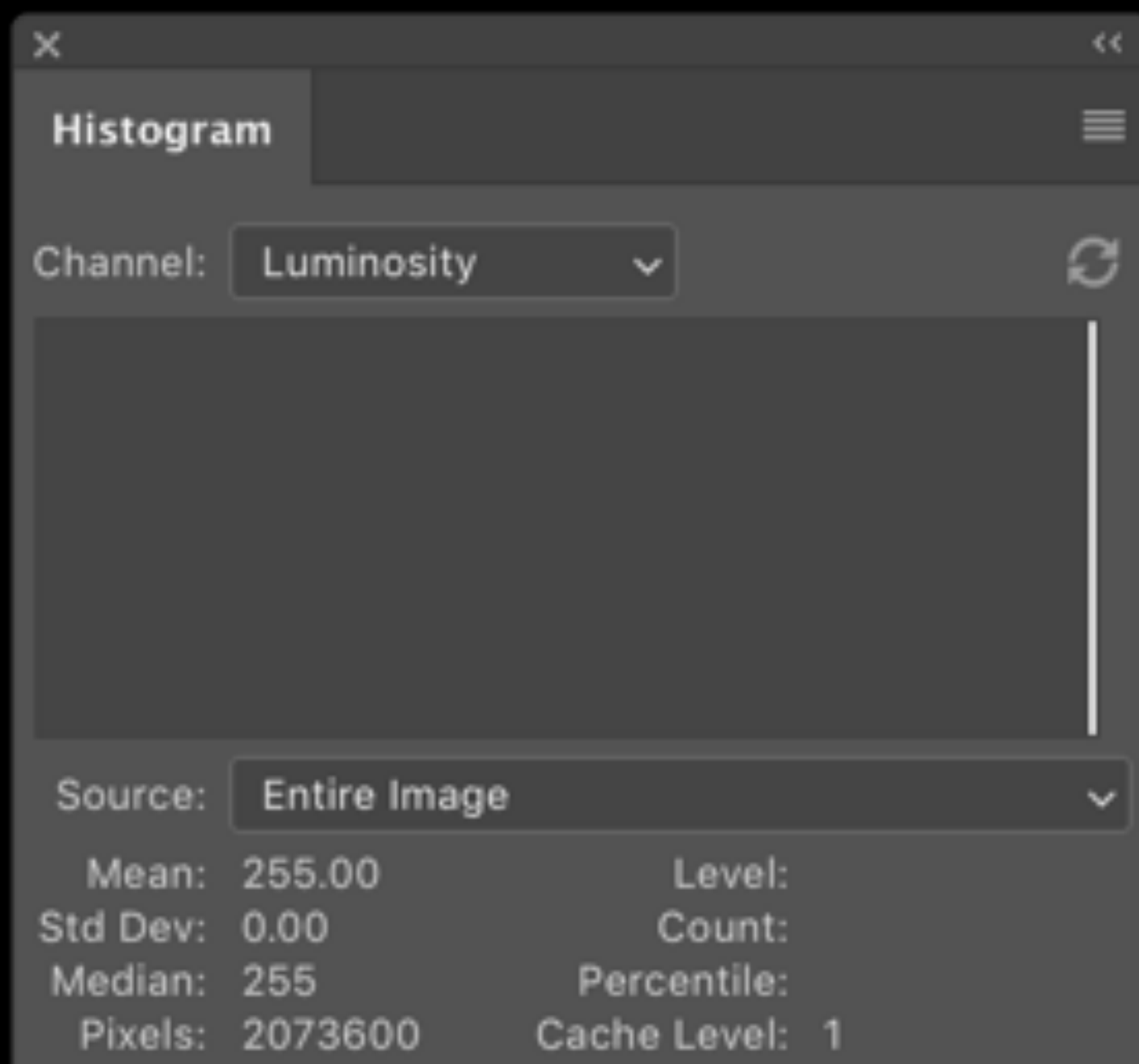


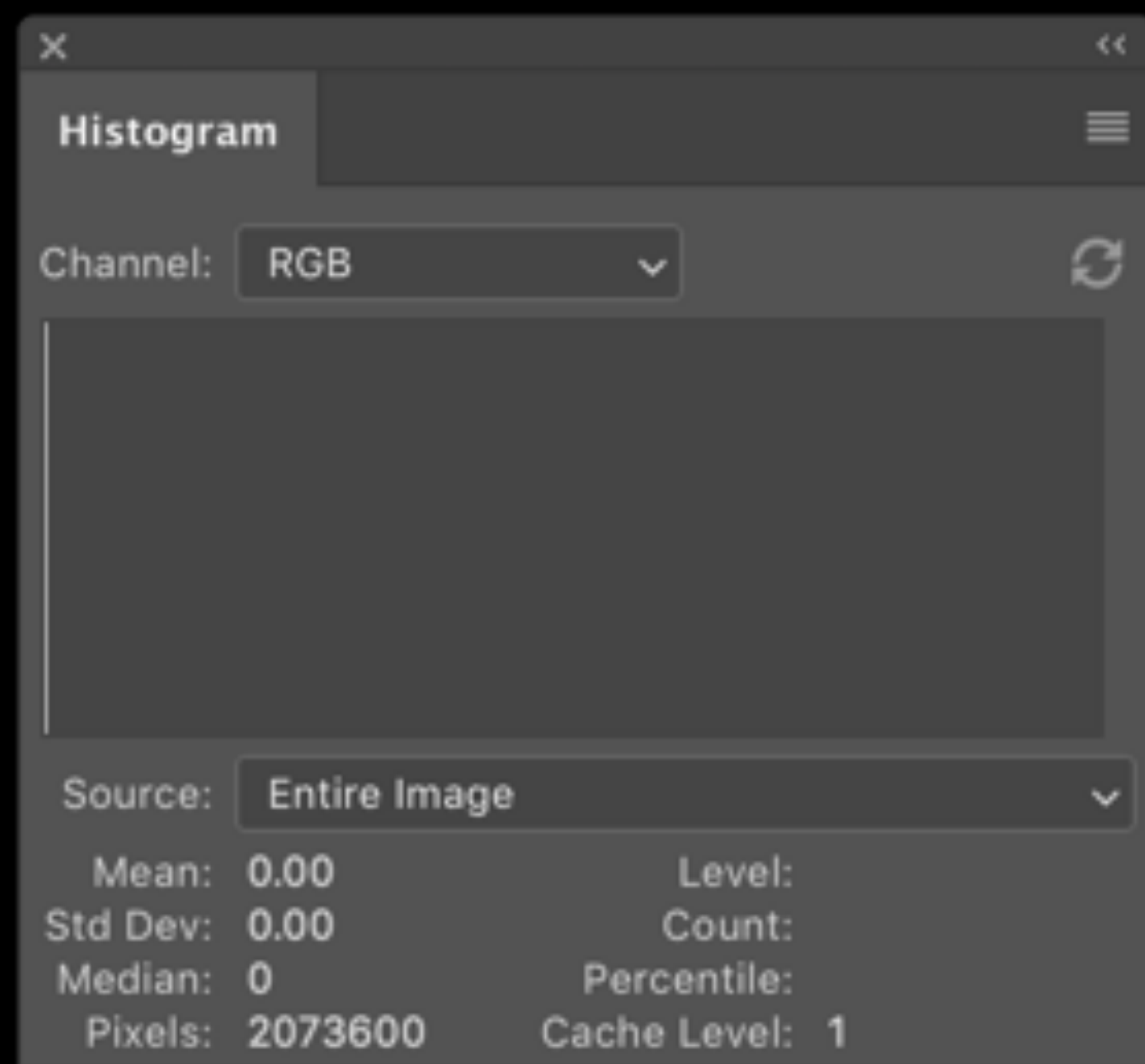
HISTOGRAM

