

EXPOSURE

The Exposure Triangle -
Shutter Speeds, Aperture, ISO

SHUTTER SPEED

This affects the overall exposure, how sharp the image will be, plus some issues over flash photography

The longer you leave the shutter open the further a moving object will travel across the picture.

How blurred it will be depends on the speed of the object, its direction and how far away it is.



1/1000 th



1/1000 th



1/640 th



1/1000 th



1/320 th



1/1000 th



1/160 th



1/1000 th



1/80 th



1/1000 th



1/40 th



1/1000 th



1/20 th



1/250 th



1/60 th



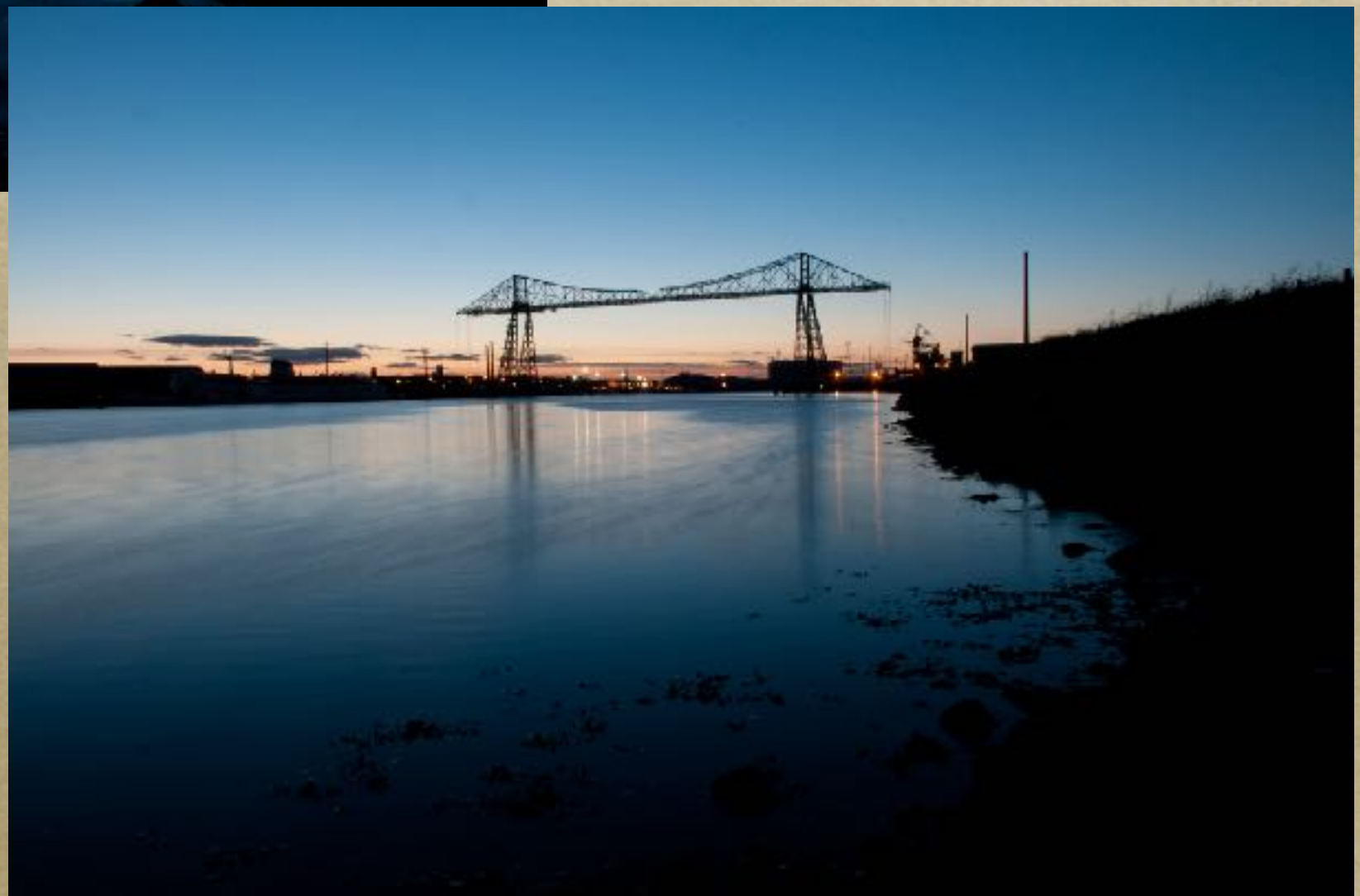
1/30 th



1/5 th f/4



1/5 th f/4



6 secs. f/22

PINTEREST

Google “Pinterest” and search it for any photography-related subject. It has hundreds of useful articles.

Moving subjects

Shutter speed choice becomes more important when you photograph moving objects. The quicker the subject is moving, the faster the shutter speed you need to freeze the subject. Go for a slower speed and the moving elements will appear blurred – but get the right degree of blur and your shot can look great.

1/250 sec



1/60 sec



1/30 sec



1/15 sec



1/5 sec



SHUTTER SPEED CHEAT SHEET

FULL STOP	1/2 STOP	1/3 STOP	SAFE SHUTTER SPEED	LIGHT	TYPES OF SHOOTING
1/2000	1/2000	1/2000			 BIRDS IN FLIGHT 1/2000
	1/1500	1/1600 1/1250			
1/1000	1/1000	1/1000			 ACTION SPORTS 1/500 - 1/1000
	1/750	1/800 1/640			
1/500	1/500	1/500			 STREET PHOTOS 1/250 - 1/500
	1/350	1/400 1/320			
1/250	1/250	1/250			 LANDSCAPES 1/125 - 1/4
	1/180	1/200 1/150			
1/125	1/125	1/125			 PANNING CARS 1/15 - 1/60
	1/90	1/100 1/80			
1/60	1/60	1/60			 WATERFALLS 1/8 - 2 sec
	1/45	1/50 1/40			
1/30	1/30	1/30			 BLURRING WATER 0.5 - 5 sec
	1/20	1/25 1/20			
1/15	1/15	1/15			 FIREWORKS 2-8 sec
	1/10	1/12 1/10			
1/8	1/8	1/8			 STARS 15 - 25 sec
	1/6	1/5 1/5			
1/4	1/4	1/4			 STAR TRAILS 15 min and up
	1/3000	0.3 0.4			
0.5	0.5	0.5			
	0.3	0.5 0.8			
1	1	1			
	1.5	1.3 1.5			
2	2	2			
	3	2.5 3.2			
4	4	4			
	6	5 6			
8	8	8			
	10	10 13			
15	15	15			
	20	20 25			
30	30	30			



9 FOOL-PROOF WAYS TO WIN A PHOTO CONTEST

To avoid camera shake you need to use a fast shutter speed.

As a rough guide, choose a shutter speed which is at least twice as fast as the focal length you have set.

For example, if your lens is set at 55mm your shutter speed should be 1/100th or faster.

Many cameras have a feature to improve on this.

Canon call it IS (image stabilisation)

Nikon VR (vibration reduction)

It's built into the body or the lens and corrects for movement of the camera so you can get a sharp picture even if you wobble a little bit.

APERTURE

There are three main reasons why you would want to change the aperture

APERTURE 1

To make the image darker or lighter

Aperture is simply a hole.

The camera lens contains a mechanism
to make the hole bigger or smaller.

So it lets in more, or less, light.



Not much light here !



Not much light here !

But opening the aperture lets more light in ..



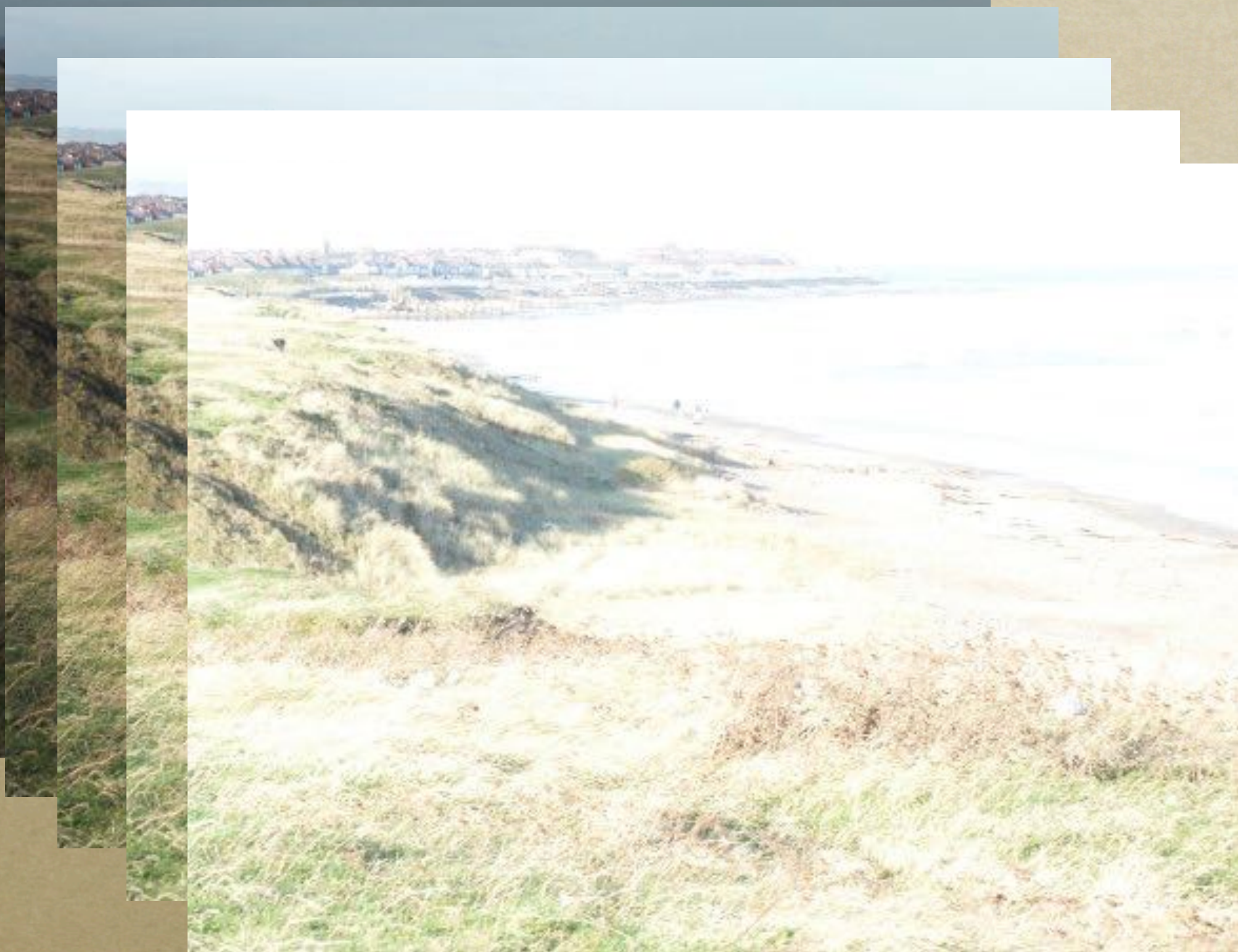




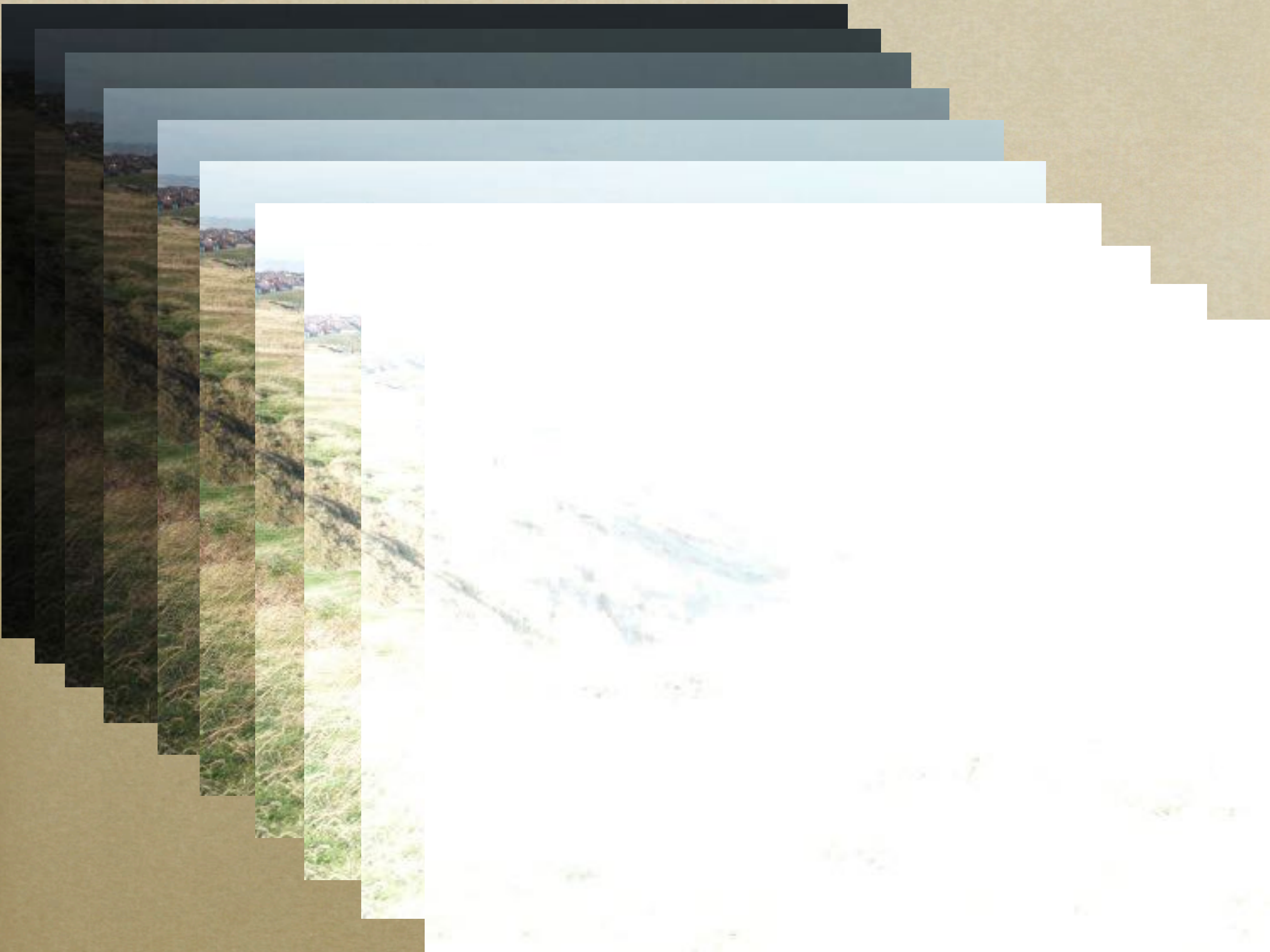














APERTURE 2

To change the depth of field

Farther objects are progressively more blurred

Farther objects are progressively more blurred

Farther objects are progressively more blurred

Farther objects are progressively more blurred

Farther objects are progressively more blurred

Farther objects are progressively more blurred

The camera lens focuses only at one distance

Nearer objects are progressively more blurred

Nearer objects are progressively more blurred

Nearer objects are progressively more blurred

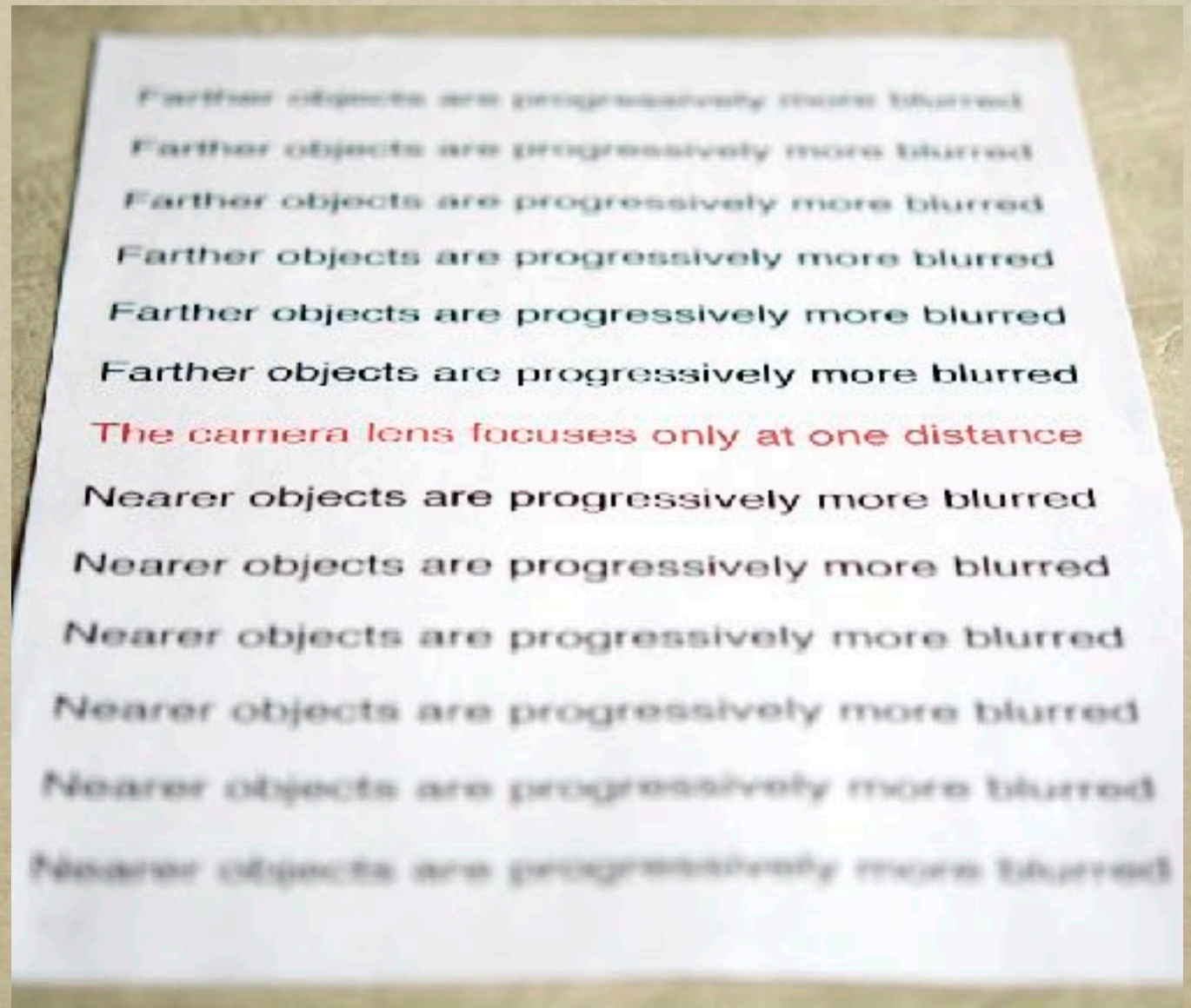
Nearer objects are progressively more blurred

Nearer objects are progressively more blurred

Nearer objects are progressively more blurred

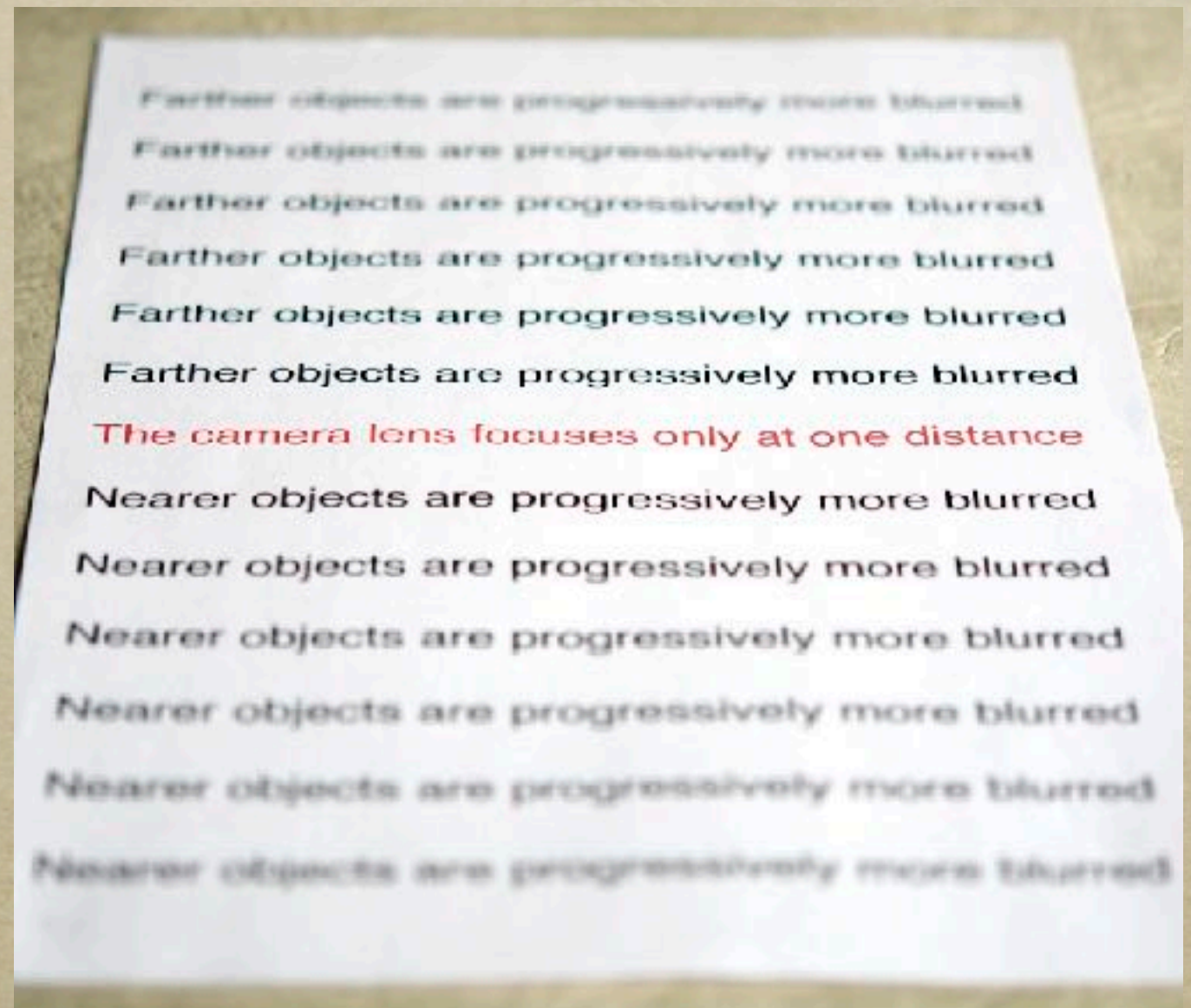
This is square to the camera
so it's sharp all over

Farther objects are progressively more blurred
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The camera lens focuses only at one distance
Nearer objects are progressively more blurred
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Nearer objects are progressively more blurred
Nearer objects are progressively more blurred



But slope it and you can see
how it becomes blurred away
from the focus point

This is square to the camera
so it's sharp all over



Our eyes can't detect a slight loss of focus so objects nearer or farther away can still appear to be sharp.

The extent of that acceptably sharp area is called **Depth of Field**

The extent of the Depth of Field
is affected by a number of factors

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- the focal length of the lens long lenses - shallow depth

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- how far away your subject is closer objects - shallow depth

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- the focal length of the lens long lenses - shallow depth
- how far away your subject is closer objects - shallow depth
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- degree of blur acceptable if you're fussy - shallow depth

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- the focal length of the lens long lenses - shallow depth
- how far away your subject is closer objects - shallow depth
- the aperture big aperture - shallow depth
- degree of blur acceptable if you're fussy - shallow depth
- final print size big picture - shallow depth

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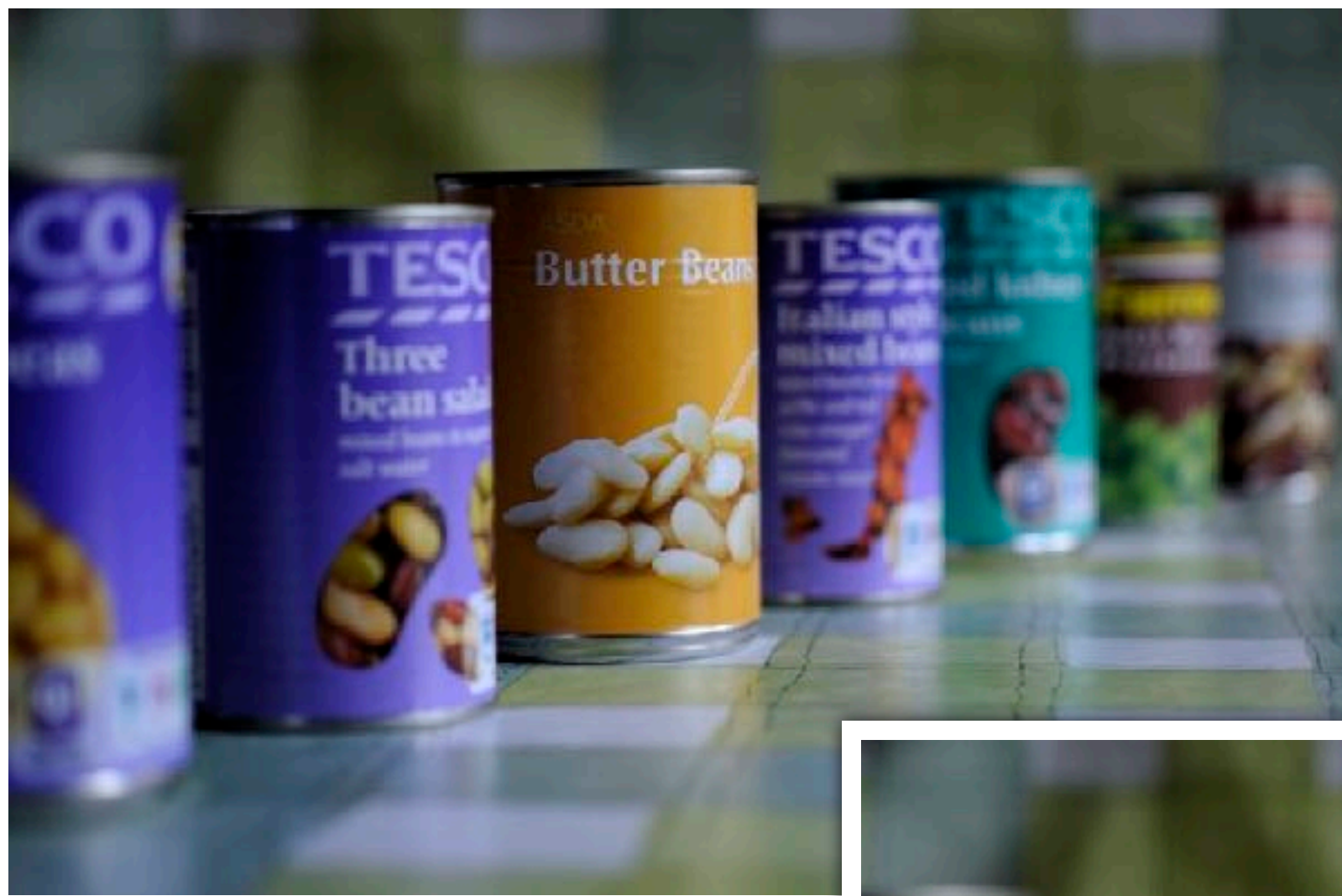
- the focal length of the lens long lenses - shallow depth
- how far away your subject is closer objects - shallow depth
- the aperture big aperture - shallow depth
- degree of blur acceptable if you're fussy - shallow depth
- final print size big picture - shallow depth

Since most of these factors are decided for other reasons
the one normally used to control Depth of Field is
the aperture.

