

The Raw Deal

Raw VS. JPG

Photo Plus Expo

New York City, October 31st, 2003.

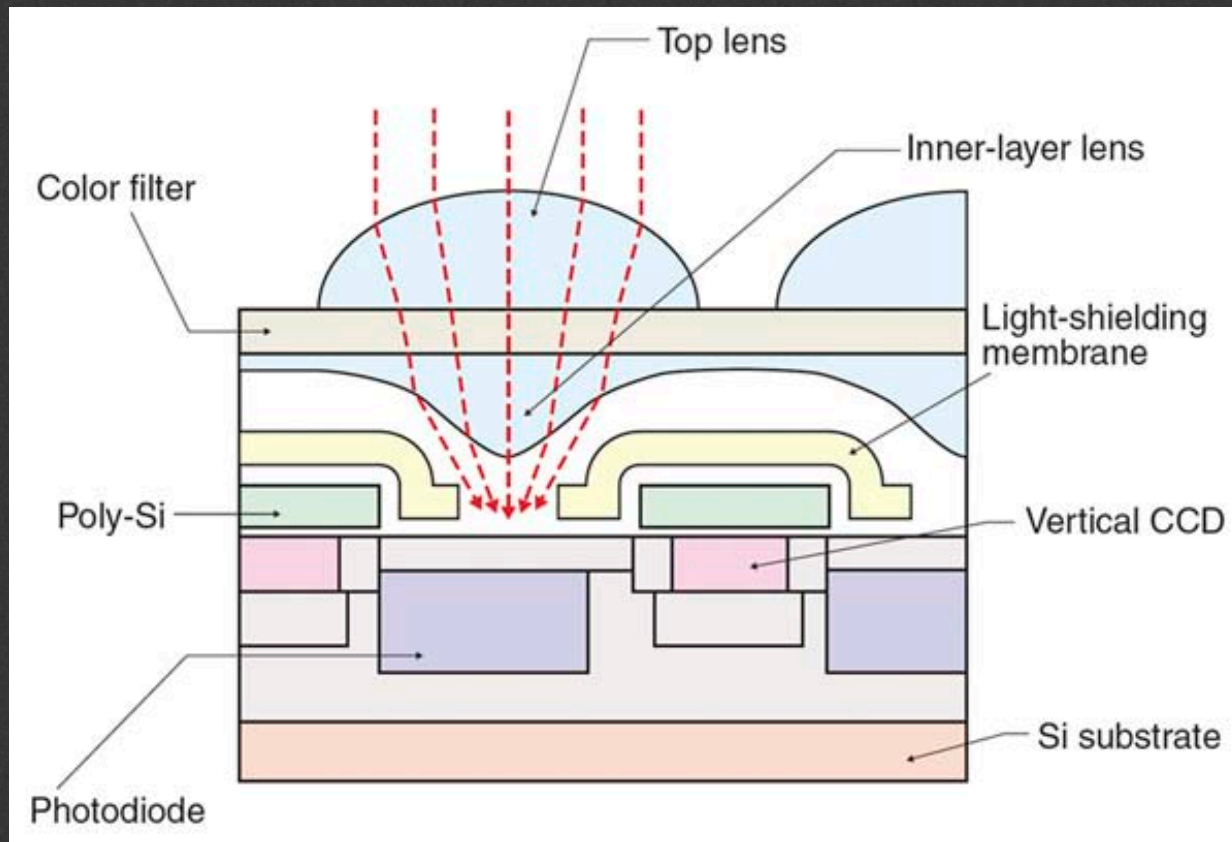
©2003 By Jeff Schewe

Notes at:

www.schewephoto.com/workshop

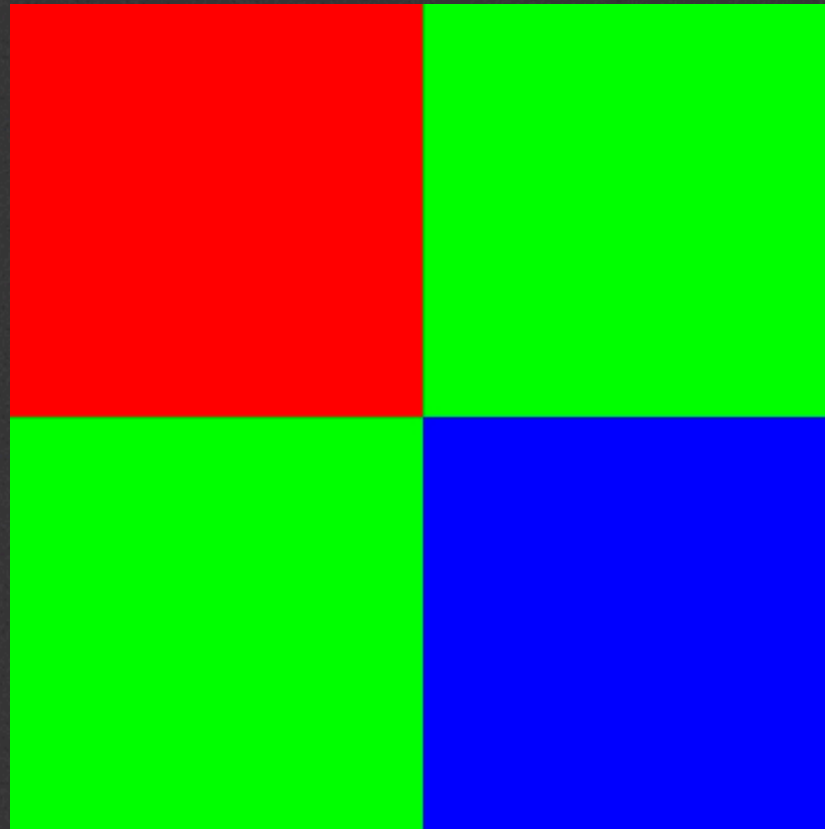
The Raw Deal

How a CCD Works The Chip



The Raw Deal

How a CCD Works
The Bayer Array



The Raw Deal

How a CCD Works
The Bayer Array

A 7x7 grid representing a Bayer array. The grid consists of 49 cells, each containing a color label and a subpixel index. The colors are Red (R), Green (G), and Blue (B). The indices range from 11 to 77. The pattern of colors is as follows:

R ₁₁	G ₁₂	R ₁₃	G ₁₄	R ₁₅	G ₁₆	R ₁₇
G ₂₁	B ₂₂	G ₂₃	B ₂₄	G ₂₅	B ₂₆	G ₂₇
R ₃₁	G ₃₂	R ₃₃	G ₃₄	R ₃₅	G ₃₆	R ₃₇
G ₄₁	B ₄₂	G ₄₃	B ₄₄	G ₄₅	B ₄₆	G ₄₇
R ₅₁	G ₅₂	R ₅₃	G ₅₄	R ₅₅	G ₅₆	R ₅₇
G ₆₁	B ₆₂	G ₆₃	B ₆₄	G ₆₅	B ₆₆	G ₆₇
R ₇₁	G ₇₂	R ₇₃	G ₇₄	R ₇₅	G ₇₆	R ₇₇