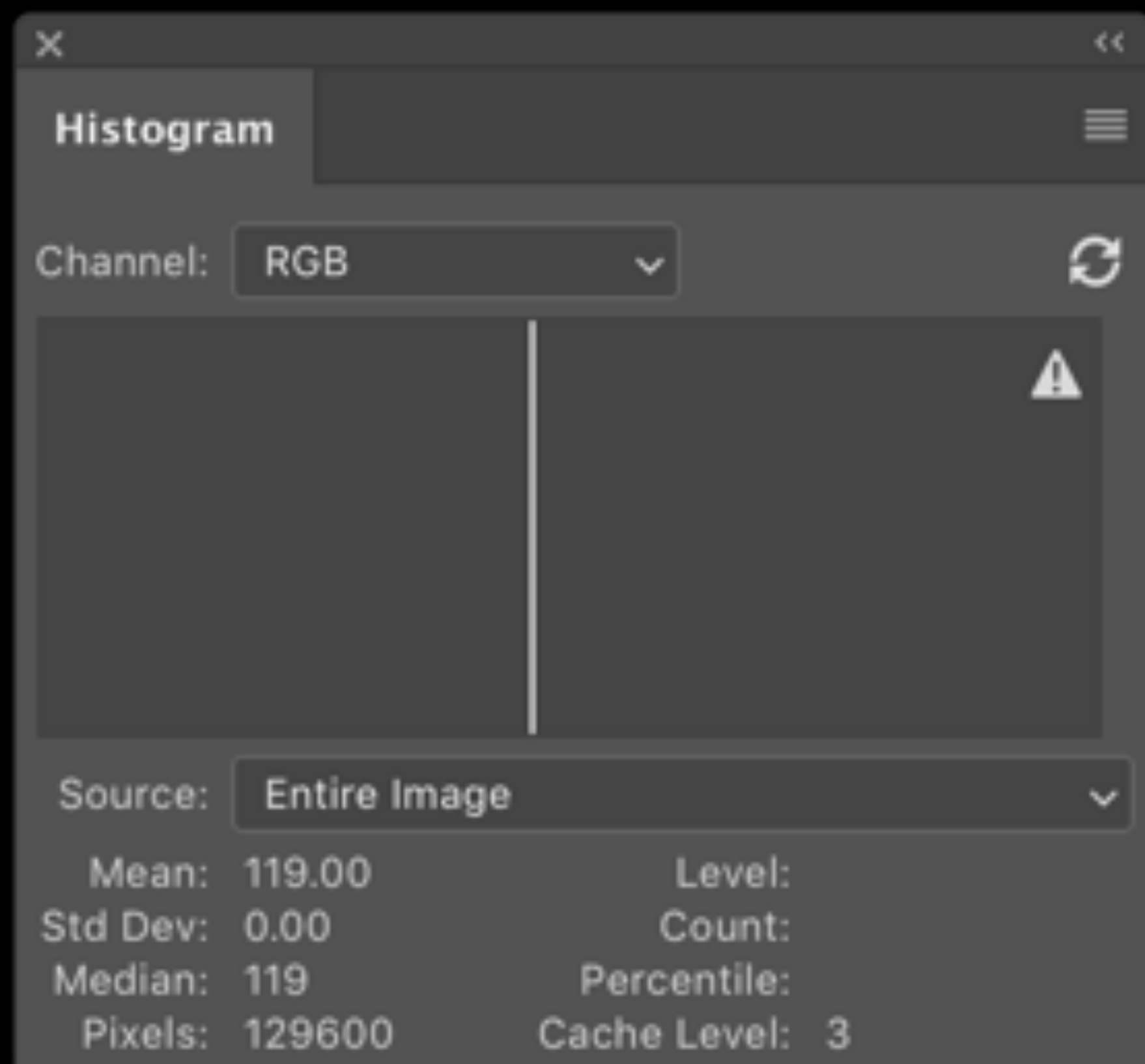
Histograms

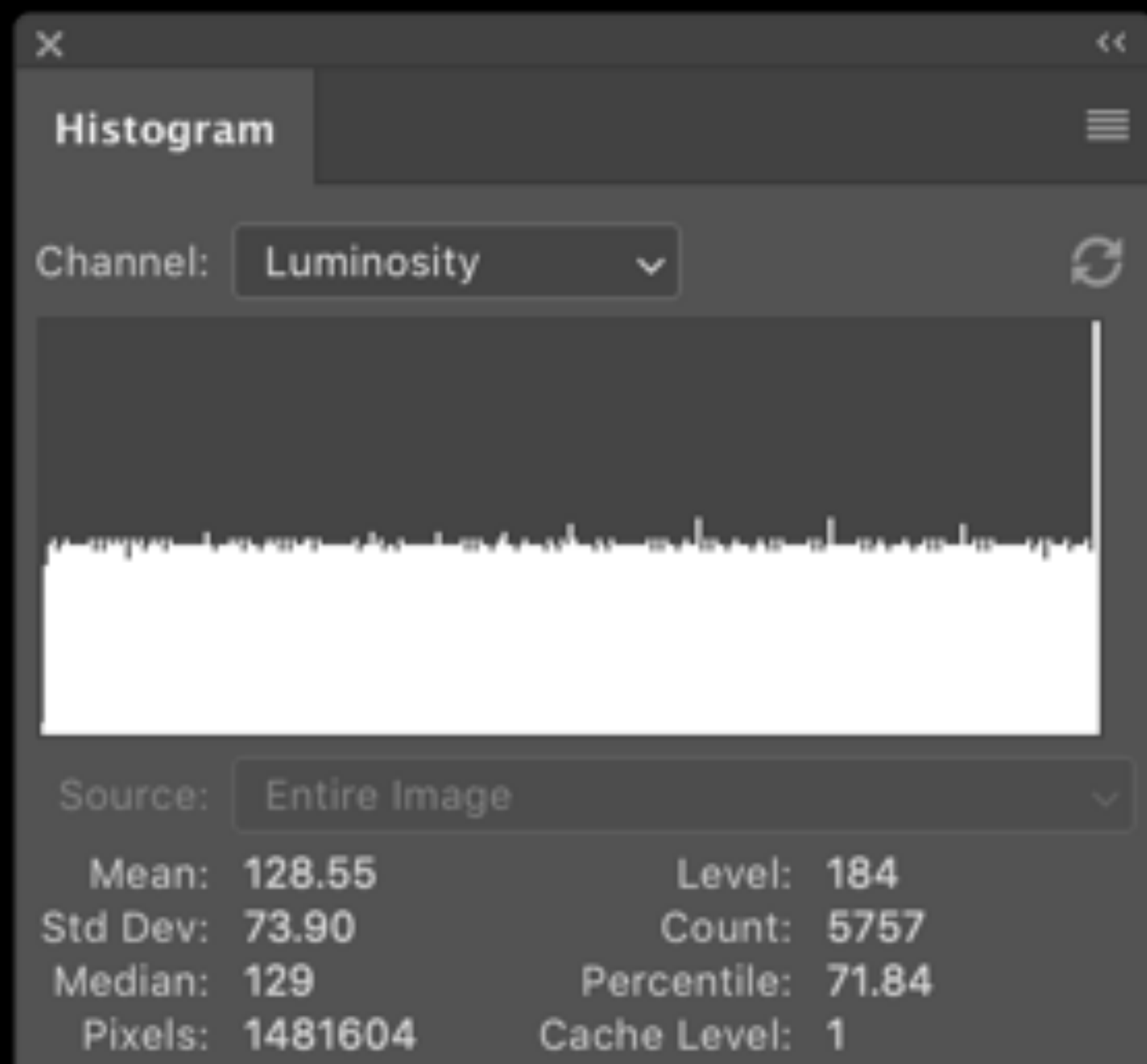
- A histogram shows the distribution of brightness values in a given image. Can also display the distribution of color values in a given image.