Here are some table top examples,
starting with the widest aperture



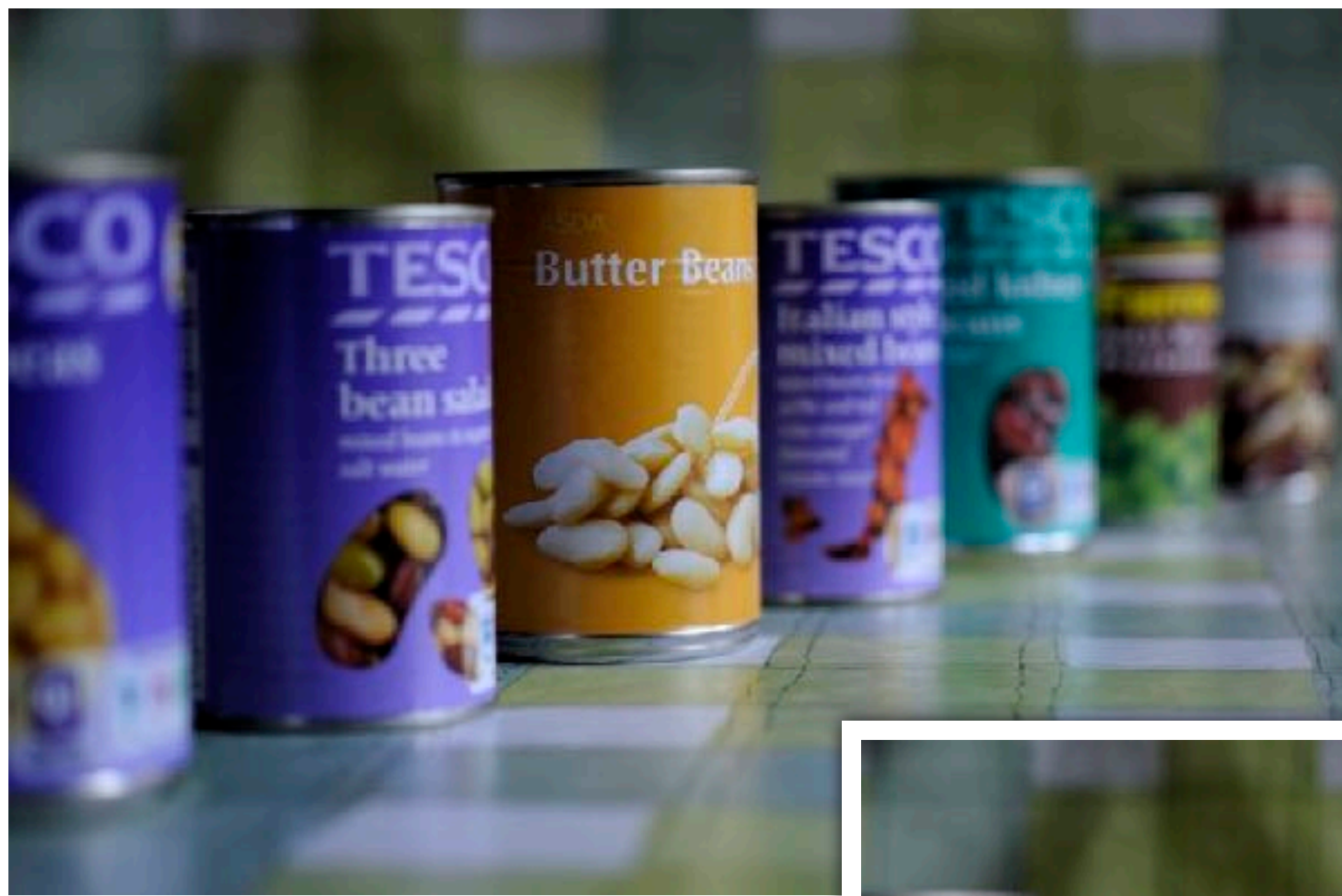
f/ 2.8



f/ 2.8



f/ 4



f/ 2.8



f/ 5.6



f/ 2.8



f/ 8



f/ 2.8



f/ 11



f/ 2.8



f/ 16



f/ 2.8



f/ 22



f/ 2.8



f/ 32

The depth of field behind your subject is
about twice as much as the depth in front of it



f/ 2.8



f/ 8

The depth of field behind your subject is
about twice as much as the depth in front of it

So to get as much of your picture sharp as possible
decide on the nearest and farthest bits you need to
to be sharp then focus about $1/3$ into that area.

Let's look at some more usual examples



f/ 2.8



f/ 2.8



f/ 4

This is one stop smaller



f/ 2.8



f/ 4



f/ 5.6

This is one stop smaller

Two stops smaller



f/ 2.8



f/ 2.8



f/ 8

three stops smaller



f/ 2.8



f/ 8

three stops smaller



f/ 22

Six stops smaller



f/ 2.8



f/ 8

three stops smaller



f/ 22

Six stops smaller

Smaller apertures give greater Depth of Field.

This is an aside but ...

The focal length of the lens affects
depth of field too



A wideangle keeps the background sharp



Wideangle



Standard focal length blurs it a little



Wideangle



A short telephoto blurs the background a lot



Standard

You can use shallow depth of field to make
the subject stand out more

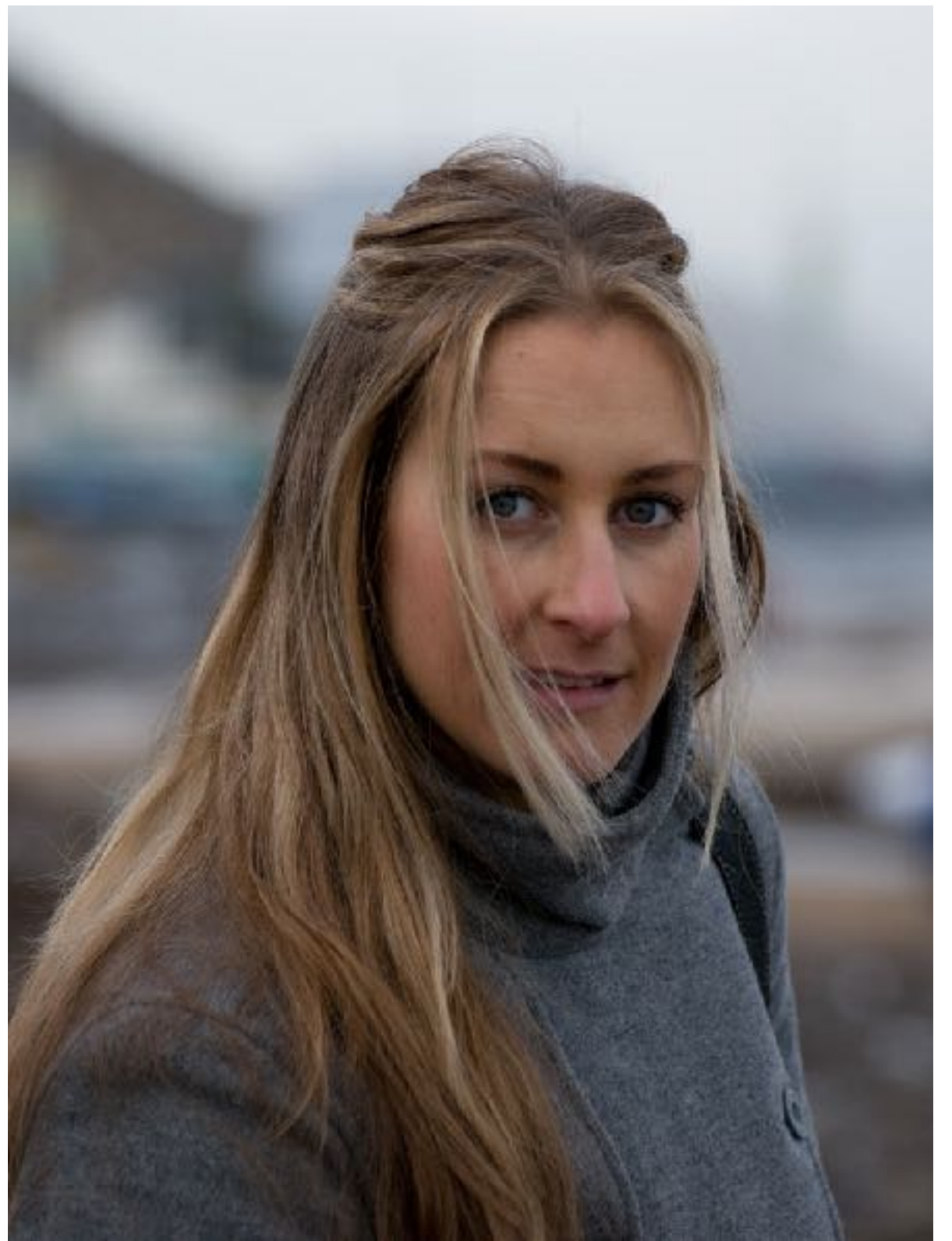


A small aperture creates
a distracting background

f/ 32



f/ 32



f/ 8

F-2.8



F-4



F-5.6



F-8



F-11



F-22



APERTURE 3

To maintain the best image quality

Very few lenses give their sharpest images when fully open and those that do are extremely expensive!

As a rule then lenses used at their widest aperture will be sharp in the centre but less so towards the corners.

Stopping down the aperture will improve corner sharpness. You'd need to test your lens to find the best aperture to use but as a rule a couple of stops down will be the best . Perhaps about f/8.

Vignetting (darkening in the corners) is also improved a lot at those apertures.

APERTURE FOOTNOTE

To avoid blur at small apertures

When the aperture is very small, less than about $f/16$, light bends around the edge of the blades and softens the image.

It's called "diffraction".

Small cameras suffer more than large ones so tiny compact cameras often have lenses which only go down to $f/8$.

ISO

How bright your picture turns out will also depend on much light the sensor needs to form the image you're after

ISO

You can think of it as how sensitive the sensor is to light.

(Actually that's not technically right, as I'll explain in a minute, but stick with me)

The **I**nternational **S**tandards **O**rganisation
has standards for all kinds of things.

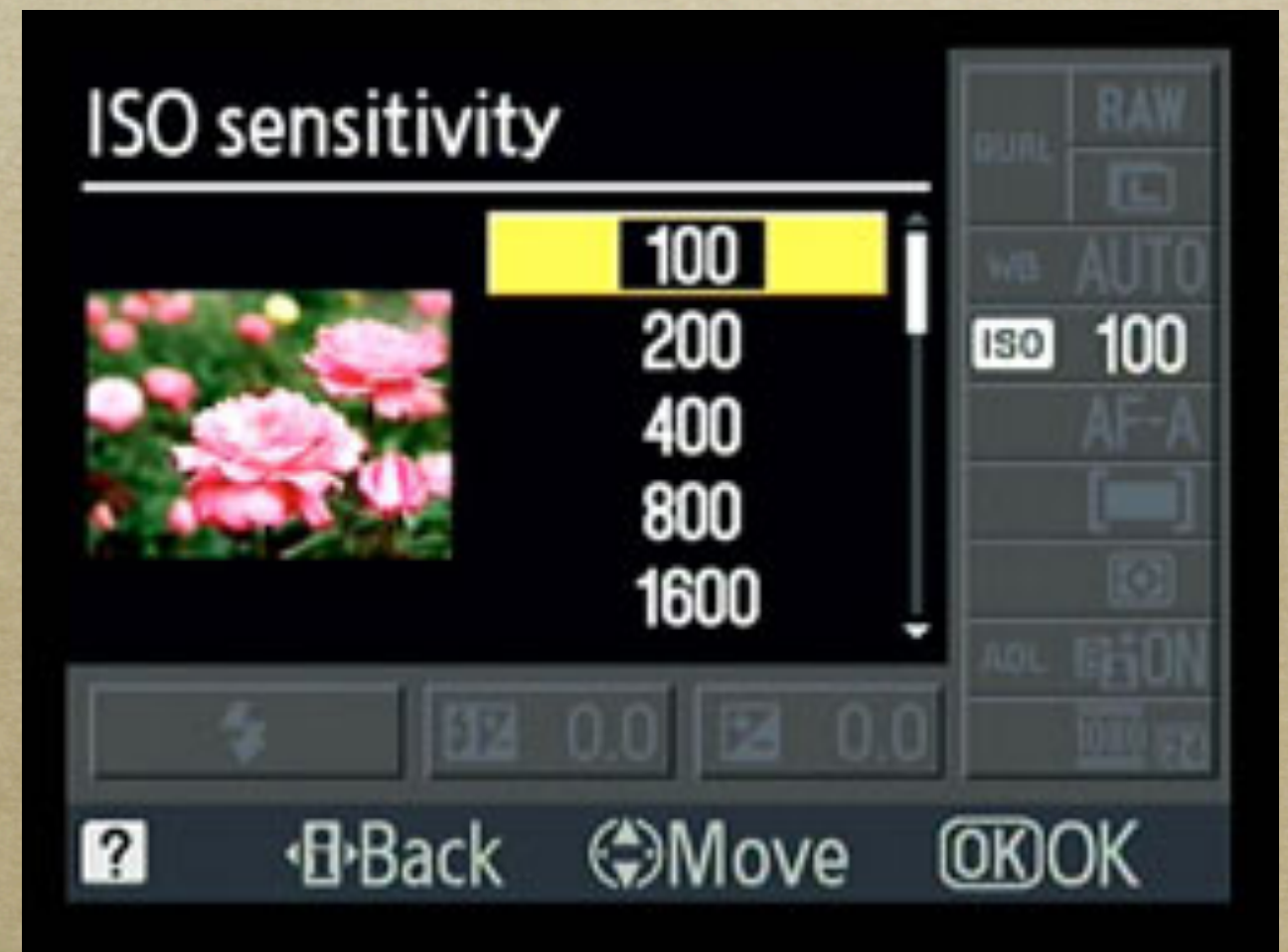
One was for the sensitivity of films in the
good old days.

Compare films of 100 ISO and 200 ISO
and the 200 is more sensitive so needs
just half as much light as the other.

For convenience the same system is applied to digital cameras.

A setting of 200 ISO will need just half the amount of light as 100 ISO.

The ISO setting on your camera may be on a dial or via a menu on the screen.



If the light is dim and you're struggling to maintain a high enough shutter speed or a suitable aperture you can increase ISO.

The downside is that higher ISOs increase the noise. This is a gritty, grainy appearance over the picture. Often it shows more in areas of smooth tone than in detailed areas.

ISO 100

ISO 1600

ISO 400

ISO 800

For maximum quality shoot at the native

ISO of your camera, probably 100 or 200.

Modern cameras cope pretty well at high

ISOs so don't be afraid to increase it to

400, 800 or even 1600. A grainy picture is

usually preferable to a blurred one!

Higher than that is worth trying, so see what

your camera is capable of.

THE EXPOSURE TRIANGLE

(at last !)

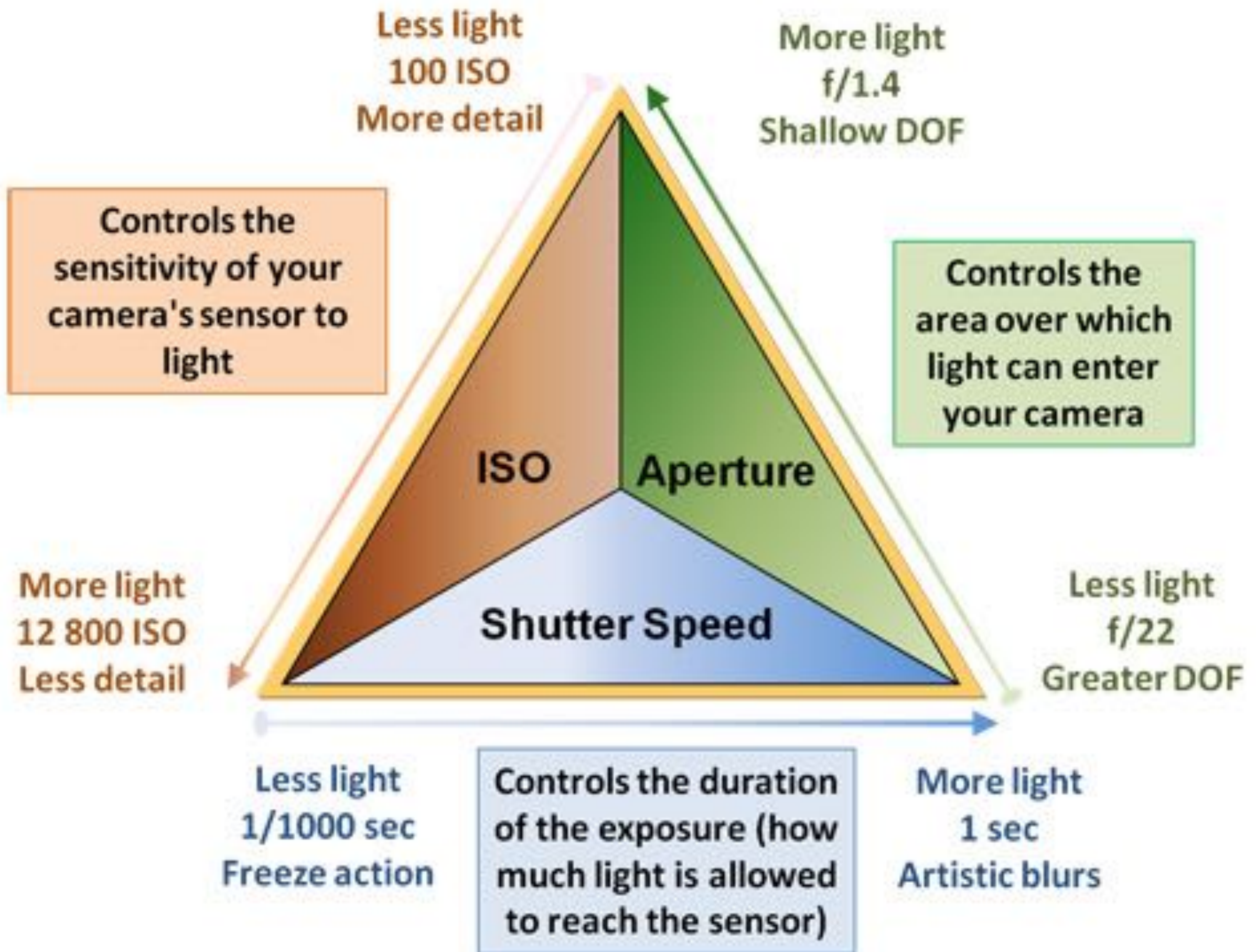
Exposure is the effect of light on the
sensor in your camera.

It is a combination of three factors :

Aperture

Shutter Speed

ISO



EXPLAINED THE EXPOSURE TRIANGLE

Knowing the effect you want to achieve will determine which exposure setting you need to choose first

In addition to their role in exposure, the choice of aperture, shutter speed and ISO have a significant impact on the look and feel of your pictures. Aperture, for instance, affects the depth of field, or how much of an image appears sharp. Shutter speed also affects image sharpness, with slower shutter speeds leading to blurred images – whether that's caused by the subject moving or the camera not being held still.

The choice of ISO enables you to use the optimum combination of aperture and shutter speed when the amount of light would normally prevent you from doing so. However, increasing the ISO also reduces the quality of your images.

Use the exposure triangle (right) to decide how to adjust the exposure: the key is that when you increase the exposure for one element (a yellow arrow), you need to reduce it for one or both of the other elements (the grey arrows) in order to maintain the same exposure. The camera can do this for you in Program, Aperture Priority or Shutter Priority, but it's something you'll need to consider when shooting in Manual mode.

Get the hang of this relationship, and you'll gain much more control over the look and feel of every image you capture.



APERTURE

f/32 f/22 f/16 f/11 f/8 f/5.6 f/4 f/2.8 f/1.4



Less exposure
Large DoF

More exposure
Shallow DoF

As you adjust the aperture, the depth of field changes, affecting how much of the shot is in focus.

SHUTTER SPEED

2,000 1,000 500 250 125 60 30 15 8



Less exposure
Frozen motion

More exposure
Blurred motion

Adjusting the shutter speed changes how moving subjects are recorded and affects how camera-shake is recorded.

ISO

100 200 400 800 1,600 3,200 6,400 12,800 26,500



Less exposure
Clean image

More exposure
Noisy image

Adjusting the ISO or light sensitivity affects how much light the sensor needs, but can introduce visual noise.

So how do you achieve
the best exposure ?

The camera will do a good job most of the time but it is sometimes fooled.

Also, it doesn't know exactly what effect you want to achieve.



My camera reckons this is
the correct exposure

“Correct”



1 stop Under



"Correct"



1 stop Under



1 stop Over





We need a method of judging exposure which doesn't rely on the camera or glancing at the screen.

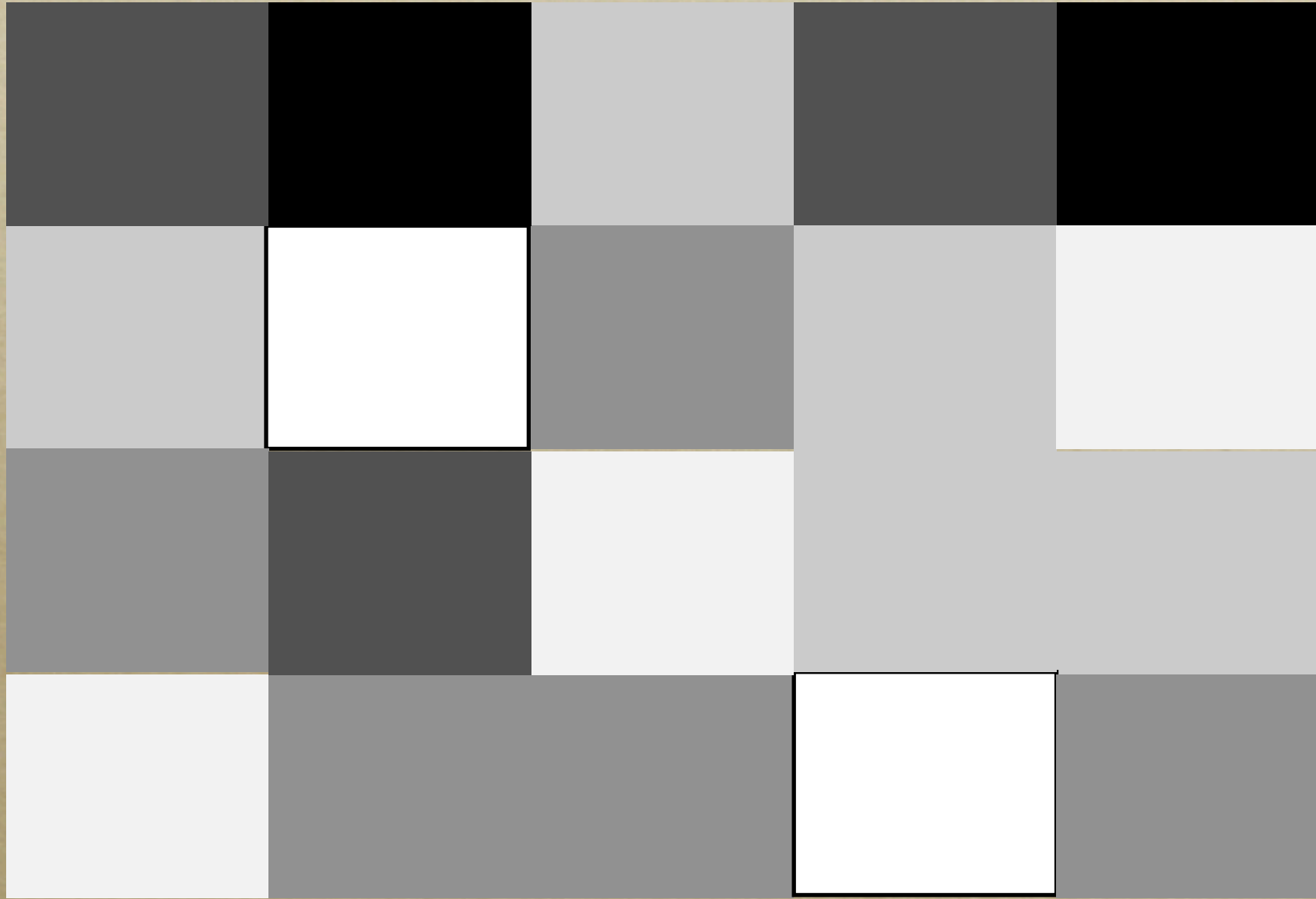


We'll quickly review what we know about histograms

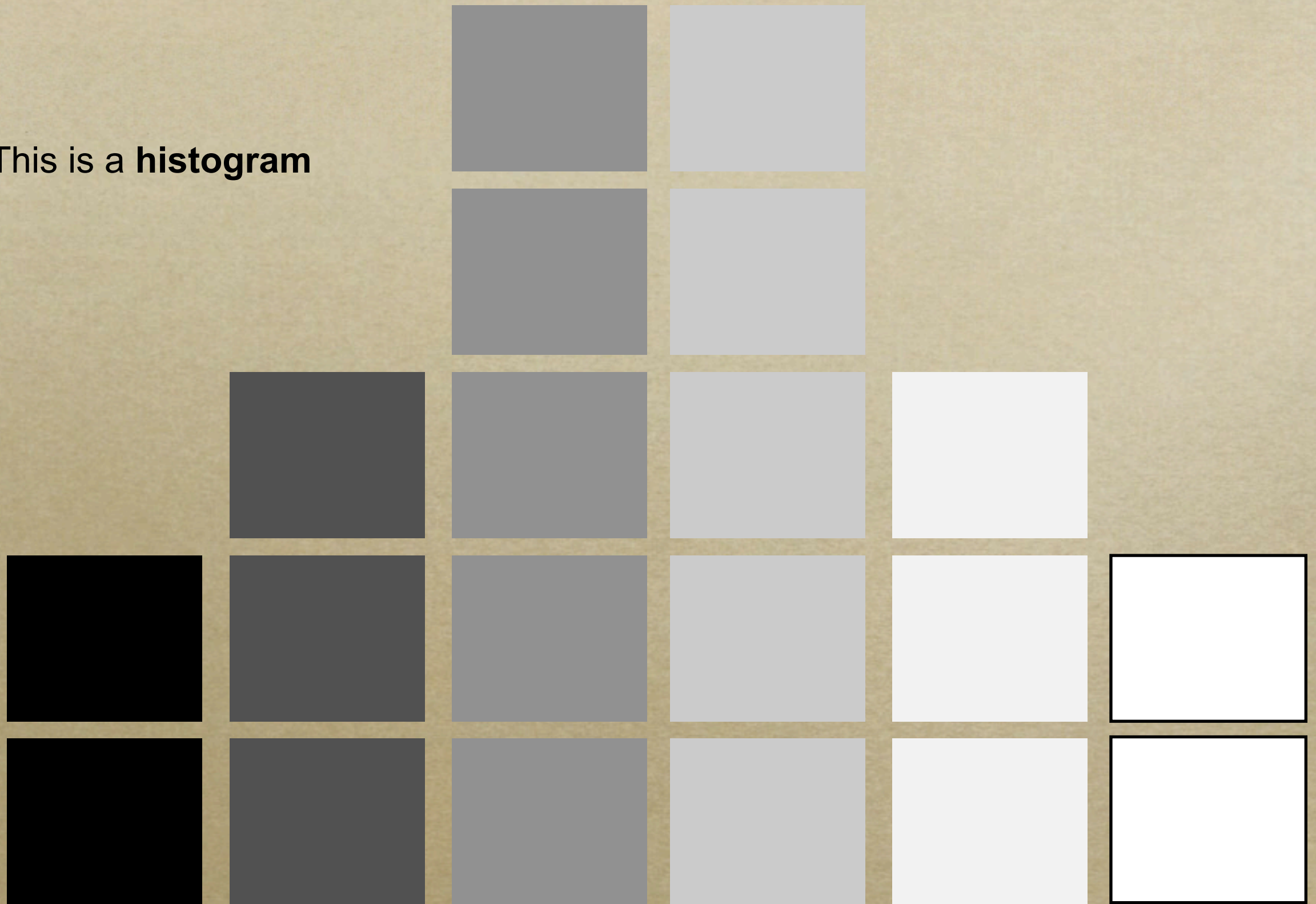
- A digital picture is made up from thousands or millions of tiny elements called **pixels**(short for Picture Elements).
- Each pixel has its own colour and brightness. Together these pixels make up a complete picture, with all its colours and brightnesses.

