Exposure

Steve Wells

What is Exposure?

You need light to make a picture. The question is, how much light? The amount of light is the exposure:

- What happens if you have too much light
- What happens if you have too little light?

Under exposed *correctly exposed* *overexposed*

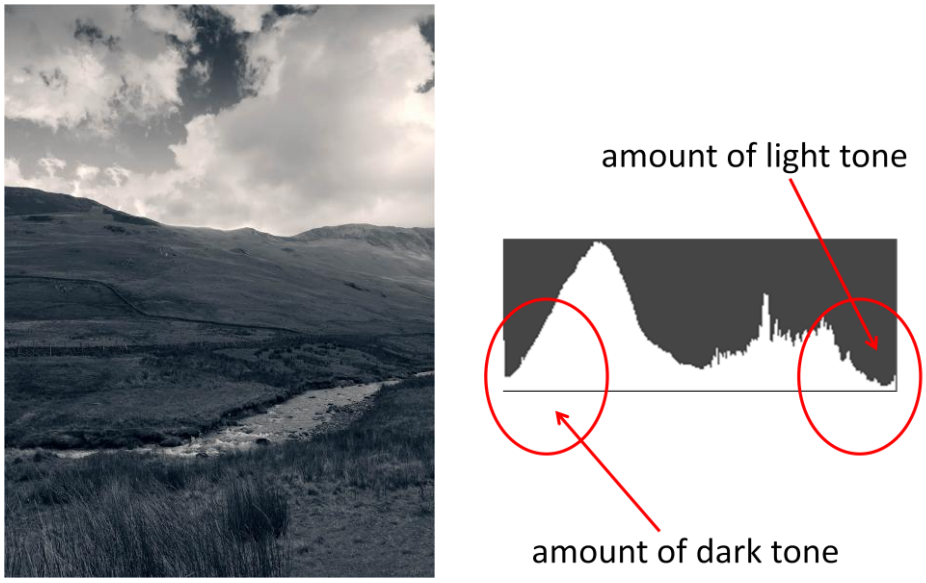
If there is too little light, the shadows will be black and lose detail. If there is too much light, the highlights will burn out to white with no detail.

So, what can your camera do to control the amount of light?

- Histogram (how much light is in the picture)
- ISO (the sensitivity of the camera to light)
- Shutter speed (how long are you going to allow the light to come in?)
- Aperture (how big is the window the light is coming through?)

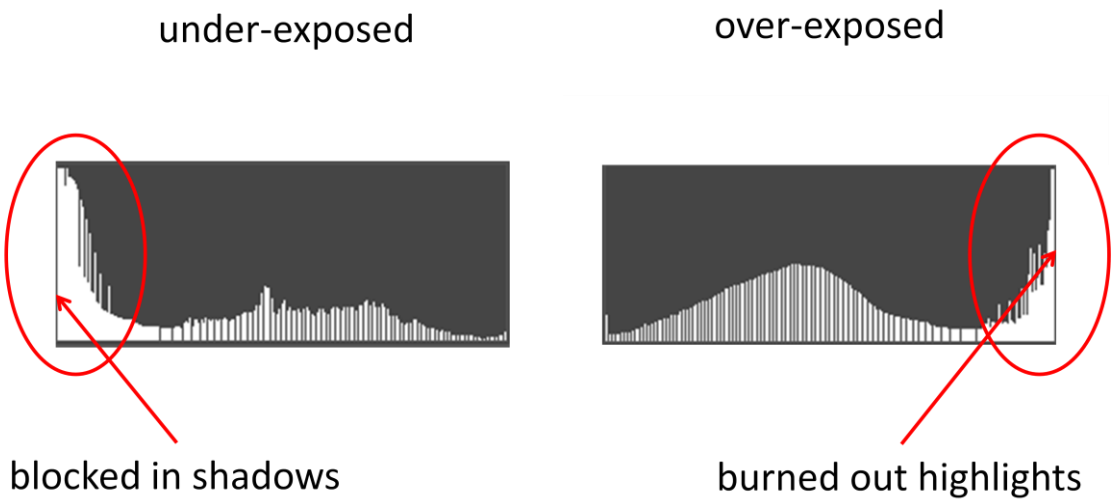
Histogram

Imagine an image converted to monochrome. There will be many different grey tones from black to white. The histogram is a graph which shows how much of each tone is in the picture.