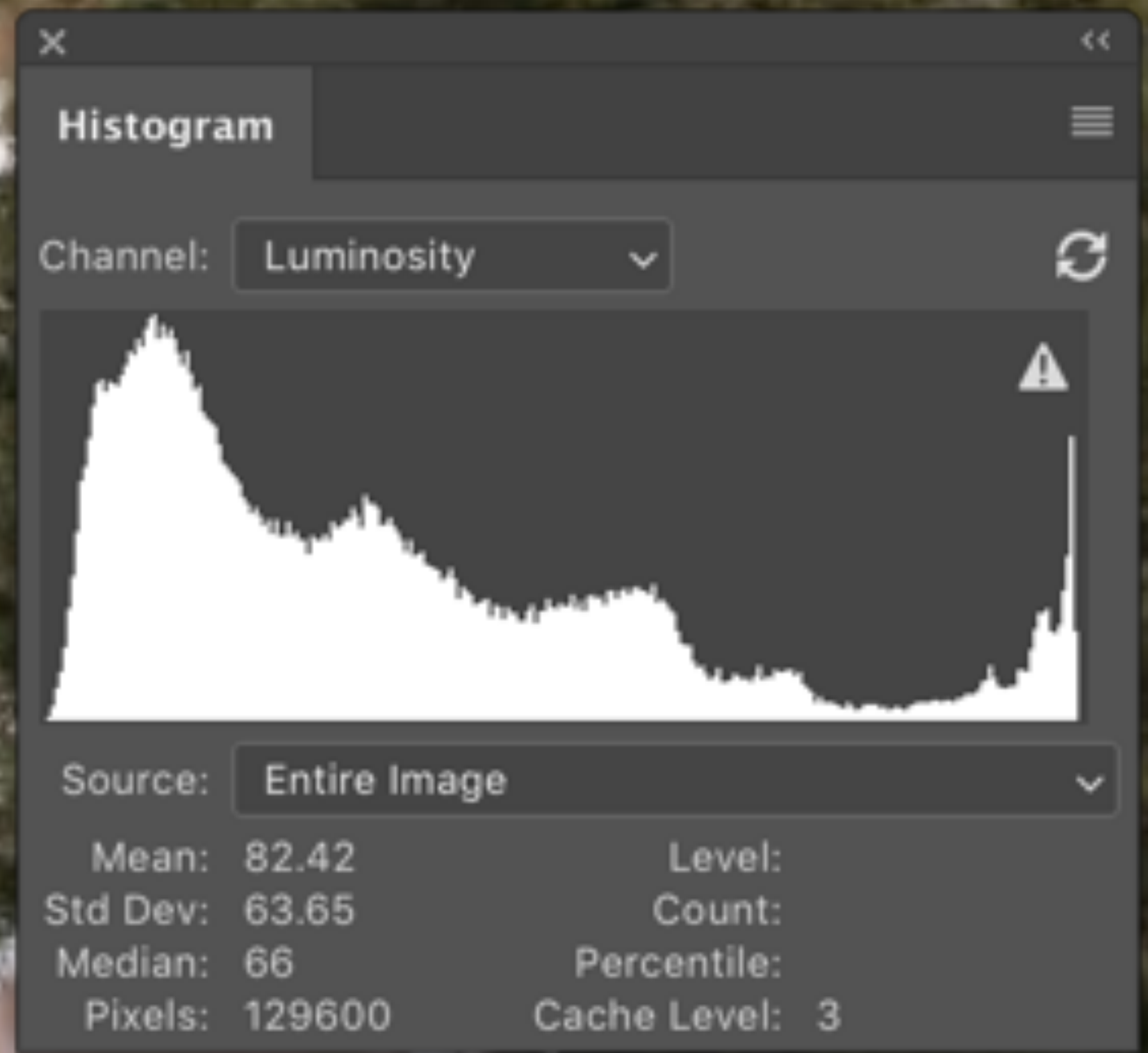