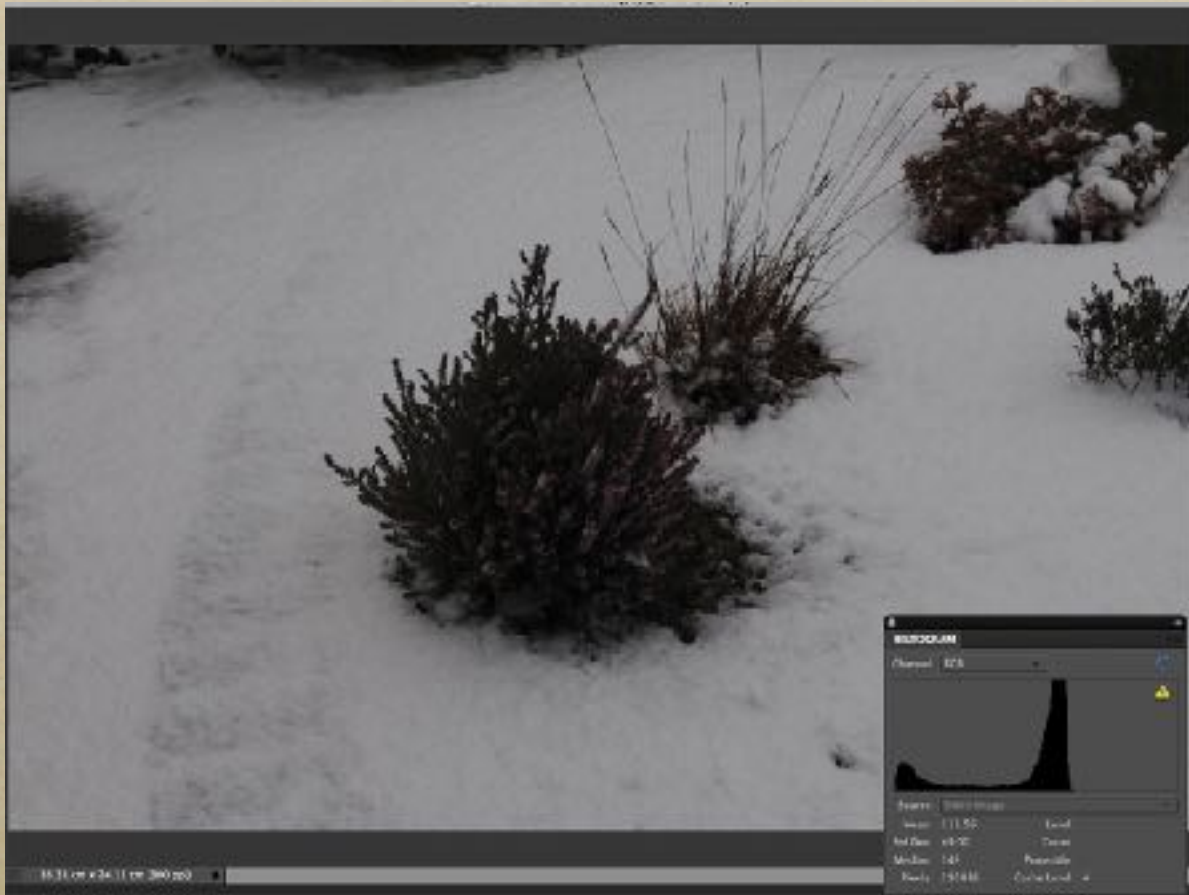
A normal picture will contain white pixels, black pixels and every possible shade in between, all spread about the picture.

- If you count up all the black pixels, the nearly black ones, the grey ones and every other one up to white, then plot them, you get a chart called a **histogram**.

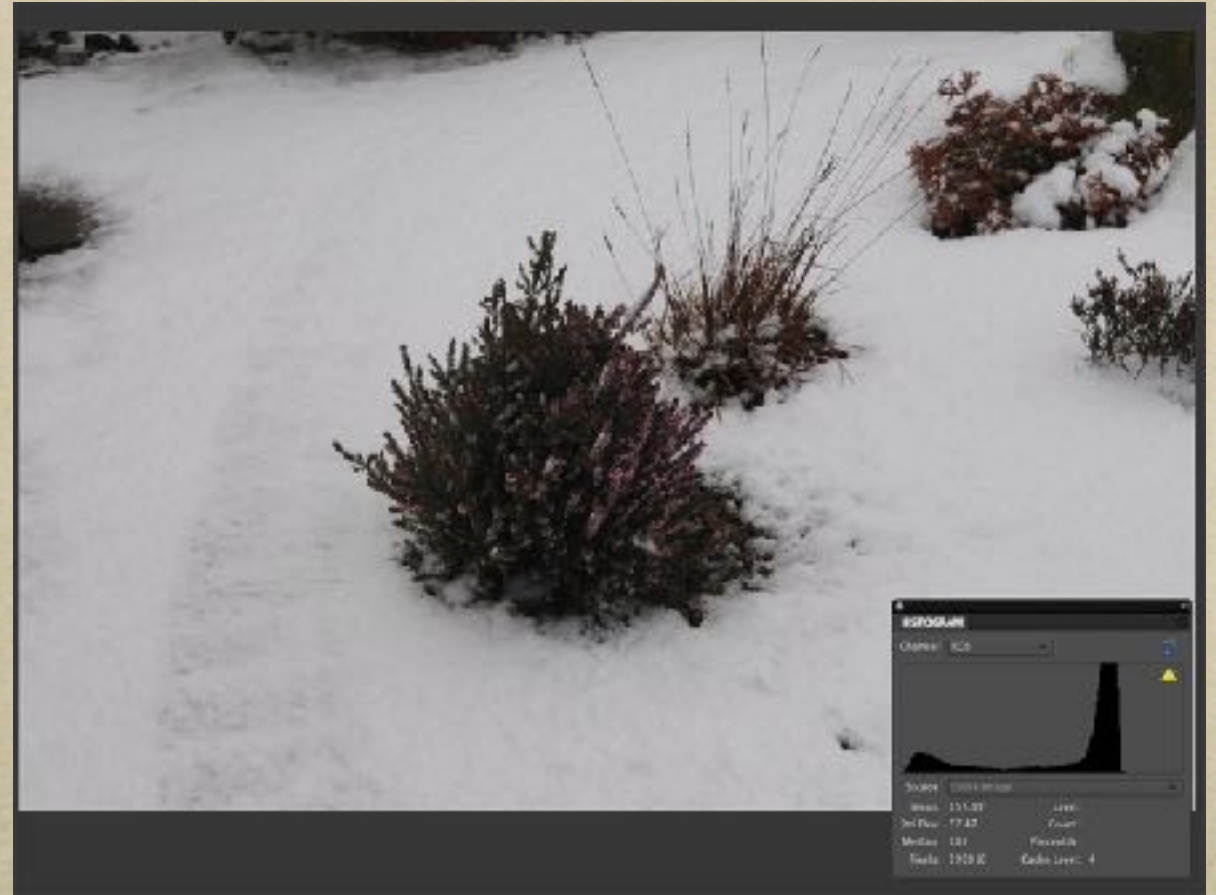
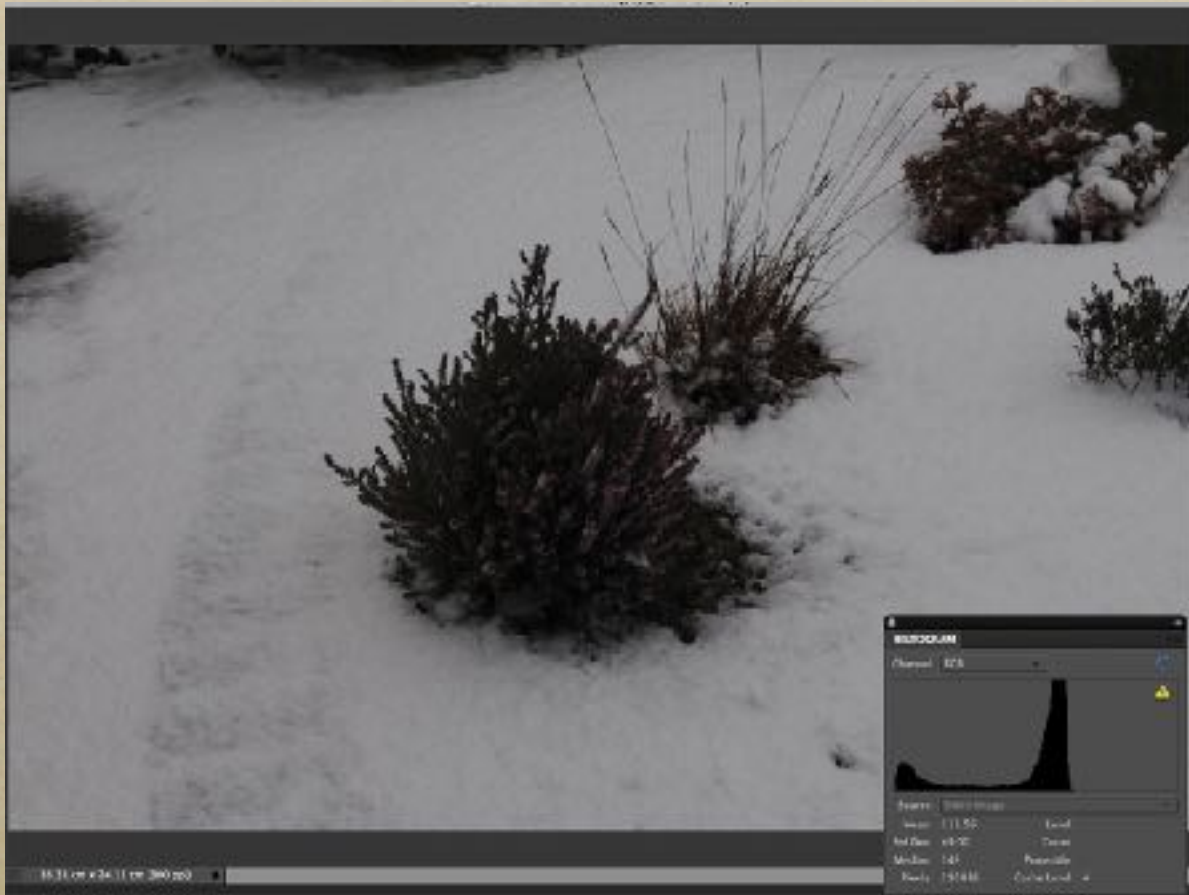


This is a **histogram**

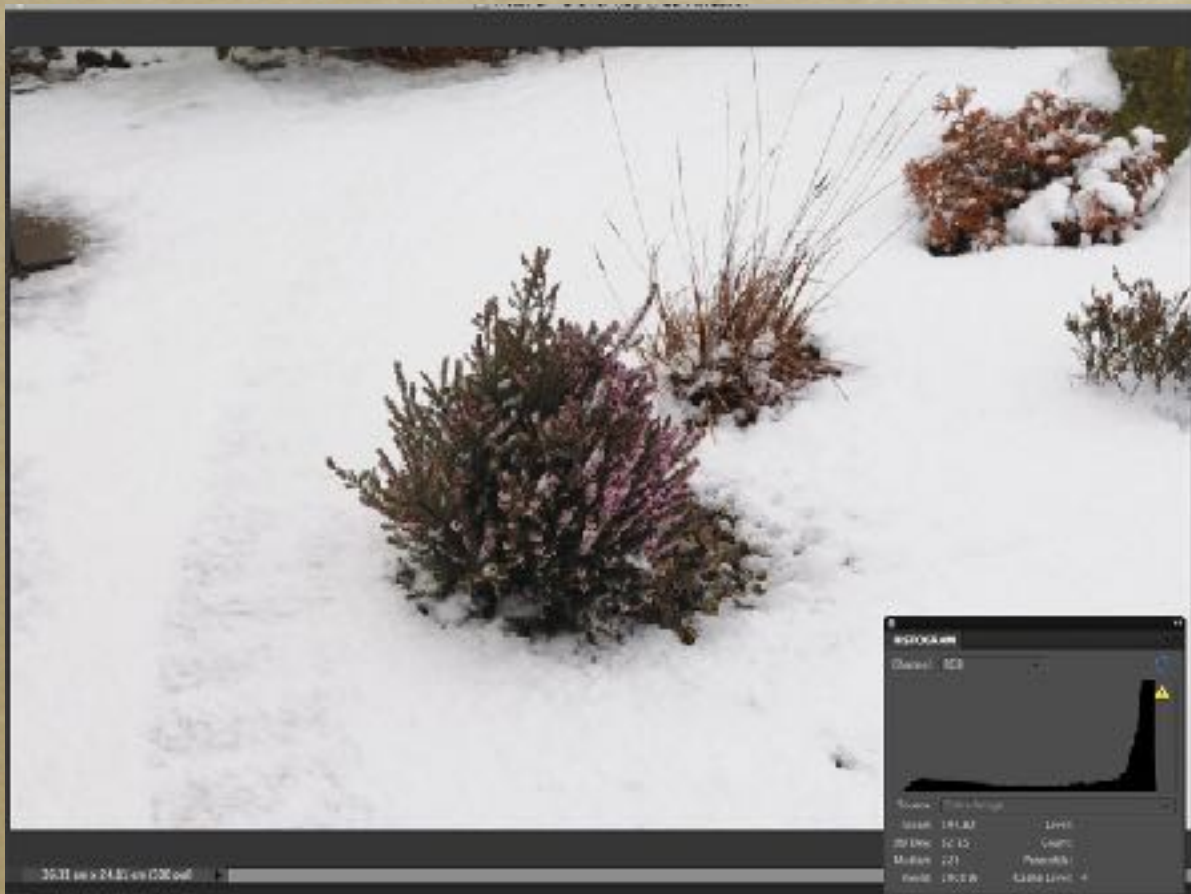
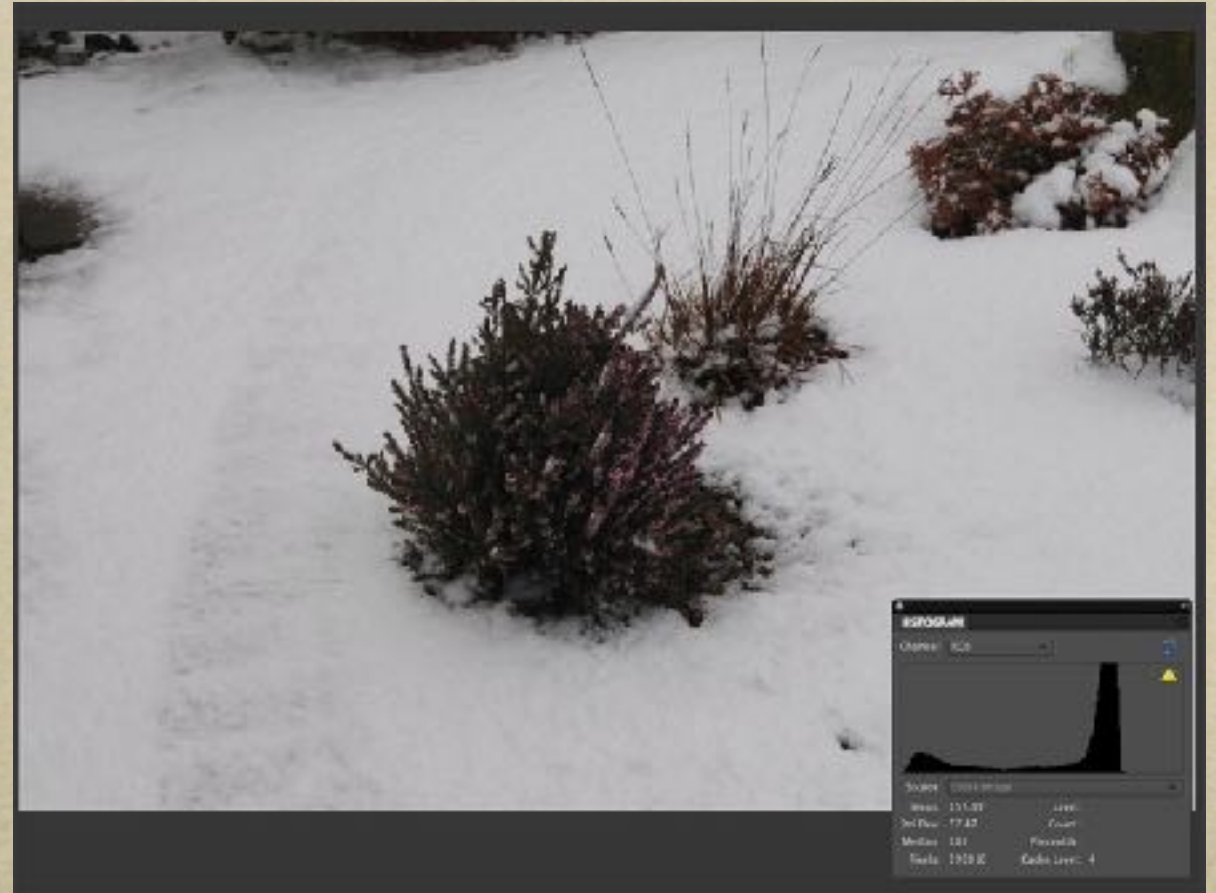
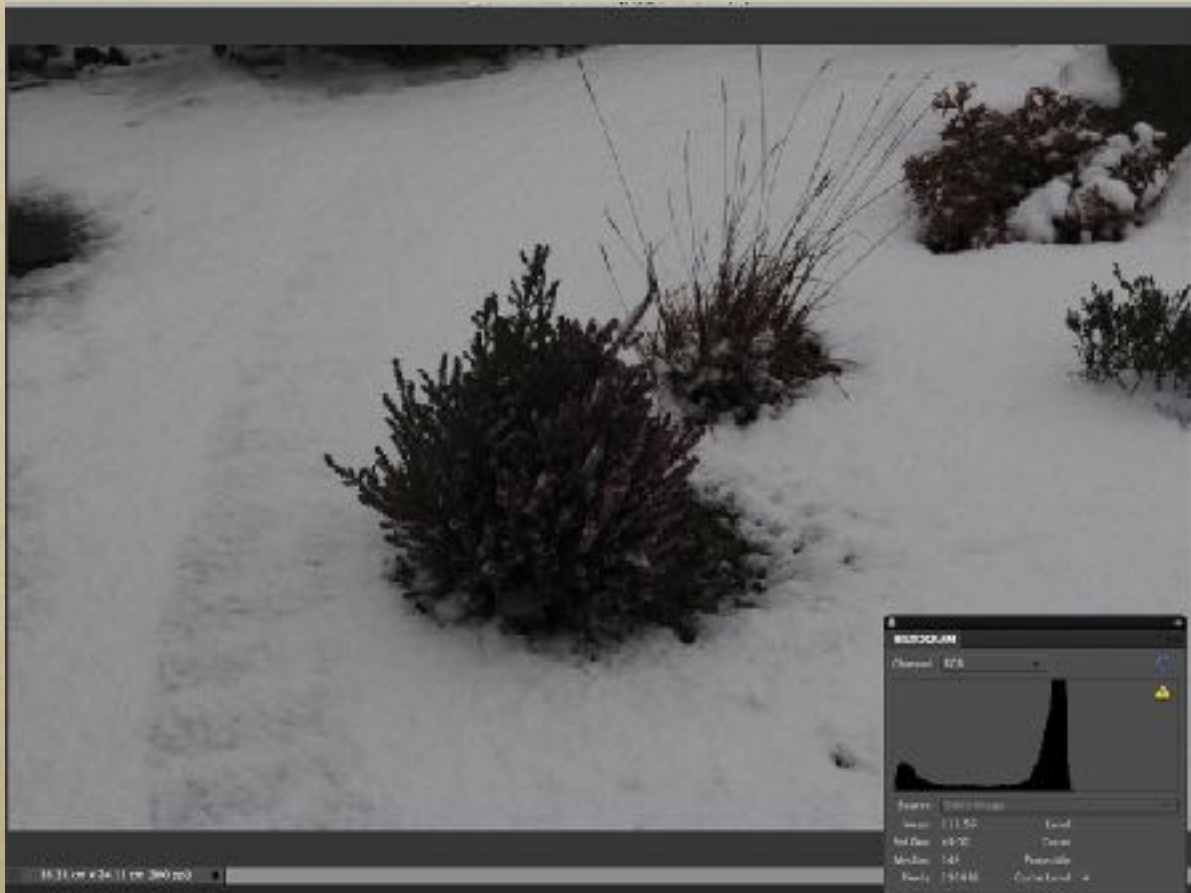


