Exposure matters

An introduction

R. Crocombe ARPS

The challenge for Film Photographers

- Ansell Adams preached “Expose for the shadows and develop for the highlights”
  - Because the film negative is equally sensitive to light tones and dark tones

- Dave Montizambert et al today preach “Expose for the highlights and process for the shadows”
  - Because Digital is extremely sensitive to overexposure and is much more sensitive to light tones than dark tones

The importance of Dynamic Range

Our eyes are very adaptive and they are also more sensitive to intensity than color.

Our eye can see 14 f-stops or Exposure Values (EVs)

DSLR 8-10 f-stops at best

A Laptop 7-9 stops

Printed Paper 5-6 stops

The issue for Digital – Stops are not equal!

The Canon software allows you to see the RAW image almost unprocessed (DPP)

Pure white

1st Stop 2,048 Levels

2nd Stop 1,024 Levels

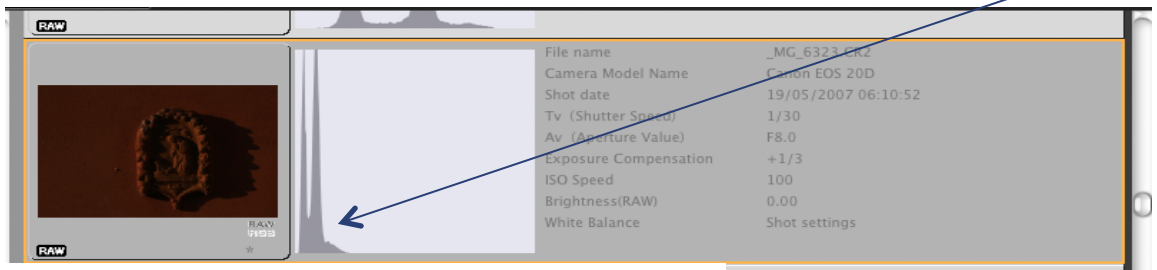
3rd Stop 512 Levels

4th Stop 256 L

5th Stop 128 L

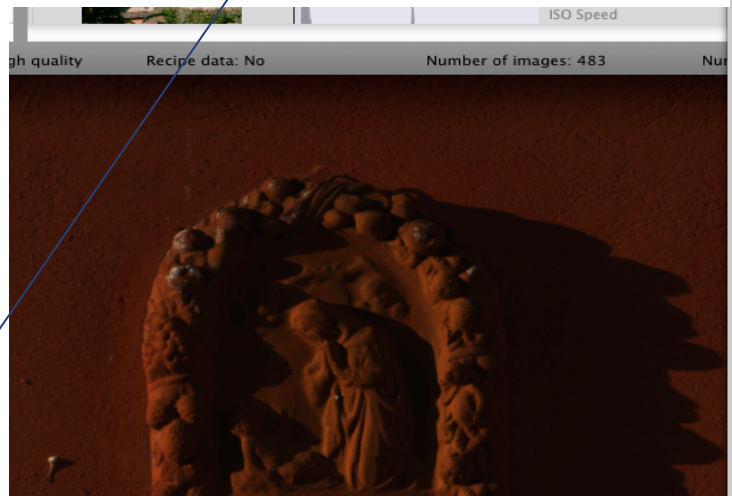
6th Stop 64 L

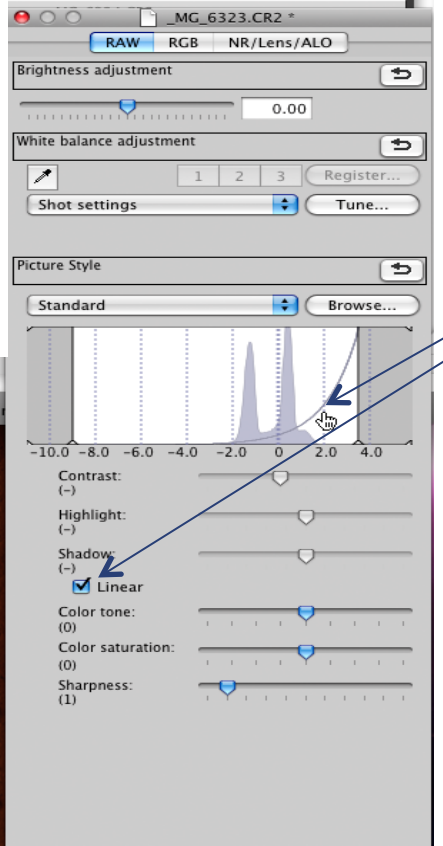
Pure black



In a 12 bit (6 stop DR) camera
Top 3 stops capture = 3585 levels = 87.5%
Bottom 3 stops = 448 levels = 12.5%

In a 14 bit (8 stop DR) camera
Top 4 stops capture 15360 levels = 93.75%
Bottom 4 stops = 1024 levels = 6.25%



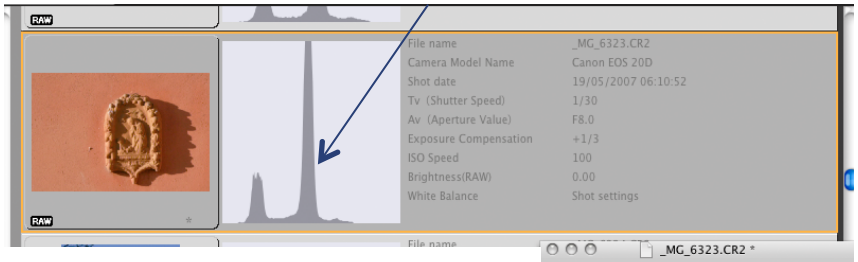


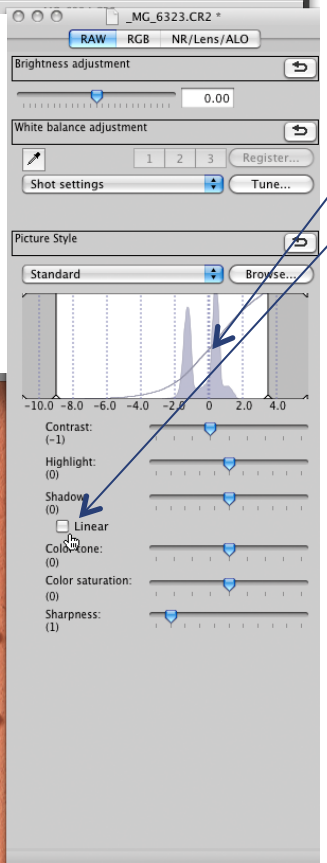
What the camera captures (so called linear gamma)

The image is much darker than we expect

The issue for Digital – Stops are not equal! - 2

Canon DPP allows you to see the RAW image almost unprocessed but one normally sees the histogram after gamma correction