Histogram showing the light and dark tones

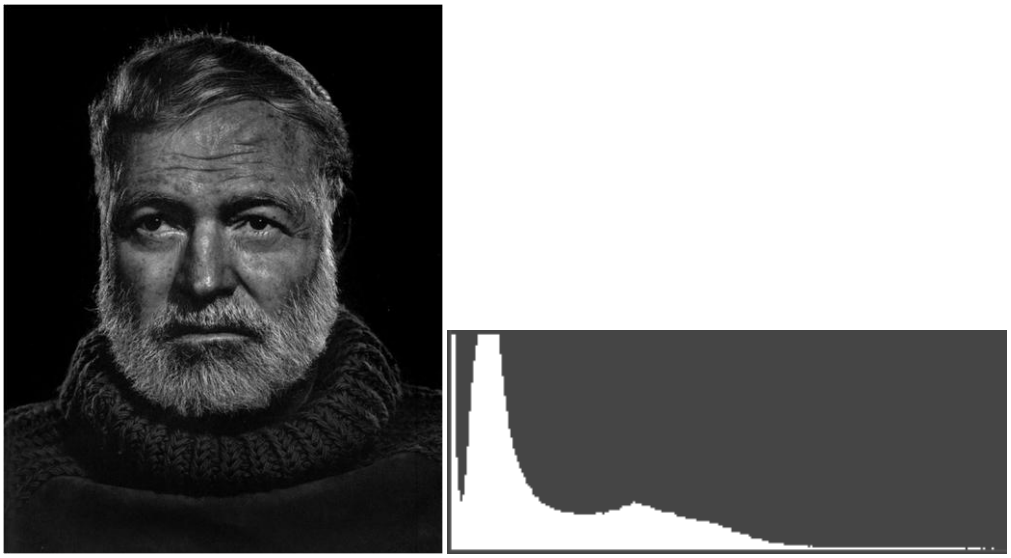
The histogram can also show whether an image is under or over exposed.



Histograms showing extremes of exposure

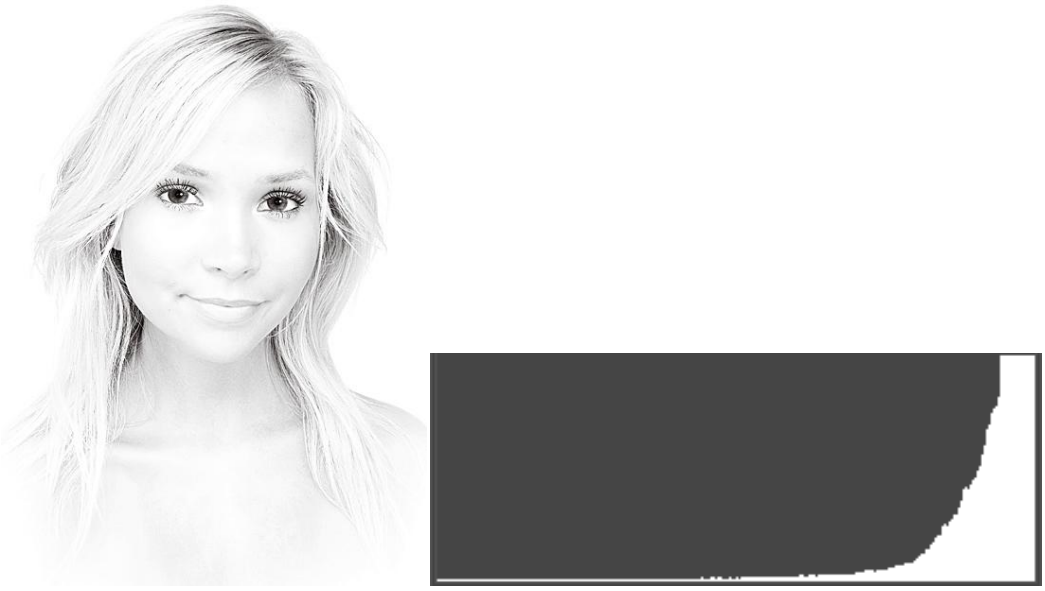
This may sound like a good idea, but you have to be aware of how you interpret the histogram. There are cases called low key and high key in photographic circles where the histogram may be misleading.

Here is a portrait of Ernest Hemmingway by Yousuf Karsh, along with the histogram. The histogram would suggest that the portrait is underexposed. Is this true?