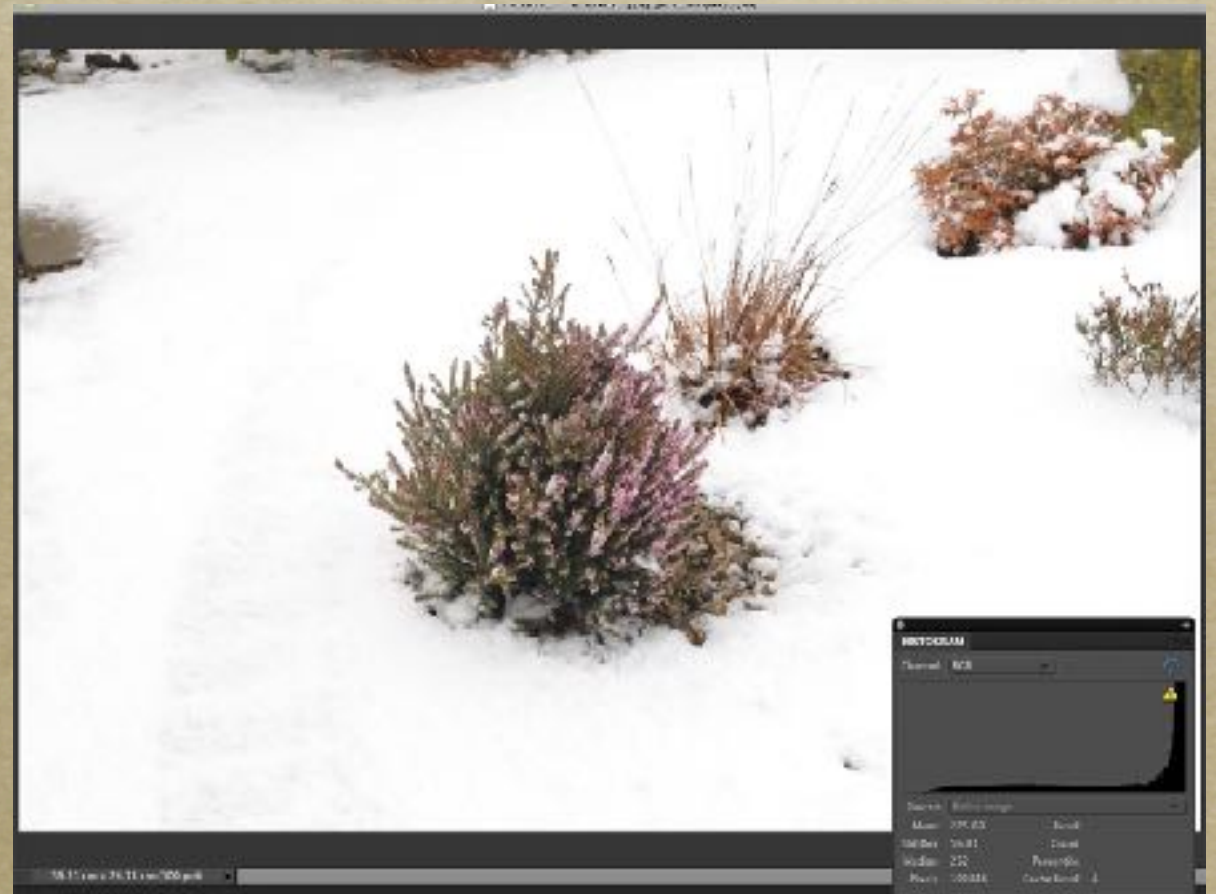
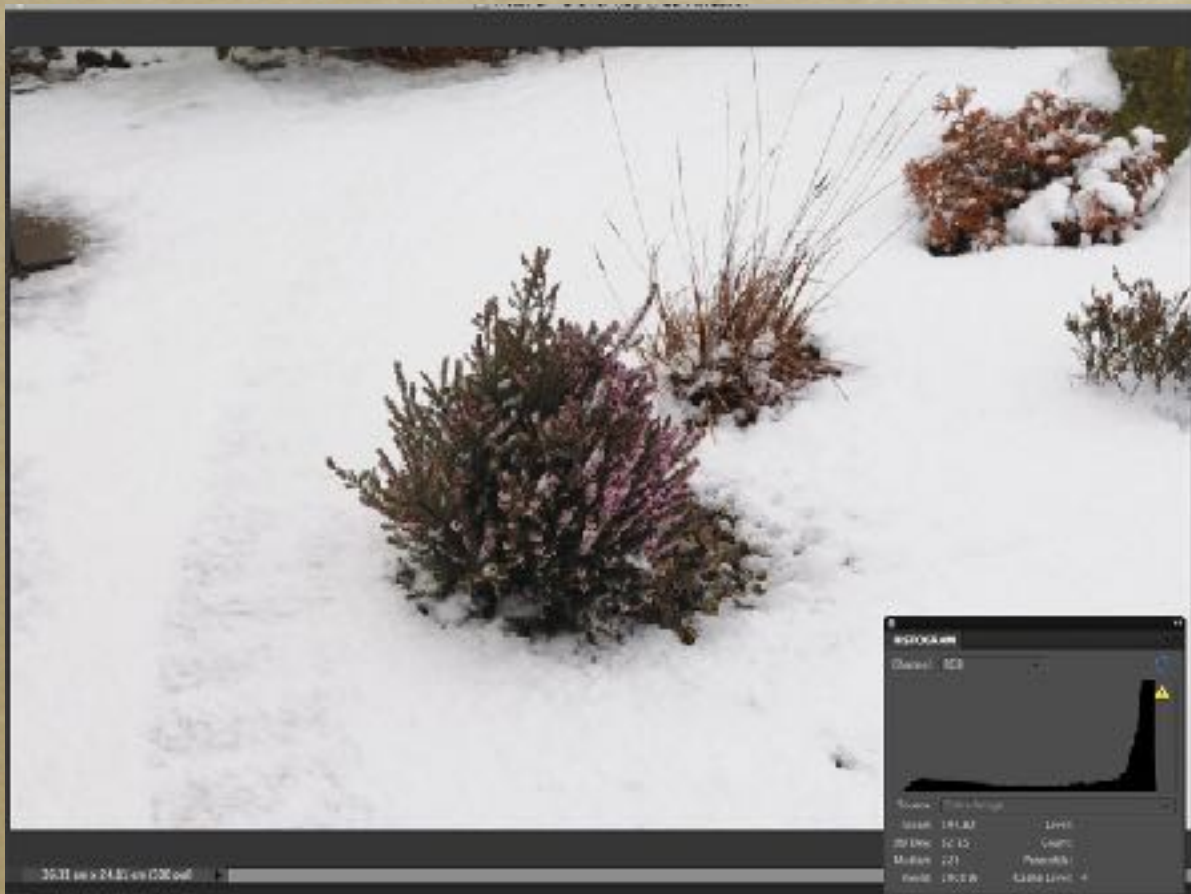
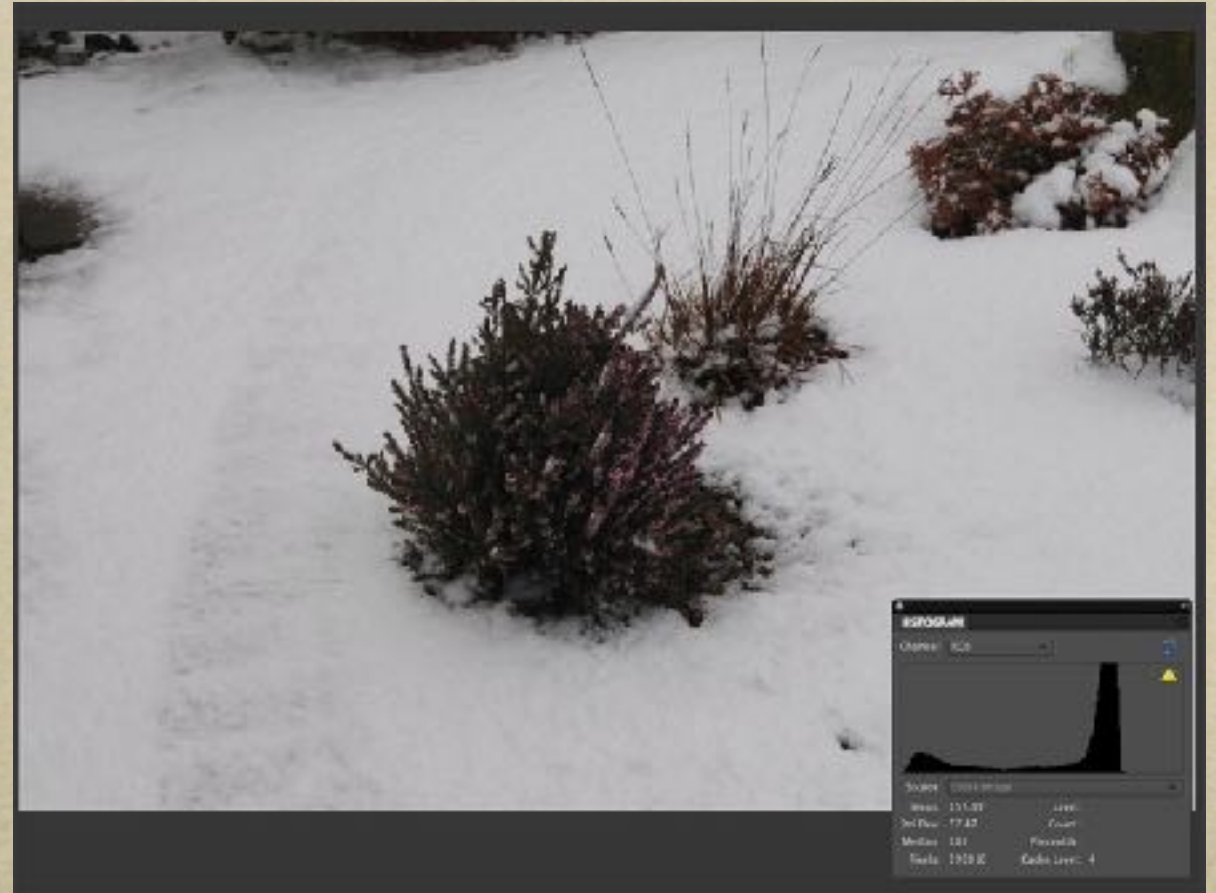
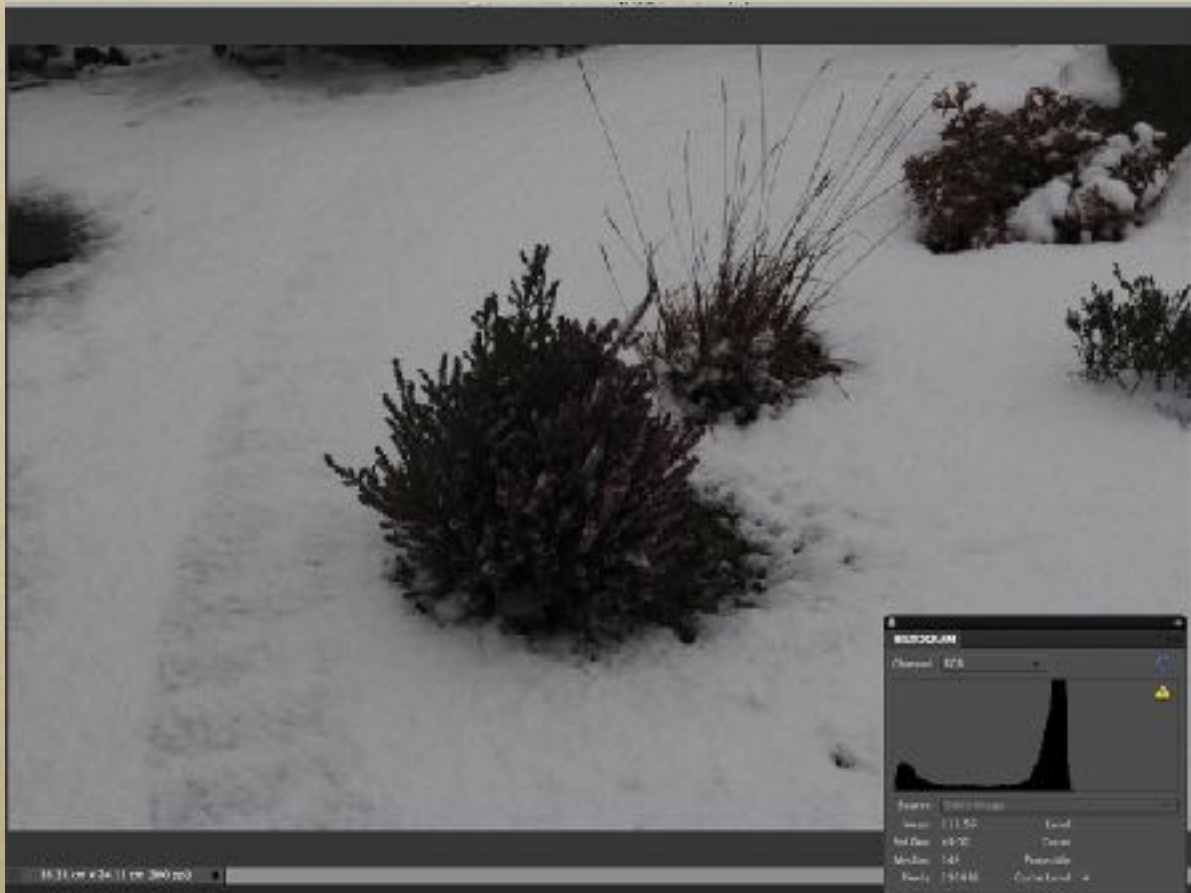


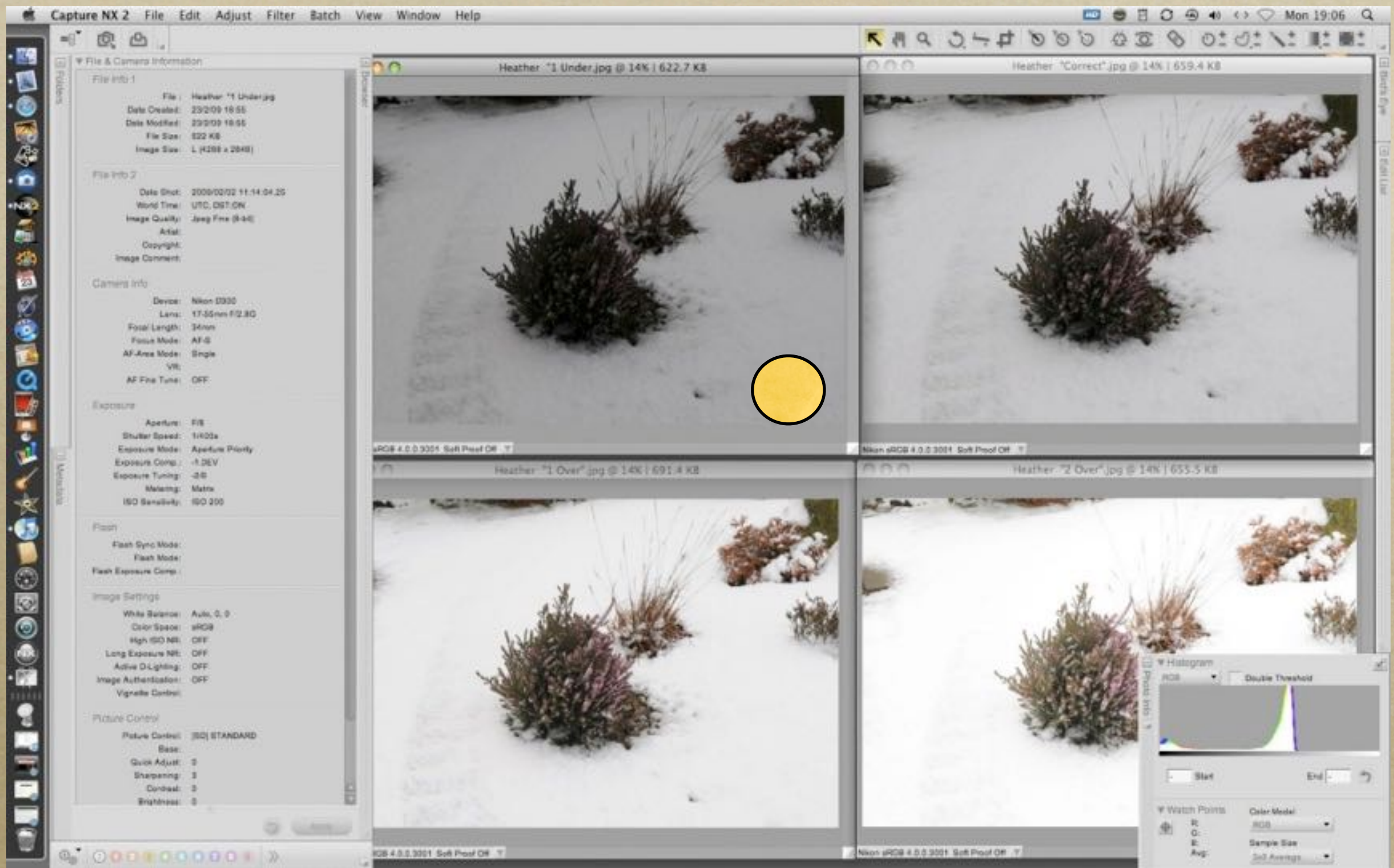
Look at the histogram



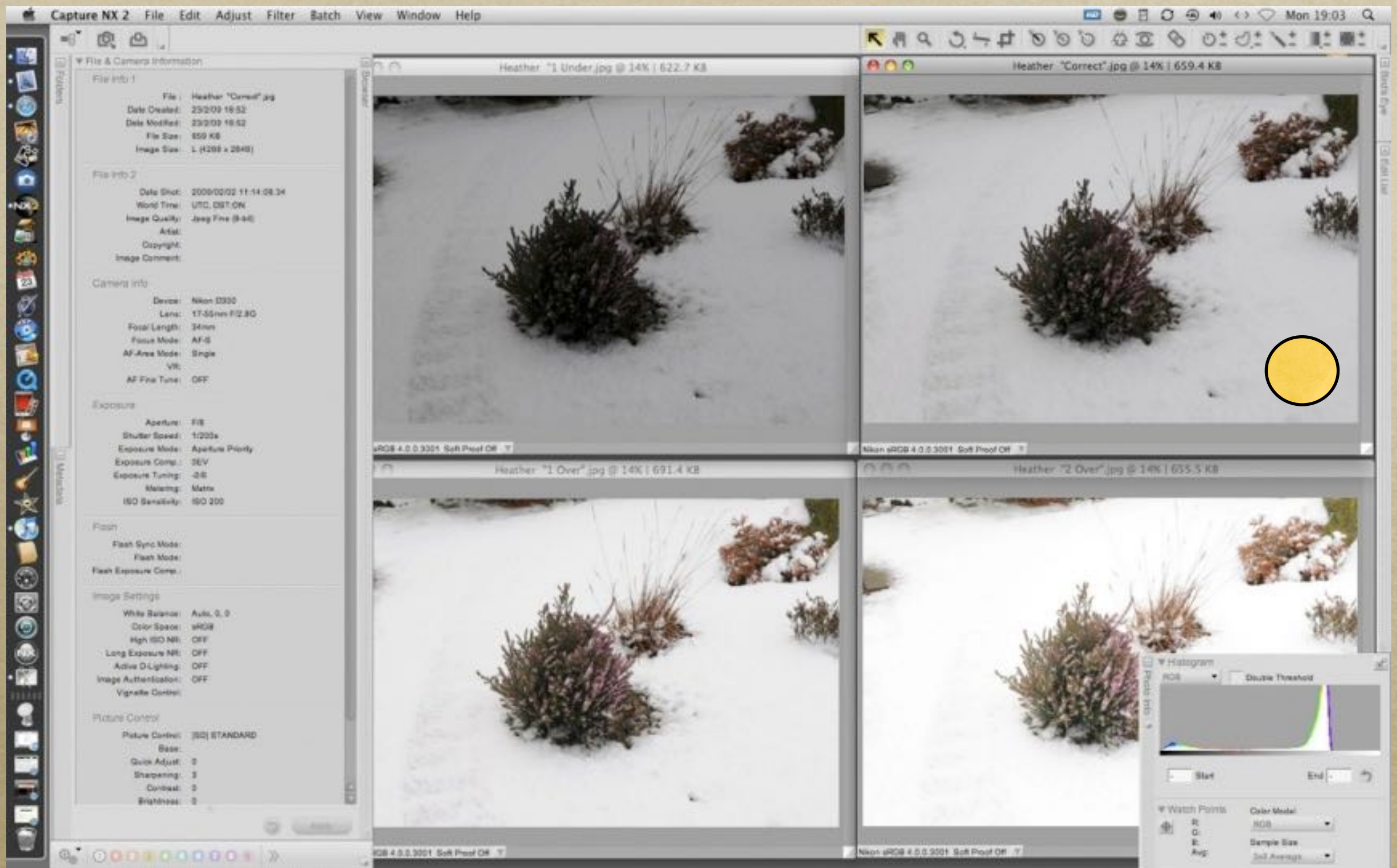
Notice how more exposure pushes it to the right



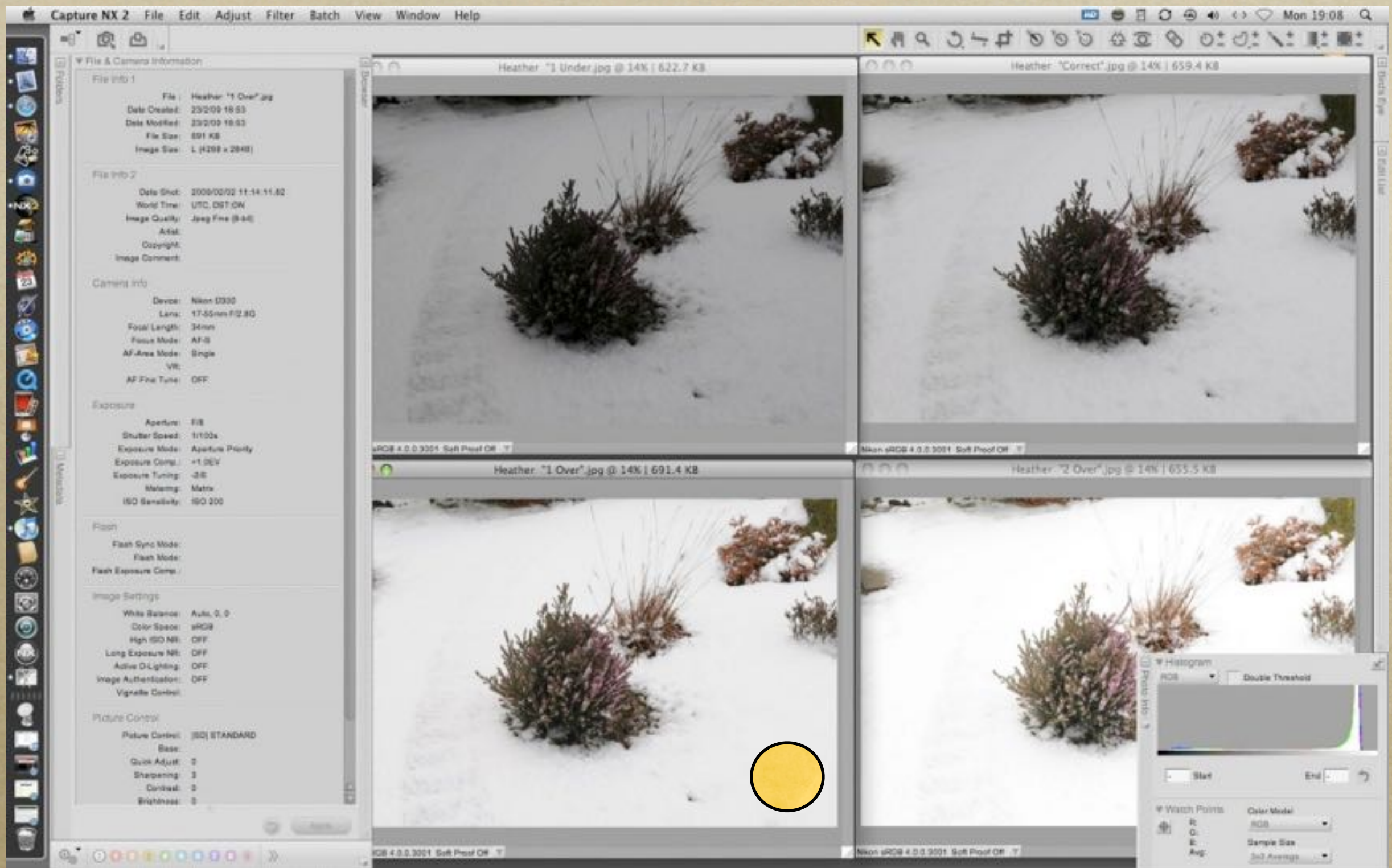




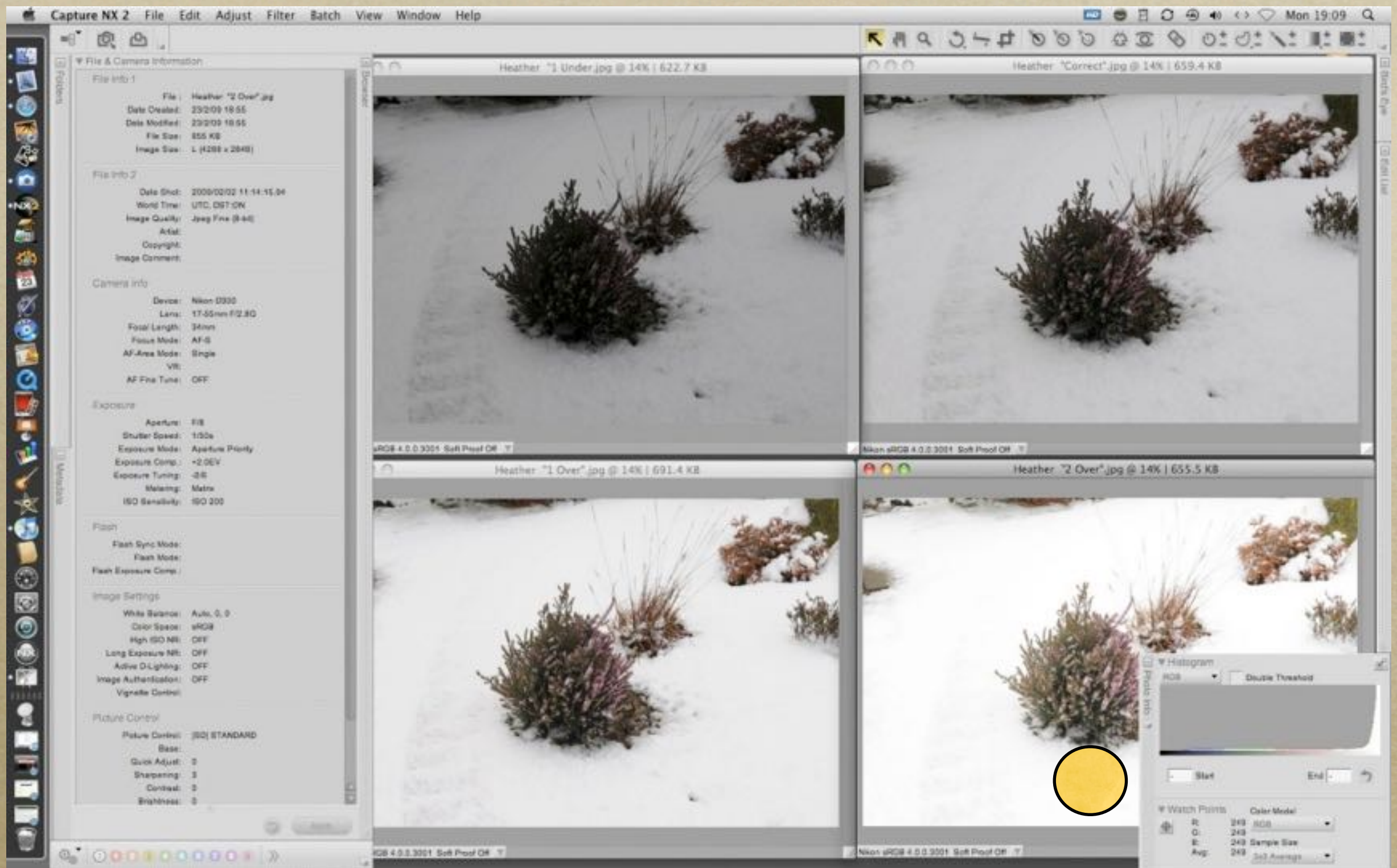
This is the darkest one. Exposure was 1/400 at f/8
See how the histogram is all on the left.



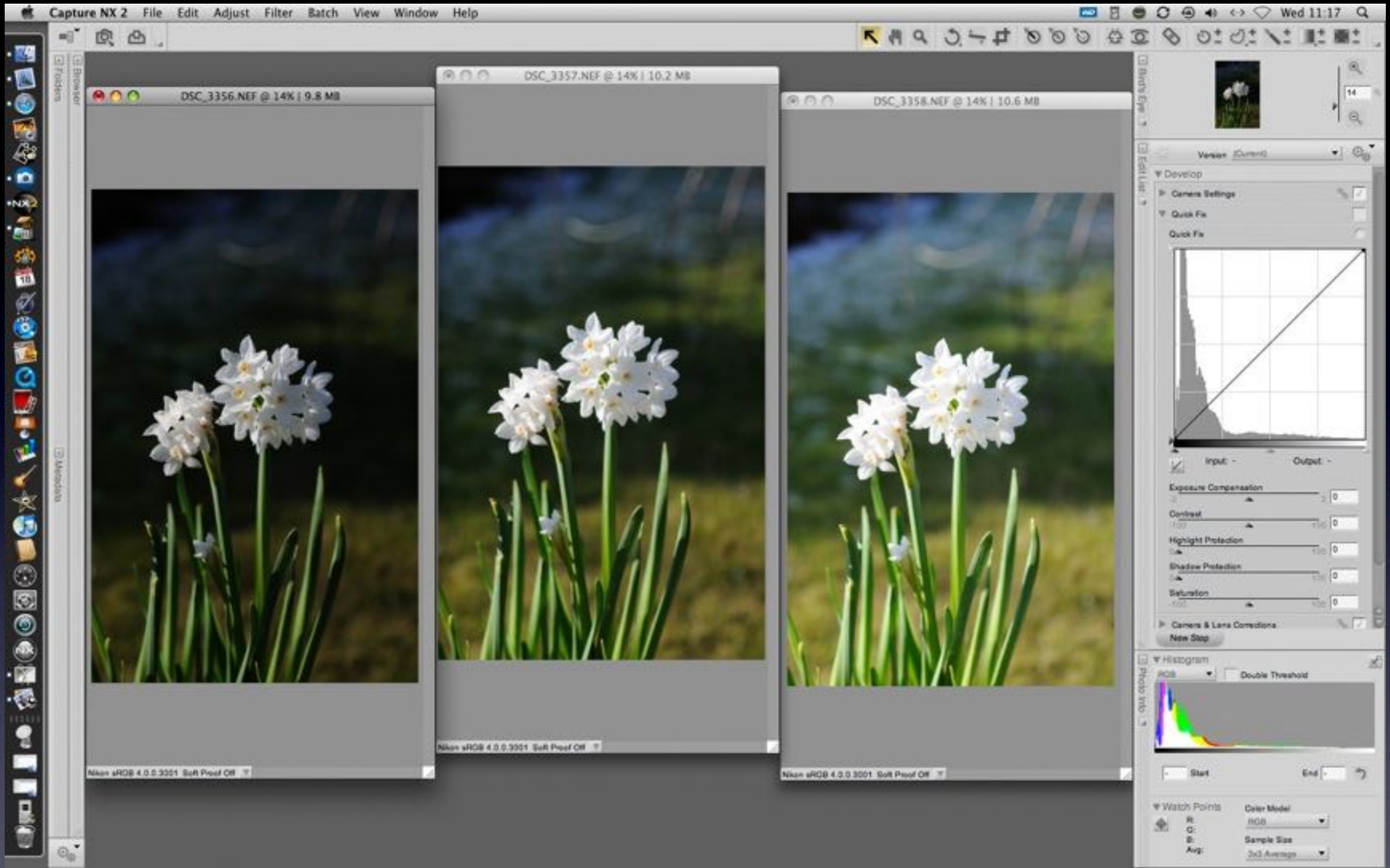
I think this is the best one. Exposure was 1/200 at f/8
The histogram has moved to the right.