The Raw Deal

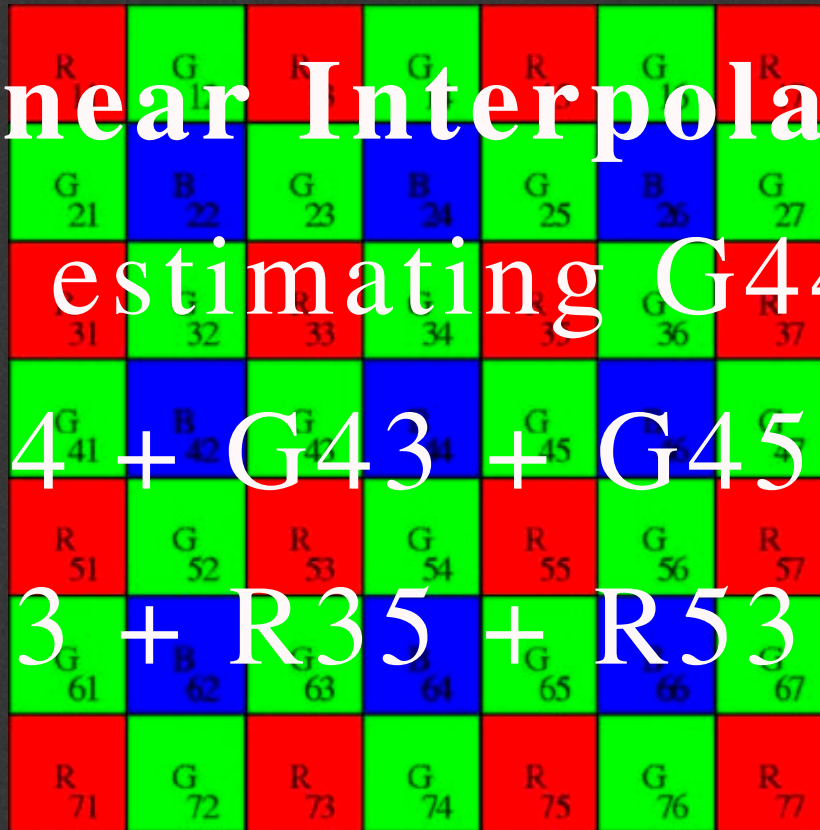
How a CCD Works
The Bayer Array

Bilinear Interpolation

At B44, estimating G44 & R44

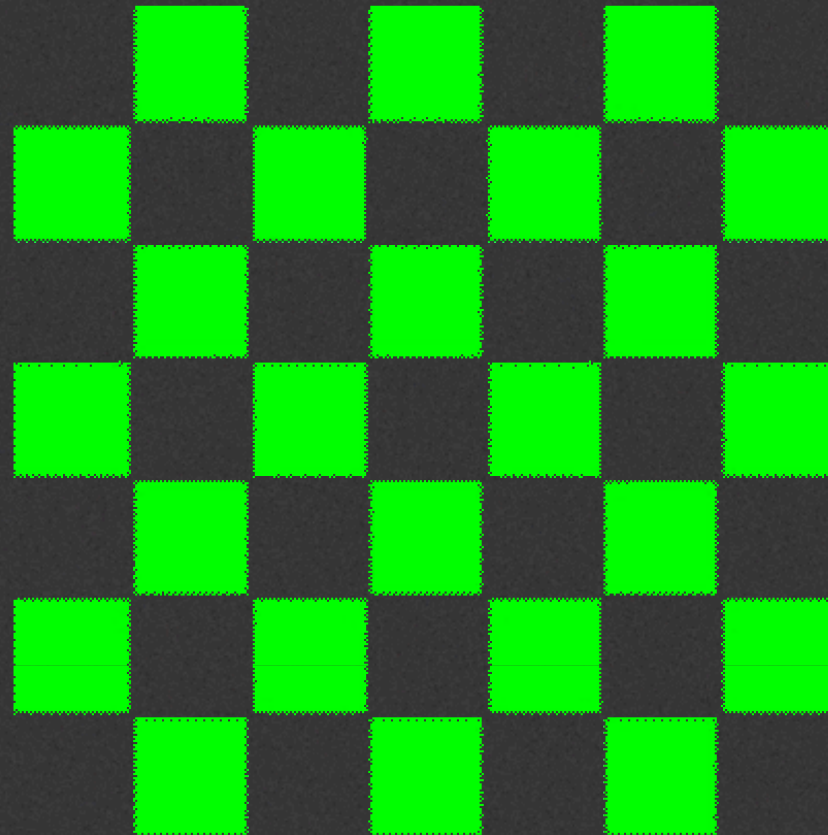
$$G44 = (G34 + G43 + G45 + G54) / 4$$

$$R44 = (R33 + R35 + R53 + R55) / 4$$



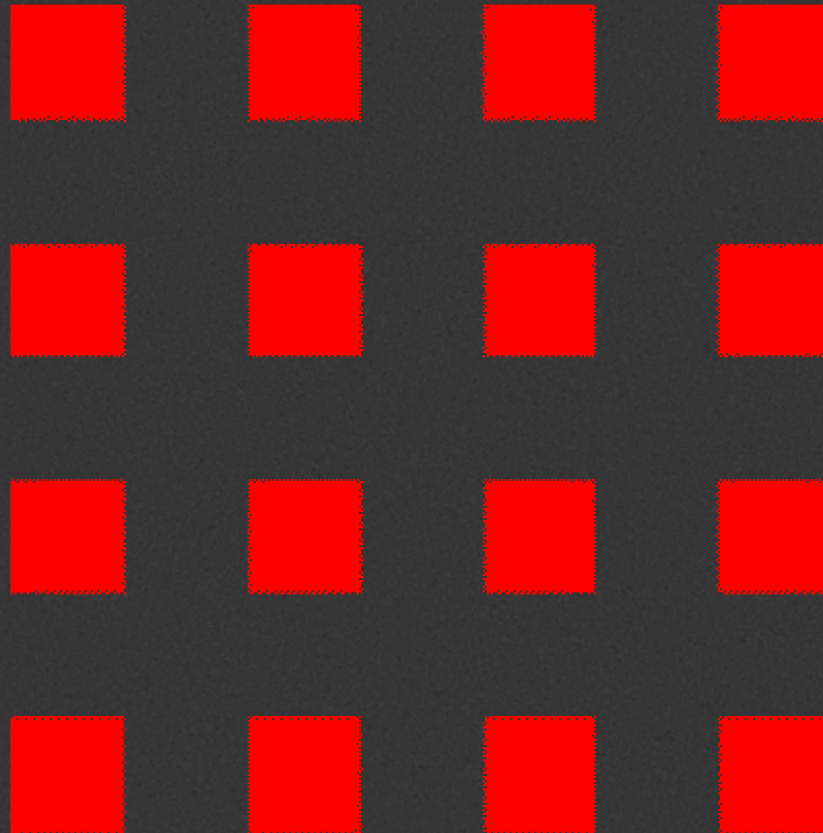
The Raw Deal

How a CCD Works
The Green Pixels +



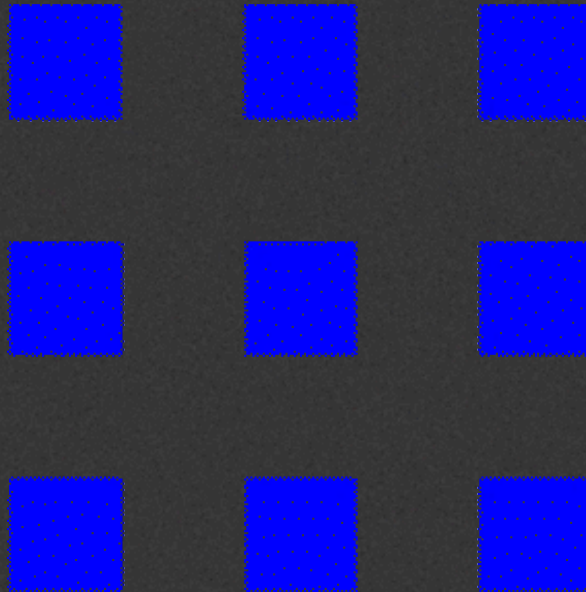
The Raw Deal

How a CCD Works
The Red Pixels +



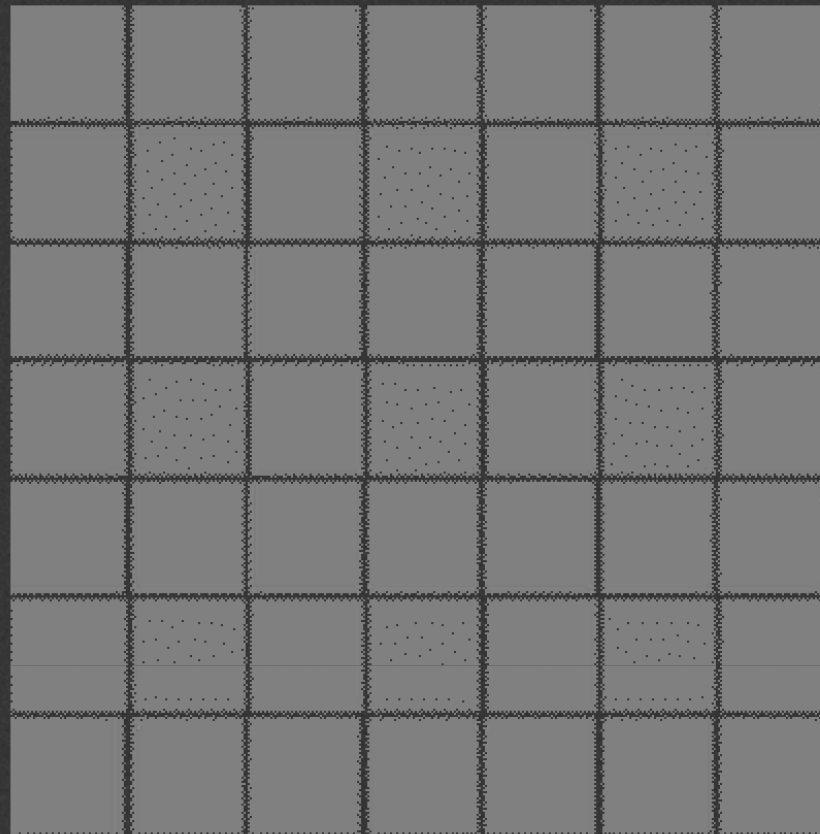
The Raw Deal

How a CCD Works
The Blue Pixels Interpolated =



The Raw Deal

How a CCD Works
The Capture



The Raw Deal

How a CCD Works

On a 2048 x 1536 pixel CCD
using a GRGB Bayer Array:

1024 x 768 pixels are RED (768,432)

1024 x 768 pixels are BLUE (768,432)

1024 x 1536 pixels are GREEN (1,572,864)

Interpolated, 2048 x 1536 = 3,145,728

Or about 3 Mega-Pixels

The Raw Deal

How a CCD Works

So, it takes four pixels or photo-sites to create one interpolated **R G B** pixel.

The interpolation, or “de-mosaicking” introduces errors and reduces the effective resolution of a sensor array.

The Raw Deal

How a CCD Works

Remarkably, today's cameras can record, interpolate, process and write to media up to 6 frames/second.

**This is Science-Fiction
and happening now!**

But. . .

It ain't perfect
just yet. . .

The Raw Deal

JPG?
RAW?

What should you shoot?

The Raw Deal

JPG has some advantages:

JPG's are small files, more fit on a card.

Captures are written to card quickly.

The camera does the heavy lifting for Raw linear to gamma color spaces.

You can use the camera to set tone curves, color spaces and white balance.

JPG's are easy to review and edit.

The Raw Deal

JPG has some disadvantages:

- Lossy compression causes data loss.

- Images acquire extraneous data-random artifacts.

- Color quantization errors reduce bit depth.

- Various compression schemes produce undocumented results.

- Degradation caused by re-saving changes.

- Locks in the linear to gamma encoding.

- Locks in white balance and tone curves.

- Artificially reduces dynamic range.

The Raw Deal

Shooting RAW has advantages:

White balance, color space and exposure adjustments are done in the RAW conversion.

Maximum dynamic range of capture.

No color quantization errors-high bit depth.

No added artifacts caused by compression.

Allows re-processing for different interpretations.

Maximum quality from the sensor.

The Raw Deal

Shooting RAW has disadvantages:

RAW linear to gamma conversion takes time.

Images are slow to preview and edit.

Requires special software to even view.