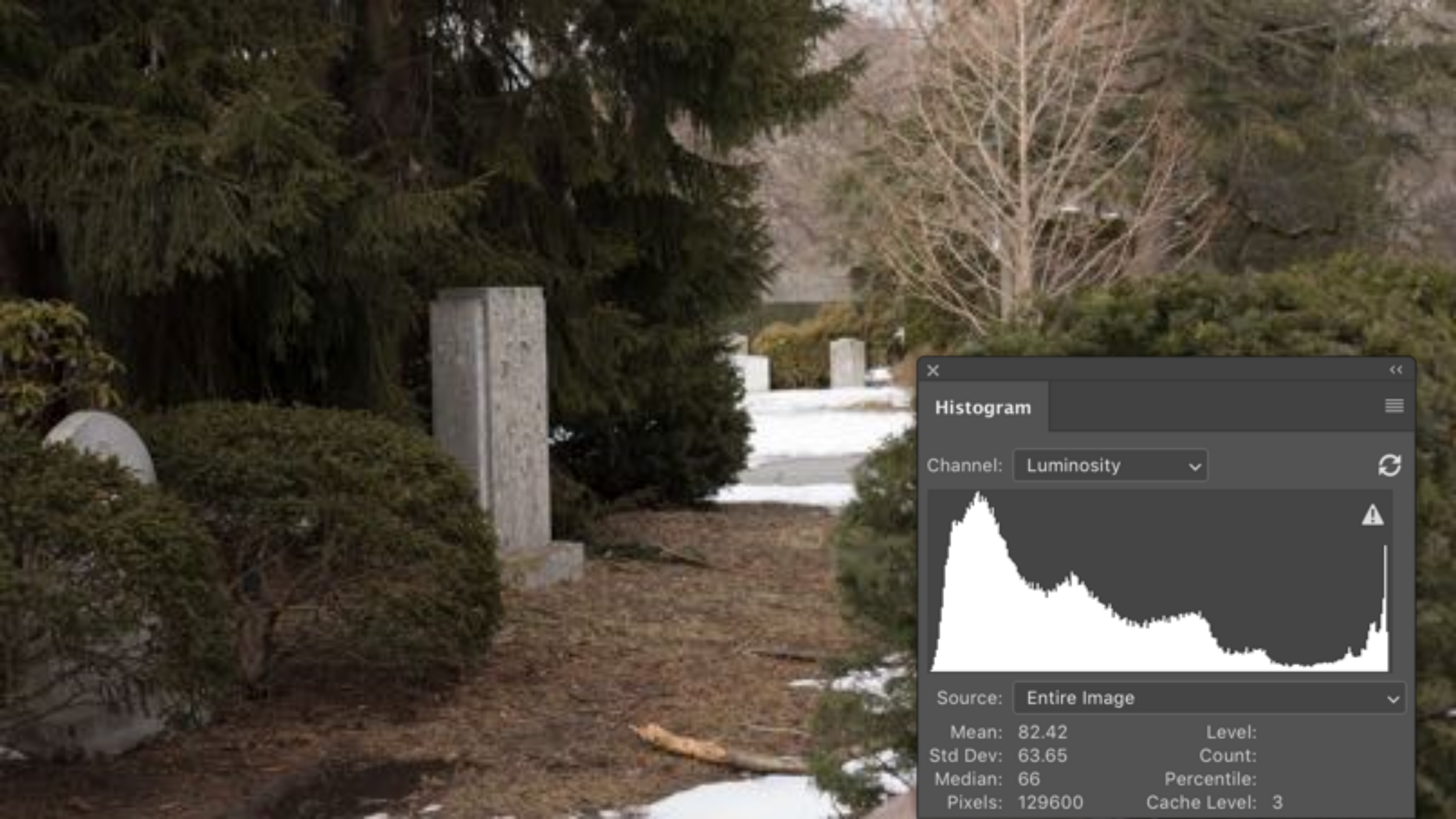