Low Key Portrait of Ernest Hemmingway by Yousuf Karsh

Then, here is a portrait entitled “Mariann” by Claus Jensen. This histogram would suggest that the image is overexposed. Again, what do you think?

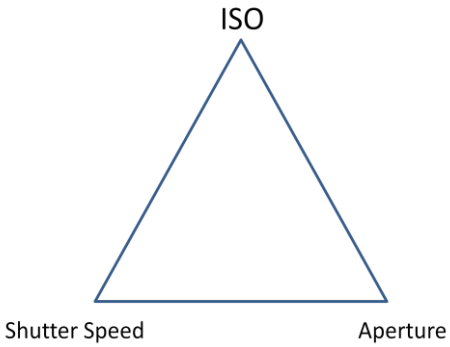


High Key Portrait of Mariann by Claus Jensen

The Exposure Triangle

The ISO, Shutter Speed and Aperture form a trio of linked values.

You will find this Triangle drawn in lots of different ways. Sometimes the three values are the sides rather than the corners. Sometimes so much extra information is loaded in to the diagram that it becomes difficult to take in.



The Exposure Triangle

The key thing is that these three values are related:

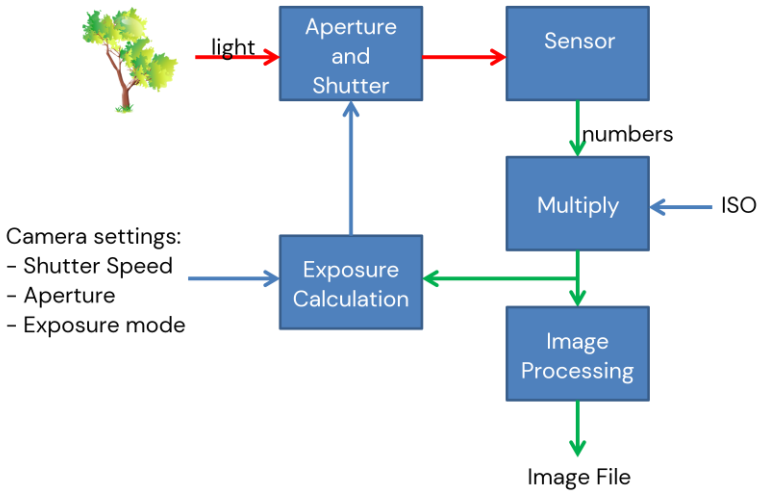
- ISO (response to high and low light levels)
- Shutter speed (how long are you going to allow the light to come in?)
- Aperture (how big is the window the light is coming through?)

If you increase the ISO, you can use faster shutter speeds and a smaller aperture. If you use a shorter shutter speed you will need to increase the ISO or aperture or both.

In fact, there is something odd about these three values. Shutter Speed and Aperture affect the amount of light falling on the sensor, but what does ISO actually do?

What we call ISO today was originally called ASA (American Standards Association – now ANSI). It was a ways to specify how sensitive a film or plate would be to light: that is, the "Film Speed". Film Speed was a description of the response of the chemicals in the film to light. Fast and slow films reacted differently to the light. It is commonly assumed that with a digital camera the number means the same thing. Despite the claims of various websites, this is not the case. Altering the ISO does not change the sensitivity of the sensor.

The photosites on the sensor react to light falling on them by creating an electric charge which is converted into a small voltage. This voltage is the same whatever ISO has been set. This voltage is then converted to a number. To be useful, this number must be amplified. The ISO value which you set on the camera determines how big this multiplication should be. The metering system takes account of the size of this multiplication when identifying the aperture and shutter speeds to be used.