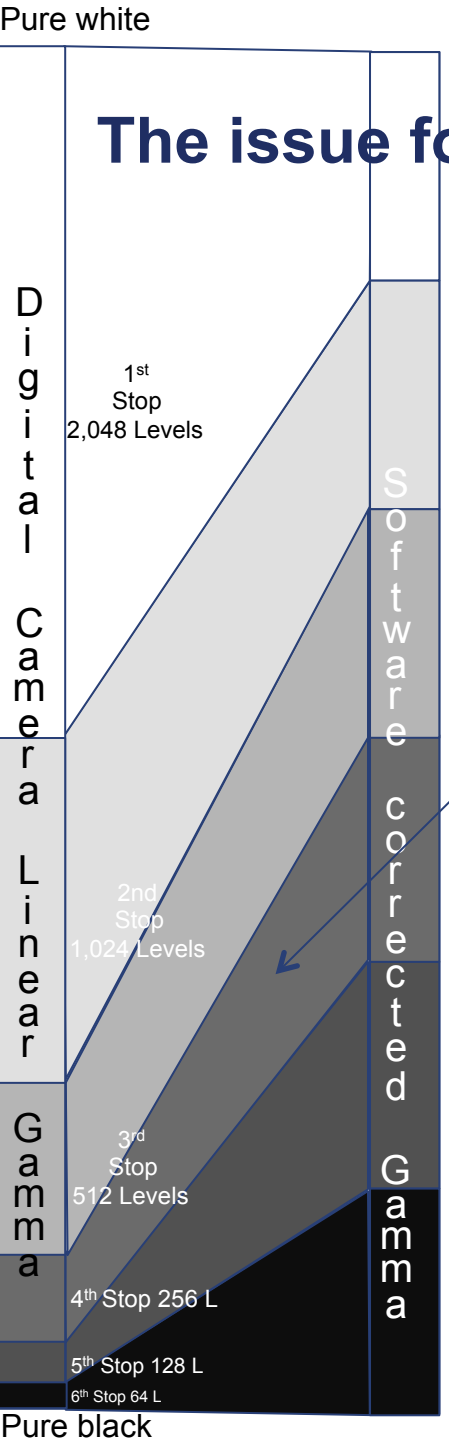




Software (Adobe, DPP etc) applies a strong curve to the linear gamma to evenly distribute the levels across all stops (680 levels per stop)

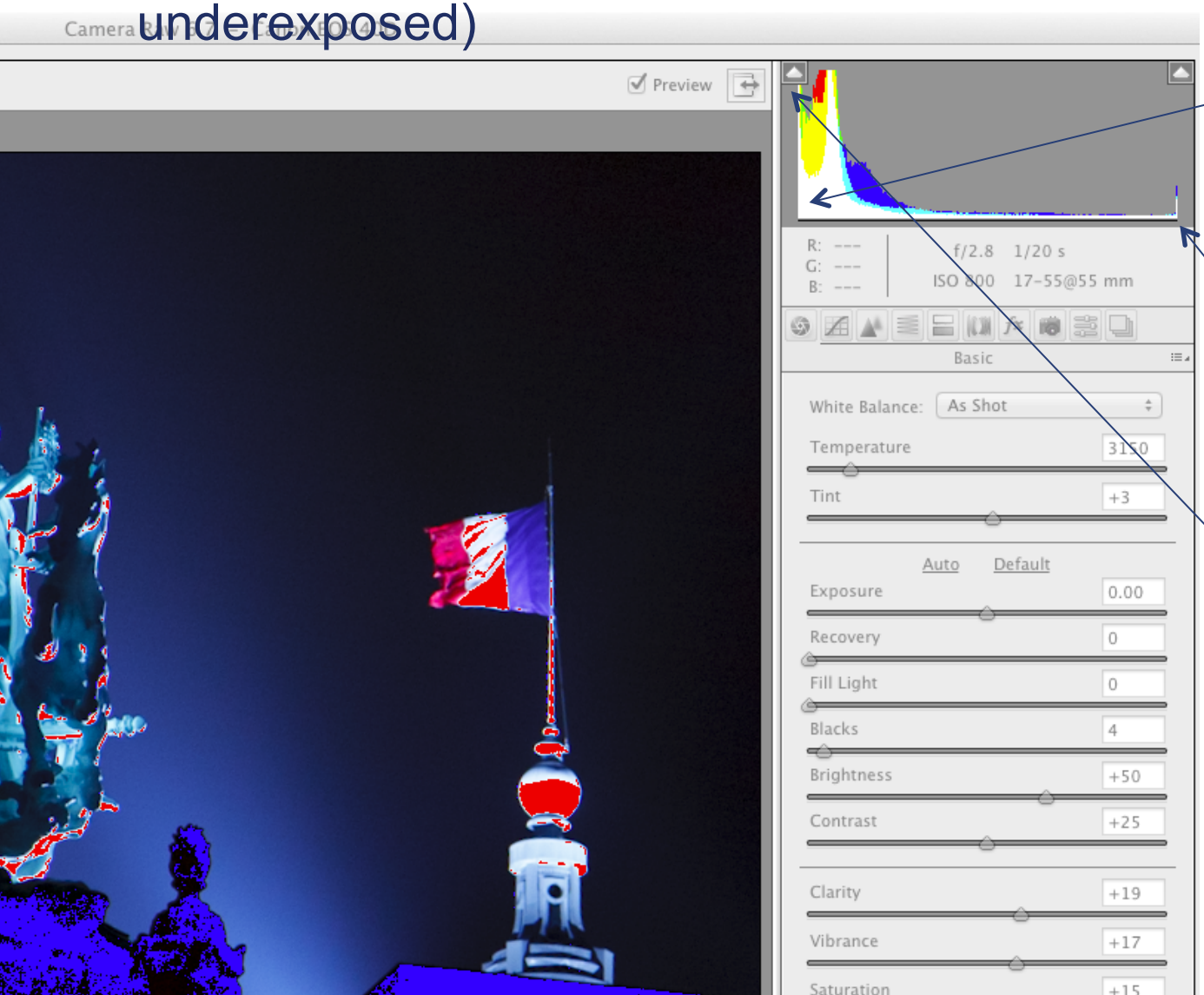
The darkest stop expands 64 levels into a 680 level container.

This is ok but if you then increase the “exposure” you are spreading these 64 levels across maybe 3 containers of 680 levels which may show up as noise or posterisation



Reading the histogram CS5

- The histogram shows us this image is low key (and underexposed) underexposed)



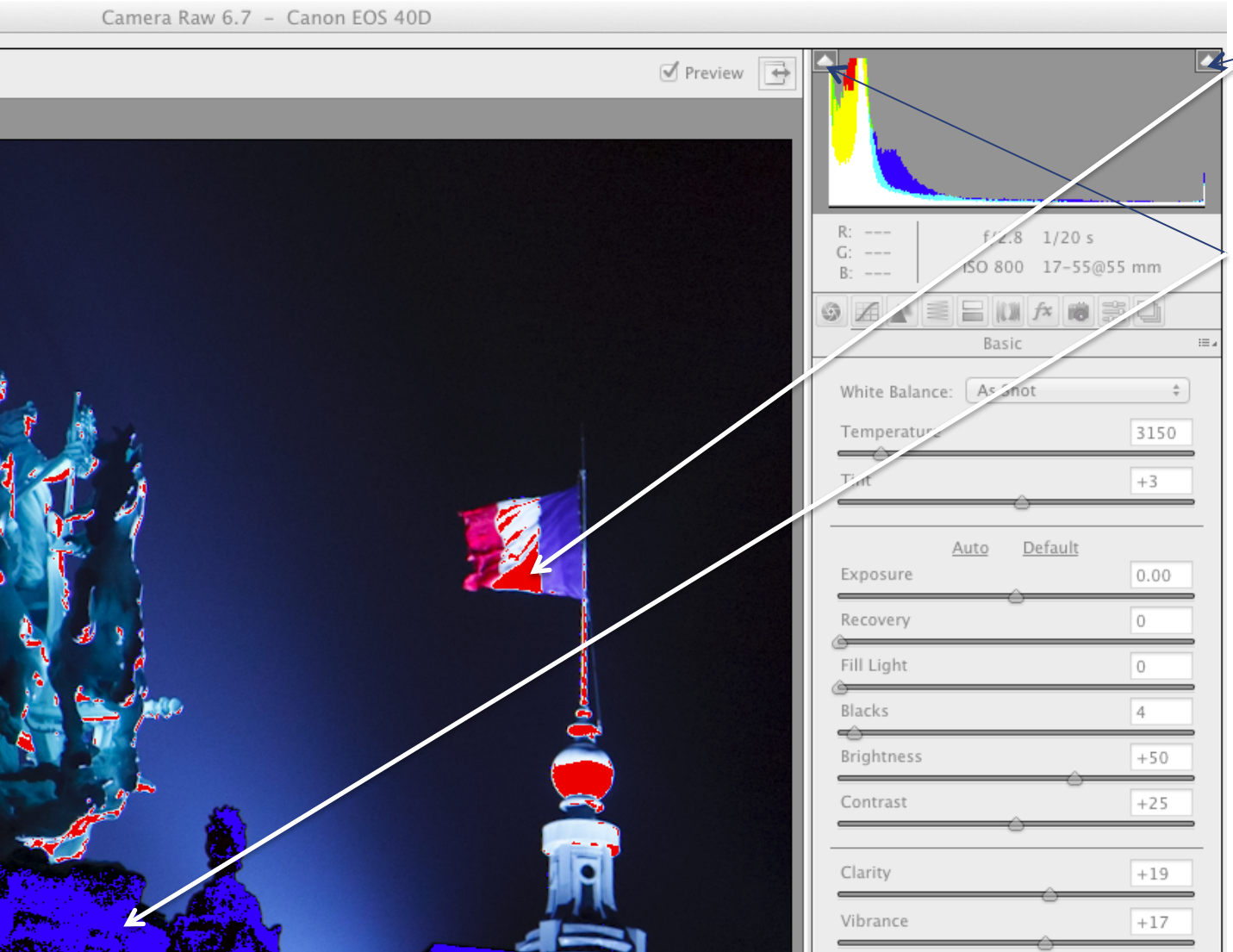
Low key because most of the levels information is on the LHS