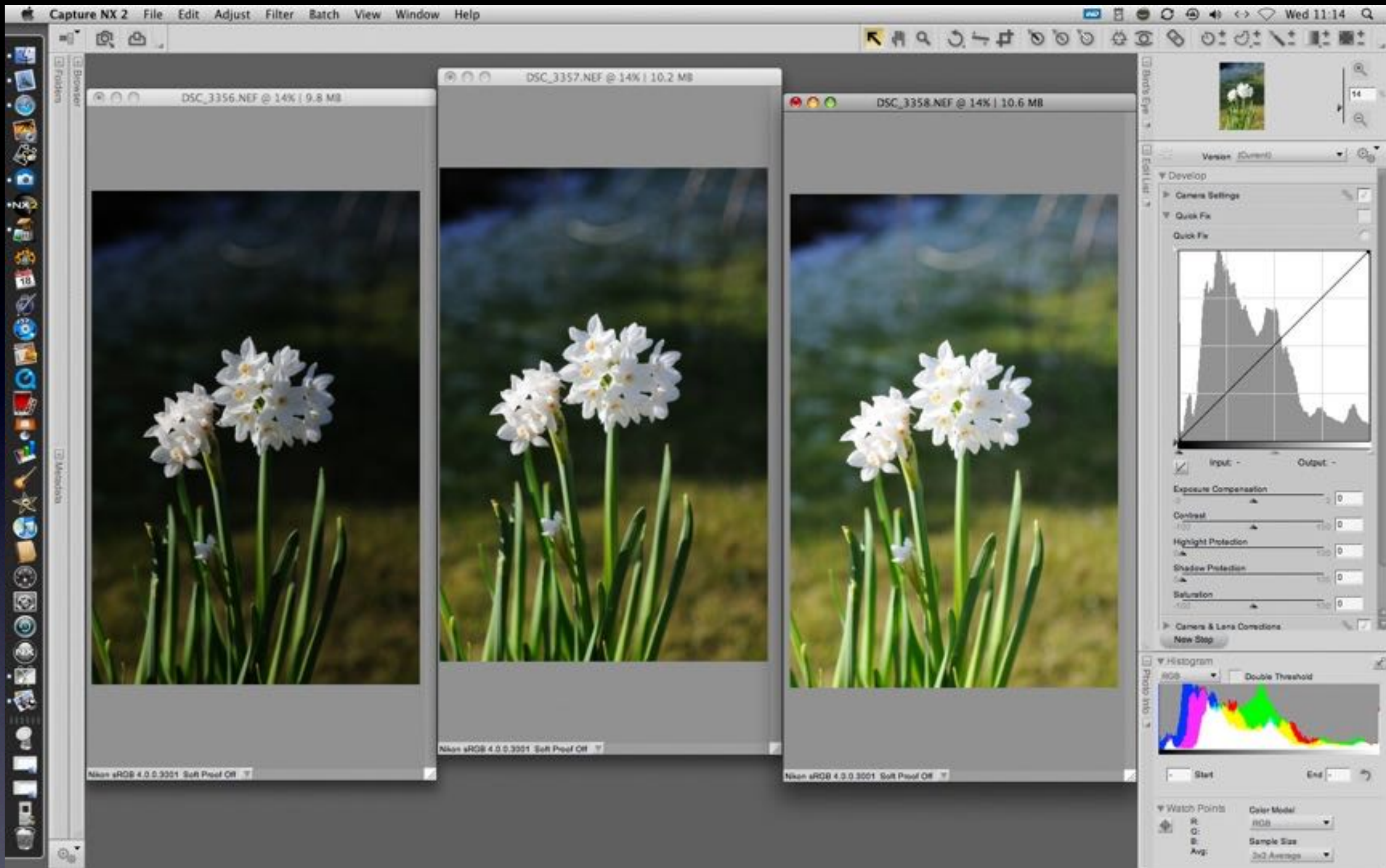
This is too bright. Exposure was 1/100 at f/8
The histogram has moved even further to the right.



Way over the top ! Exposure was 1/50 at f/8
The histogram has moved off the right edge of the chart.

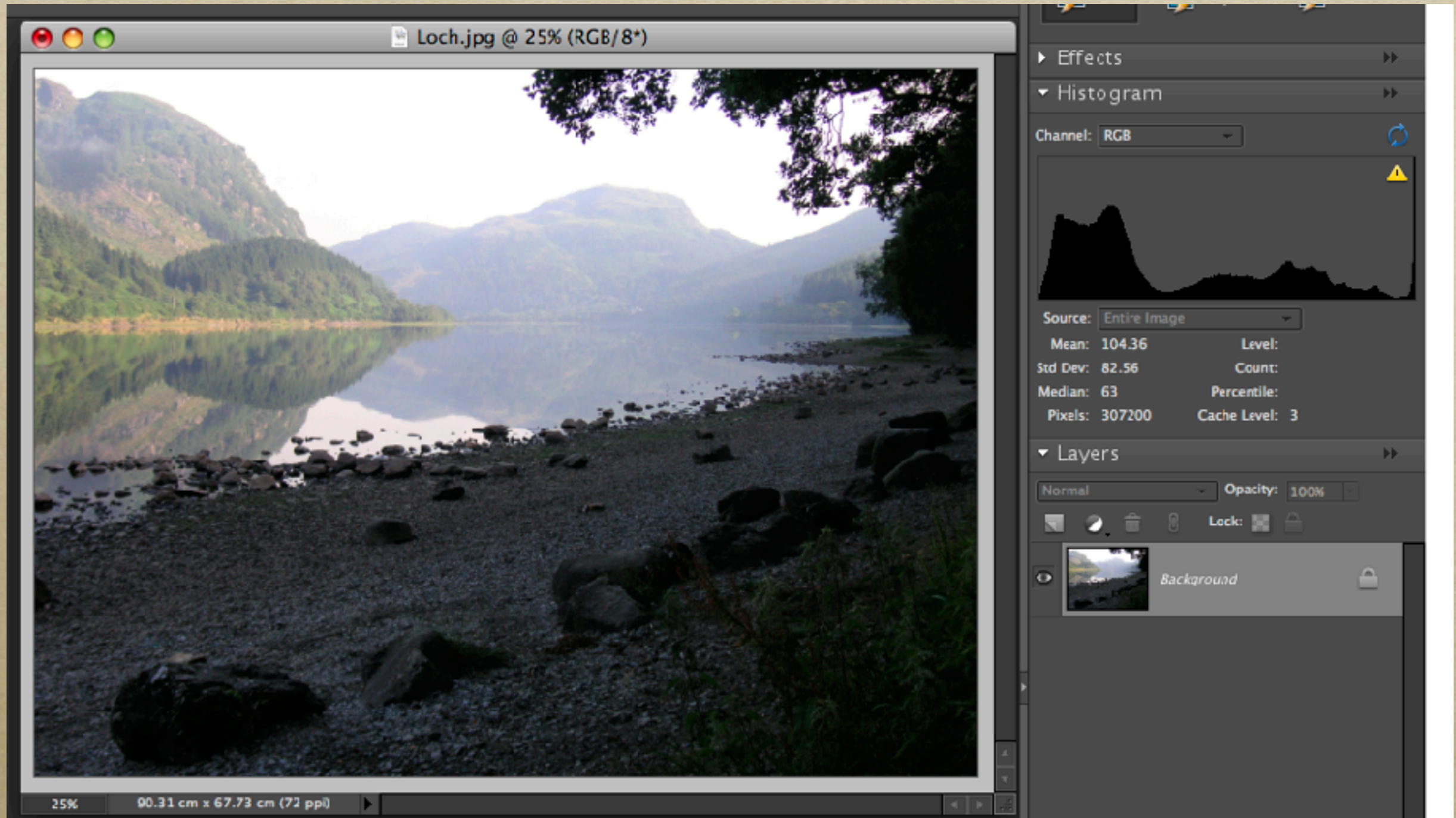


1 Stop Under-Exposure



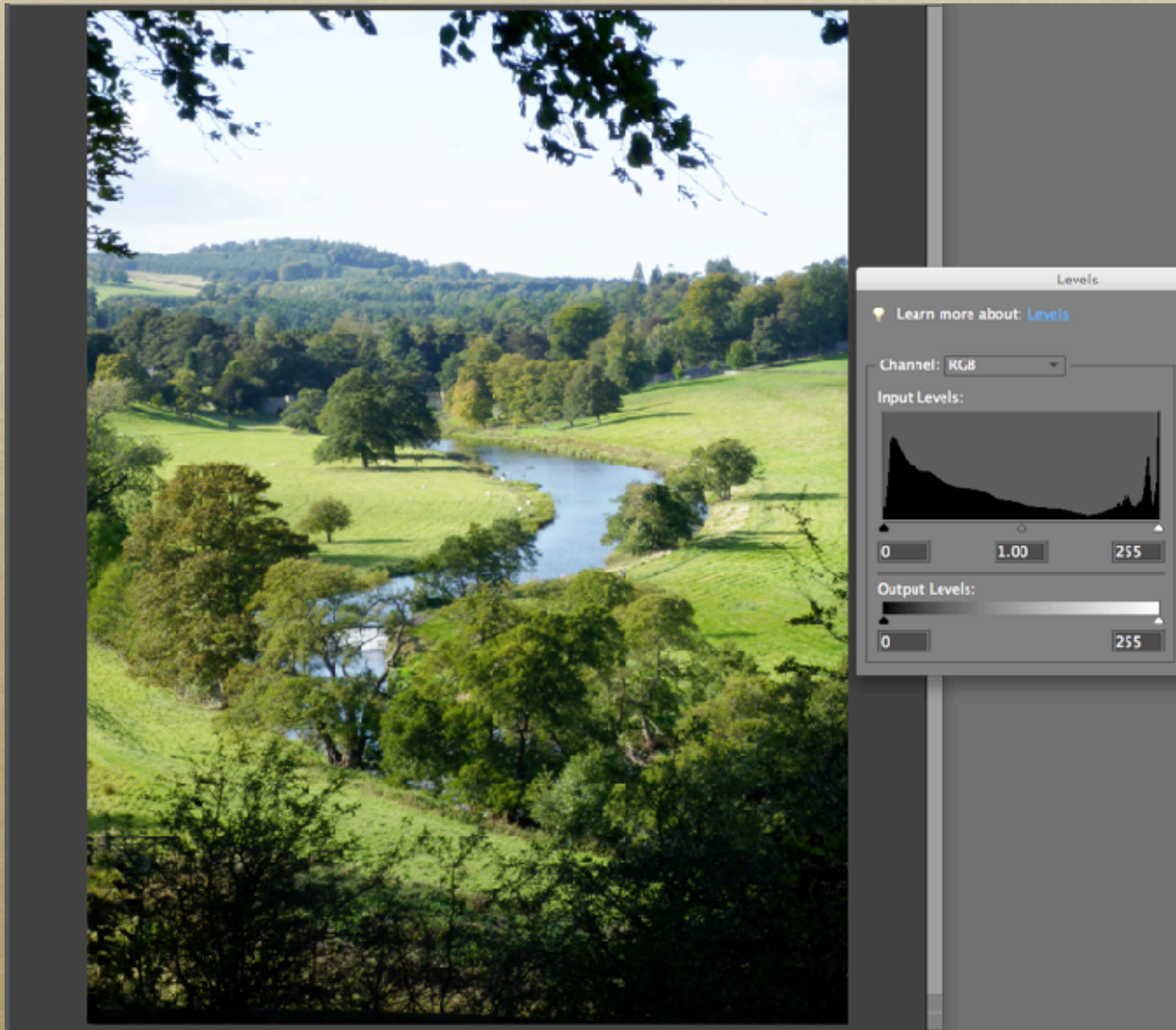
1 Stop Over-Exposure

Some normal histograms

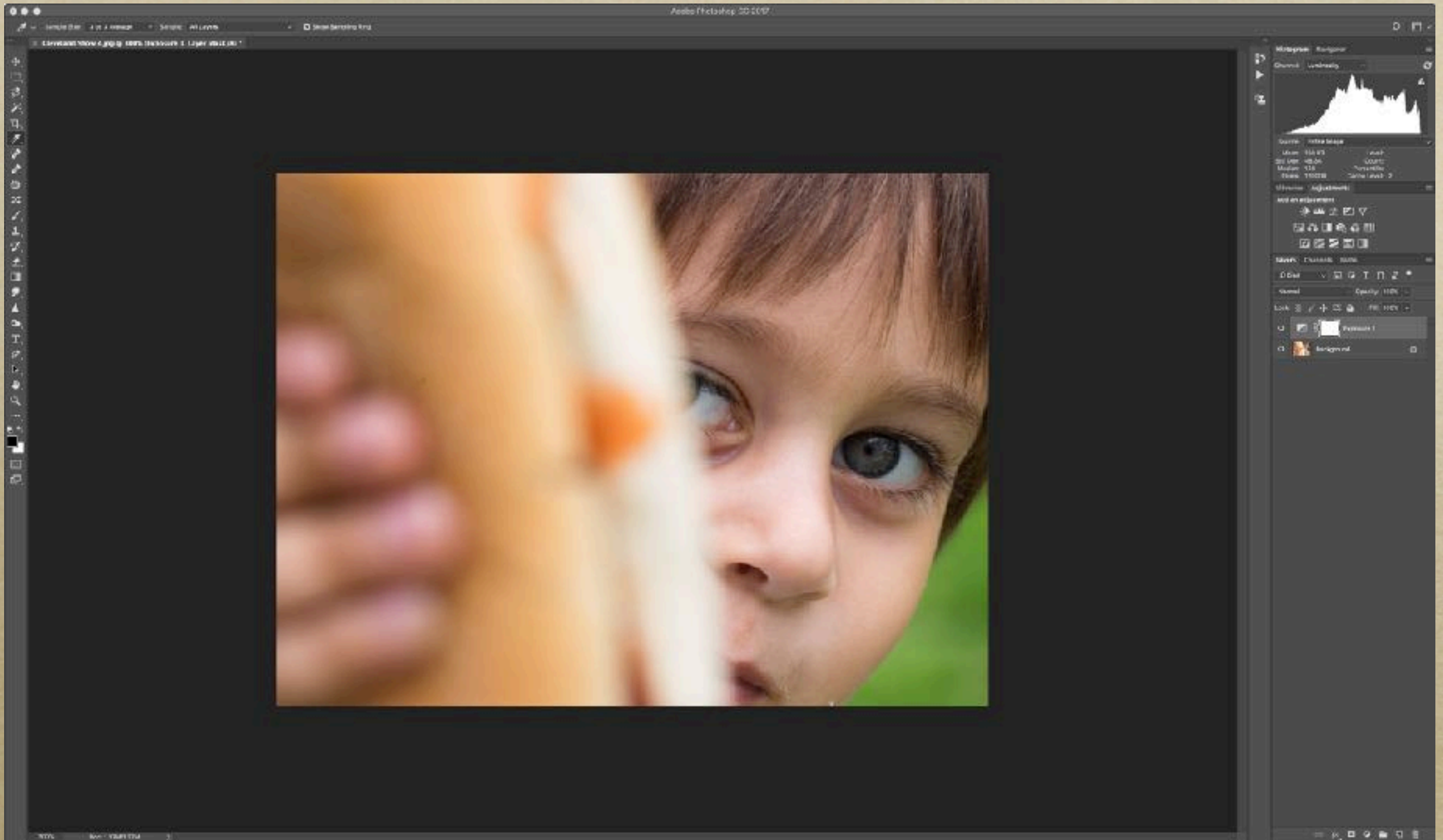


This is a normal type of picture.

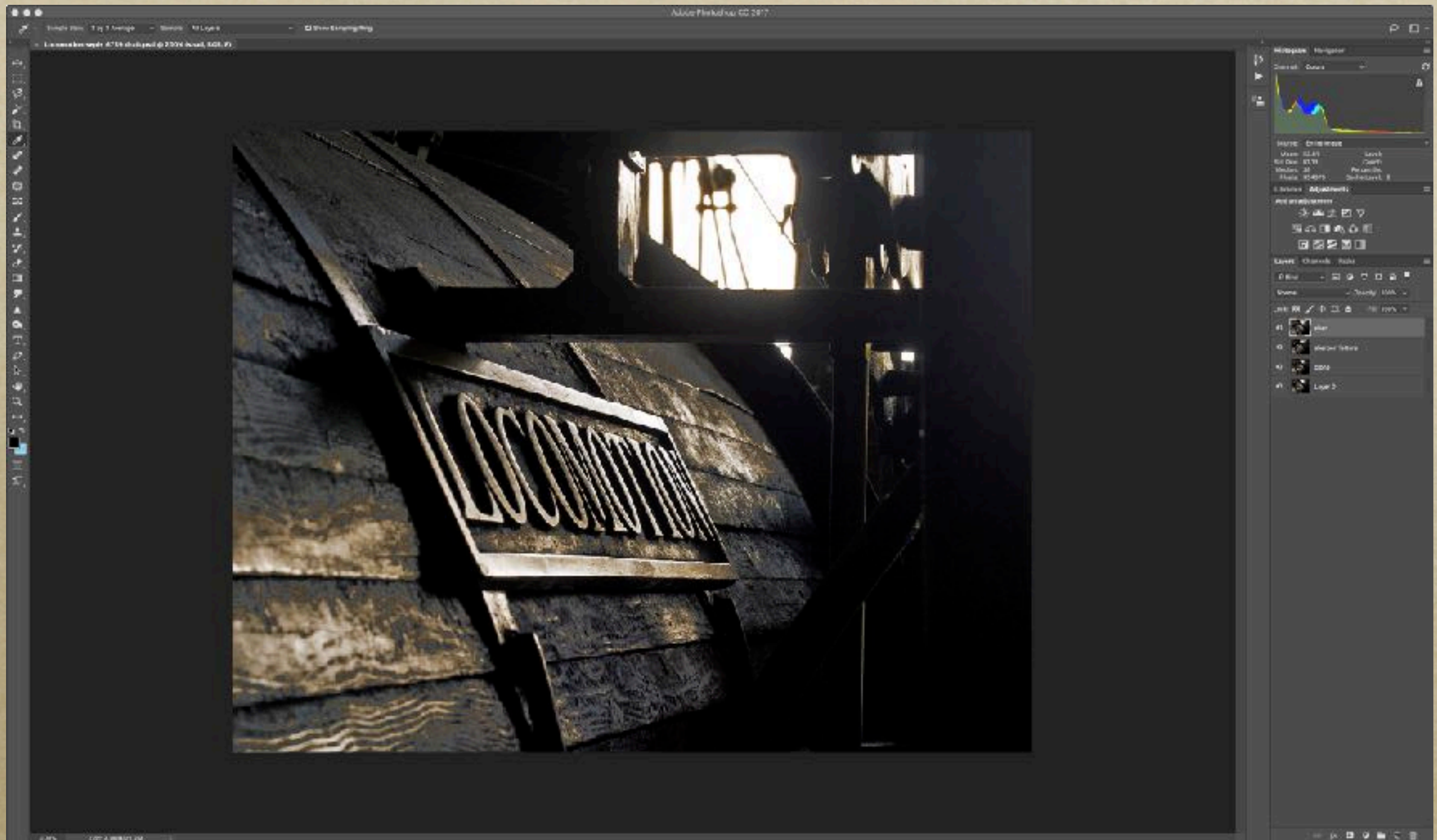
See how the histogram spreads right across the chart.



Another ordinary shot with a full histogram



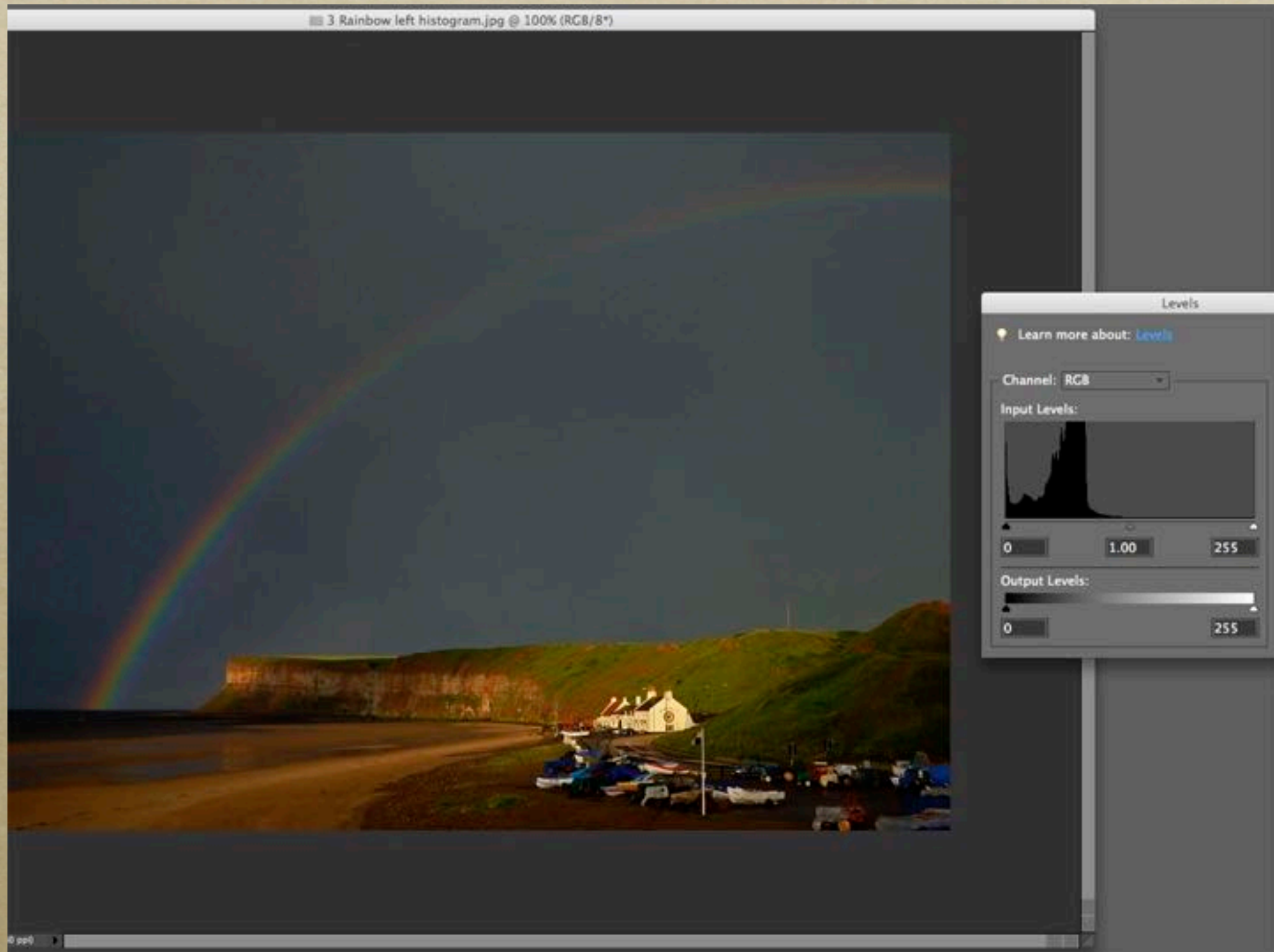
The histogram here looks bunched up to the right but that's only because there are big areas of light tone.



Compare this one. The histogram is bunched to the left because of the large areas of dark tone.

BUT BEWARE !

You must judge the histogram on what
you expect it to look like.



The histogram is over on the left,
but that's how it should be !

All of these histograms are displayed on the computer
but they are also shown on your camera.



On my SLR



and my compact.

How to Adjust the Exposure

Most cameras have a control for exposure compensation.

Sometimes it's a dial to turn.



Often it's a button to press while you turn a dial.



On my compact it's a slider on the touch screen.



+ values make the picture brighter

and shift the histogram to the right

- values make it darker

and shift the histogram to the left

I'd like to show you another way of assessing the exposure

If a picture is under-exposed it is possible to make some correction on the computer

But if over-exposed you can't resurrect blown highlights so you don't want to over-expose if you can help it

The playback display on the camera can be set to show any bleached out areas

Highlights



I have Highlights turned on on my display.

It flashes black and white on burnt out areas.

Highlights

Canon – press Display / info to scroll through the viewing options in playback mode.

Find the histogram and highlight information.

Canon is clever enough to show lost shadows as well.

Nikon – press up or down on the D-pad to scroll through viewing options.

Turn on highlights by going to :

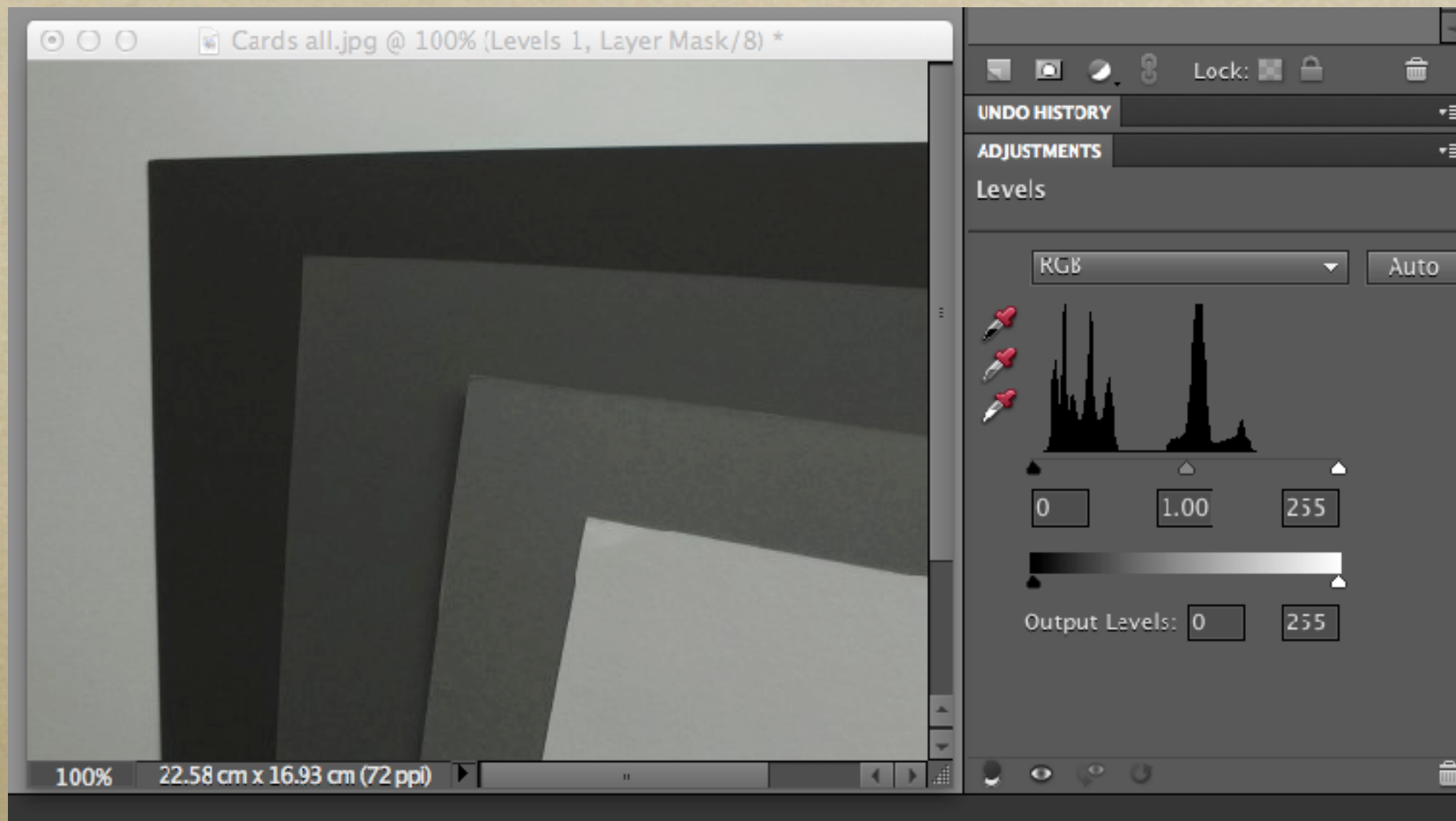
Menu > Playback Menu > Display Mode > Highlights

Why the Meter Can Be Wrong

The exposure meter in the camera has some most sophisticated features.