Larger files mean less captures
and slower writing to cards.

Processing files requires interpretation.

The Raw Deal

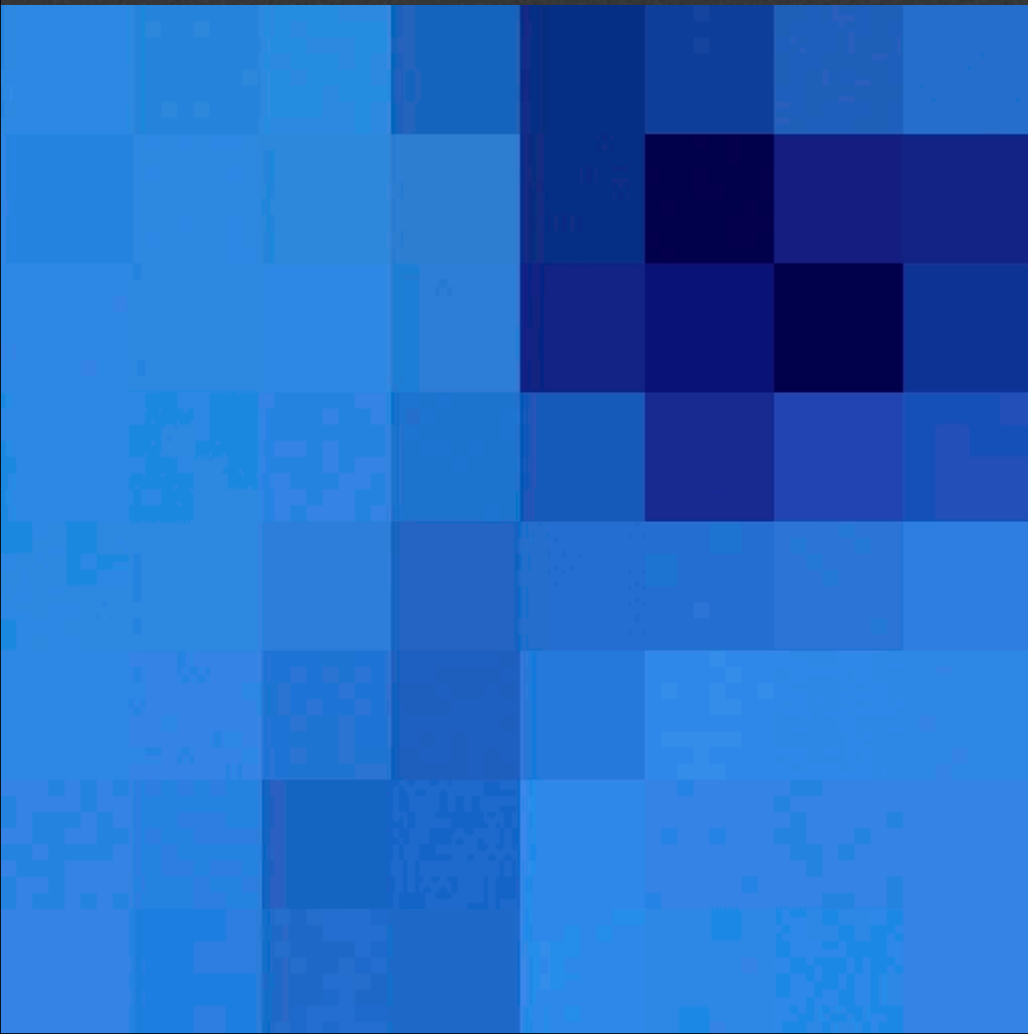
JPG?

RAW?