Overexposed because a few levels are stacked up against the RHS

Underexposed because many of the levels are stacked up against the LHS of the chart

Reading the histogram CS5/ACR 6.7

- Adobe Camera Raw can show us WHERE the image is under/over exposed

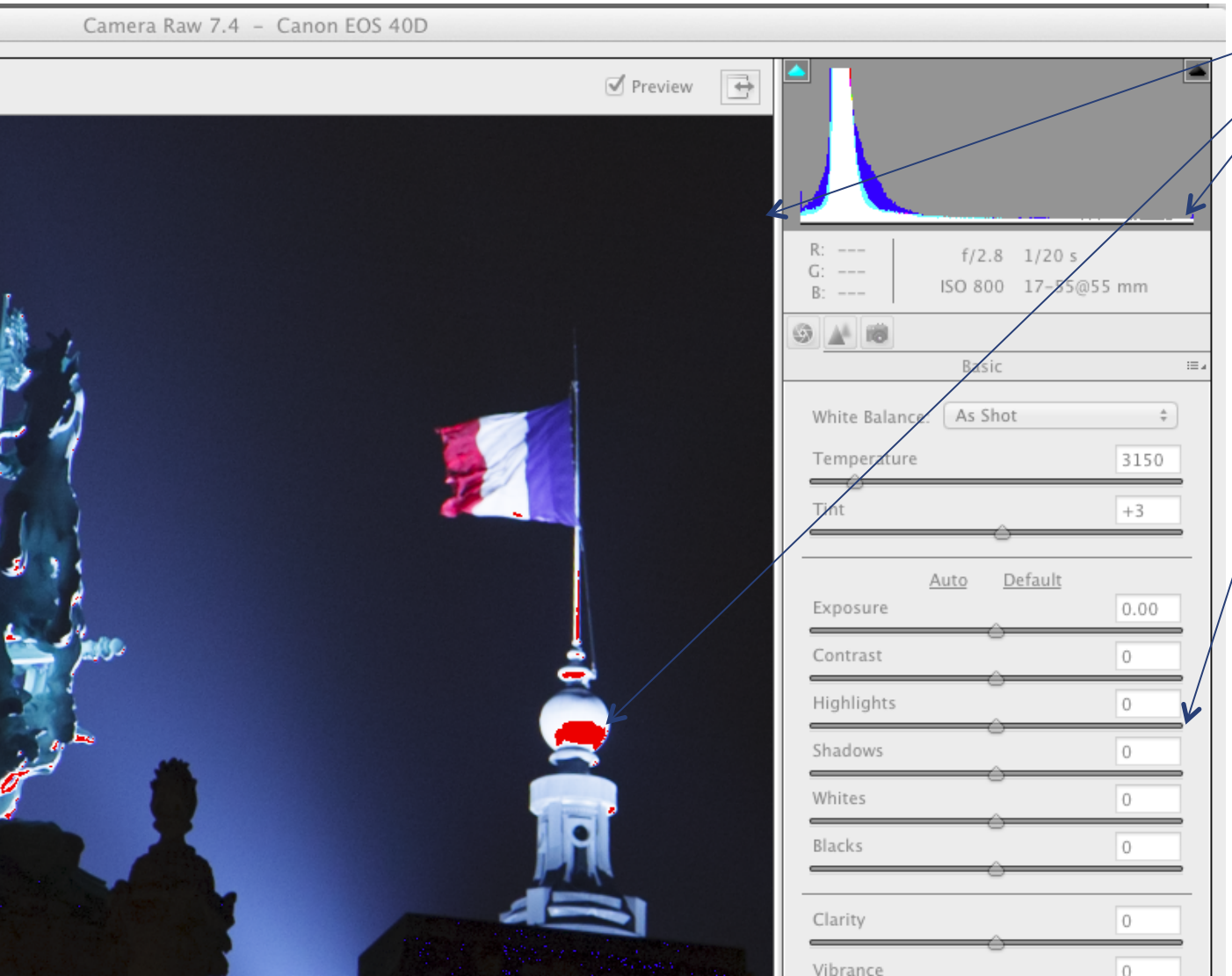


Click on the RH triangle - overexposed elements show red

Click on the LH triangle - underexposed elements show Blue

Reading the histogram Elements 11/ACR

The latest ACR (7.4 in 2012 process) improves over/under exposure handling

