Colour Management

theory & practice

I said it in Hebrew—I said it in Dutch—
I said it in German and Greek:
But I wholly forgot (and it vexes me much)
That English is what you speak!

-Lewis Carroll, *The Hunting of the Snark*

Consider the problem of analogue

- What difference does film choice make in colour photography? Why one film and not another?
- What about colour papers?
- Different enlargers and printers?
- Viewing conditions, signs of the zodiac, your mood swings?
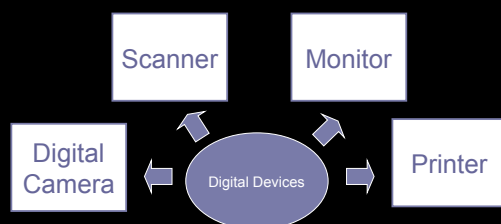- . . . . . and you expect *uniform colour*?

The tv shop scenario

- Same devices = different colours

- Different devices = even more colours

So what about digital photography?

- Different devices record/display colours differently . . . . just like analogue media!

Scanner   Monitor

Digital Camera   Digital Devices   Printer

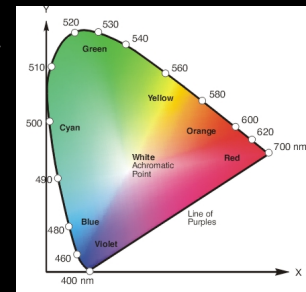## Colour varies from device to device

- Each individual device records or displays colour data differently to the next
- Solution?
  - A common set of standards
- How?
  - A common colour environment <u>independent</u> of any single device
  - A system of information transfer from one digital device to another

Solutions

- Colour environment
  - Colour Space
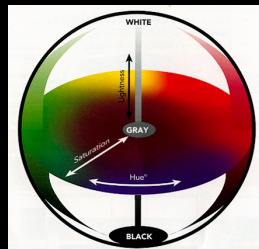- Information transfer
  - Colour Profiles

CIE XYZ and the standard observer

- A model of colour based on human vision
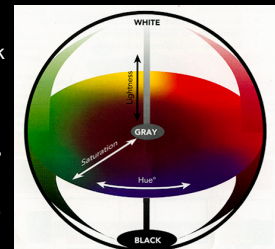
- A map of what is visible to the eye

What is a colour space?

- A three dimensional *representation* of the colours that can be contained, captured or reproduced using a certain colour model
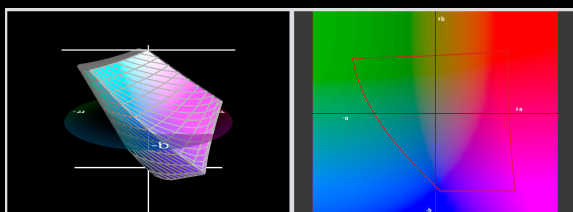

Munsell colour model

- 3D model of colour
  - Poles – White to Black
    - Greyscale, white, greys, black
  - Circumference – Hue
    - Spectral colours - reds, greens, blues . . .
  - Radius – Saturation
    - Purity of colour, lack of greyscale *polution*

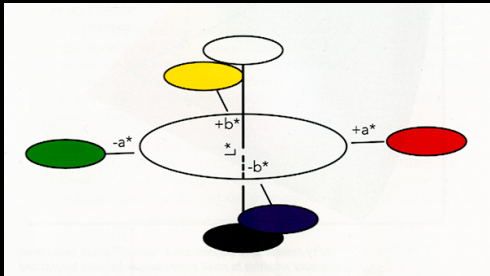## Representation of a colour space –
Adobe RGB(1988)

- 3D model
- 2D model

CIE Lab colour

- Photoshop and Lightroom's reference table
- A colour mapping system
- Triple axis:
  - L axis – vertical axis, tonality black to white (0 to 100)
  - a axis – horizontal axis, colours green to red (-128 to +128)
  - b axis – horizontal axis, colours blue to yellow (-128 to +128)

- No hue can contain <u>both</u> green and red, or blue and yellow, only <u>one</u> from each pair (axis)