Matrix or Evaluative metering decides what it thinks the subject is before deciding on the exposure to give.

But it can be fooled :

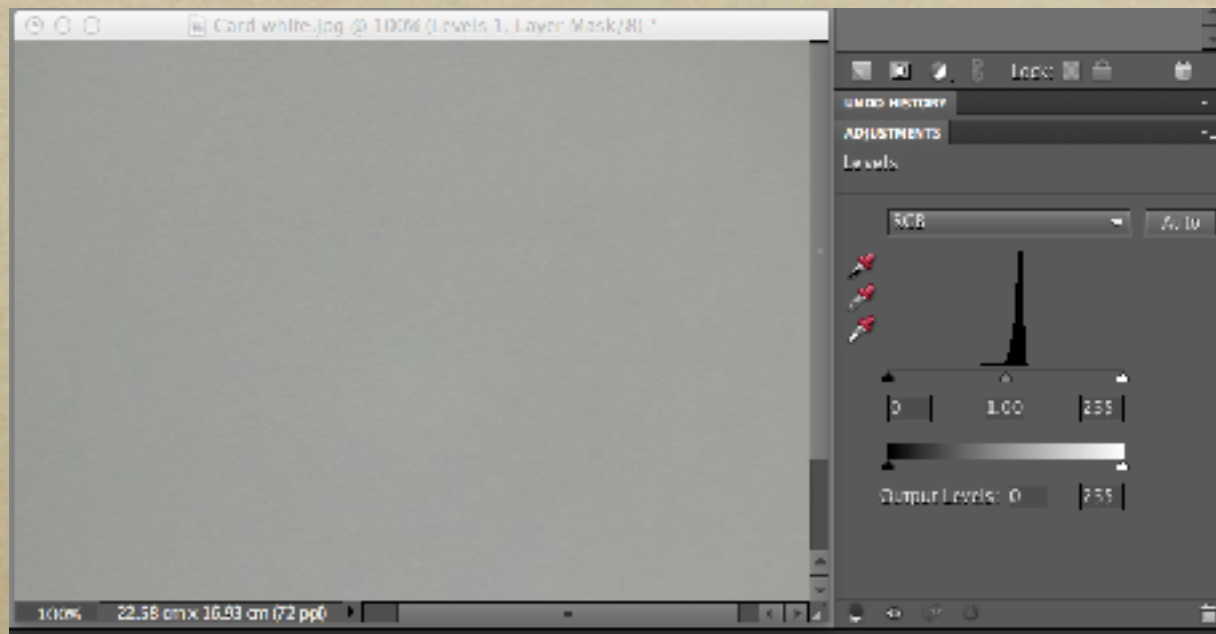


These are pieces of card, from white through grey to black.
Notice the gaps in the histogram.

The same cards photographed on auto exposure.

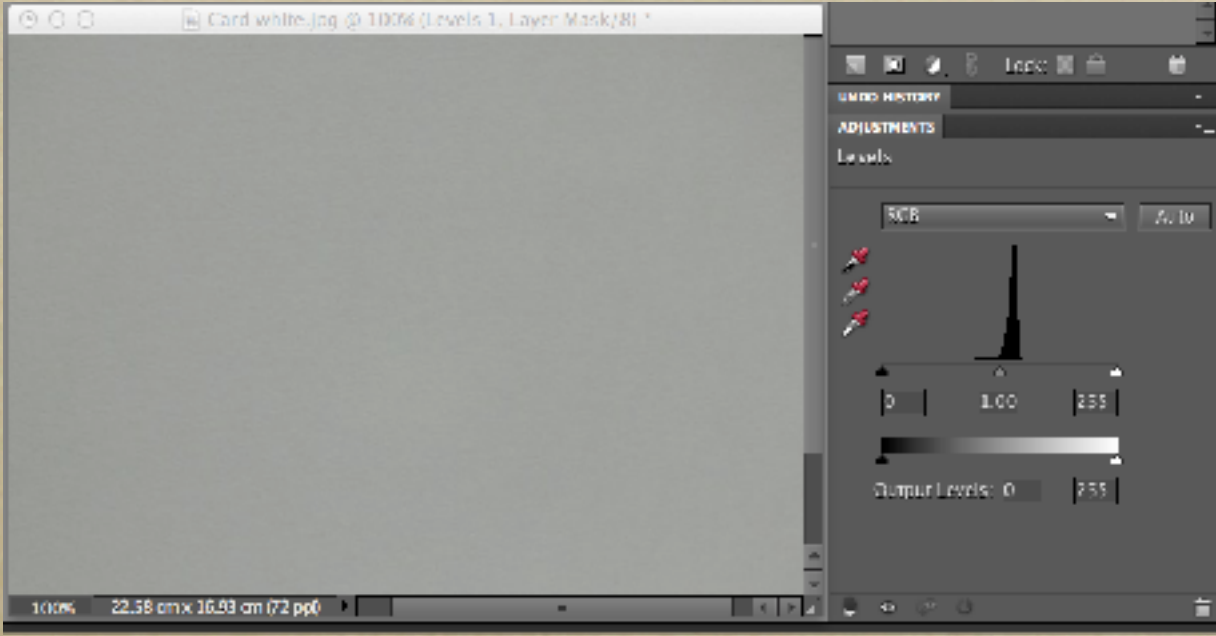
The ignorant camera thinks each card on its own is a mid-grey.

The same cards photographed on auto exposure.
The ignorant camera thinks each card on its own is a mid-grey.

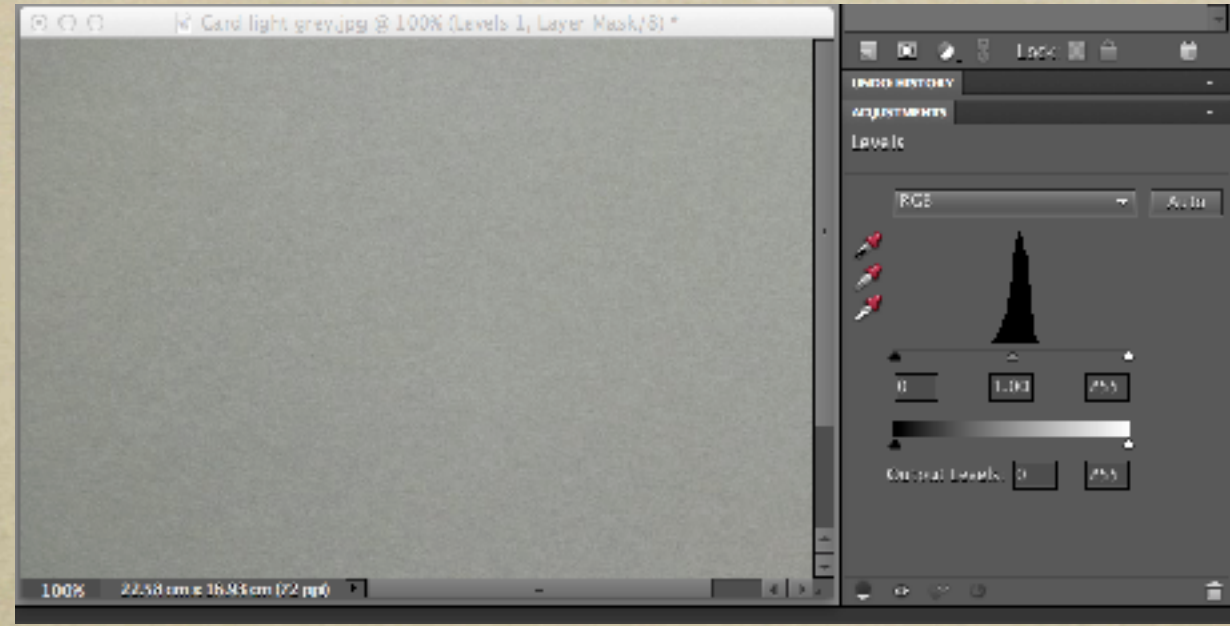


White

The same cards photographed on auto exposure.
The ignorant camera thinks each card on its own is a mid-grey.

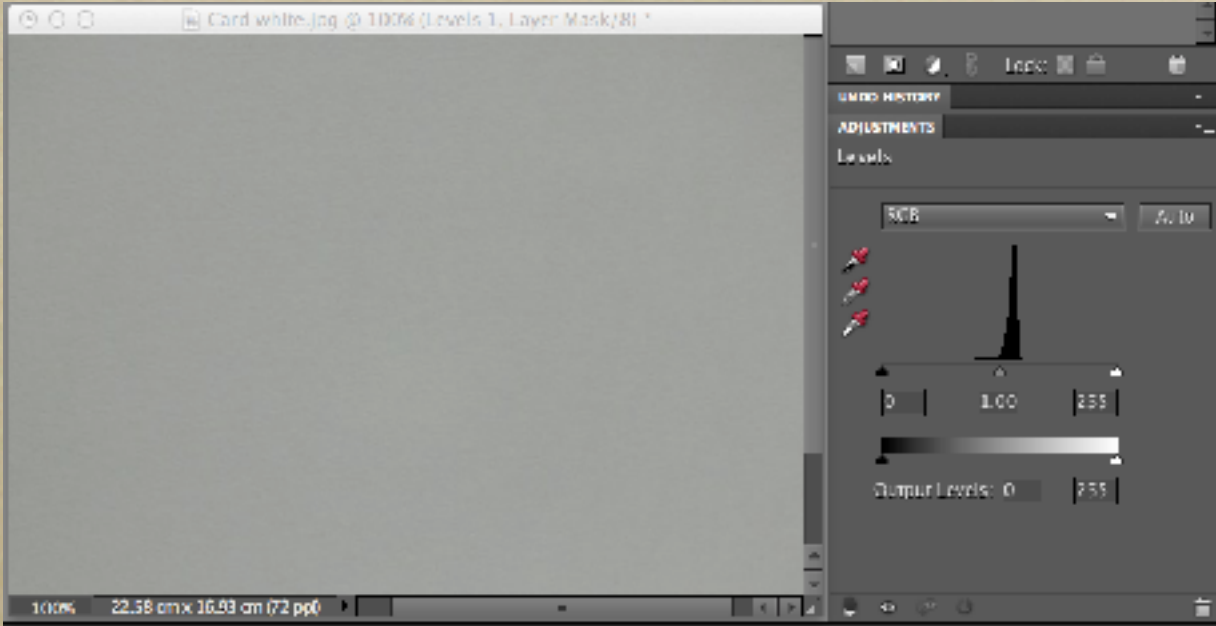


White

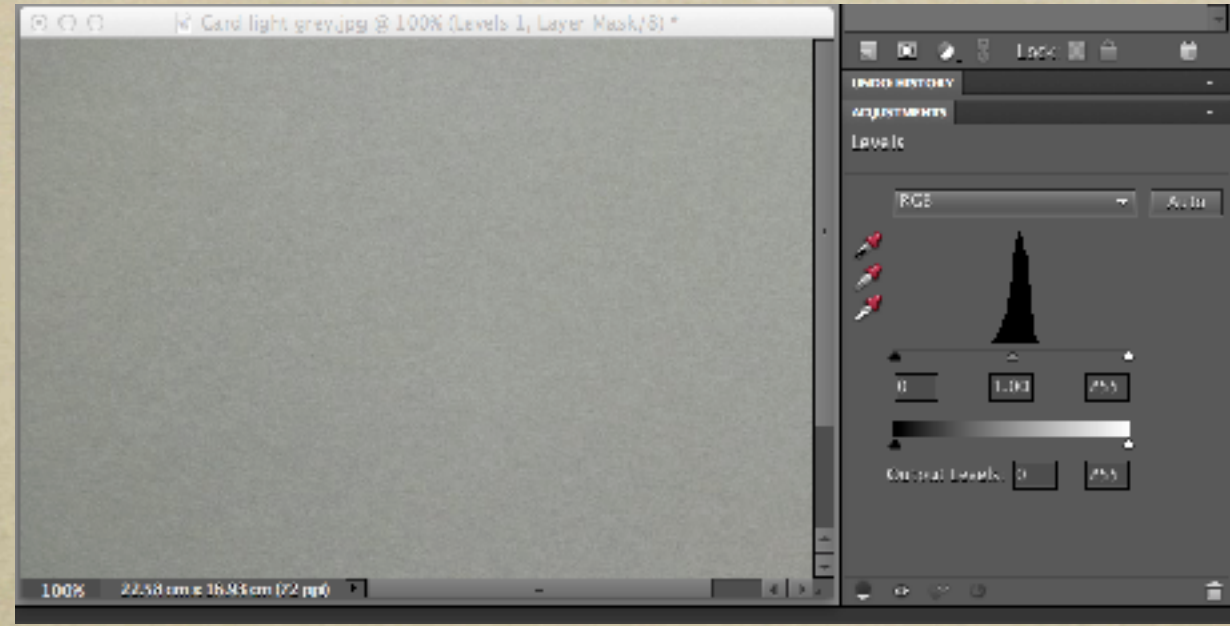


Light grey

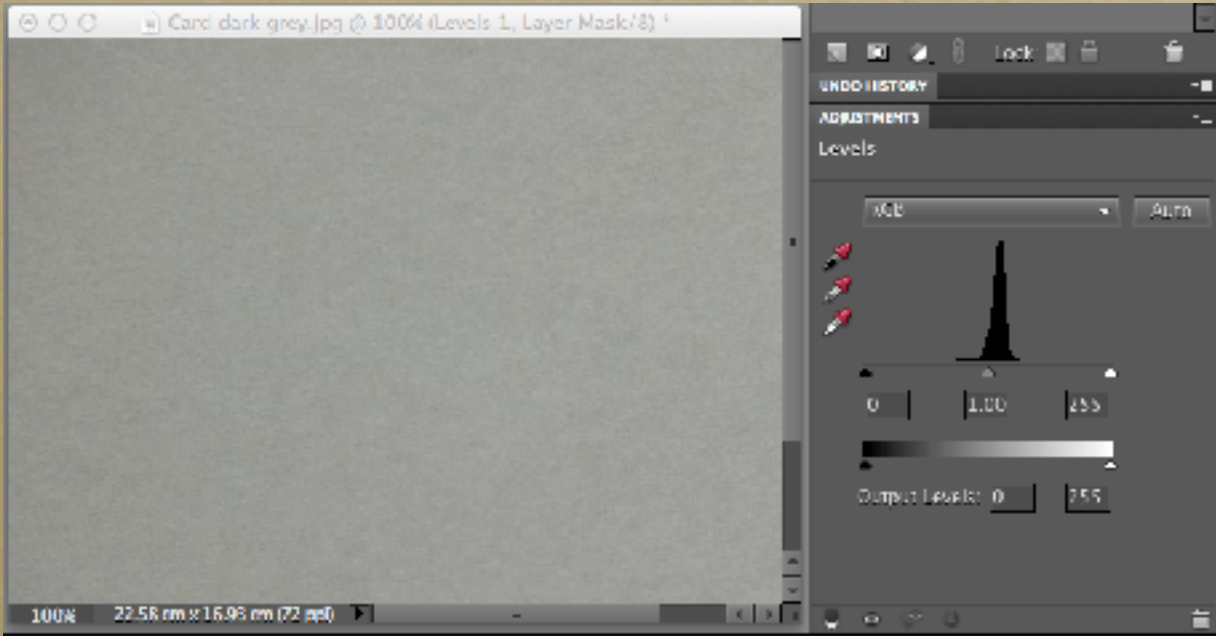
The same cards photographed on auto exposure.
The ignorant camera thinks each card on its own is a mid-grey.



White



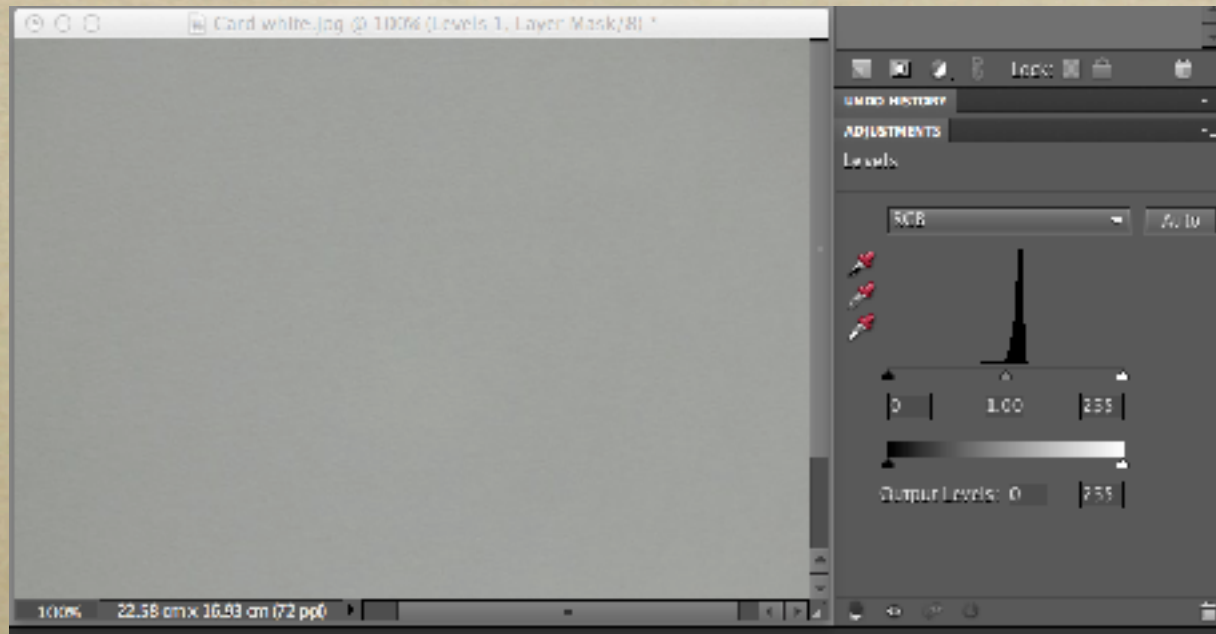
Light grey



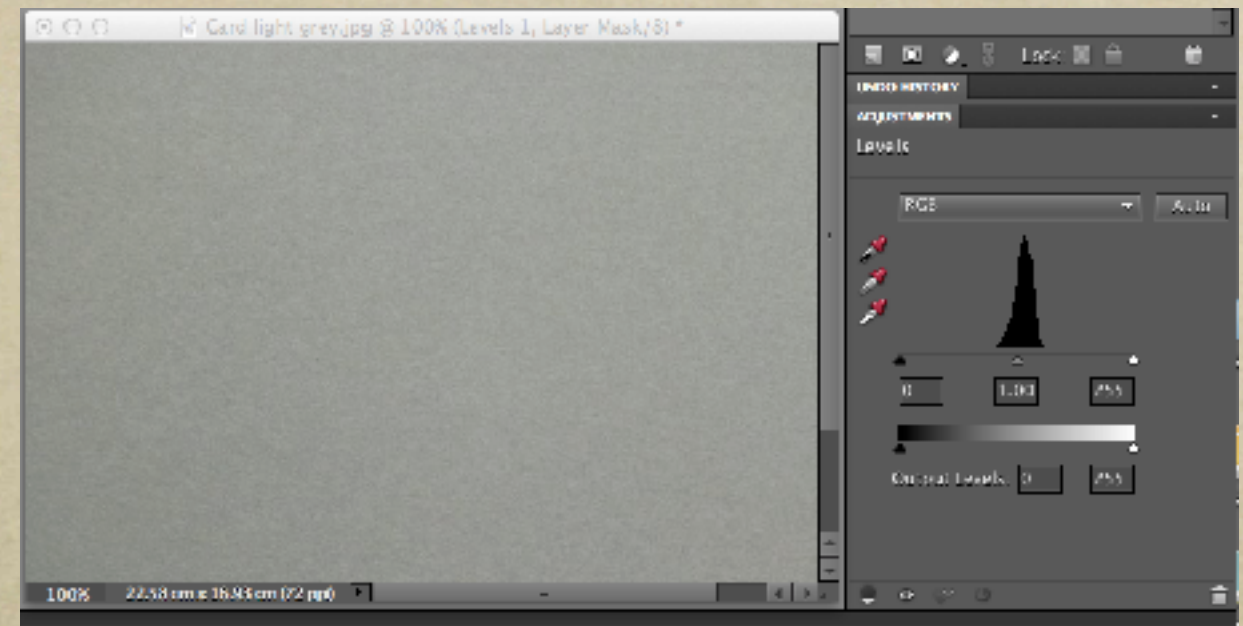
Dark grey

The same cards photographed on auto exposure.

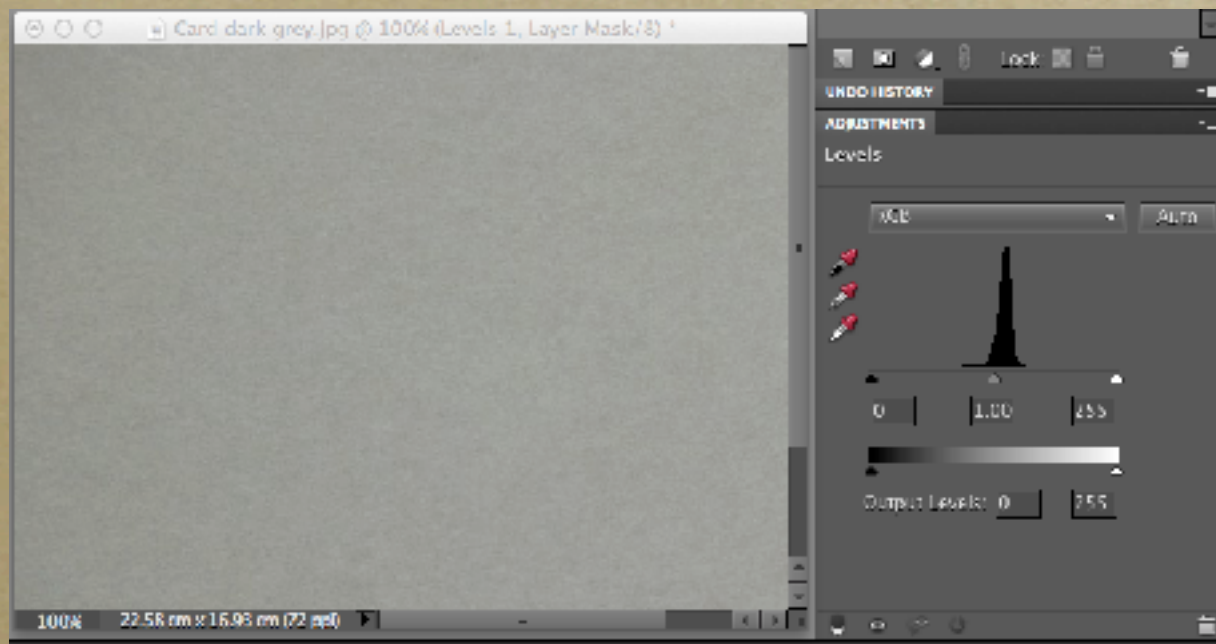
The ignorant camera thinks each card on its own is a mid-grey.