ISO 100

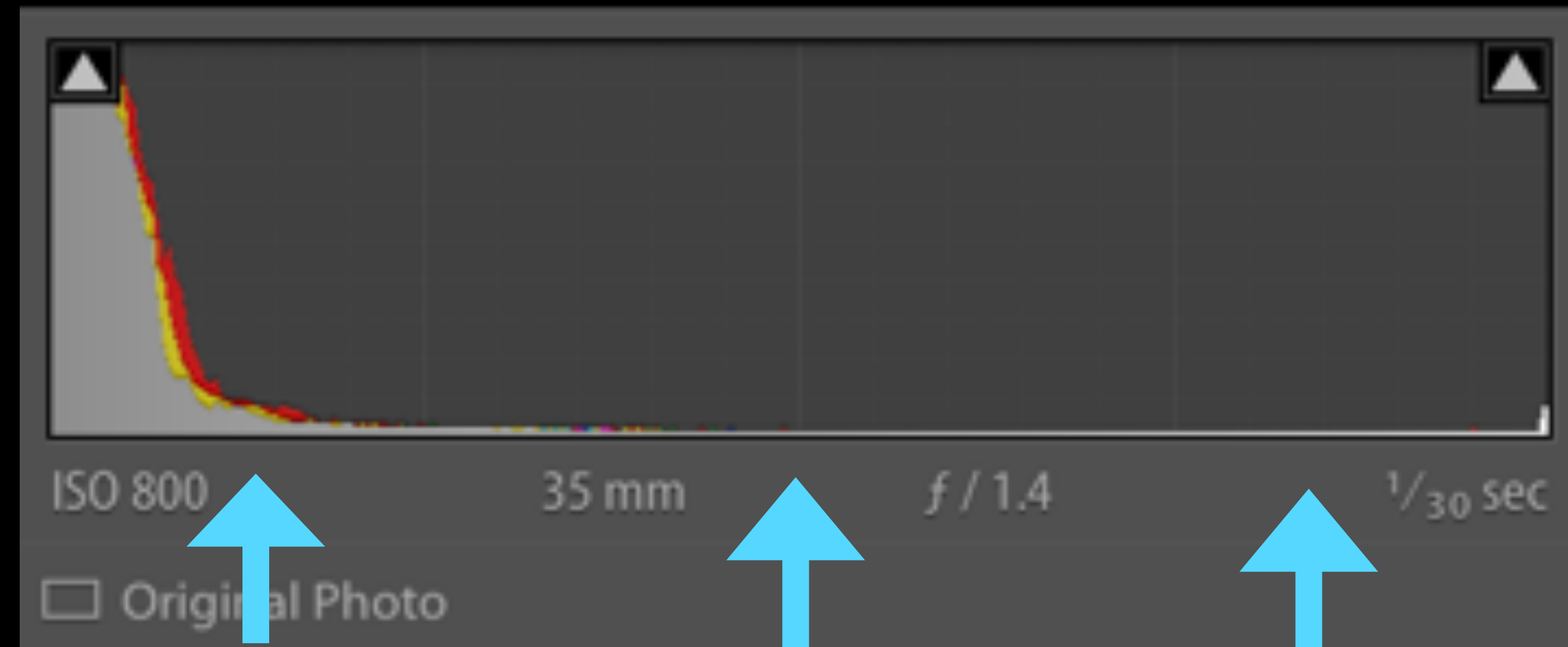
f 5.6

1/100th



"LOW KEY" HISTOGRAM

- Pushed to which side?
- Shadows clipping?
- Highlights clipping?