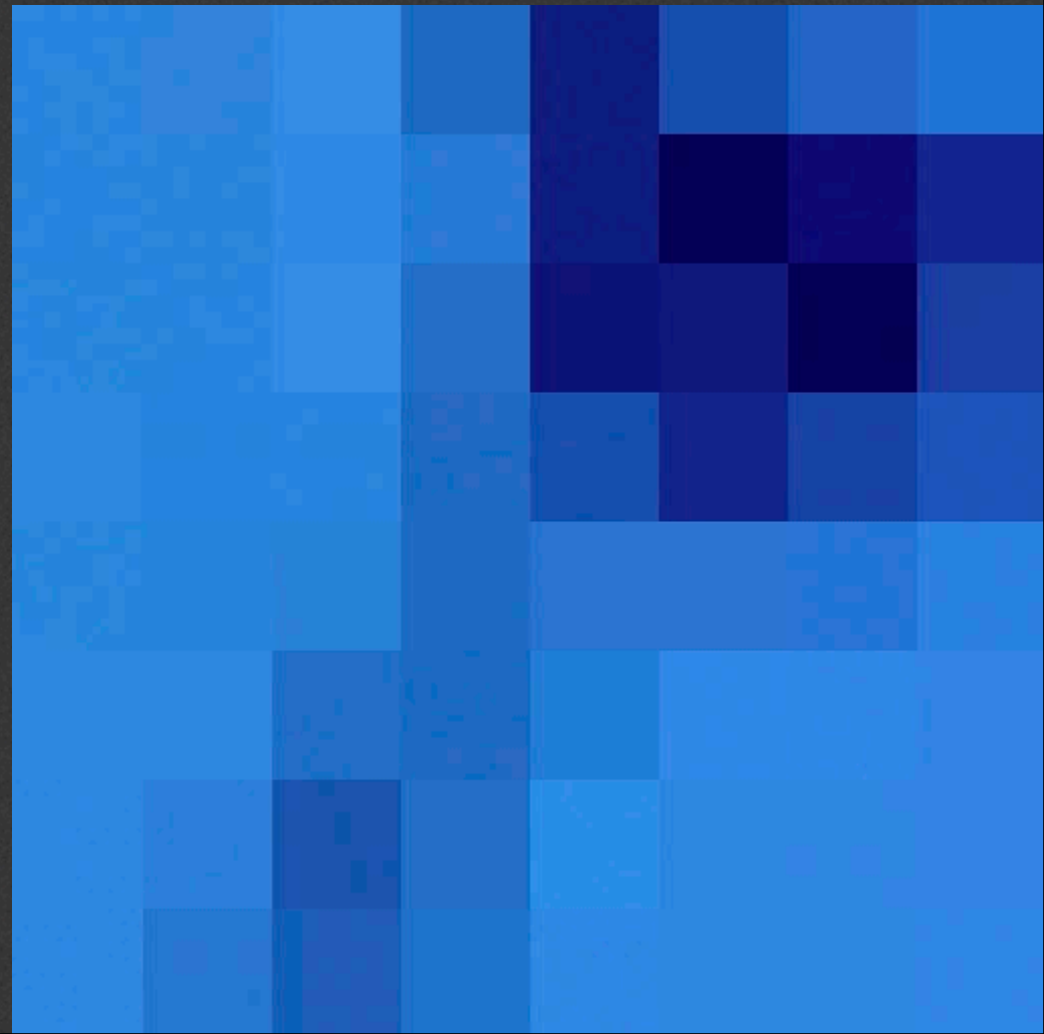


The Raw Deal

JPG

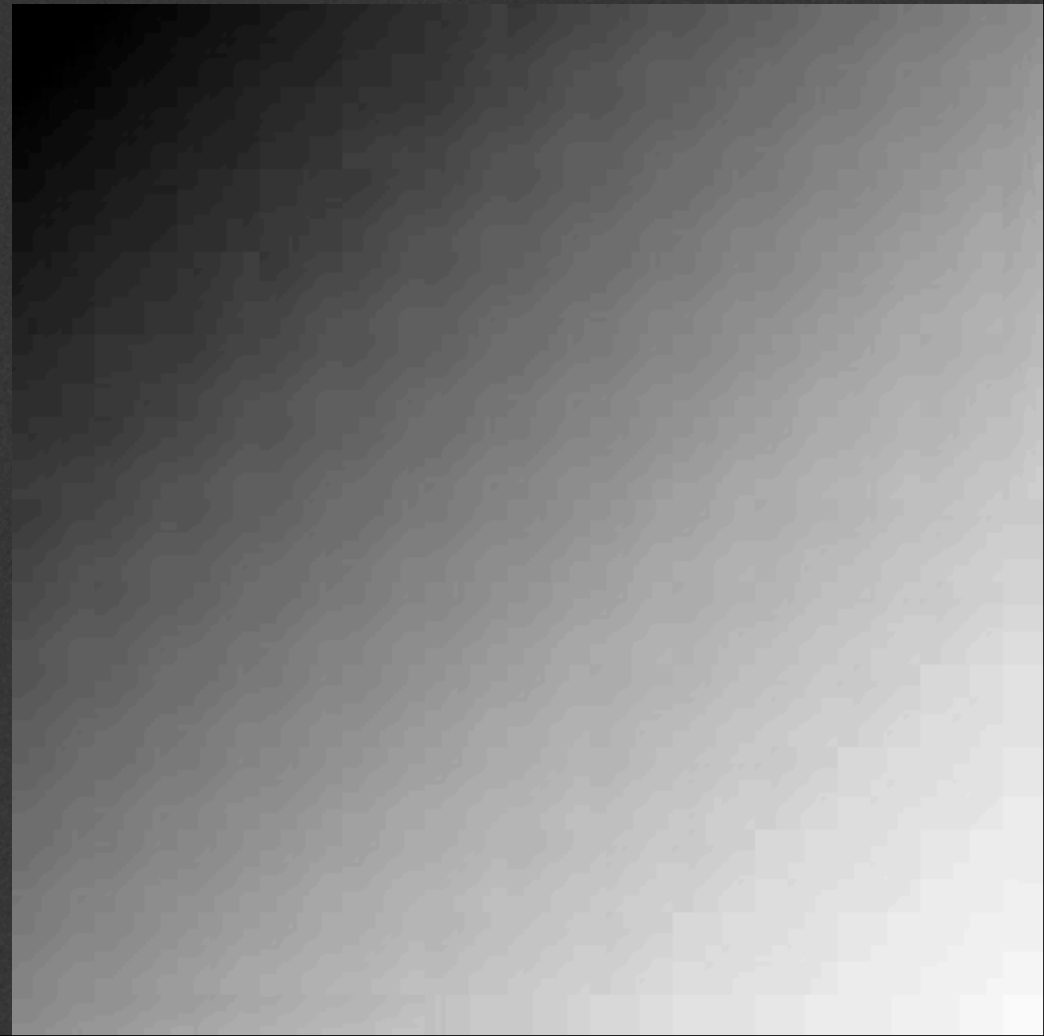
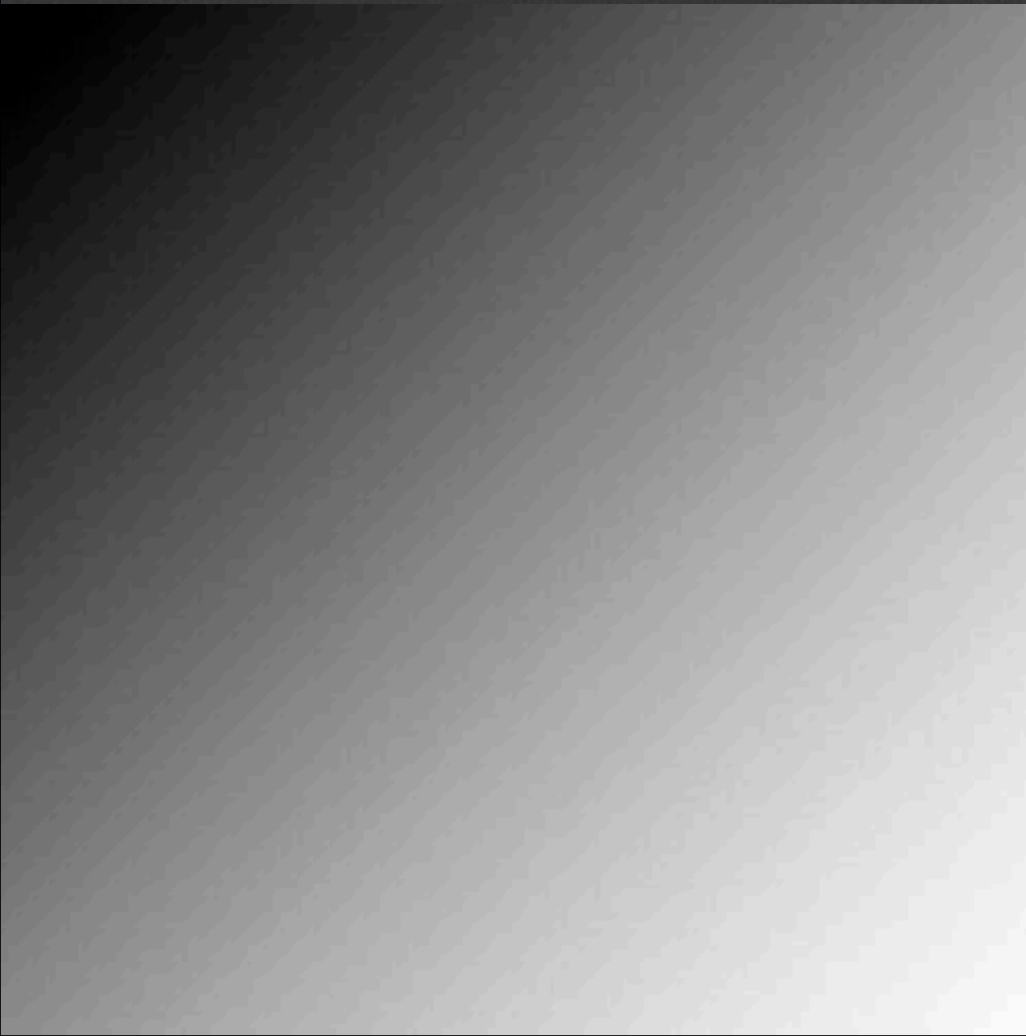


RAW



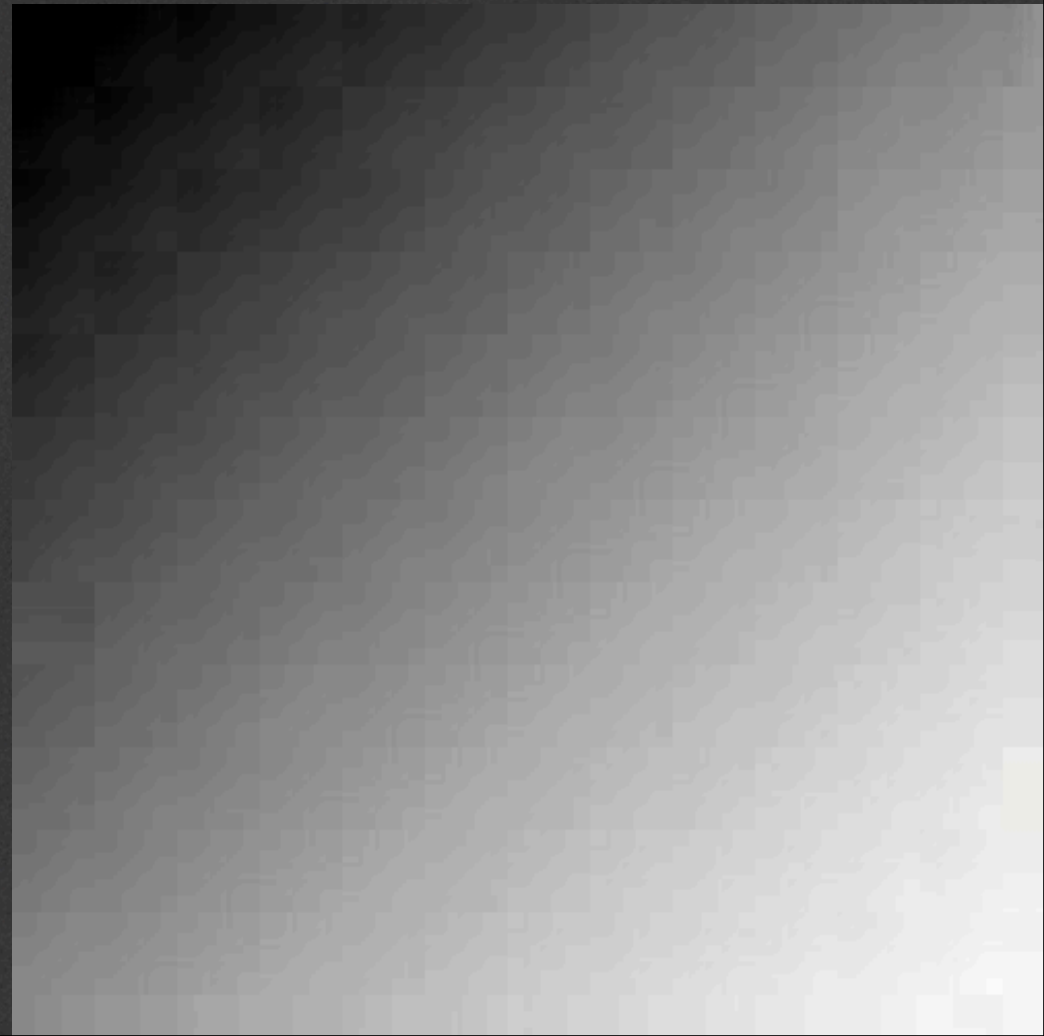
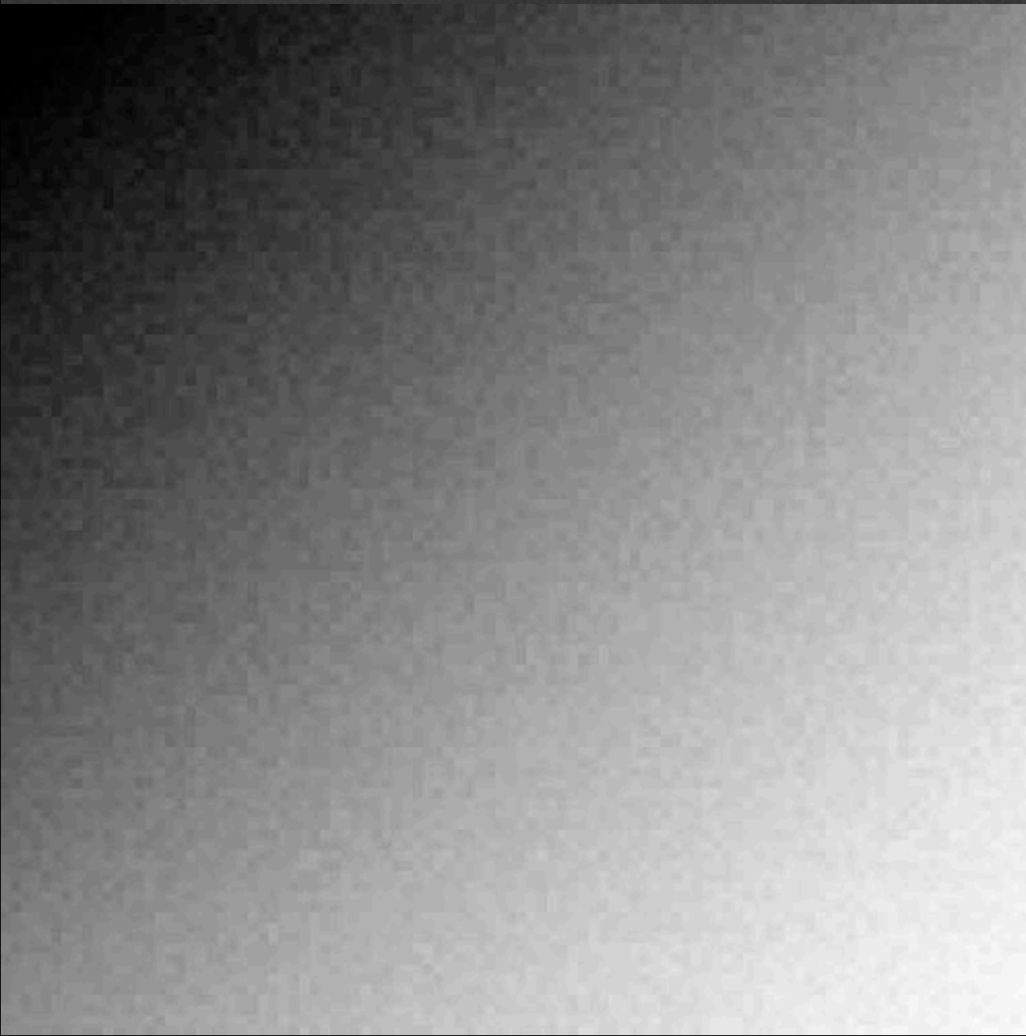
The Raw Deal