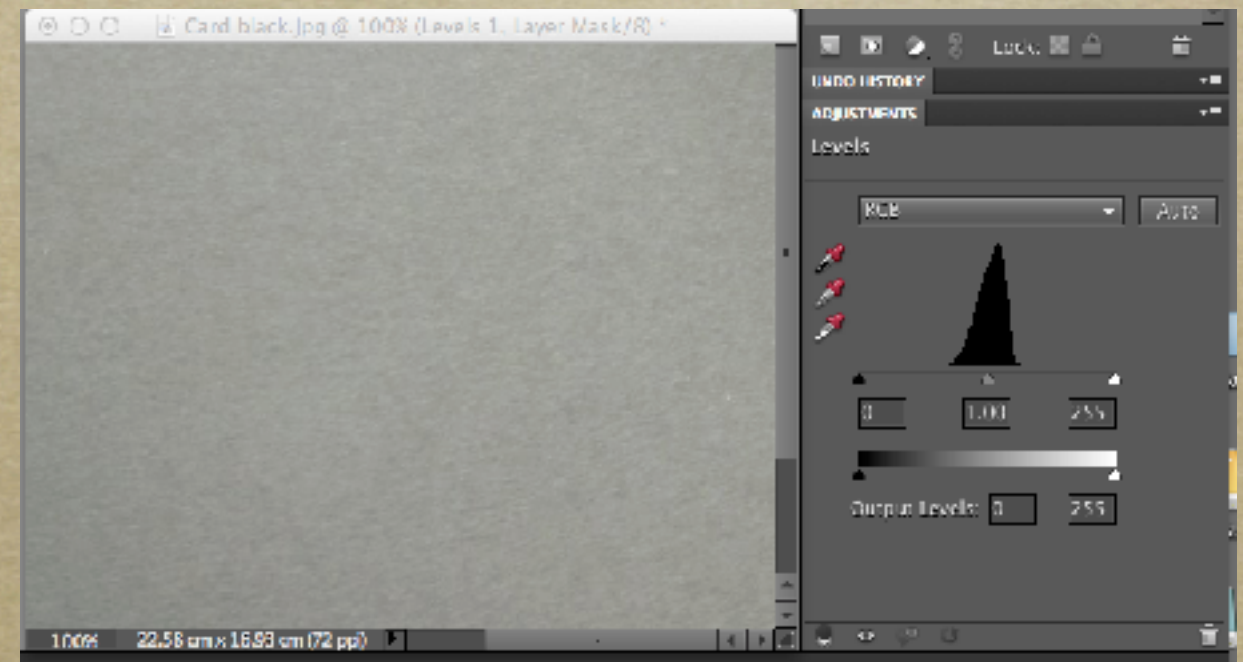
White



Light grey

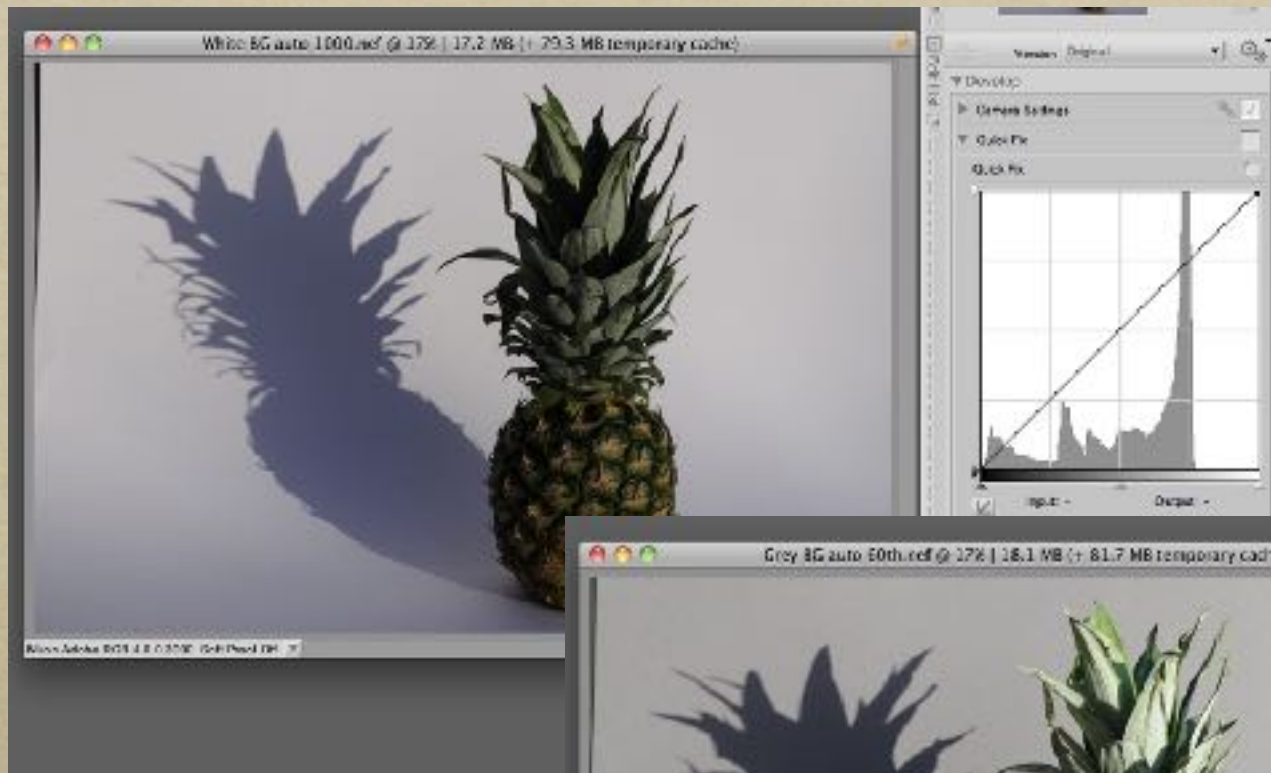


Dark grey

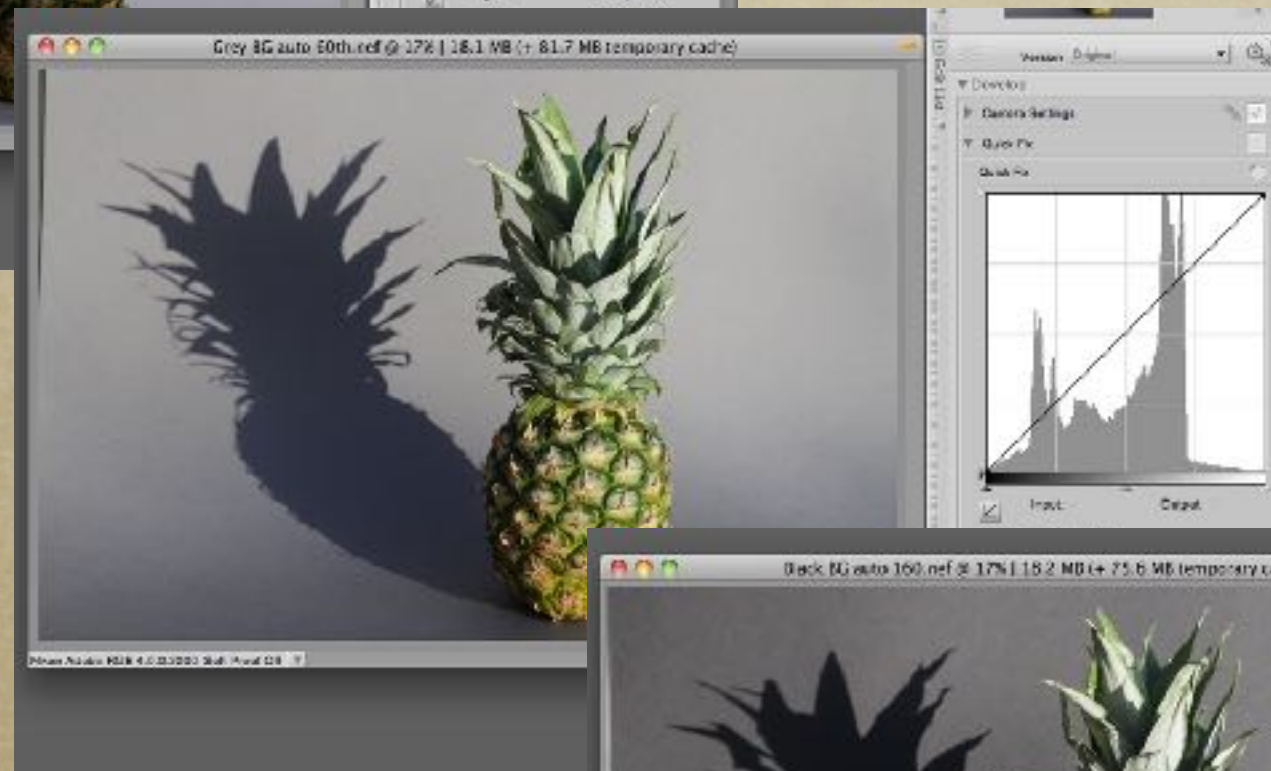


Black

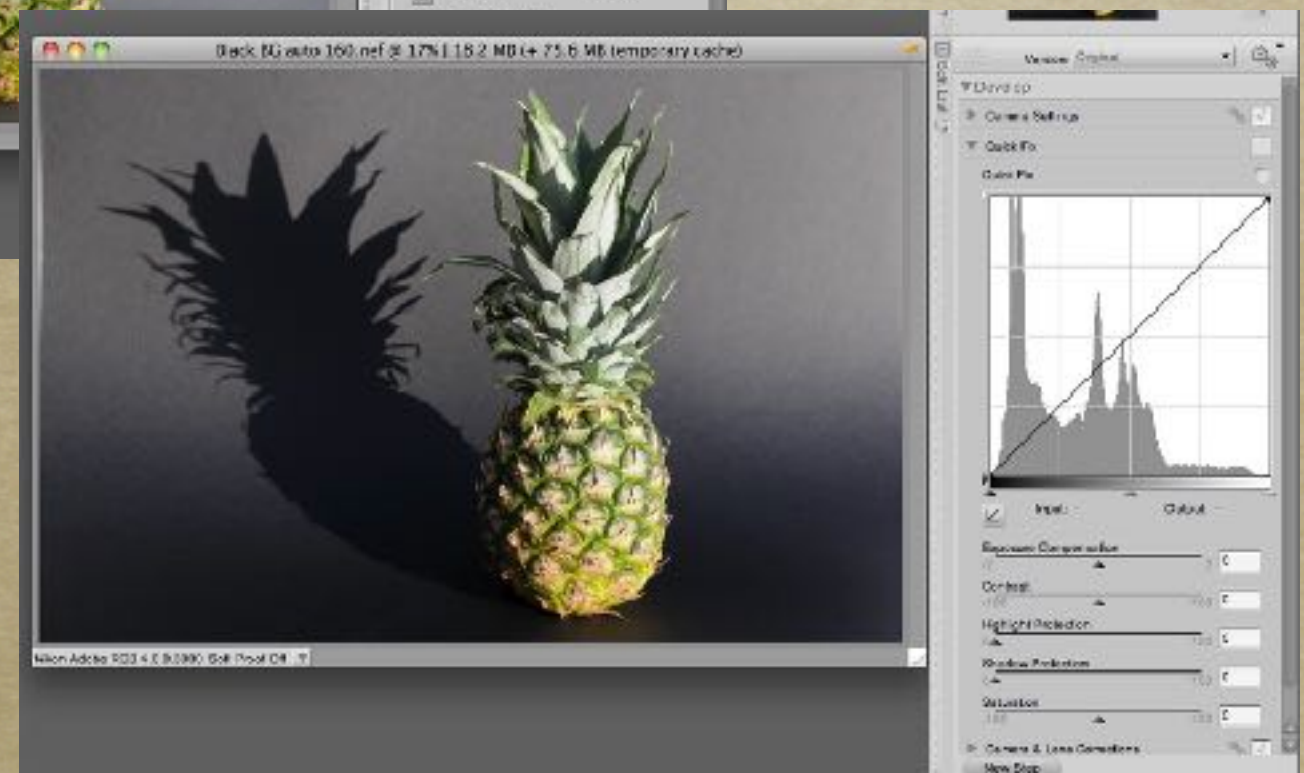
Notice that the histograms are almost identical !



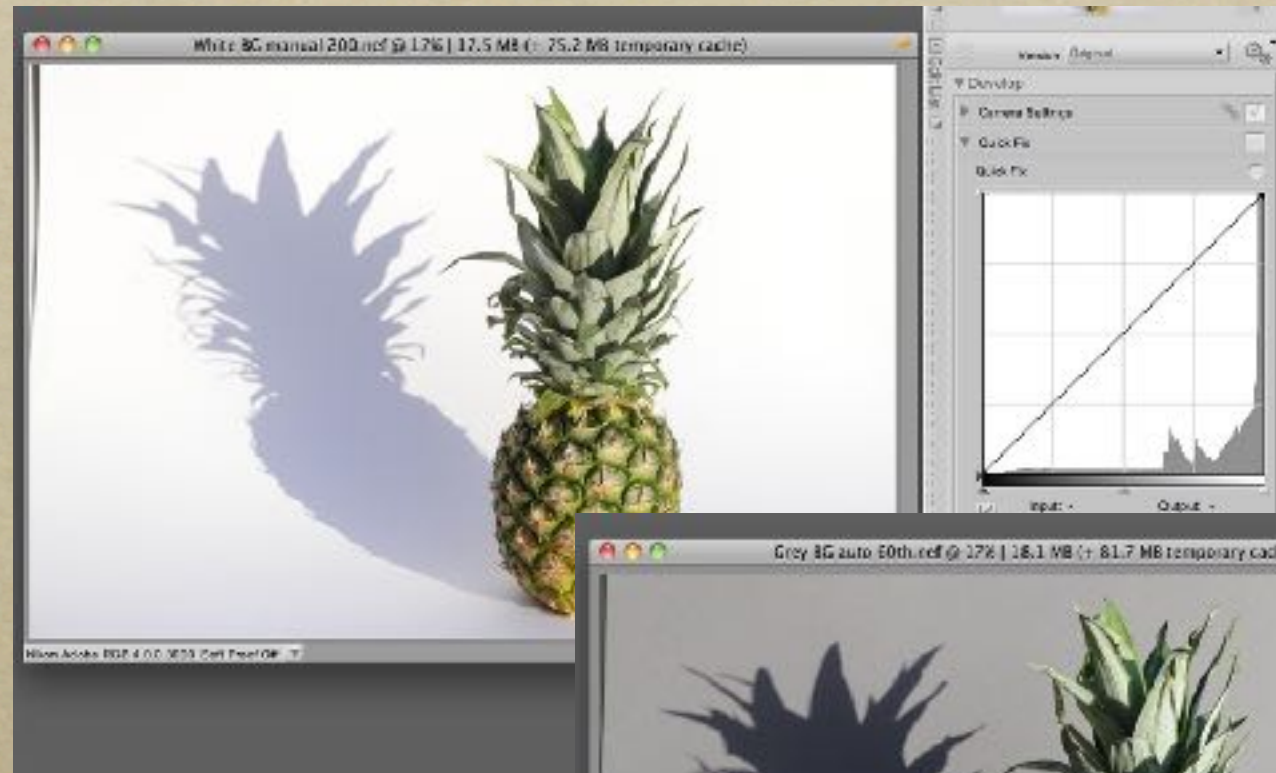
White b/g
auto 1/1000th



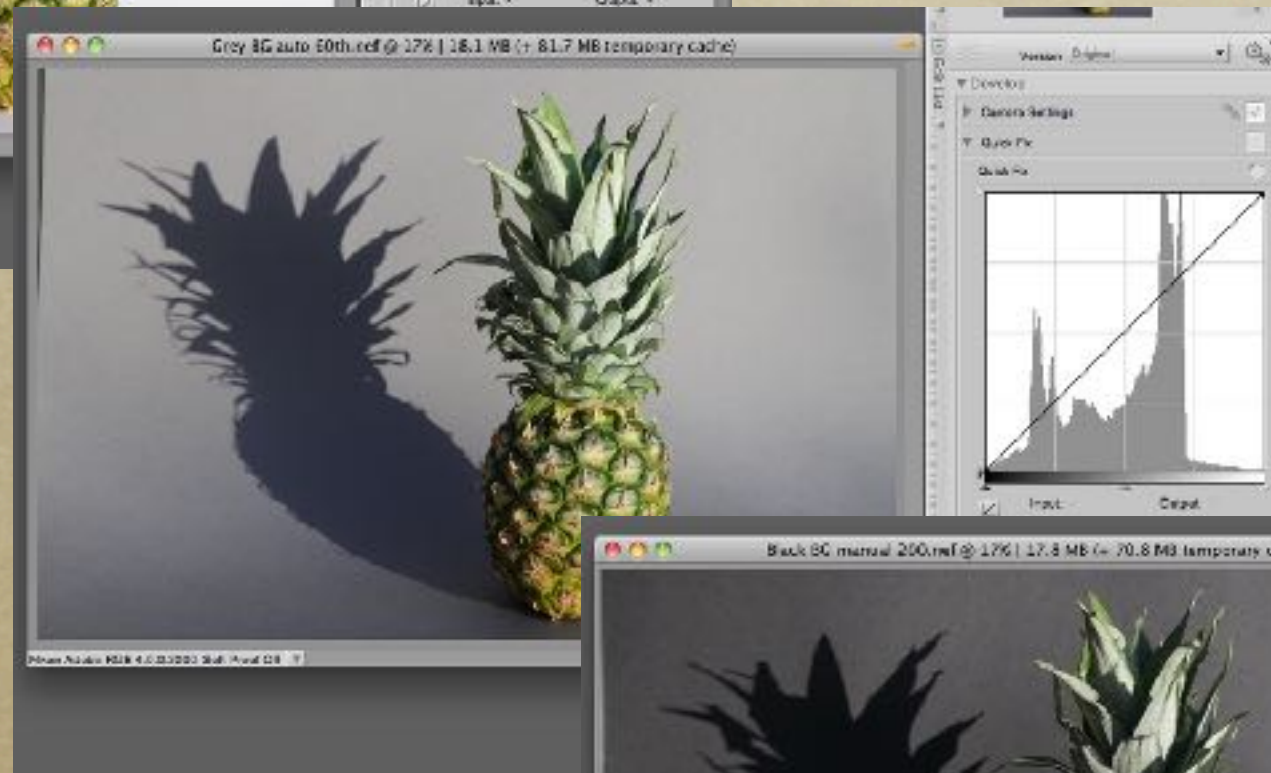
Grey b/g
auto 1/200th



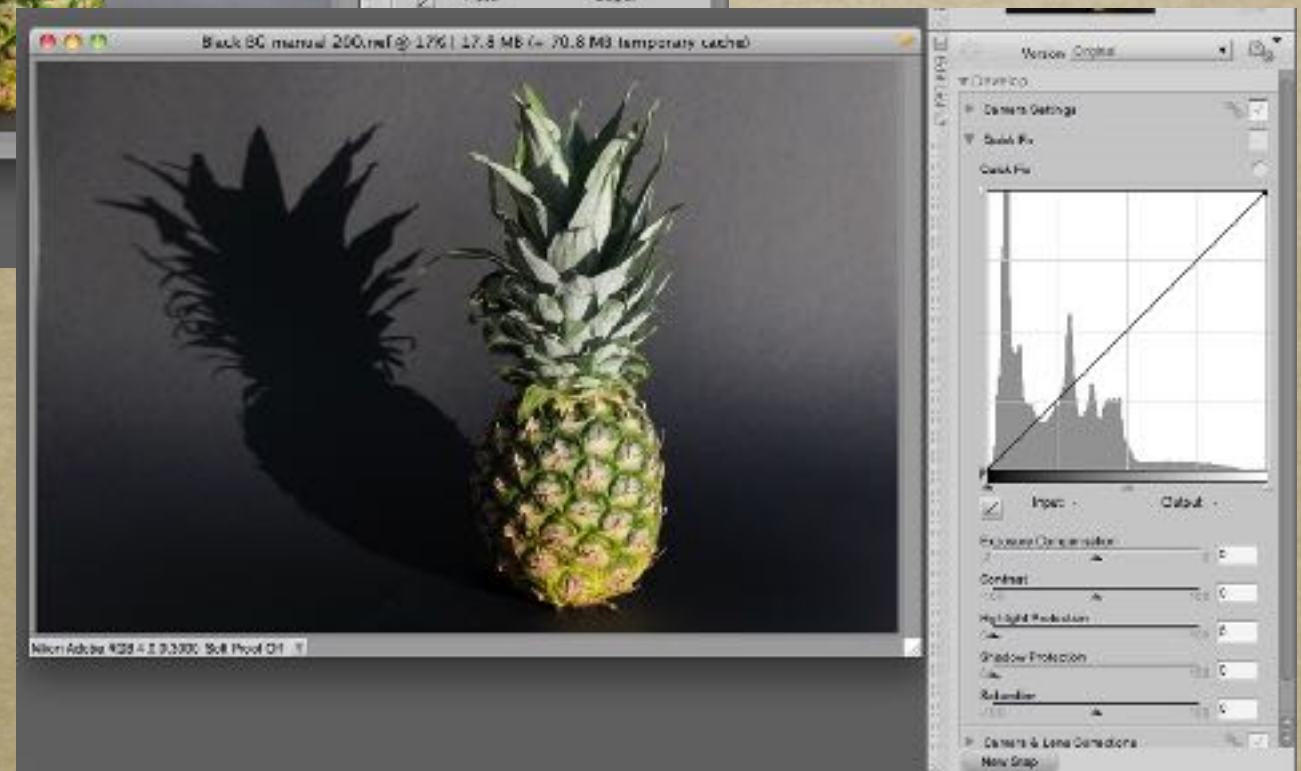
Black b/g
auto 1/160th



White b/g
manual 1/200th



Grey b/g
auto 1/200th



Black b/g
manual 1/200th

**But the histogram isn't necessarily
accurate either !**

Raw v jpeg

Raw gives you a broader range of tones.

It produces marginally sharper images (at huge magnifications) and is capable of producing superior quality

But Raw always needs extra work on the computer and the files are big so the camera can't store as many images.

Raw v jpeg

jpeg produces smaller file sizes so you can store more of them in the camera

The camera automatically adjusts settings to improve image quality (as the camera thinks fit)

Raw v jpeg

Raw is like old-fashioned film :

you have to process it in the darkroom to create the best result

jpeg is like a Polaroid print straight from the camera :

it's already been processed to give a reasonable result

The problem with Raw when judging exposures is that the camera can't display an unprocessed picture on the screen.

So the camera creates a low-quality jpeg and displays that.

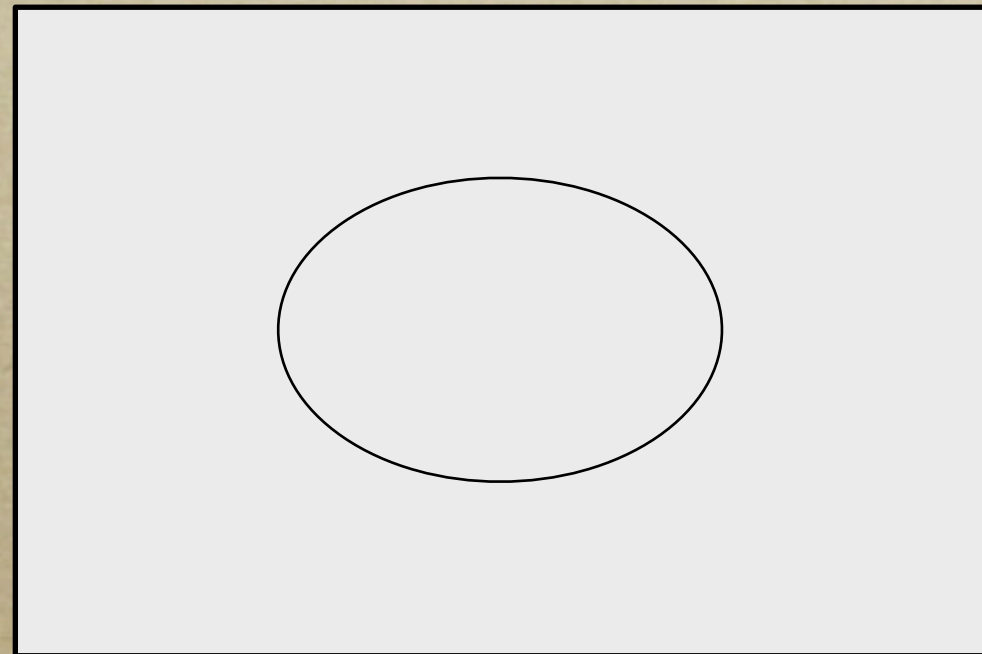
The histogram relates to the processed jpeg instead of the unprocessed Raw file.

Still, the Raw and the jpeg histograms will differ less than the the displays would, so your best bet is to rely on the histogram.

Different Metering Patterns

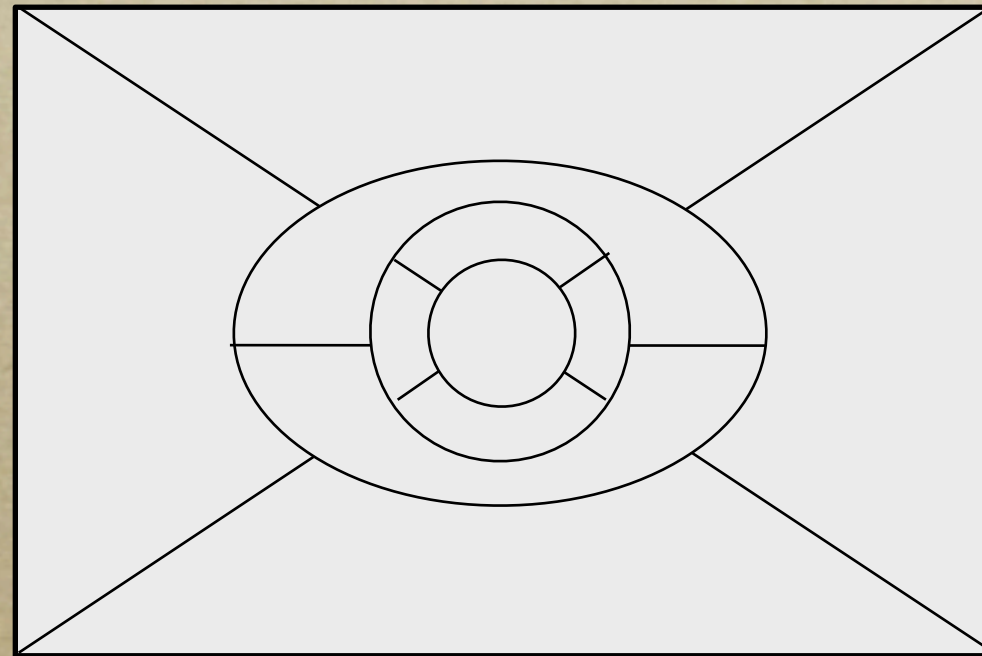


The earliest built -in meters measured the average light from the whole of the screen



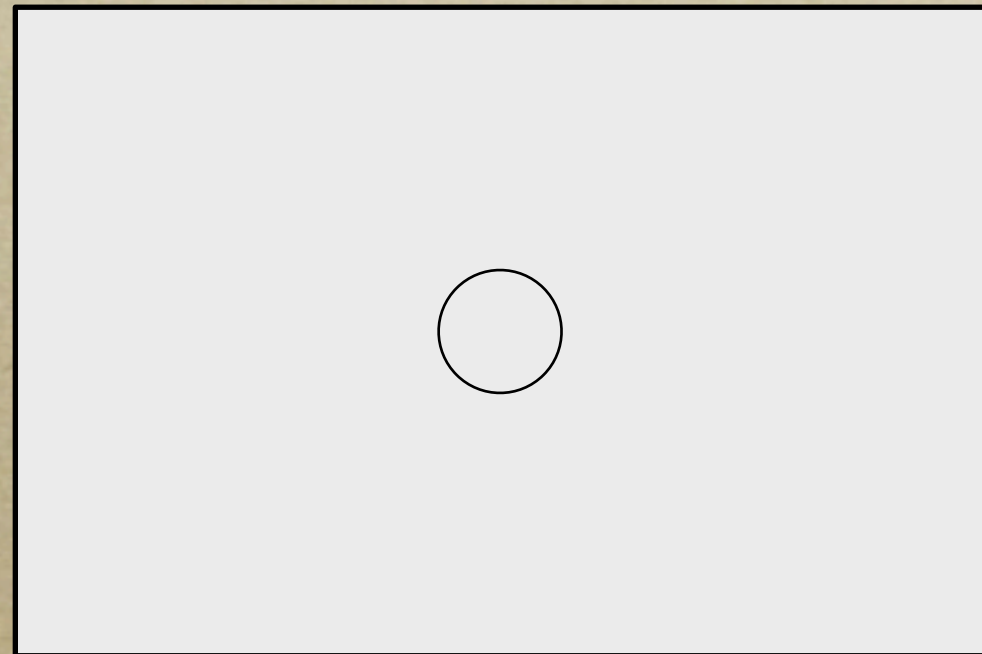
As the most important object is usually in the centre of the screen
an improvement is to take more notice of the centre.

80% of the reading is measured from the central area.



A generally more accurate system is Matrix or Evaluative metering.

The camera takes measurements from all the different areas and compares them with scenes stored in its computer database.