Shadows

Midtones

Highlights



1/30s f/1.4 ISO800 35mm
Dan Coffey, 2017



ISO 800

35 mm

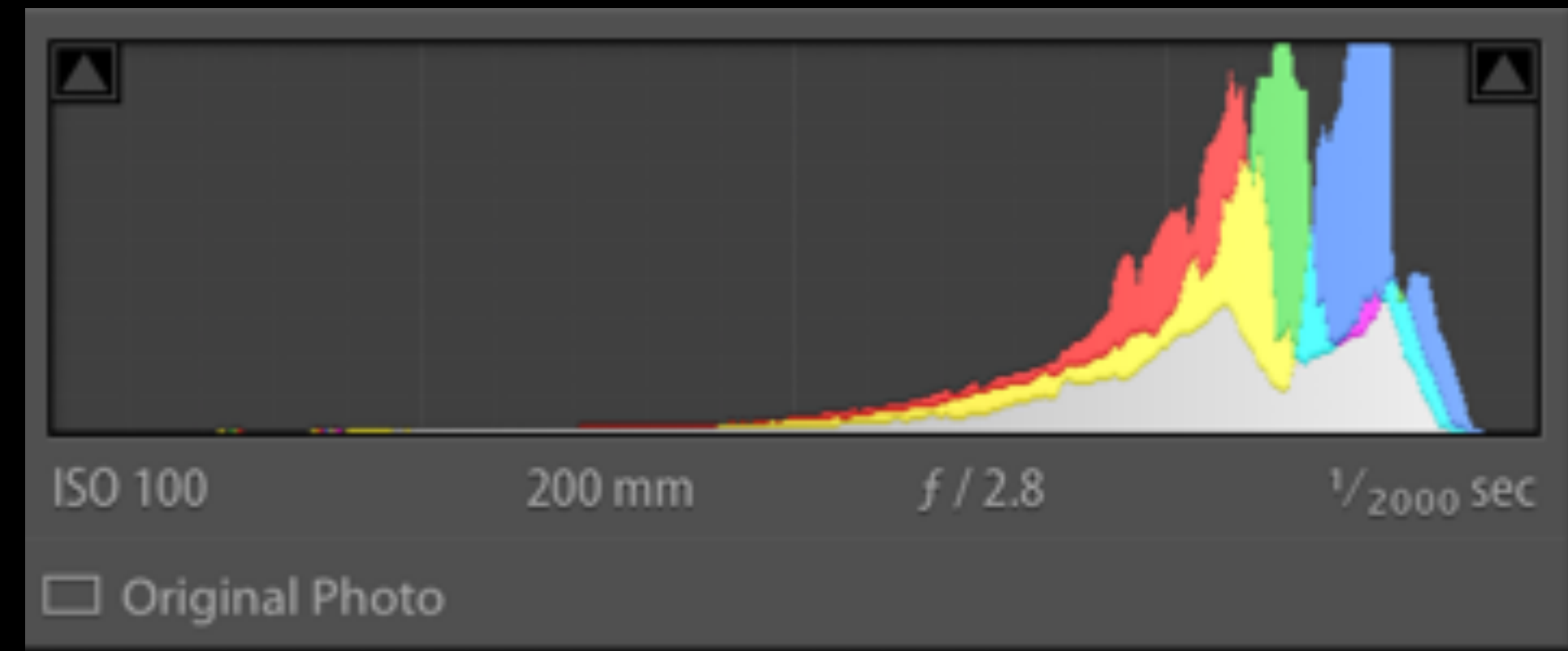
f / 1.4

1/30 sec

Original Photo

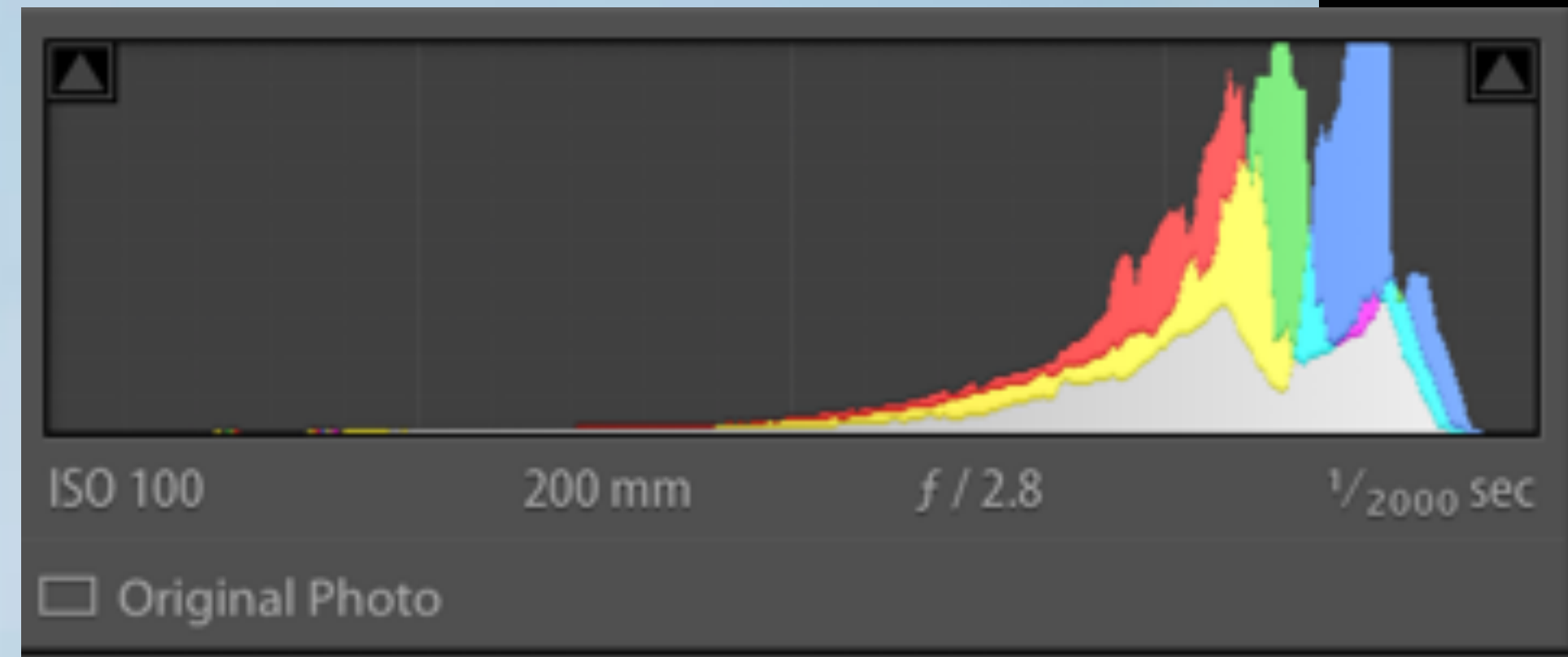
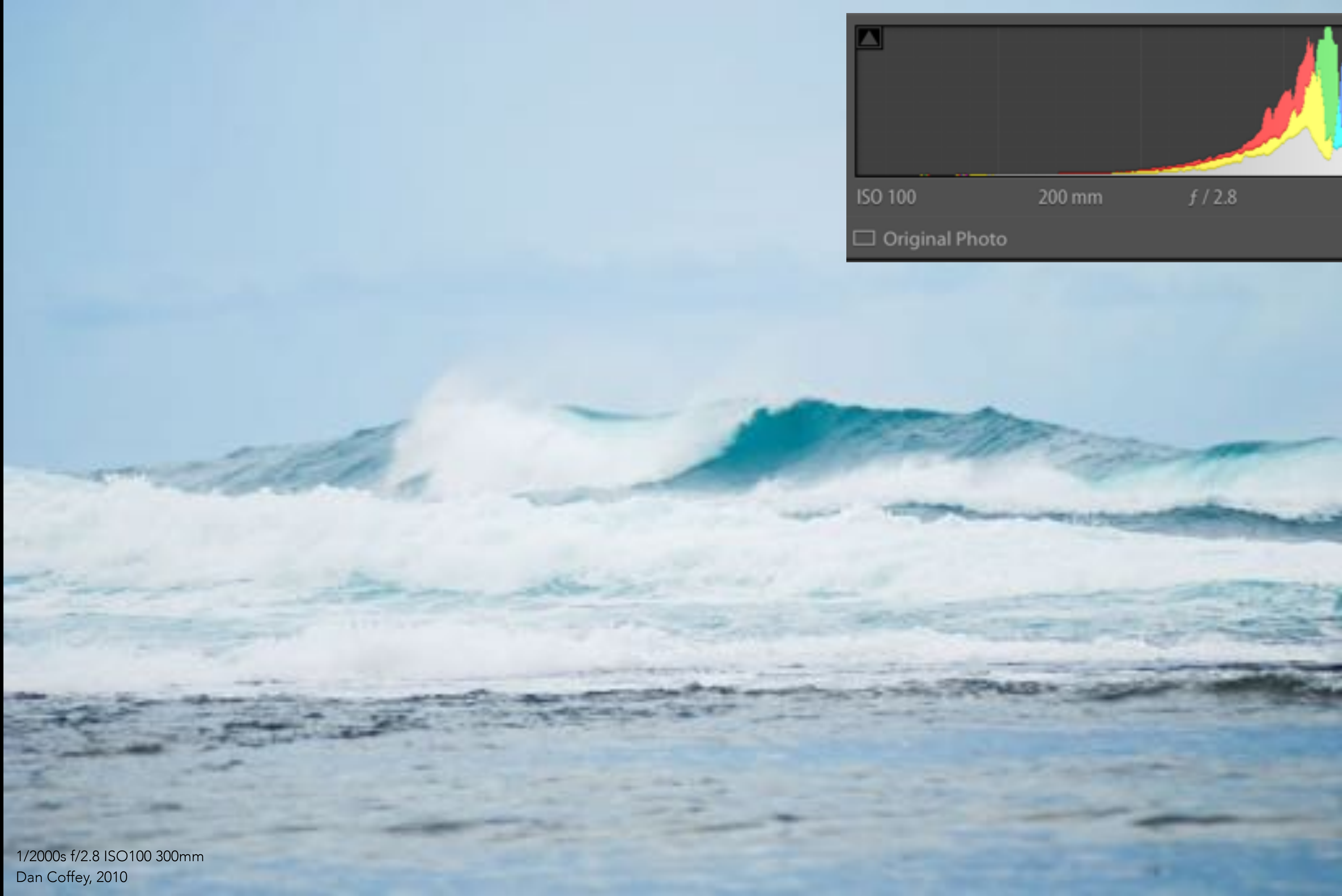
"HIGH KEY" HISTOGRAM

- Pushed to which side?
- Shadows clipping?
- Highlights clipping?





1/2000s f/2.8 ISO100 300mm
Dan Coffey, 2010



1/2000s f/2.8 ISO100 300mm
Dan Coffey, 2010

Putting it all together

- Examples of images w/ very intentional exposure choices
 - Narrative intention
- Creative over and underexposure





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