Exposure Processing

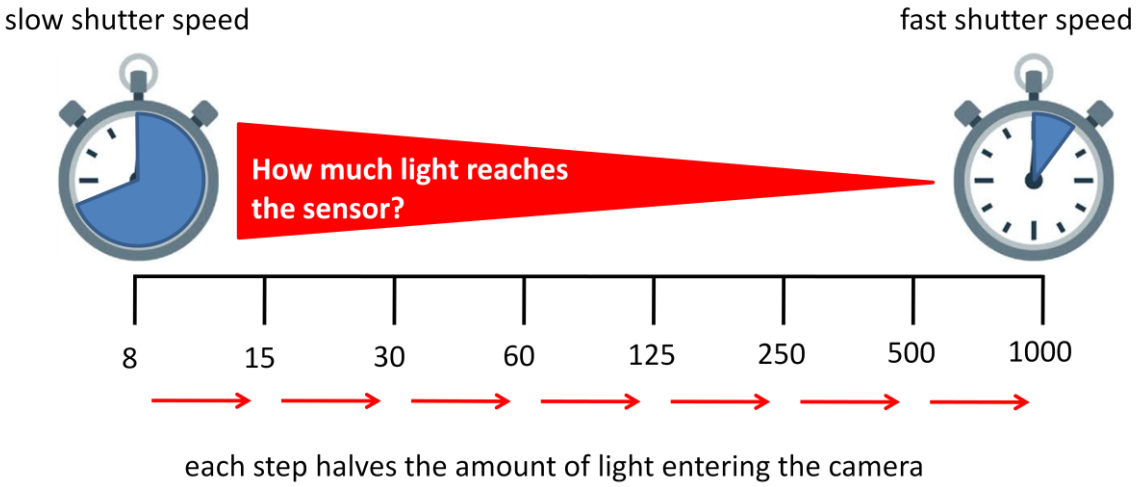
So, there is a link but it is not as obvious as it seemed to be in the days of film. Despite all of this, photographers still tend to think of ISO as affecting the sensitivity of the camera to light.

Shutter Speed

Exposure is traditionally measured in "stops". One stop is a doubling or halving of light. So, shutter speeds are traditionally a sequence like this:

1 2 4 8 15 30 60 125 250 500

These should be read as reciprocals. So, "500" means "1/500". So, the sequence starts with 1 second, then a half and the next a quarter and so on. The actual numbers are historical: half of 1/60 should be 1/120. Different camera makers at different times used different sequences and we are left with a combination of them. The principle remains, however, that going along this sequence the numbers halve (in one direction) or double (in the other direction.)



Points to note:

- a slow shutter speed increases the chance of camera shake;
- a fast shutter speed freezes motion;
- a slow shutter speed blurs motion.

Aperture

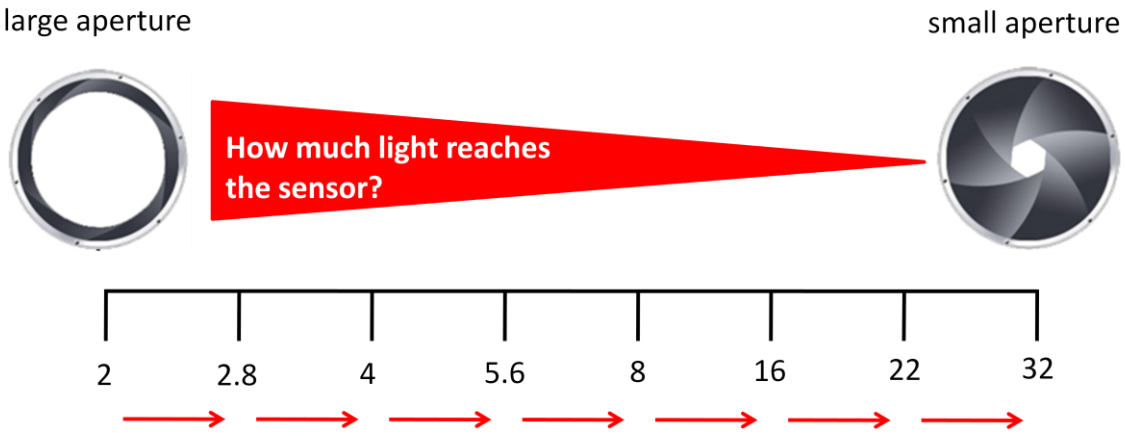
Apertures similarly are in a sequence of stops: halving or doubling the area of the hole the light passes through. In this case the numbers are even less obvious:

1.4 2.8 4 5.6 8 11 16 22 32

With these "f" numbers, a small number means a large aperture (more light) and a large number means a small aperture (less light.) The principle of doubling remains. As you move from 2.8 to 4 you are halving the amount of light. As you move from 16 to 11 you are doubling the amount of light.