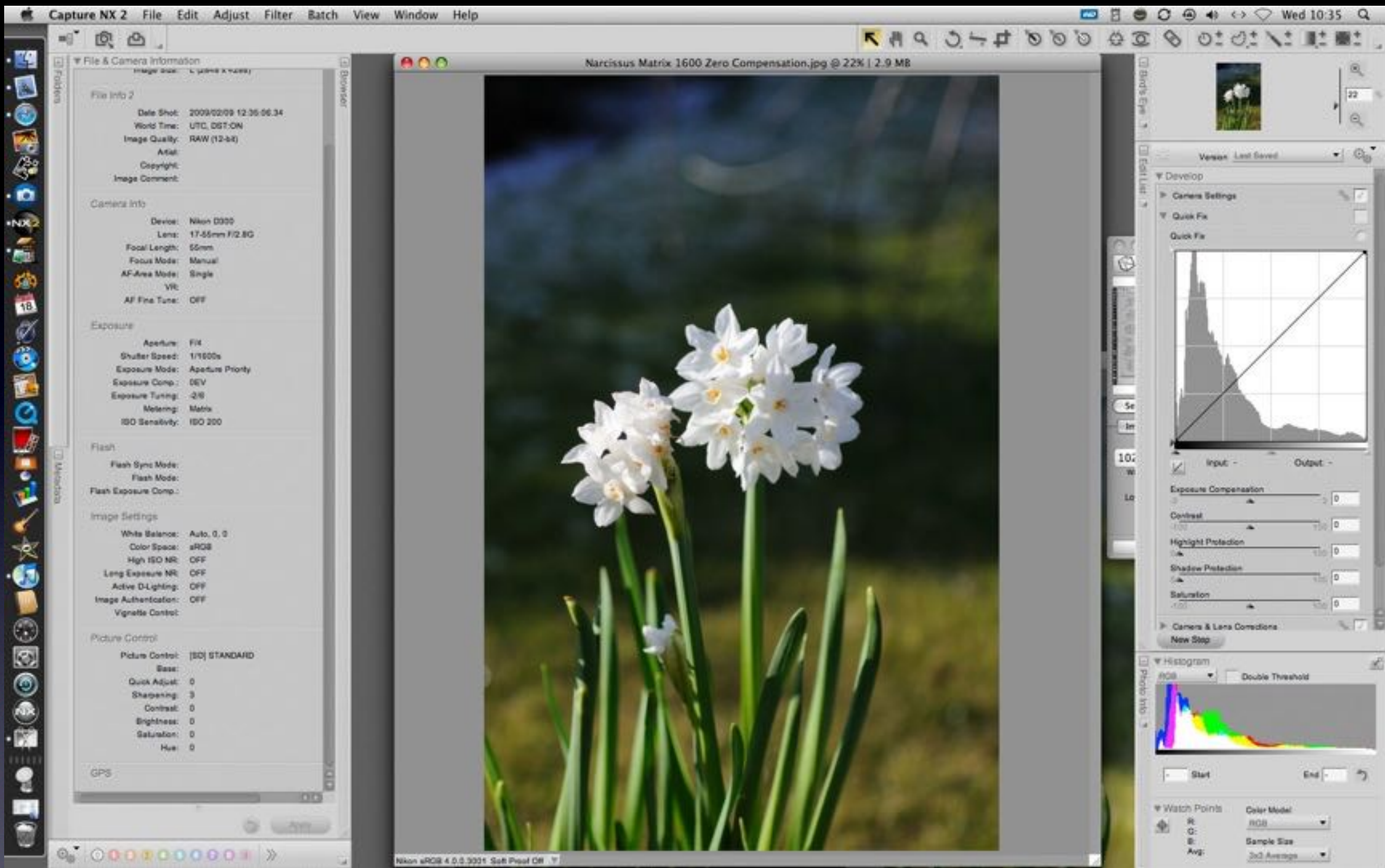
A spot meter reads only from a very small area in the middle, typically 5% or less of the total area.

You can gauge exposures very accurately but needs judgement.

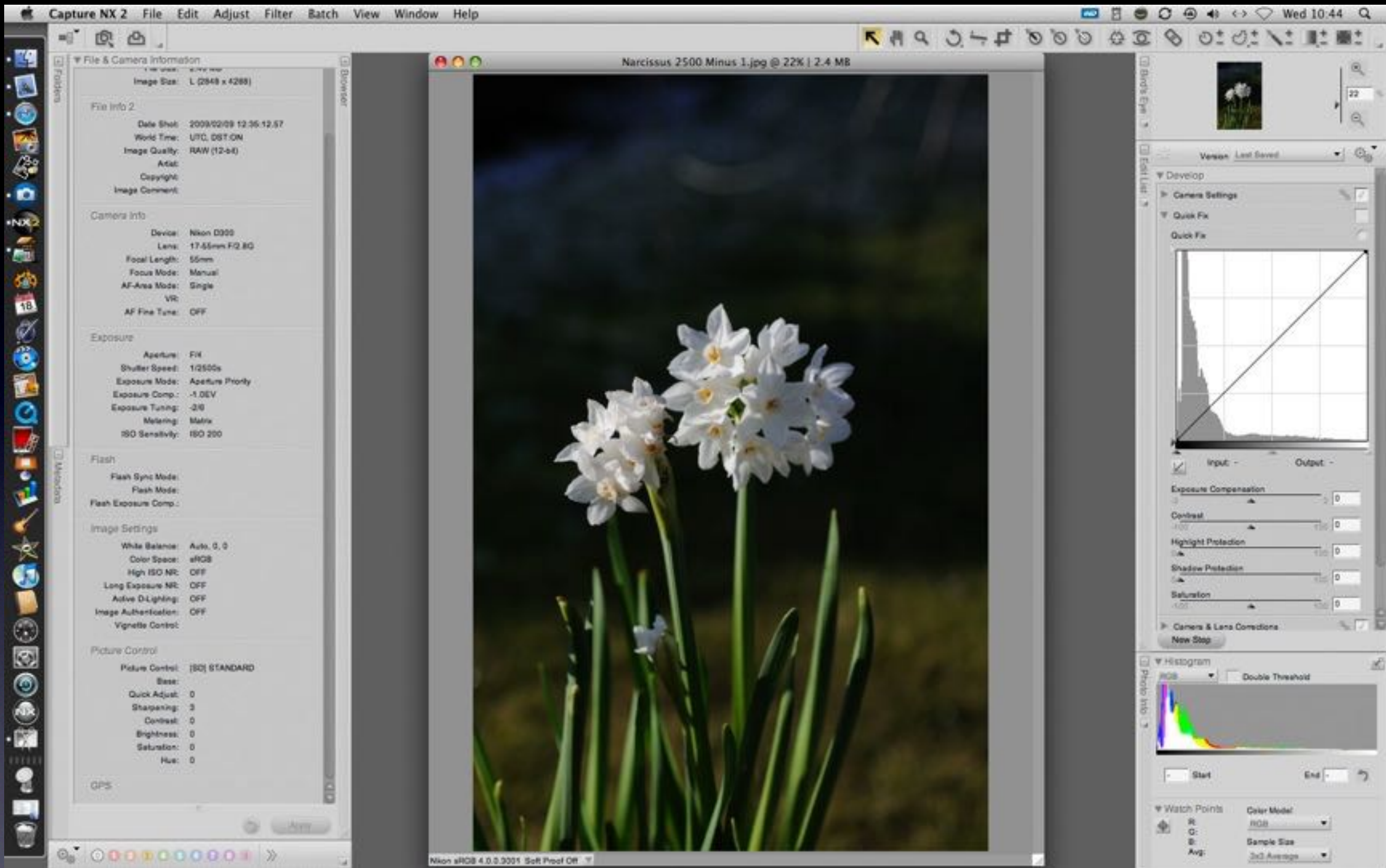
But all these systems are based on the idea that you are trying to produce a mid-grey.

The standard grey reflects 18% of the light which hits it.

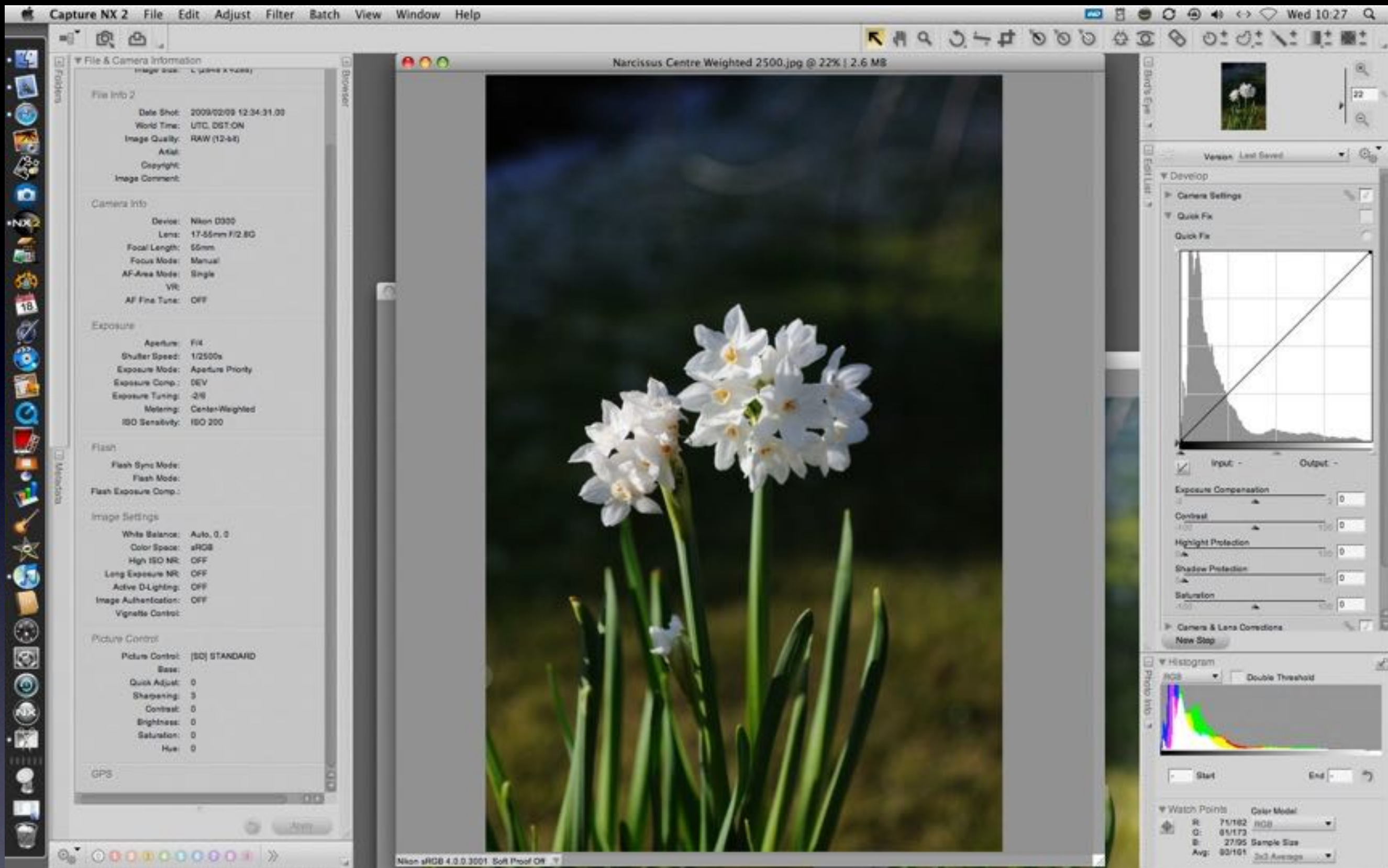
Let's look at a light subject against a dark background



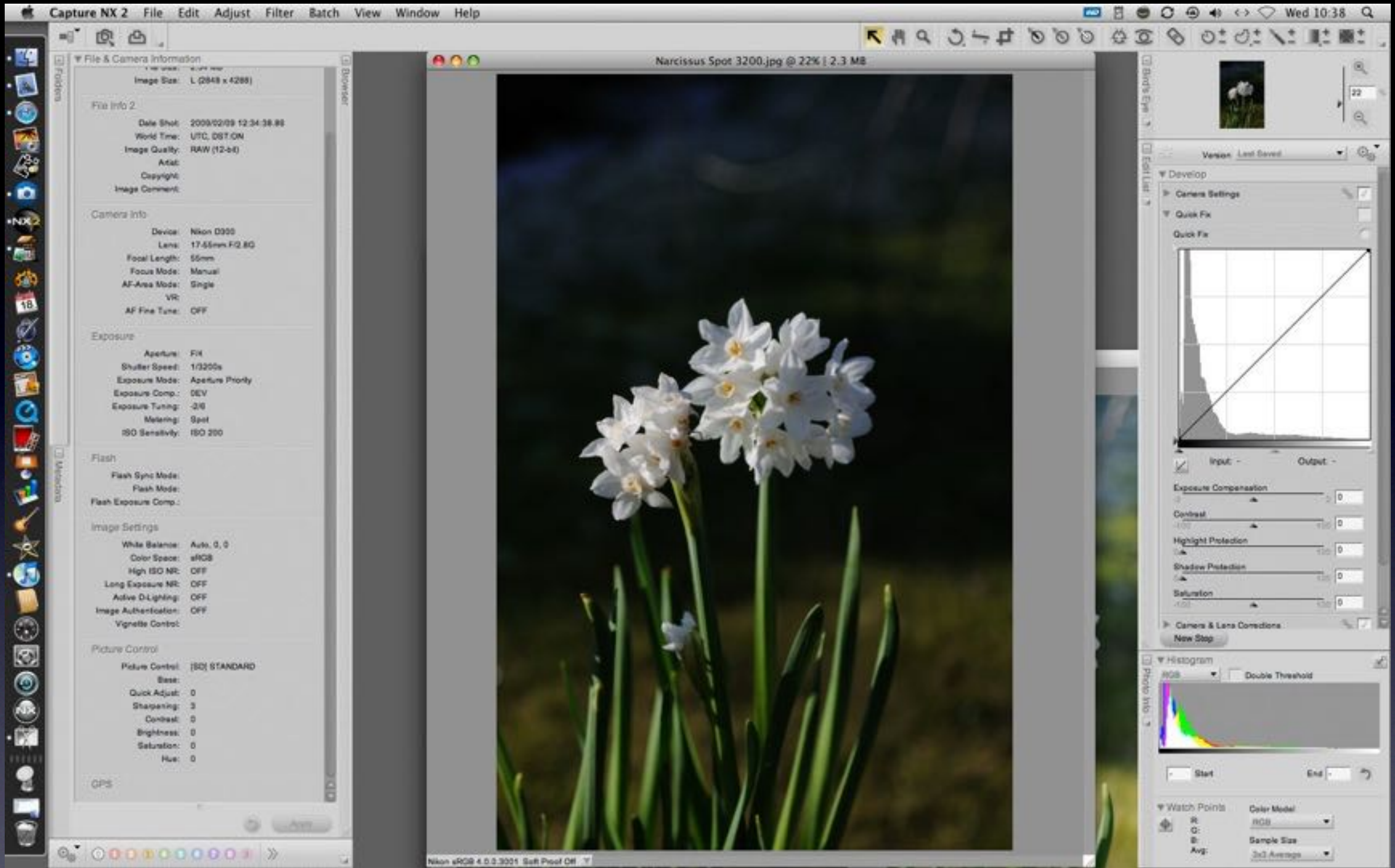
Matrix or Evaluative Metering. The flowers are a bit burnt out.



Matrix Metering Minus 1 EV. I compensated manually.



Centre Weighted Metering



Spot Metering. Records the very centre as grey.

Now a dark subject against a light background

File & Camera Information

Date Created: 23/2/09 19:32
 Date Modified: 23/2/09 19:32
 File Size: 677 KB
 Image Size: L (4288 x 2848)

File Info 2

Date Shot: 2009/02/22 11:13:25.00
 World Time: UTC, DST: ON
 Image Quality: Jpeg Fine (8-8C)
 Artist:
 Copyright:
 Image Comment:

Camera Info

Device: Nikon D950
 Lens: 17.55mm F2.8G
 Focal Length: 34mm
 Focus Mode: AF-S
 AF-Area Mode: Single
 VR:
 AF Fine Tune: OFF

Exposure

Aperture: F8
 Shutter Speed: 1/100s
 Exposure Mode: Aperture Priority
 Exposure Comp.: 0EV
 Exposure Tuning: -2/3
 Metering: Spot
 ISO Sensitivity: ISO 200

Flash

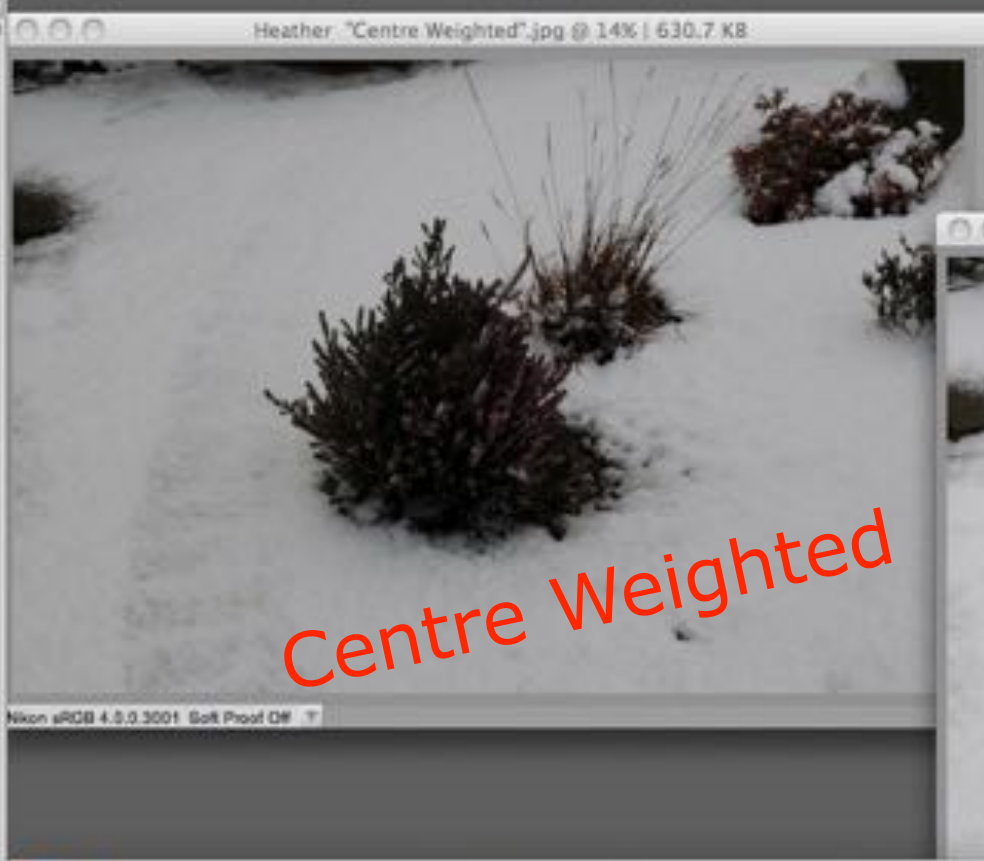
Flash Sync Mode:
 Flash Mode:
 Flash Exposure Comp.:

Image Settings

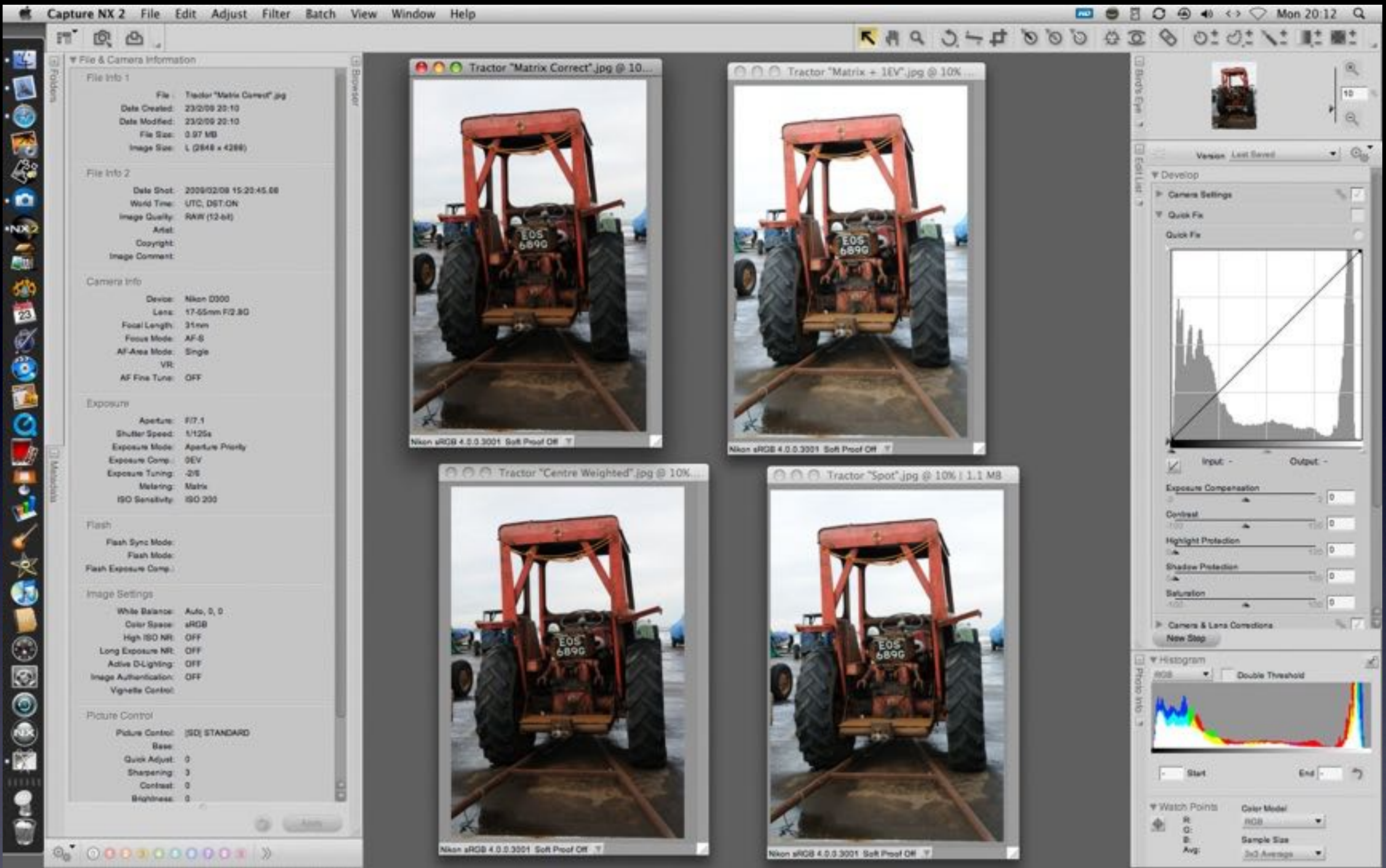
White Balance: Auto, 0, 0
 Color Space: sRGB
 High ISO NR: OFF
 Long Exposure NR: OFF
 Active D-Lighting: OFF
 Image Authentication: OFF
 Vignette Control:

Picture Control

Picture Control: [SD] STANDARD
 Base:
 Quick Adjust: 0
 Sharpening: 3
 Contrast: 0
 Brightness: 0
 Saturation: 0
 Hue: 0



A more normal subject still produces subtle differences



Matrix "Correct"
Centre Weighted

Matrix "Correct" + 1EV
Spot Meter

Tips for Adjusting Exposure

- Always have the **Highlights** feature switched on
- Take a photograph and review it on the camera's screen
- Bring up the histogram
- Is the shape of the histogram what you would expect ?
- Is the histogram shifted too far to the left or right ?
- If too far left take another photograph but give + exposure
(a longer shutter speed or a larger aperture (smaller f/number))
- If too far right take another photograph but give - exposure
(a shorter shutter speed or a smaller aperture (bigger f/number))
- **NEVER** use the picture on the screen to judge if the exposure was what you wanted. For accuracy always check the histogram !

WHY ISO IS WRONG !

With film, the longer you shone light on it the darker the picture became.

But a digital sensor just measures how much light is hitting each spot.

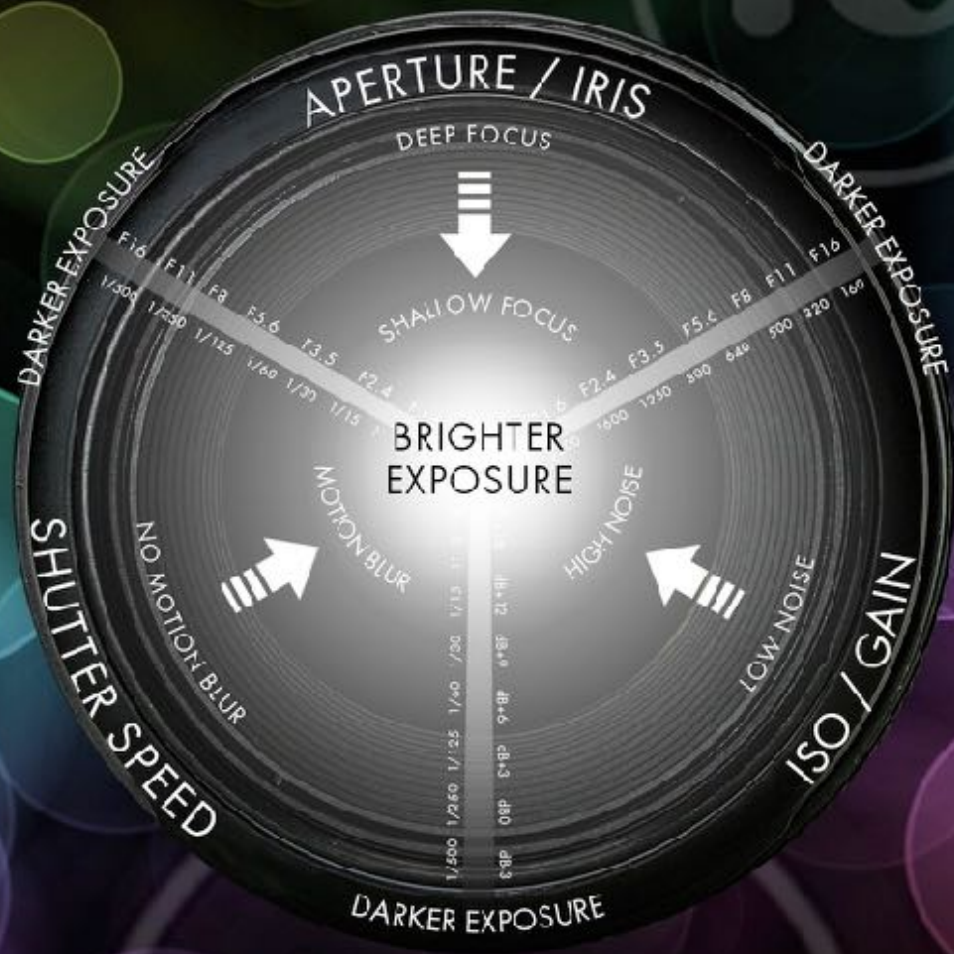
To make it seem more sensitive the camera “turns up the volume” electronically.

The proper term is “gain”.

Just like music, loud volumes increase background noise and this creates the graininess and loss of detail.

The 3 Elements of Exposure

The terms APERTURE and ISO are commonly found on Still Cameras and HDVSLRs. ISO and GAIN are terms used for traditional video cameras.



APERTURE / IRIS

How big is the hole letting light into the camera
Smaller FStop means larger hole & brighter exposure

F1.6	F2.4	F3.5	F5.6	F8	F11	F16	F32
BRIGHTER EXPOSURE				DARKER EXPOSURE			
SHALLOW FOCUS (SMALL DEPTH OF FIELD)				DEEP FOCUS (LARGE DEPTH OF FIELD)			



SHUTTER SPEED

How long will the sensor gather light for the image
Measured in seconds or fractions of a second

5"	2.5"	1"	1/15	1/30	1/60	1/120	1/250	1/500	1/1000
BRIGHTER EXPOSURE					DARKER EXPOSURE				
LARGE AMOUNTS OF MOTION BLUR					SHARPER IMAGES WITHOUT BLUR				



ISO / GAIN

How sensitive the sensor is to light
Higher Values means more sensitive (Video Gain is in dB)

6400	3200	1600	1250	800	650	500	400	320	160	100
dB+18		+12	+9		+6		+3		0	-3

BRIGHTER EXPOSURE					DARKER EXPOSURE					
LOTS OF DIGITAL NOISE					VERY LITTLE DIGITAL NOISE					



These two got it right.