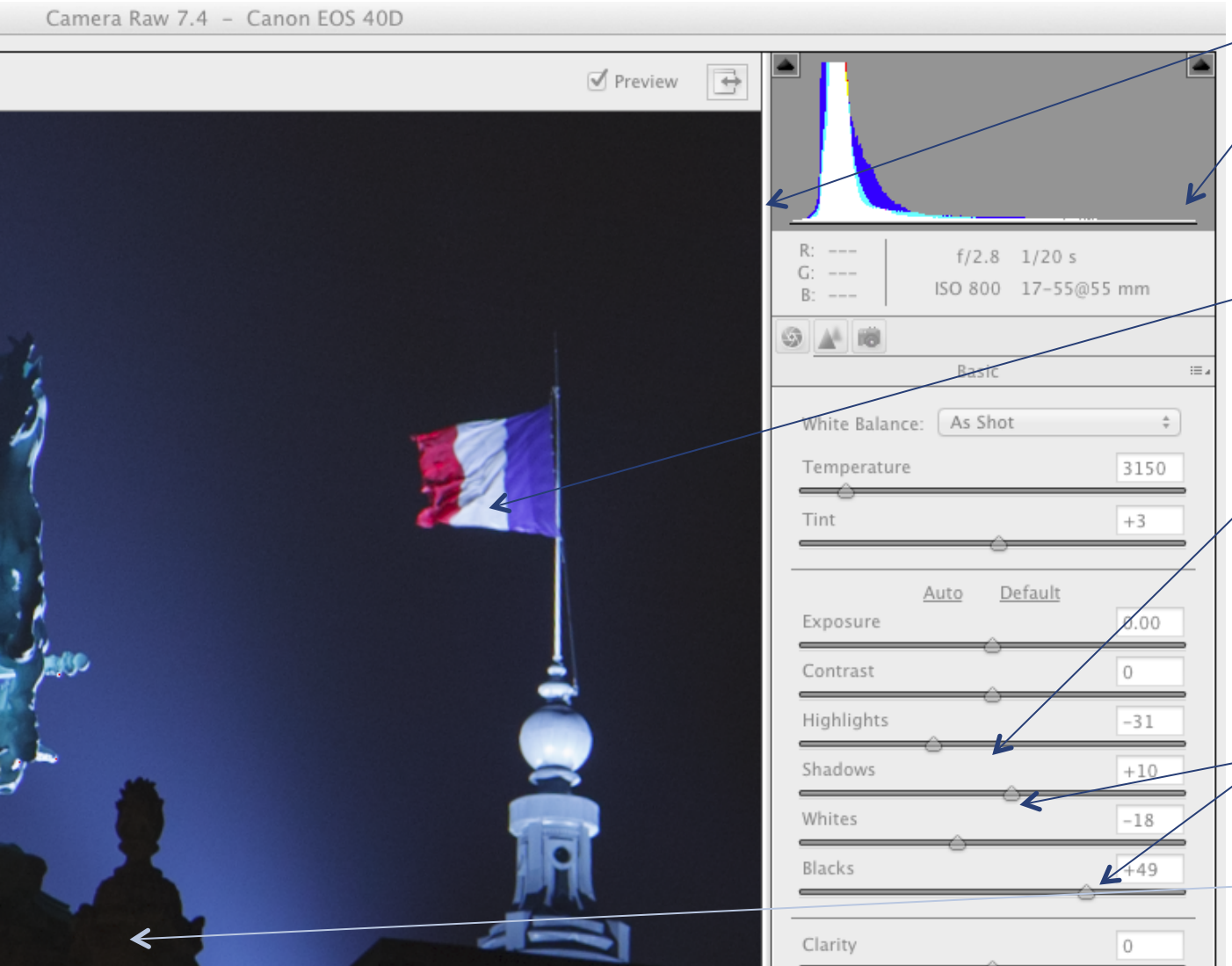


LH and RH sides are nearly clear of the sides

The names for the sliders have changed (allowing both over and under adjustments)

Reading the histogram Elements 11/ACR 7.4

- ACR 7.4 using process has extended the latitude of over/under exposure



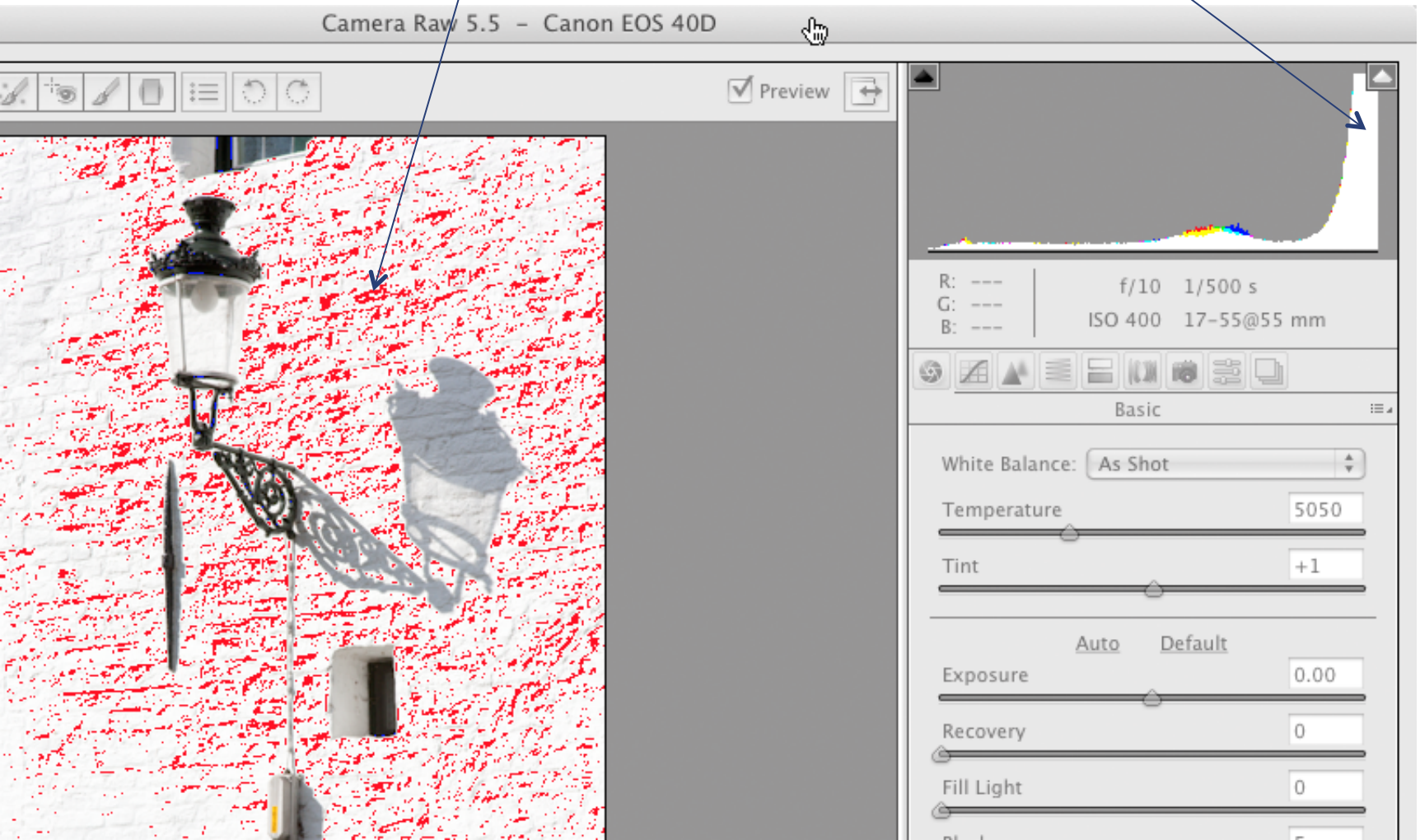
LH and RH sides have moved away from their respective edges

Decrease the Highlights slider and ACR will reconstitute third channel (R, G or B) from the others still not over-exposed.