Low Frequency JPG



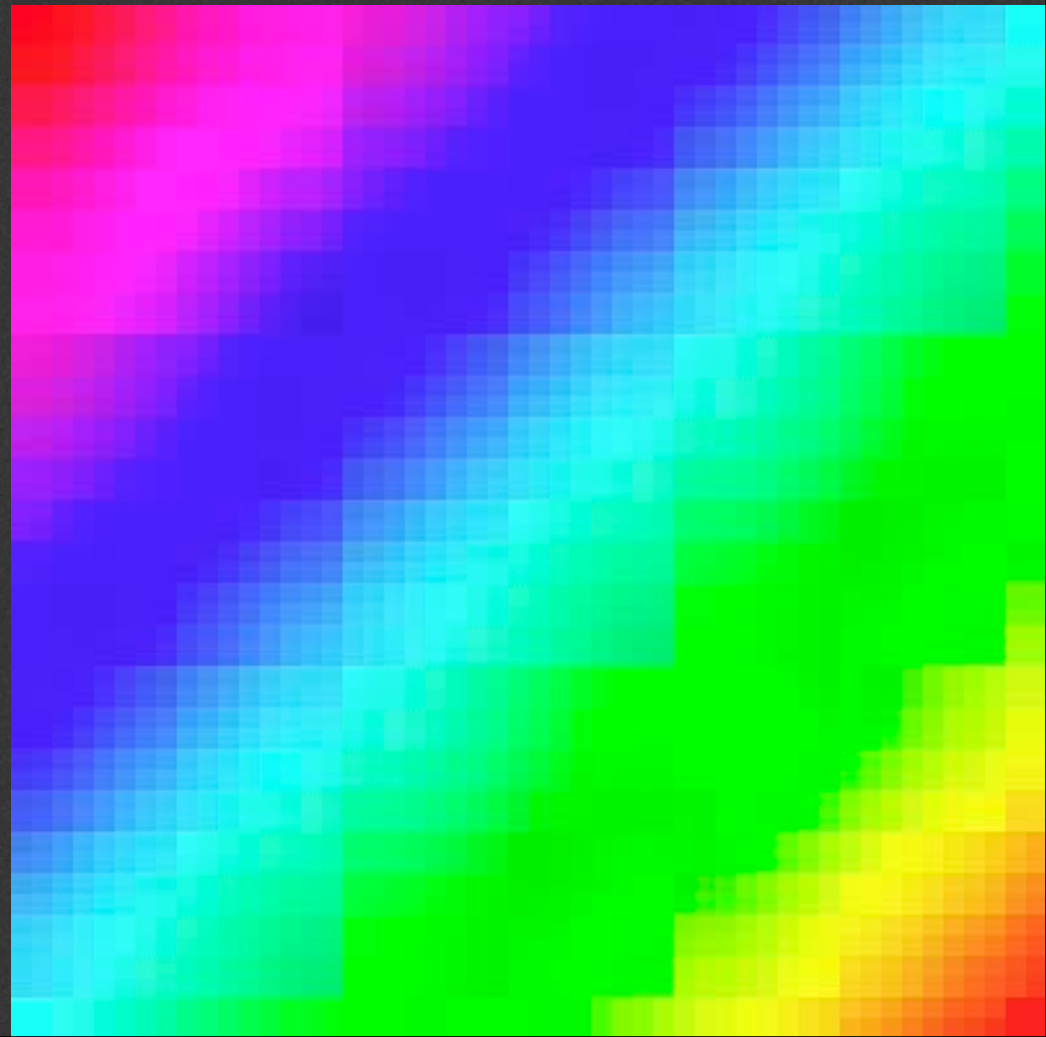
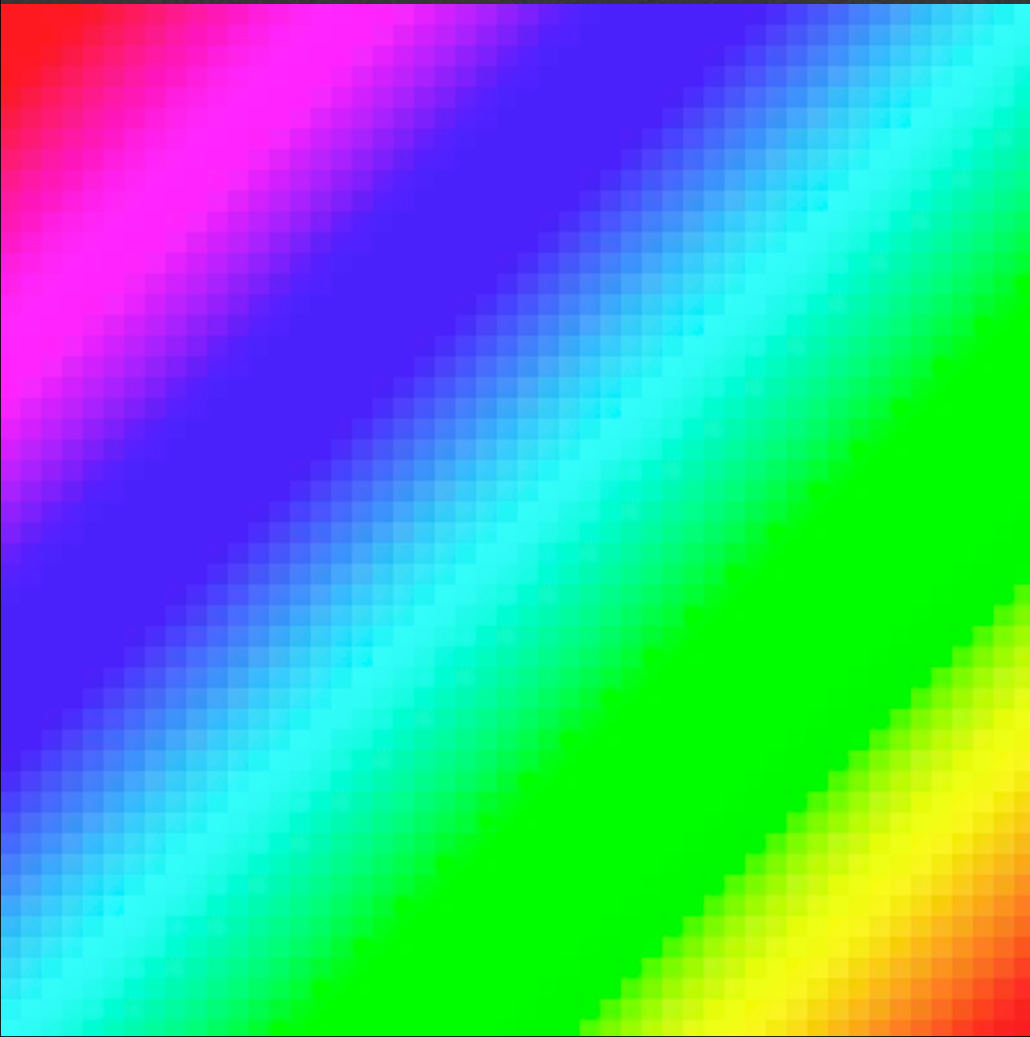
The Raw Deal

High Frequency JPG



The Raw Deal

JPG Color Quantization Artifacts



Optimizing Digital Captures

You still have to know
how to shoot.

Photoshop is not an excuse
for poor photography.

Camera Shake

1/60 sec



1/5 sec



Shot Crop

Loose?



Tight?



Shot Crop



Shot Crop

Shot Loose



Shot Tight



ISO & Noise



ISO & Noise

ISO 100



ISO 400



ISO & Noise

ISO 100



ISO 800



ISO & Noise

ISO 100



ISO 1600





What Is



The



Best



Exposure?



Digital Captures

Are NOT the same as film.

Digital is a new medium
that requires a new exposure paradigm.