Lab colour - the triple axis

Lab Channels

L channel - Luminosity

a channel – Red to Green

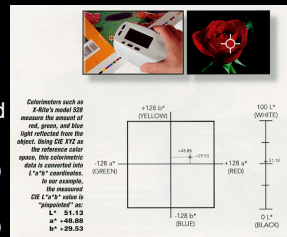b channel – Yellow to Blue

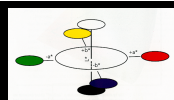## Lab Channels combined

L channel

a + b channels combined

Mapping a colour to Lab

- Each colour has a *map* co-ordinate within the colour space
- A red would be mapped as follows:
  - L 51.13 (black/white axis)
  - a 48.88 (green/red axis)
  - b 29.53 (blue/yellow axis)

Lab numbers (Adobe RGB 1998)

Colour	RGB	Lab
White	255 255 255	100 0 0
Mid Grey	128 128 128	50 0 0
Black	0 0 0	0 0 0
Red	255 0 0	63 90 78
Green	0 255 0	83 -128 87
Blue	0 0 255	30 69 -114
Yellow	255 255 0	98 -16 104
Magenta	255 0 255	68 101 -51
Cyan	0 255 255	86 -83 -22

Colour Spaces

- sRGB – consumer device usage
- Adobe RGB (1998) – photo & repro industry
- ProPhoto RGB – limited, but increased usage

sRGB Colour Space

- Designed for consumer devices and Windows PCs (gamma 2.2)
- A uniform space for monitors, ink jet printers and amateur cameras
- Good for web design
- Not suitable for repro work
- Clips CMYK, deficient in cyan
- If no profile available for an camera or scanner file, assume it to be sRGB
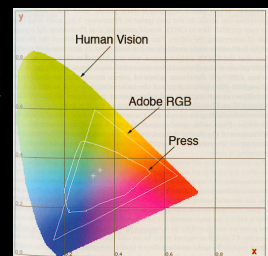
Adobe RGB (1998)

- Large Gamut
- Gamma 2.2 (Mac and Windows)
- Use for any images which will be manipulated
- Use for photo and repro work
- Recommended for conversions from RGB to CMYK
- Standardised workspace for Temple Bar

ProPhoto RGB

- A very large gamut colour space
- Used with high-end digital cameras
- 1.8 gamma encoding
- Lightroom's colour management space
  - 1.00 gamma, since RAW files use Linear Gamma
  - Files can have different colour spaces assigned on export from Lightroom
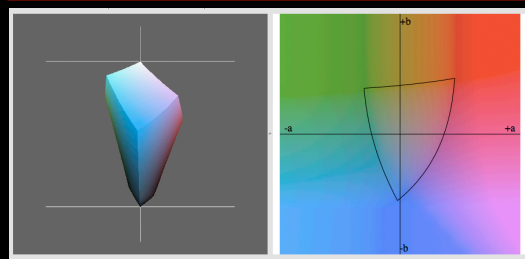
Gamut

- The range of colours that a device or colour space is capable of containing, capturing or reproducing
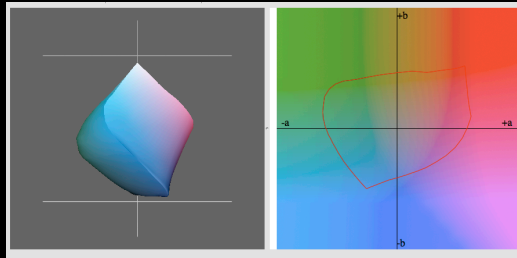

Implications of colour gamut

- It follows, therefore, that all devices/colour spaces will not display all colours equally
- Colours falling within the common gamut of two colour spaces *can* be rendered similarly e.g. camera and monitor
- Colours which are outside the common gamut must be rendered to within the useable colour spaces
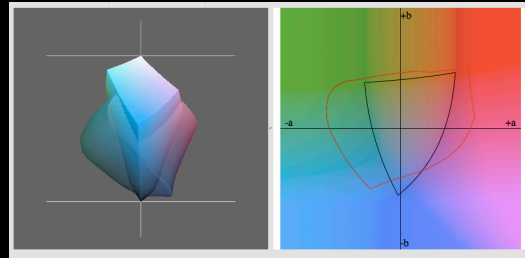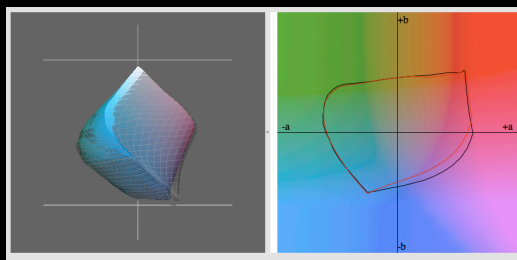
MacBook Pro screen gamut