Increase the Shadows and Blacks sliders to reduce the black clipping to zero

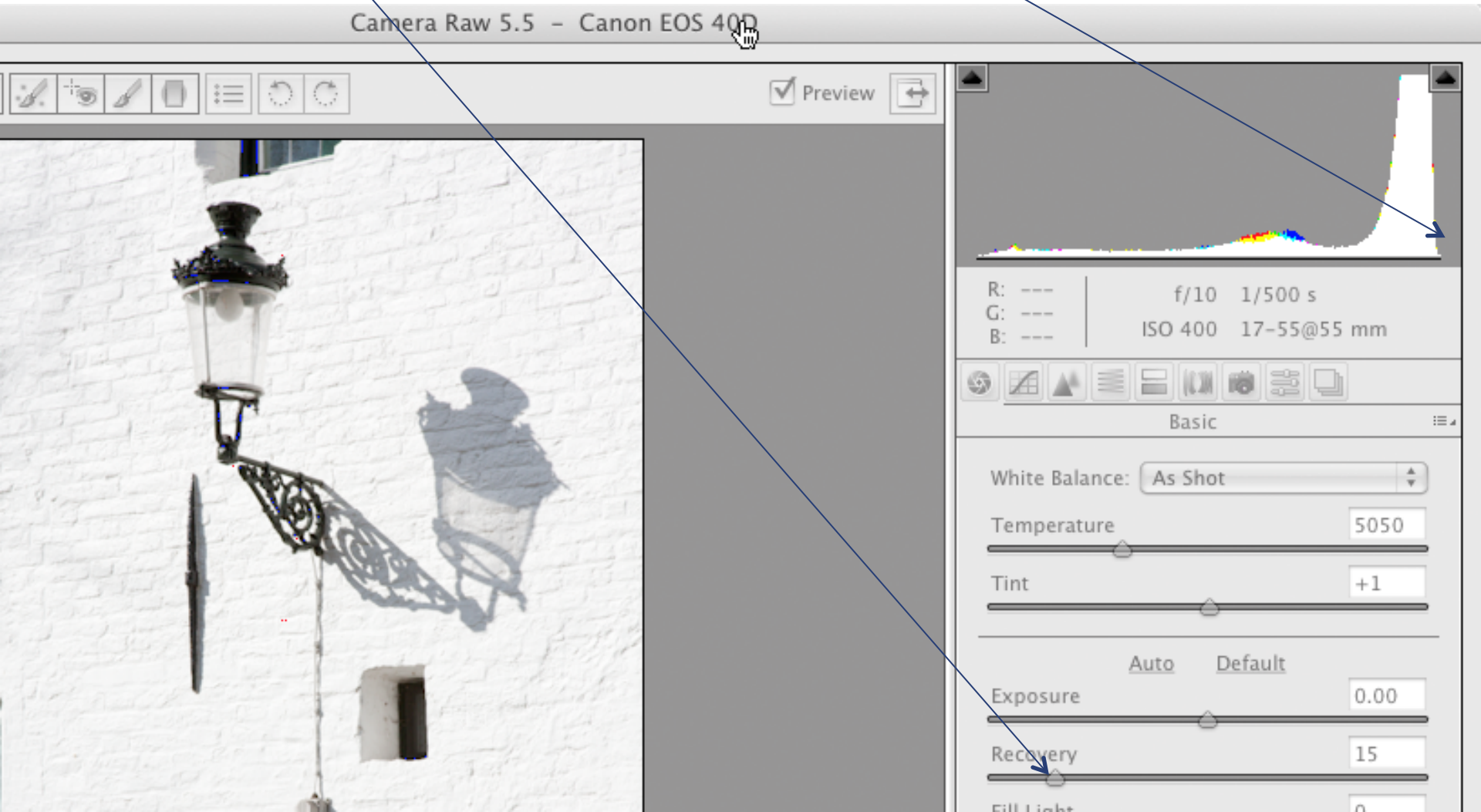
High-key histograms

- This image is high-key (most of the levels on the RHS) and slightly overexposed (areas shown in red)



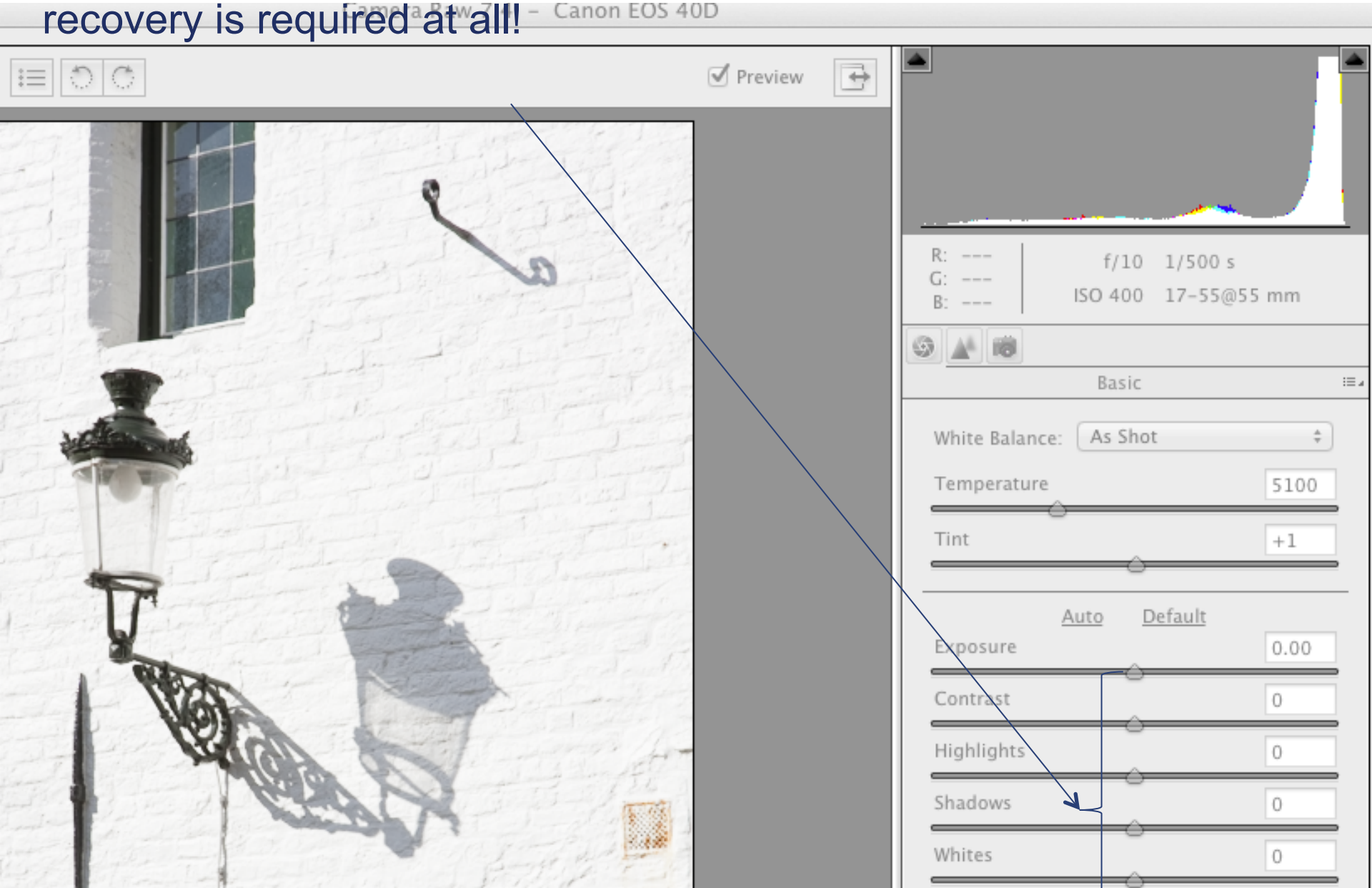
High-key histograms - 2

- But not so overexposed that ACR cannot recover the information (with Recovery) and thus bring the histogram back inside the range