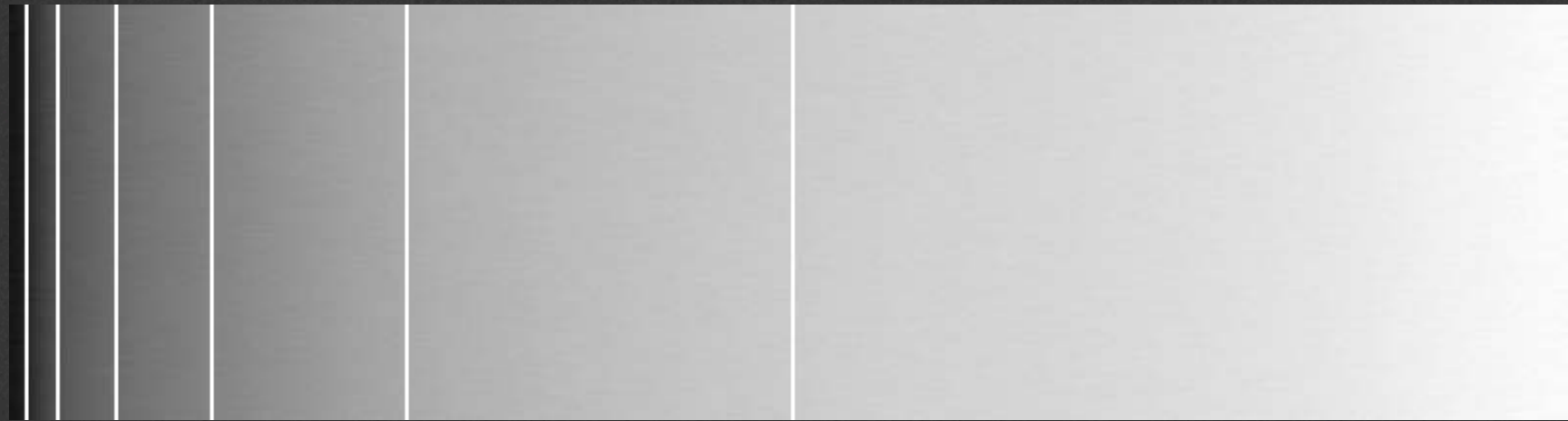
Digital Captures

Digital sensors are linear
recording devices.

Digital Captures

A 12 Bit sensor captures
4096 levels.

The brightest stop contains 1/2 of all the bit
depth a sensor is can record.



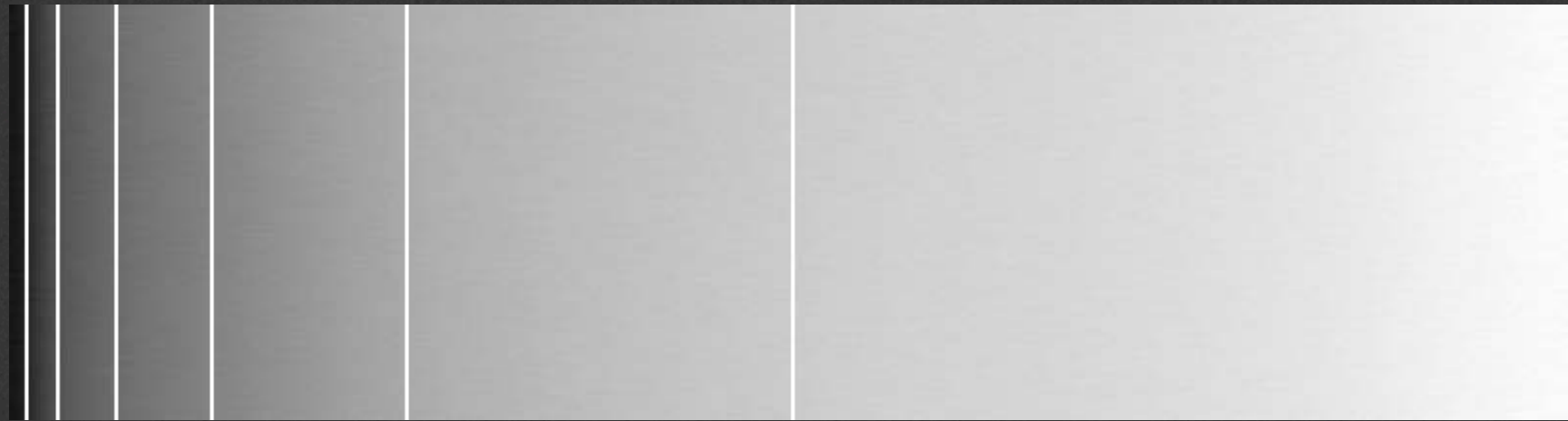
32 levels
64 levels
128 levels
256 levels

512 levels

1024 levels

2048 levels

Underexposing by one stop wastes 1/2 the levels a 12 bit sensor can capture.



32 levels
64 levels
128 levels
256 levels

512 levels

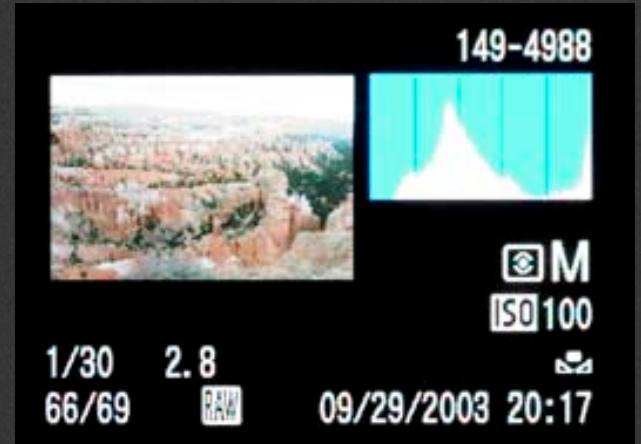
1024 levels

2048 levels

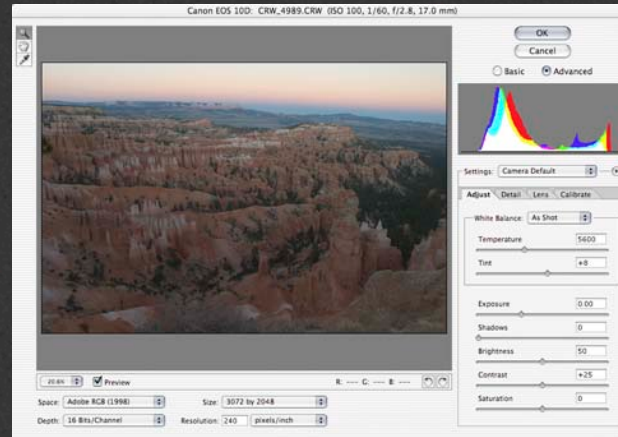
That's the primary reason for lowered signal to noise ratio.

It means noisy images.

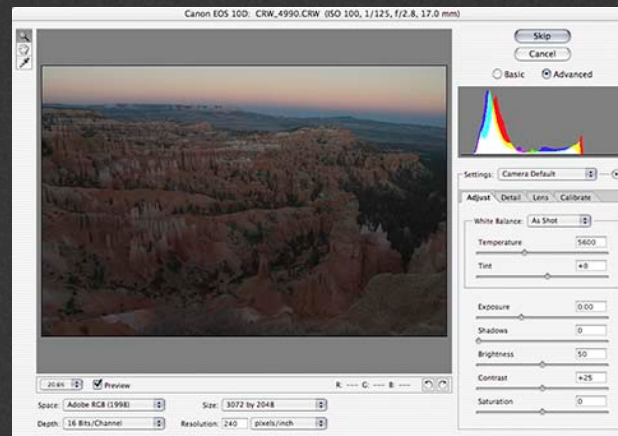
+1?

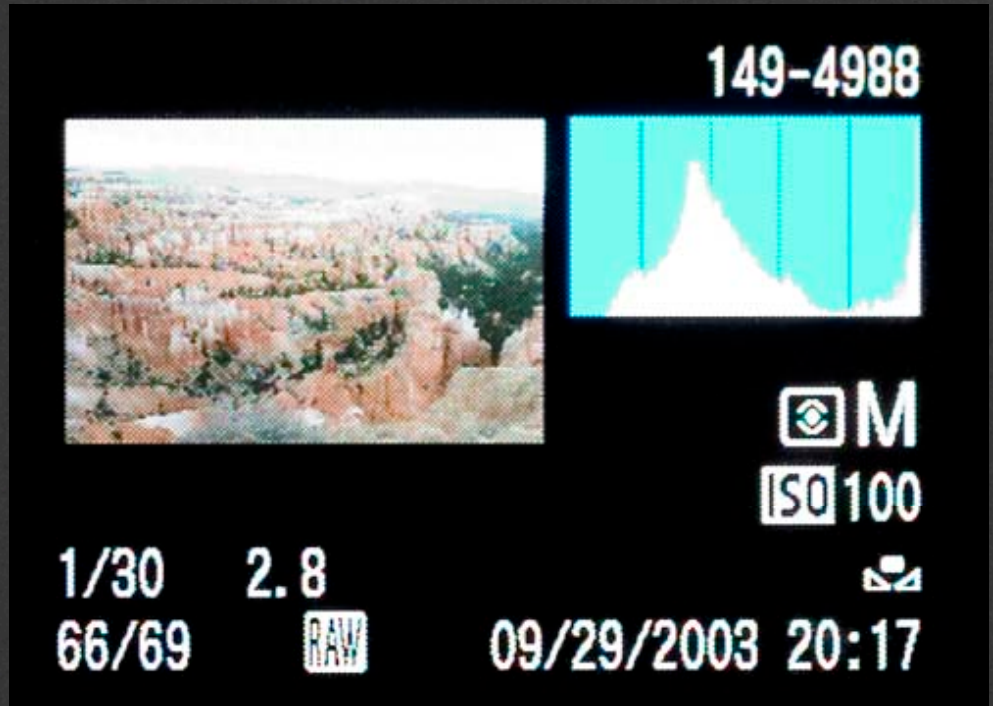
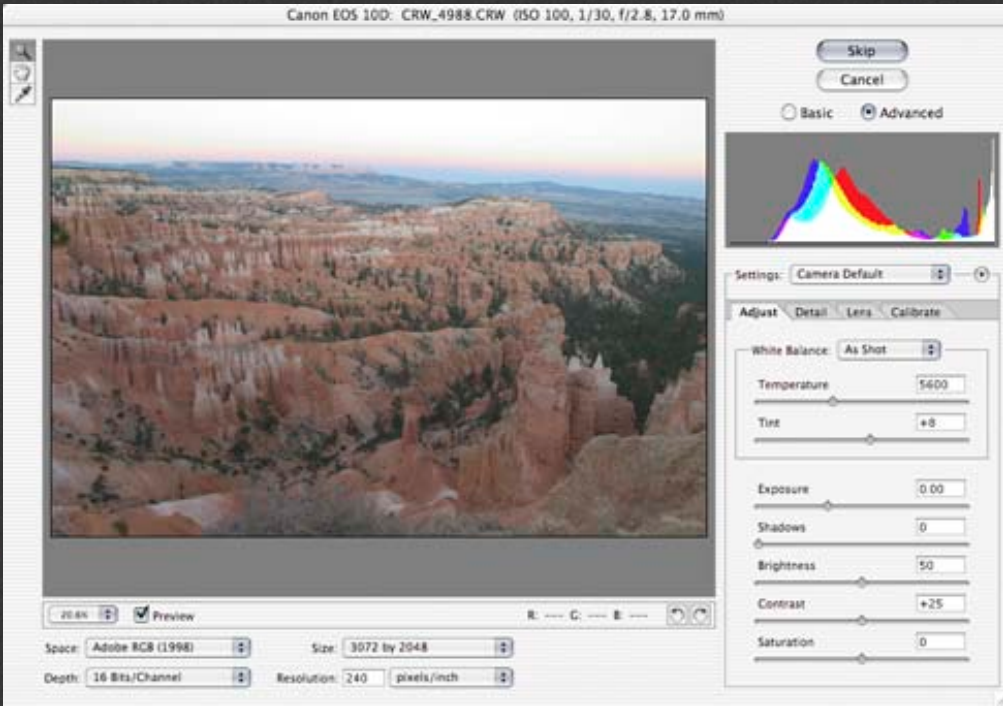