Permajet Oyster 271 paper

Laptop and paper gamut compared

Permajet Oyster 271 paper printed on 4800 & 4880 printers
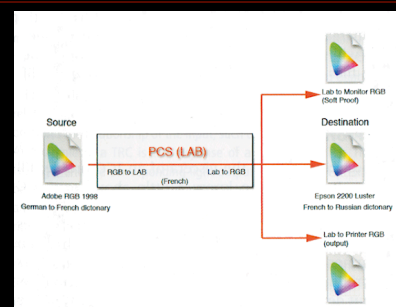

Profiling

- Assessment of a device as to how it delivers colour <u>without any</u> adjustment.
- Creation of a set of adjustments, a profile, which direct the device output as close to *device independent colour* as possible
- Application of that profile to the device within a colour managed environment.
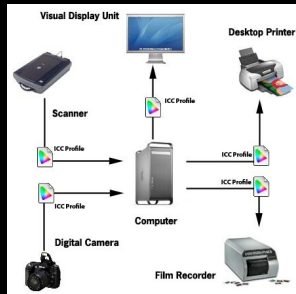
Consider this problem

- You want to translate a text from German to Russian, but ……
  - You don't have a german to russian dictionary
  - You have german to french dictionary, and …
  - You have a french to russian dictionary, so …
- Maybe you could do the following …
  - Translate from german to french, then …
  - Translate from french to russian. QED

Profile Connecting Space
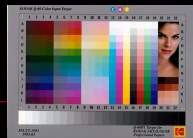
Colour Management Environment

Monitor calibrating & profiling

- Monitors must be (a) calibrated and (b) profiled.
- What is seen on the monitor is a colour corrected preview, <u>not the actual file data</u>.
- The data (the image file) is *device independent colour*.

Scanner profiles

- Scanners can be profiled subject to software using a target
- There is always a default profile
- Imacon scanner allows a choice of multiple profiles for different films types
- Profiles are automatically tagged, attached, to the scanned image files

Camera profiles

- Usage varies depending on circumstances
- Profiles are useful in controlled photographic environments, e.g. studio, advertising, fashion
- A White Balance Grey Card is more useful in external situations, e.g. documentary and landscape
- Use a Gretag Macbeth colour target for camera profiling
- RAW files have colour spaces applied at the processing stage, however camera profiles can also be applied at this stage.
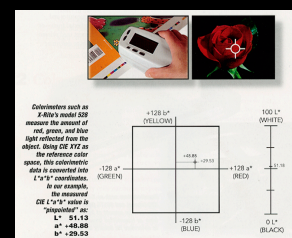
Printer & paper profiling

- Printers and papers profiles should be made in combination
- Tests sheets are printed <u>without any</u> colour management to assess the colour bias of the printer & paper combination

Printer & paper profiling

- The colour samples are read with a colorimeter and compared to the *ideal* (device independent) *colour*
- A profile is then generated which directs the printer how each colour should be printed

Printer & paper profiling

- Therefore each printer model will have its own range of paper profiles unique to it

- A profile applies only when using the <u>same</u> <u>paper</u> with the <u>same settings</u> on the <u>same printer</u> as were used in making the profile

References

- Evening, M (2013) *The Adobe Photoshop Lightroom 5 Book,* Adobe Press
- Evening, M (2013) *Photoshop CC for Photographers*, Focal Press
- Rodney, A (2005) *Colour Management for Photographers*, Focal Press

- http://www.photoshopforphotographers.com/CC_2013/Help_guide/PDFs/colormanage.pdf
- www.digitaldog.net
- www.apple.com/colorsync
- www.adobe.ie
- www.computer-darkroom.com

"To pursue it with forks and hope".

Notes available @
www.fixerstain.com