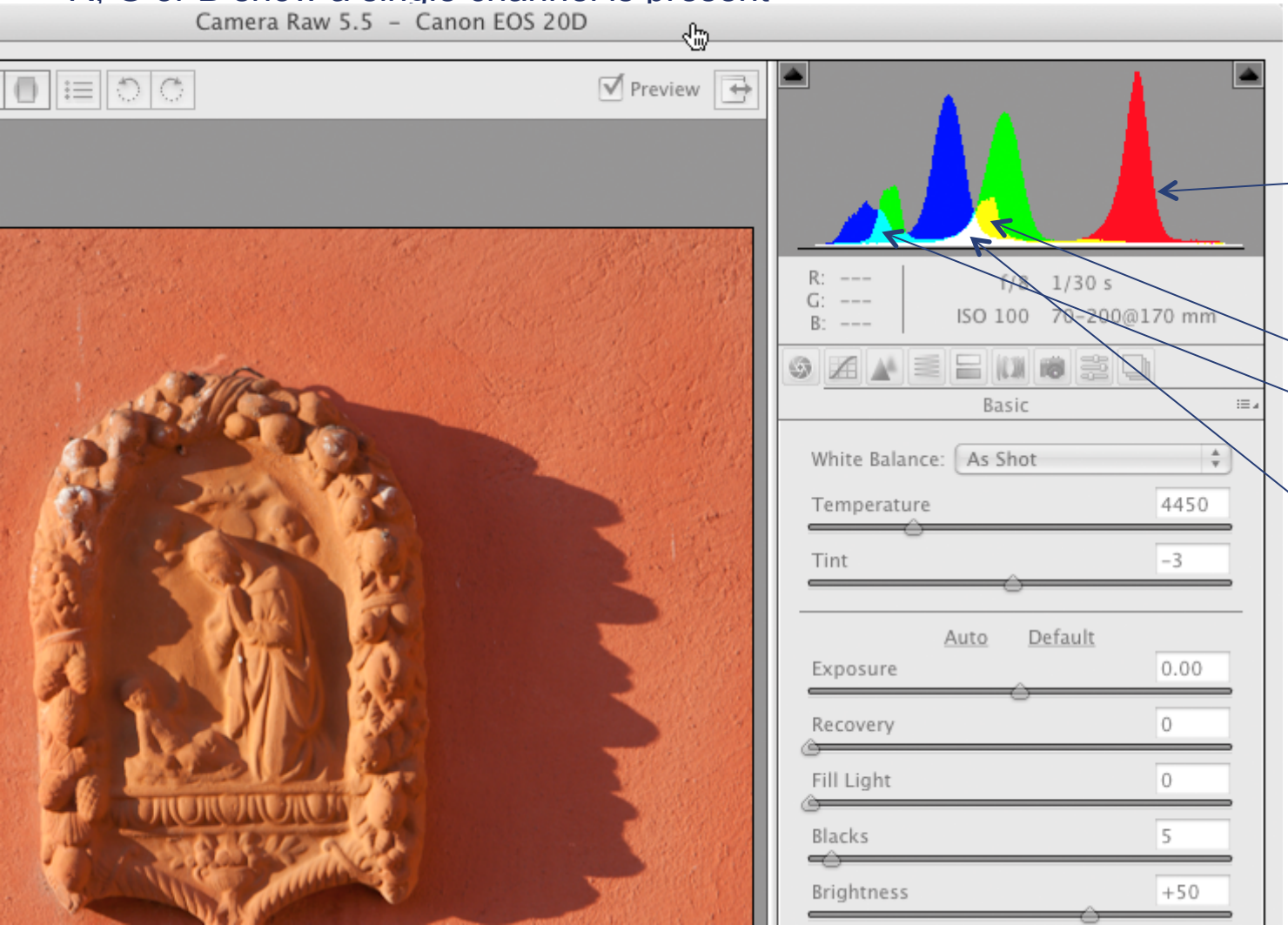
High-key histograms - 3

In Elements 11/ ACR 7.4 the 2012 process is so good no additional recovery is required at all!



Colours inside the histogram

- White areas indicate all three channels (R,G & B) are present
- Complementary colours (Yellow, Cyan & Magenta) show the presence of their two primaries
- R, G or B show a single channel is present



The histogram shows this to be a nearly monochrome image (three very distinct peaks) with red being predominant (lightest)

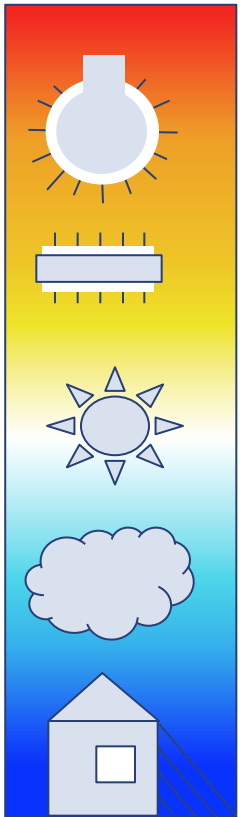
Two areas show complementary colours:
Yellow = (Red & Green)
Cyan = (Blue & Green)

One area shows up as white where all three channels are present

White Balance & Colour temperature

Our visual system is very clever and can make any colour temperature look “white”. Cameras aren’t so clever and need help to avoid a subsequent colour caste

AWB

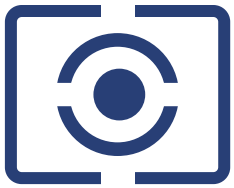


- Auto white balance – Whatever the camera guesses
- Tungsten – 3000 degs indoor lighting
- Fluorescent – 4000 degs (with green hints!)
- Sunny – around 5500 degs clear sky – warm white
- Cloudy – around 7500 degs cloudy – cool white
- Shady – Around 9000 degs – blue white

Tuning for white balance

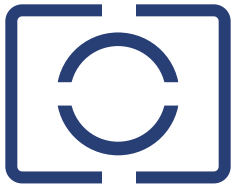
- One way is to use the WB control on the camera
- Another is to establish a custom white balance
  - Expose an image through an averaging filter and call that temperature “white”
- Another way is to include a grey card in a sample photo and use this to set the white balance in post processing (using the white balance pipette).

Metering mode impacts

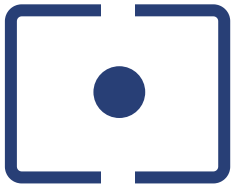


- Evaluative metering
  - Averages light from all the scene to set exposure
    - Assumes main subject is same brightness as rest of scene
    - Good for portraits and backlit subjects

- Partial Metering
  - Averages light from centre 8% of scene
    - Assumes central area is exposure priority
    - Good when background much brighter than central scene



- Centre weighted average metering
  - Weighted at the centre and averaged for entire scene
    - Give a compromise between centre and rest of scene
    - Default catch-all lighting mode (when in doubt about others)



- Spot metering
  - Averages light from centre 3.5% of scene
    - Meters central subject and ignores the rest
    - Good when you want specific subject to be correctly exposed

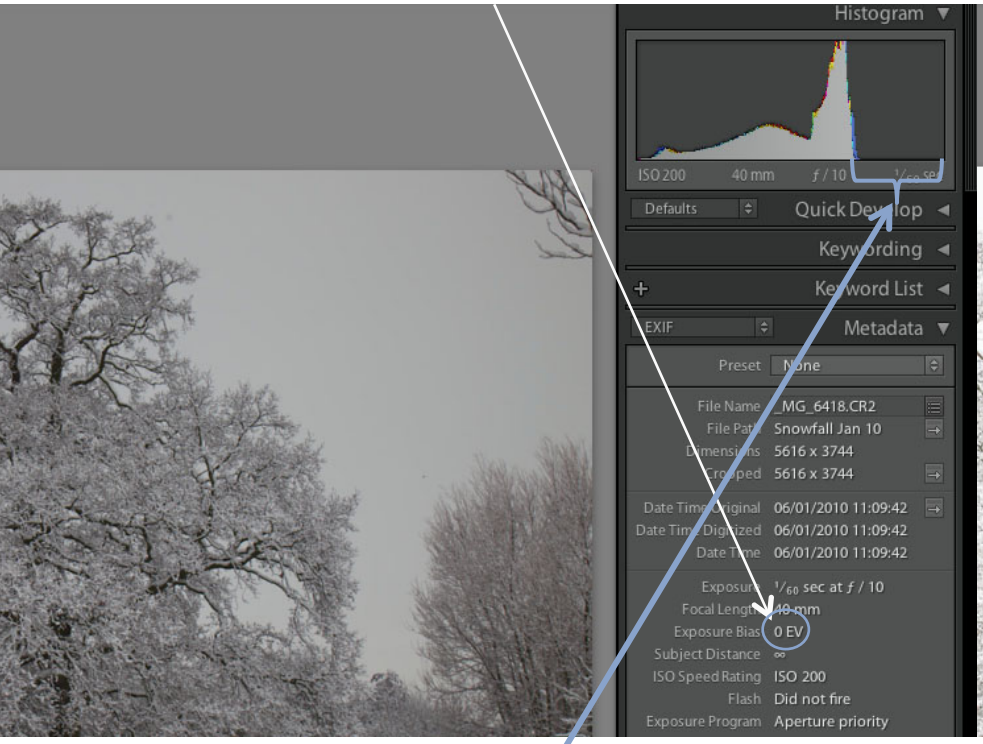
Auto exposure issues

- To calculate exposure, the in-camera meter assumes that the average reflectance in the scene to be photographed is the equivalent of a mid (12%-18%) grey card
- If the real scene has a reflectance significantly different then the auto exposure will incorrectly set the exposure – but predictably!
- For a white scene (eg snowy) the DSLR will **underexpose** the scene to "average" its reflectance to that of mid grey
  - This makes the bright scene look duller (by up to 2 stops!)
- For a dark scene (night shot with street lamps) the DSLR will **overexpose** the scene to average its reflectance to mid grey
  - This makes the scene look brighter than you may want it
- The next slides illustrate these effects and what you could do about them