Middle?

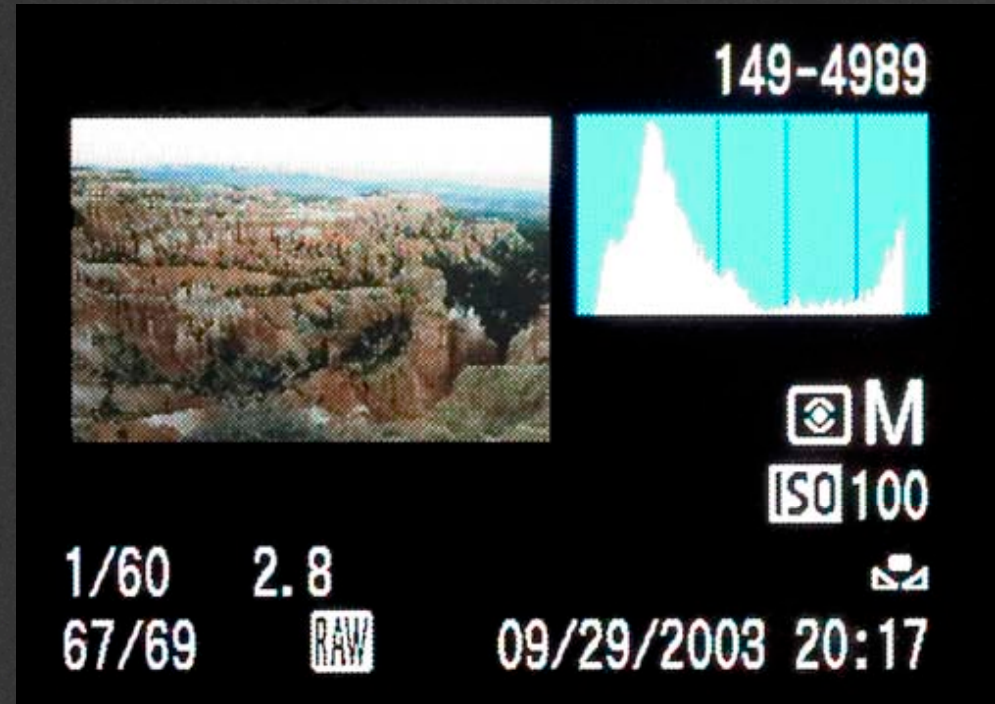
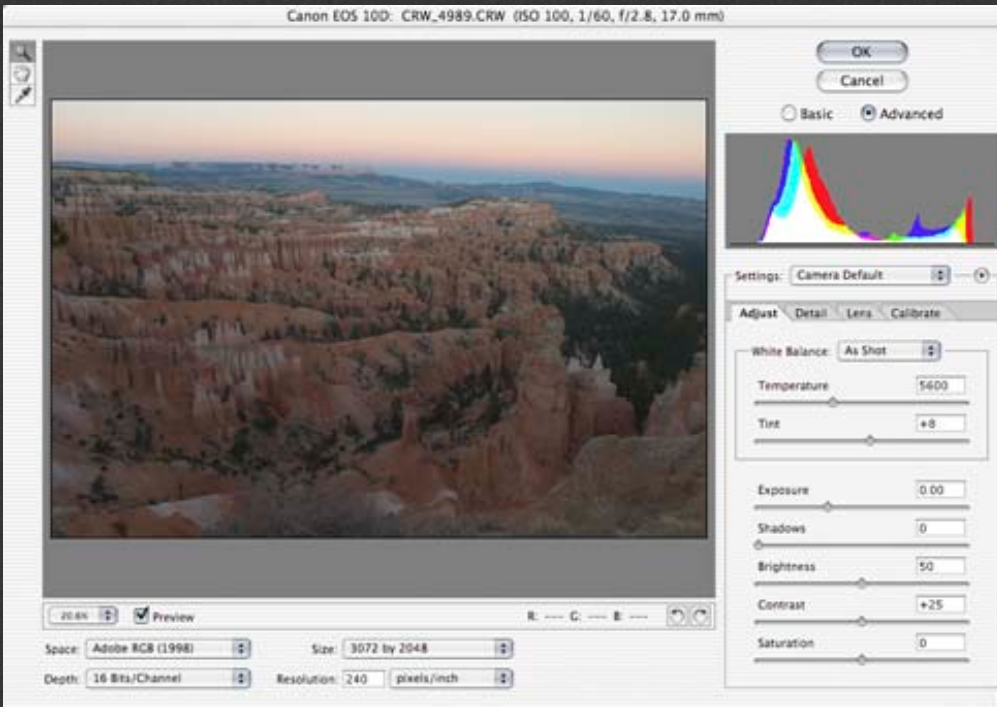


-1?

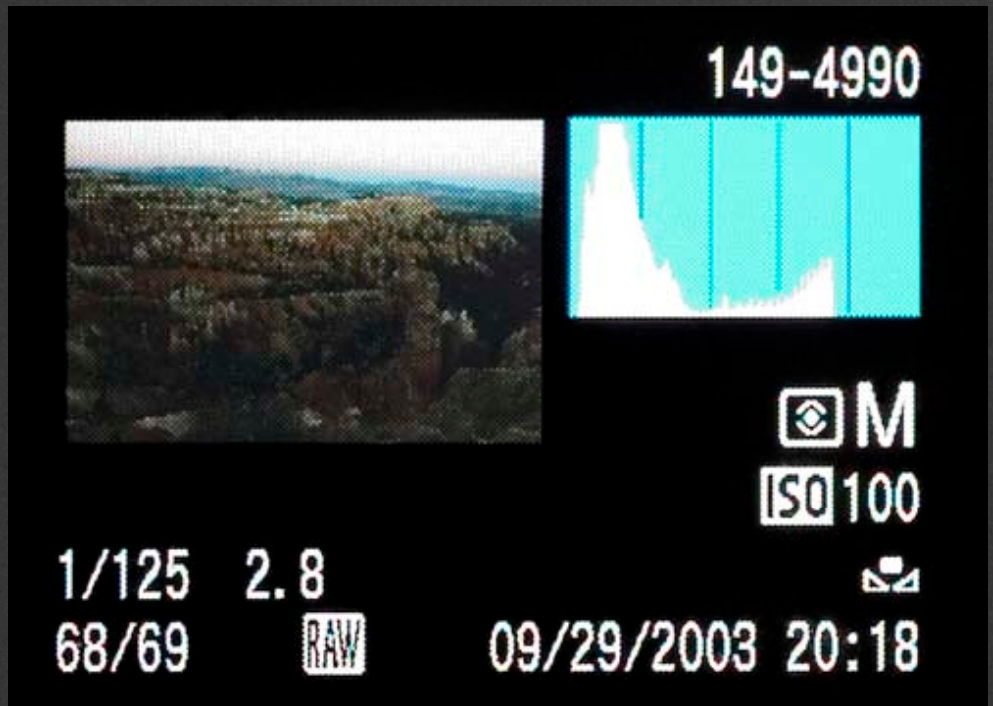
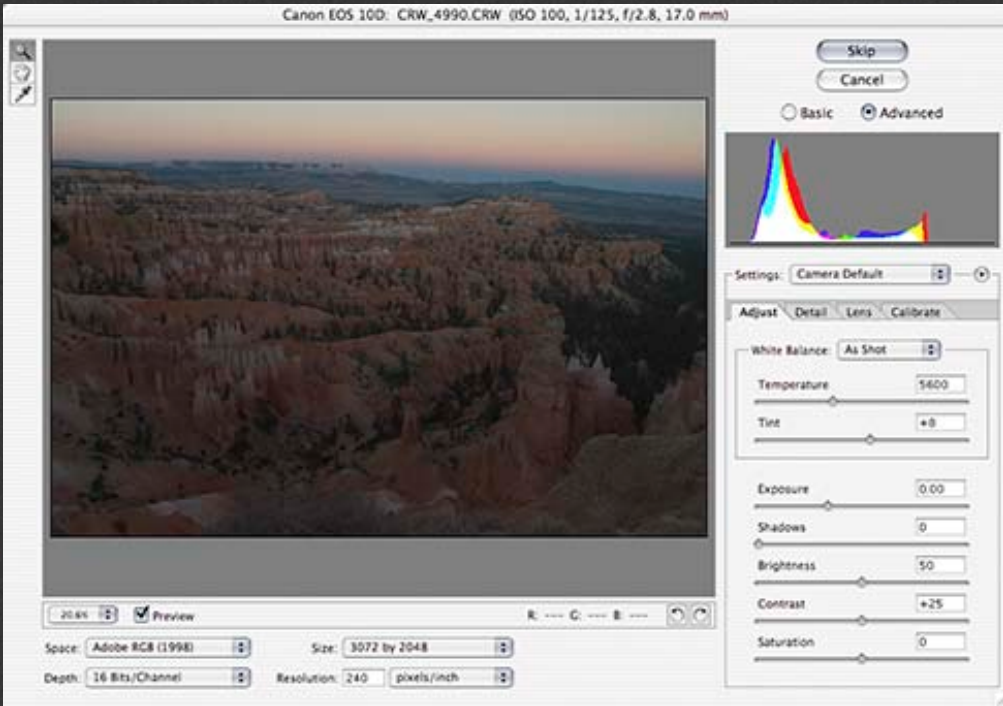




1/30 @ F2.8
Plenty of middle tone,
but highlights in sky are clipped.