Points to note:

- a small aperture increases depth of field;
- a large aperture reduced depth of field.



each step halves the amount of light entering the camera

ISO

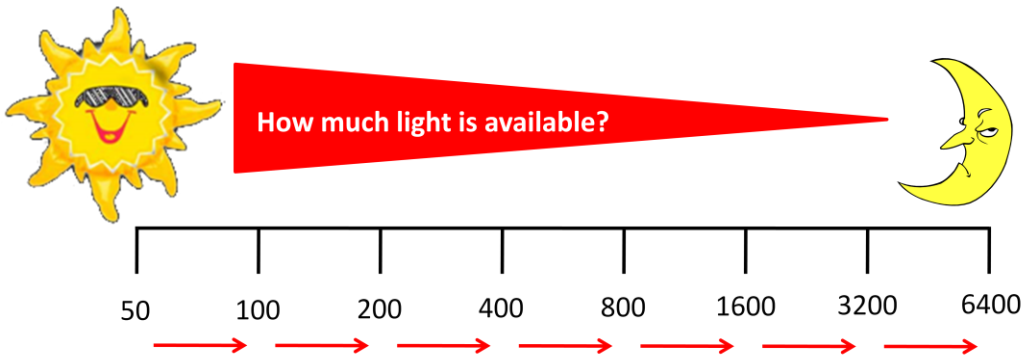
ISO similarly works with doubling and halving.

50 100 200 400 800 1600 3200 6400

Each move to a higher ISO doubles the amplification of the signal coming off the sensor.

You set the ISO depending on how much light there is about – are you in bright midday sunlight near the equator or are you trying to photograph a black cat in a coal cellar?

The higher the ISO you set, the more the numbers coming off the sensor are multiplied, and the smaller the amount of light the camera needs to capture. That is, by setting a high ISO, the camera can afford to set a smaller aperture and a shorter shutter speed.



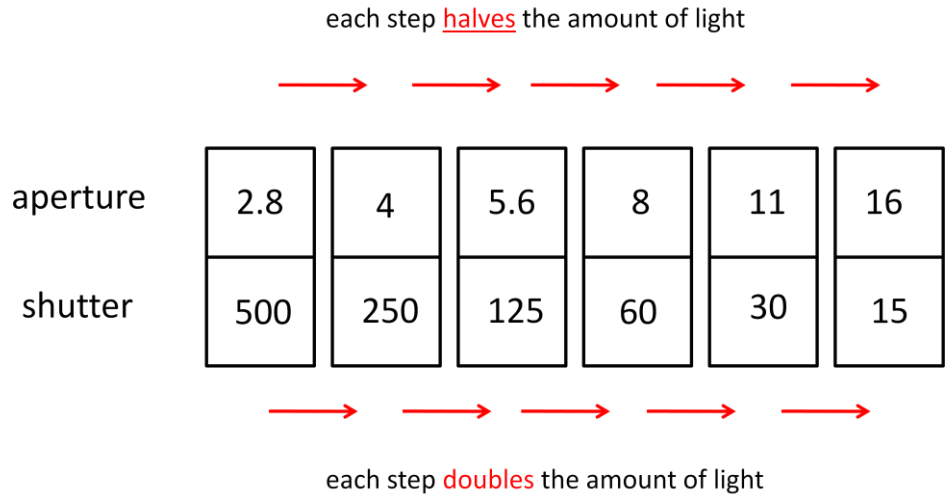
each step halves the amount of light the camera needs

Points to note:

- high ISO enables you to photograph in low light;
- high ISO increases the noise in the image.

Your Choices

Many combinations of shutter speed and aperture provide the same exposure. As you increase the exposure by a stop with the aperture you can reduce it again with the shutter speed.



Combine this with the options for adjusting the ISO and you have choices to make:

- Depth of field;
- Noise;
- Camera shake.

Then, finally, there is the issue of the camera meter. Should you trust it? A camera meter will try to produce an average neutral tone. It can't tell the difference something bright under average lighting and something of average tone under bright lighting.

This is why snow often looks wrong in photographs. The meter sees a bright white scene and thinks that it needs to underexpose to produce a more neutral tone. So, you get blue-grey snow instead of the bright white which you saw.

You need to take over.

Compact System Cameras

A compact system camera displays in the viewfinder, or on the back of the camera, a copy of the image you will get of you press the shutter. Assuming you haven't changed the settings for the display, you can use this to estimate the exposure.

Simply adjust the exposure settings until the image on the back of the camera looks the same brightness as the subject in front of the camera.

Thornbury Christmas Lights
the exposure was estimated by comparing the scene with the image on the back of a Compact System Camera.

Orkney Sundown
one stop under exposed compared with the meter