See http://www.cambridgeincolour.com/tutorials/camera-metering.htm for a more detailed explanation

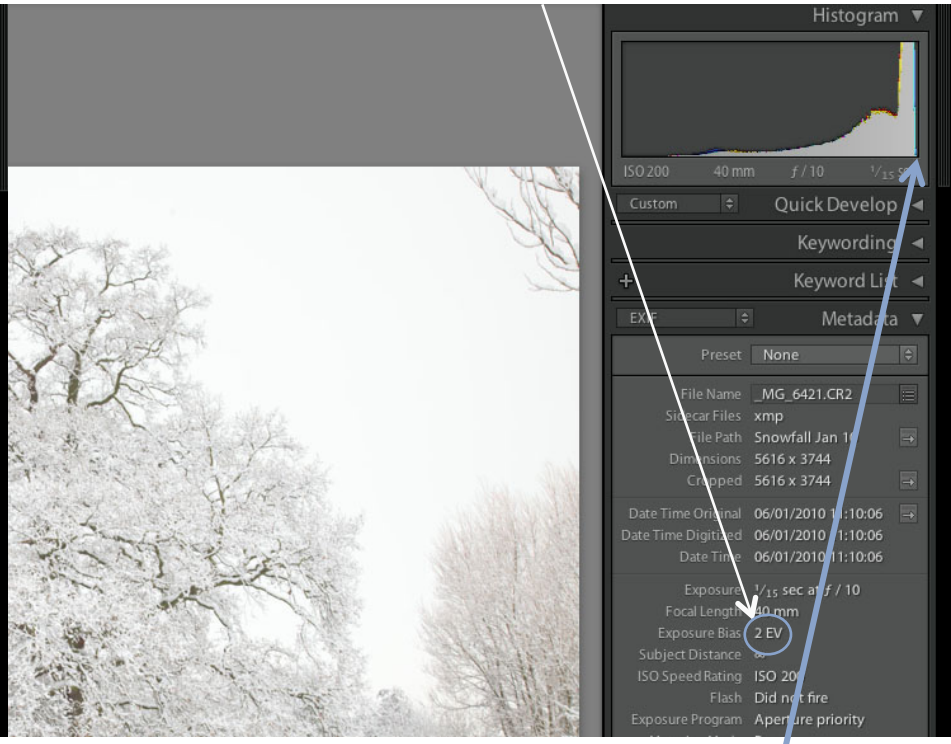
Underexposed bright scene - A snowy tree

Auto exposure with no compensation



Histogram shows a gap between the “lightest” end and the “lightest recorded tones” of the histogram. The whites of the snow are grey (They measure R 142 (67%) G 142 (67%) B 142 (67%))
These two “unused stops” between them may contain some ¾ or (3170 levels) of all the detail available

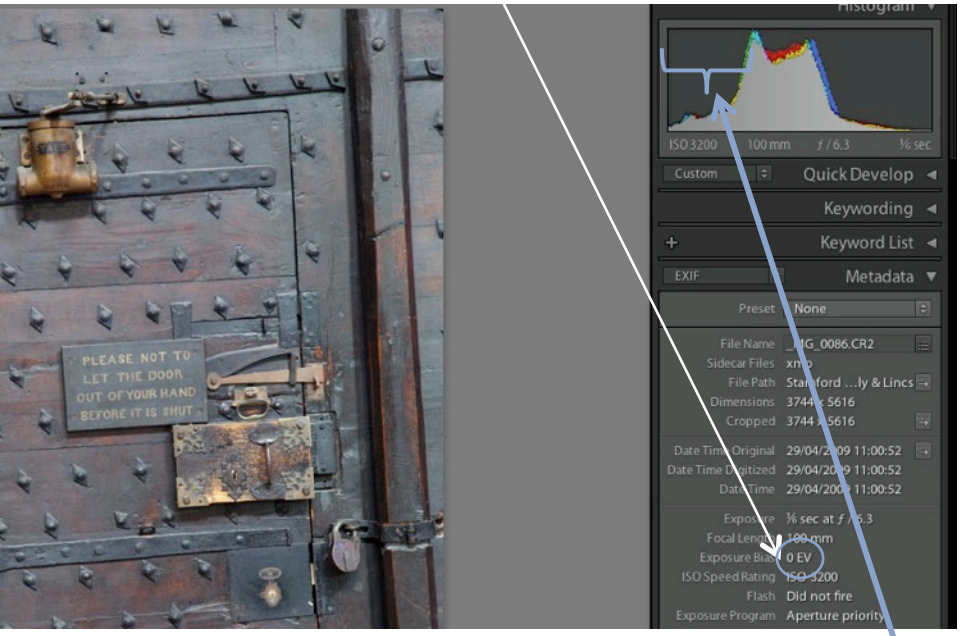
Auto exposure with +2ev compensation



Histogram shows no gap between the “lightest” end and the “lightest recorded tones” of the histogram. The whites of the snow are white (They measure R 242 (98%) G 242 (98%) B 242 (98%))
All of the available sensor is being used to collect detail

Overexposed dark scene – An ancient door

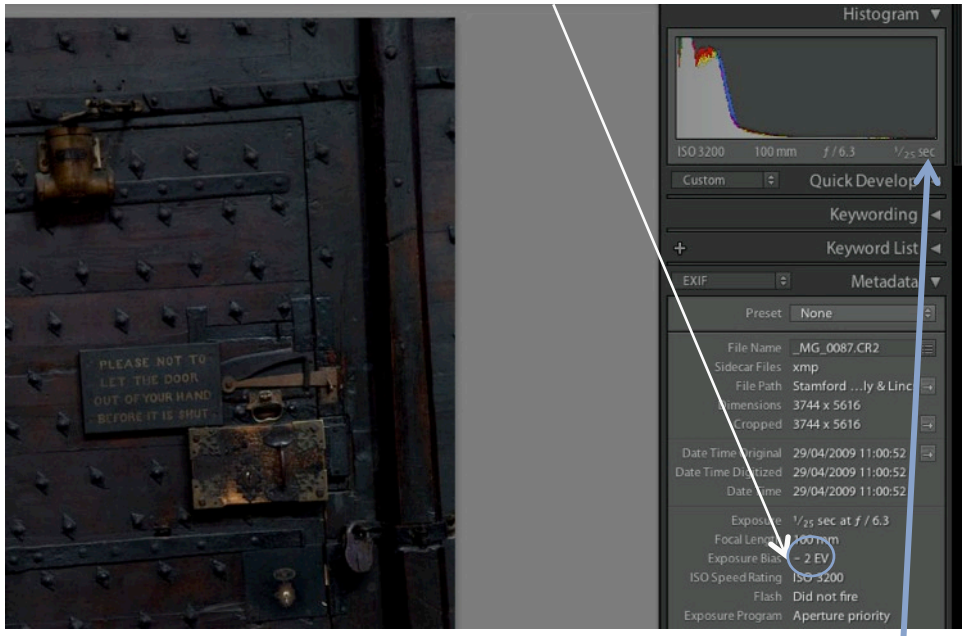
Auto exposure with no compensation



Histogram of this dark feature has been moved to the centre and seems too light for the scene remembered.
The lower door has become light grey (measuring R 82 (39%) G 80 (39%) B 88 (43%))

These two “overexposed stops” between them have allowed the capture of 768 levels of information in the middle two stops (versus only 192 levels in the darkest two stops)

Auto exposure with -2ev compensation



Histogram of this dark feature is focussed on the left hand (dark) end. The door now looks the correct shade as remembered
The lower door now registers as dark grey (measuring R 16 (7.2%) G 15 (7.2%) B 18 (9.6%))

Whilst the lightness and hue appear correct the histogram shows that all the information is captured in the darkest two stops which hold only 192 levels.