1/60 @ F2.8
Middle tone is down ,
but highlights in sky are preserved.



1/125 @ F2.8
All tones are down
To open this exposure will increase
noise a LOT!

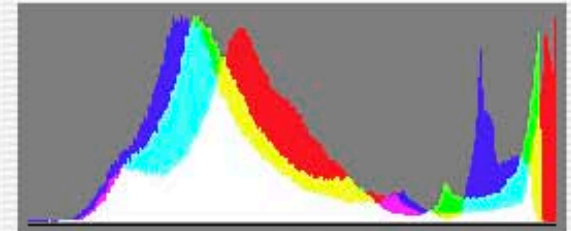


Skip

Cancel

Basic

Advanced



Settings: Custom

Adjust Detail Lens Calibrate

White Balance: As Shot

Temperature 5600

Tint +8

Exposure +0.50

Shadows 6

Brightness 75

Contrast +25

Saturation 0

20.6%

Preview

R: 245 G: 243 B: 233

Space: Adobe RGB (1998)

Size: 3072 by 2048

Depth: 16 Bits/Channel

Resolution: 240 pixels/inch

Exposure correction in Camera Raw



Multi-composite of 2 16 bit exposures.

Image Optimizing



Image Optimizing

Original Image



Image Optimizing

Step Interpolation



Image Optimizing

Luminous Sharpening



Image Optimizing

Adding Grain



Image Optimizing

Original Image



Film vs. Digital

Canon 1Ds and a Canon EOS 1
Same Lenses, same Lighting, Same Shots

Which Will Win?

Film vs. Digital

The Setup:

Canon 1Ds production unit

Canon EOS 1 with the following lenses:

24mm PC

100mm Macro

Film vs. Digital

The Setup:

Balcar Studio Strobes

Mono-pod

Kodak EPP

Capture set at ISO 100

Film scanned in 16 bit on

Imacon 848@ 6700PPI

Digital Captures processed in 16 bit through
CameraRaw beta, courtesy of Adobe Systems

Film vs. Digital

The Setup:

3 still life shots. . .1/3 stop brackets, normal E-6 processing. Film scanned and sized for prints without rez'ing. Minimal sharpening applied. CameraRaw settings, set to "As Shot", camera set to daylight, minimal sharpening and smoothing applied.

Up rez'ing done through Photoshop with multi-pass Bi Cubic at 110%/pass.

Film vs. Digital

The Shots:



Film vs. Digital

The Results?



Film Scan



1Ds Capture



Film Scan @ 100%



1Ds Capture @ 100%



Film Scan



1Ds Capture



Film Scan @ 100%



1Ds Capture @ 100%



Film Scan @ 50%



1Ds Capture @ 50%



Film Scan



1Ds Capture



Film Scan @ 100%



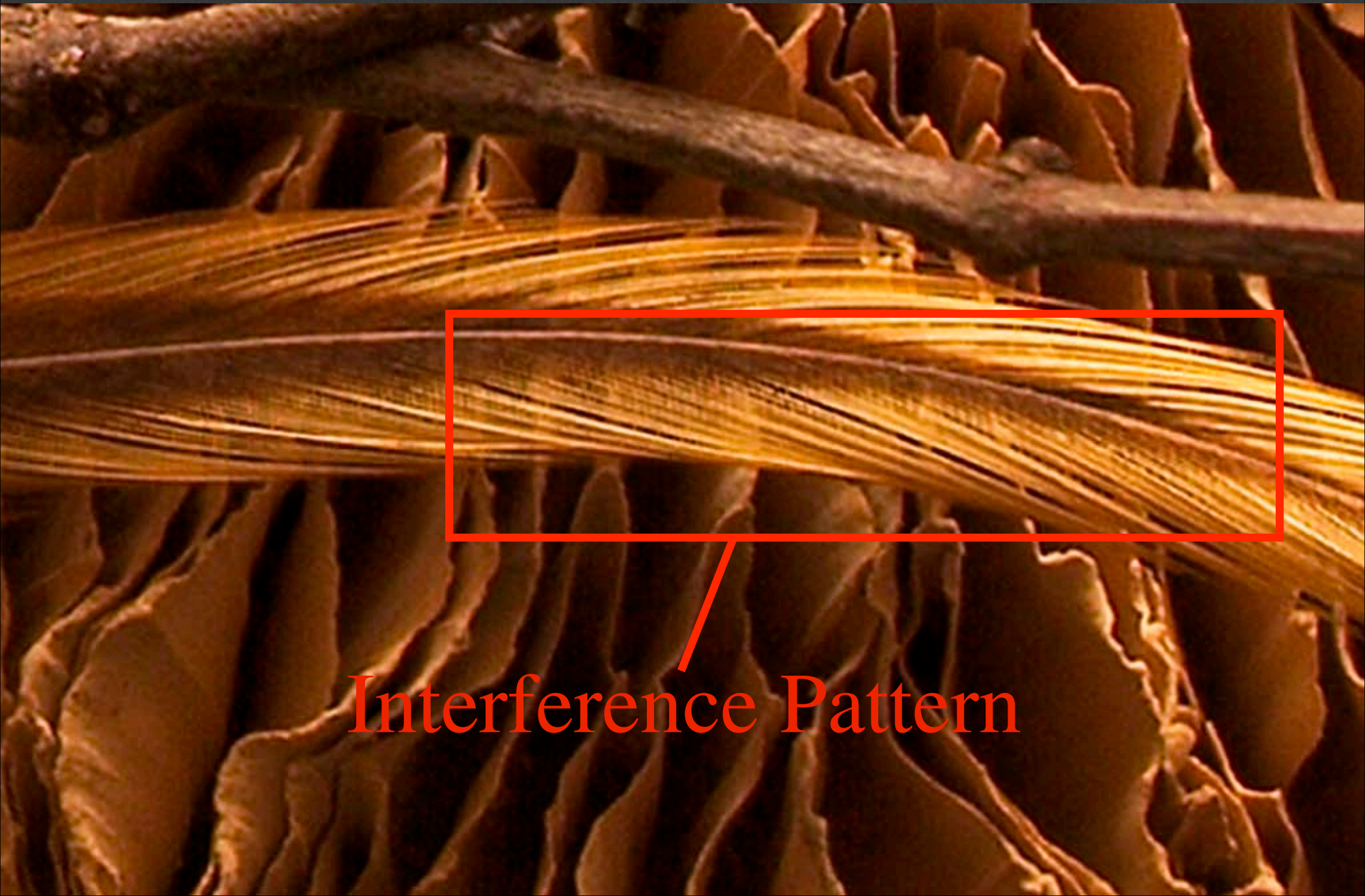
1Ds Capture @ 100%



Film Scan @ 100%



1Ds Capture @ 100%



Interference Pattern

Film Scan @ 50%



1Ds Capture @ 50%



Film vs. Digital

Conclusions...

Film vs. Digital

Conclusions...

Digital Capture with the 1Ds contains significantly more resolution than film. So much resolution in fact that lens design will now have to be carefully evaluated.

Film vs. Digital

Conclusions...

Between Film's grain and
Digital Capture's noise,
Digital Captures produce more acuteness
and greater textural information.

Film vs. Digital

Conclusions...

Digital Capture with the 1Ds contains significantly wider scene luminance range than film. At least one and perhaps up to two stops more than transparency film.

Additionally, processing Raw captures through CameraRaw allows great flexibility.

Film vs. Digital

Conclusions...

Digital Capture with the 1Ds contains significantly more accurate color rendition than film. Additionally, captures contain more textural color information without the tendency to clog up.

Film vs. Digital

Conclusions...

Digital Capture with the 1Ds has more accurate ISO ratings than film.

ISO 100, is indeed 100.

With film, 1/4 to 1/3 more exposure is required. In addition, significant tone & color correction is possible with captures.

Film vs. Digital

Conclusions...

Digital Capture with the 1Ds still can contain an interference pattern between a subjects texture and the chip which can produce a moire pattern. However, this is less likely with higher resolution cameras.

Film vs. Digital

Conclusions...

Digital Capture with the 1Ds allows significantly faster turn around time potential. CameraRaw significantly increases productivity and decreases workflow bottlenecks.

Film vs. Digital

Conclusions...

Resolution: Digital Capture

Scene Luminance Range: Digital Capture

Color Rendition: Digital Capture

ISO Accuracy: Digital Capture

Time To Finished Image: Digital Capture

Film vs. Digital

Digital Capture
Beats
Film.