Implications of the “Dark door” overexposure 1

- Auto exposure tries to align all tones to mid grey
- A very dark scene (eg the door) gets **over-exposed**
- To get the remembered exposure we must reduce it by up to 2 stops (-2ev) to darken it again.

Image taken as ISO3200 and defaulted to 2 stops over -> Reduced exposure by 2 stops to get tone

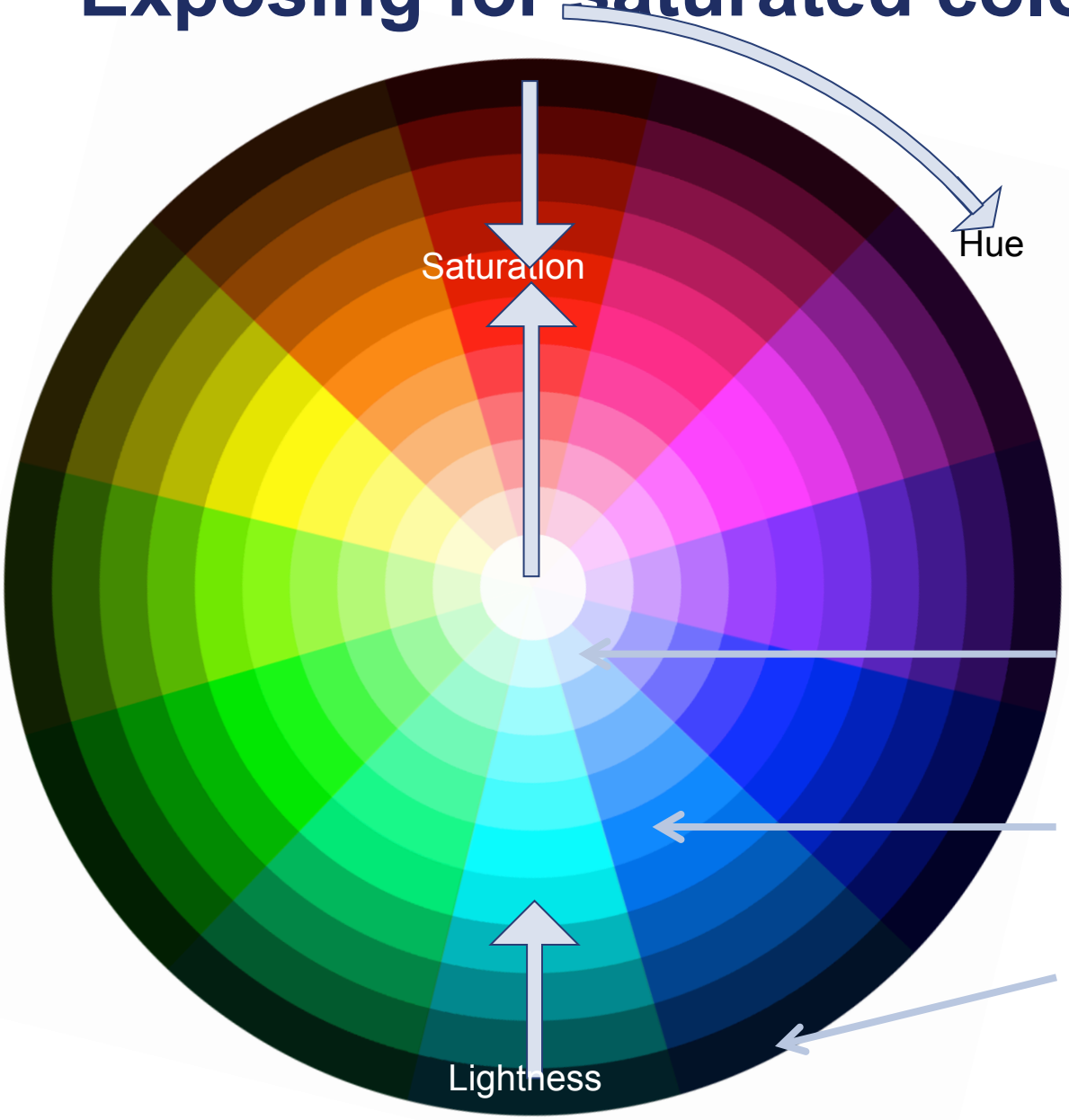
Implications of the “Dark door” overexposure - 2

- BUT taking an image where all the levels are focussed in the lowest two stops has implications:
  - We are capturing all light in the lowest levels of sensitivity of the sensor – where the most noise lurks
  - Where the fewest gradations exist (64 levels in the lowest stop, 128 in the next highest, etc)

+2 stops overexposed at ISO3200 (what it looks like at 0EV) > -2stop capture what it looks like at 0EV

- I have found that using RAW and reducing the exposure by -2ev in software (DPP, ACR, …) produces a more finely detailed and lower noise image than in-camera approaches

Exposing for saturated colours



To maximise colour information:

Brightest tones are washed out

We must focus key subject colouration in the mid-tones

Darkest are muddy

The Zone system applied to Digital

- Ansell Adams - three different exposure scales for the negative:
  - The full range from black to white, represented by Zone 0 through Zone X.
  - The *dynamic range* comprising Zone I through Zone IX, which Adams considered to represent the darkest and lightest “useful” negative densities.
  - The *textural range* comprising Zone II through Zone VIII. This range of zones conveys a sense of texture and the recognition of substance.

Zone	Negative Description	Colour relevance
0	Pure black	
I	Near black, with slight tonality but no texture	
II	Textured black; darkest part of image where slight detail is recorded	**with no colour available**
III	Average dark materials and low values showing adequate texture	**with muddy colour**
IV	Average dark foliage, dark stone, or landscape shadows	**with dark colour**
V	Middle grey: clear north sky; dark skin, average weathered wood	**with saturated colour**
VI	Avg Caucasian skin; light stone; shadows on snow, sunlit landscapes	**with pastel colour**
VII	Very light skin; shadows in snow with acute side lighting	**with faded colour**
VIII	Lightest tone with texture: textured snow	**with all colour washed out**
IX	Slight tone without texture; glaring snow	
X	Pure white: light sources and specular reflections	

Conclusions

- Before processing the image, look at the histogram:
- High key (mainly light and focussed on the right side of the histogram)
- Low key (mainly dark and focussed on the left hand side of the histogram)
- Overexposed (RHS of histogram not finishing with a zero level)
  - Also shown up in the ACR image with red blotches
- Underexposed (LHS of histogram not finishing with a zero level)
  - Also shown up in the ACR image with blue blotches
- Only certain “zones” can convey colour information
- There is no “right” histogram – it’s up to you to interpret the image how you feel is appropriate

Further reading

- http://www.sphoto.com/techinfo/histograms/histograms.htm
- Dave Montizambert's article in SWPP magazine
  - http://www.swpp.co.uk/professional_imagemaker/lighting-digital-5.htm
- Bruce Frazer's article on linear gamma
  - http://www.adobe.com/digitalimag/pdfs/linear_gamma.pdf
- Michael Frye's article on the Zone system applied to digital
  - http://www.outdoorphotographer.com/how-to/shooting/the-digital-zone-system.html
- A good book on exposure:
  - **Perfect Exposure** Micheal Freeman Published by Ilex