Light

"Photography is 50% photographer, 40% light, and 10% equipment."

Photography means drawing with light. You don't actually take a picture of something: you record the light emitted or reflected from something. Understanding something of light can greatly improve your photography. This Lesson covers some theory about light, and follows up with some practical advice on how to deal with specific kinds of light.

The most important classification of light in photography is the division between available light and artificial light. Available light is the light that happens to illuminate the scene the photographer wants to photograph: it can be daylight, moonlight, starlight, streetlight, or interior lighting. Artificial light (in this sense) is light that the photographer controls to achieve a specific purpose in the photograph. It can be on-camera or off-camera flash, studio lights, or just any old light hauled up for the photo. A reflector is something in between: a device the photographer uses to modify available light to improve the picture.

For most purposes, available light should be used whenever possible, and artificial light should be made to look as "natural" as possible... unless the photographer has some very specific artistic or aesthetic purpose in mind.

With these things in mind, let's get down to the business at hand. What is light? What characteristics does it have? How does it get to the camera? And what can we do about it?

Characteristics of light

The three most important characteristics of light are brightness, colour, and temperature. Brightness does not need much explanation, but colour and temperature are slightly more subtle concepts.

Light is electromagnetic radiation visible to the human eye. It consists of different wavelengths, which are perceived as different colours. Very long wavelengths are perceived as red, and very short ones as violet. In between are orange, yellow, green, blue, and indigo. Beyond red are infra-red, microwaves, and radio waves; beyond violet, ultra-violet, X-rays, and gamma rays.

Light that has a specific colour is emitted on a narrow band of wavelengths. For example, the yellow sodium streetlights only cover one wavelength - that emitted by excited sodium atoms. The same is true for most coloured light, such as the different-coloured flares used in fireworks, neon signs, Christmas lights, and so on. coloured light can only show up tonality (dark to light) in those colours that reflect the colour of the light. For example, a blue object in sodium light appears completely black: try it out for yourself if you don't believe me. However, a green object also reflects yellow light, so it will not look black - and an object that is exactly the same colour as the sodium lights will look identical to a white object.

White light is a combination of many wavelengths. It can show up tonality in all colours. However, the wavelengths may not be evenly distributed: the light may have a colour cast. For example, normal incandescent interior lighting is heavily weighted towards the orange-red end of the spectrum, and fluorescent light has a green cast. This is where white balancing comes in: it corrects for the distribution
of wavelengths in the available light, and gives objects their "actual" colour. The human eye white-balances automatically - that's why we perceive a white sheet of paper as white even when it's lit by orange incandescent light... but if we photograph it in daylight white balance, the photo will appear orange. (Or vice versa: if we take a picture of a white sheet of paper in daylight using incandescent white balance, it will appear blue.)

The colour cast of white light can be unambiguously expressed as a temperature, usually in the Kelvin scale. It is a physical fact that if you heat an object to a given temperature, it will emit light with a certain colour cast, no matter what material the object is made of. However, this light is still "white" in the sense that it contains light of all wavelengths: therefore, it can reveal tonalities in all colours, and it is possible to correct for the colour cast by white balancing.

In a nutshell: you can white balance to correct colour casts in white light, but not for coloured light. There is no way of getting natural-looking colour in a scene lit by sodium streetlights: there simply aren't any blue or green photons to carry the information.

Light sources

Light always starts on its journey from a light source. Light sources can be usefully classified into three types: direct or point-like, diffuse, and ambient. Each type of light source gives a picture specific characteristics. The fabled "good light" largely means a balanced mixture of the three.

Direct (point-like)

Direct light is emitted by a small, bright, and point-like source, and shines directly onto the subject. Some important point-like sources are the sun, a flash gun, and some forms of interior lighting. Direct light causes sharply defined, deep shadows and flattens out three-dimensional detail. A cylinder bathed in direct light will look very similar to a box next to it: the line dividing light and dark is sharp, and there's little or no gradation from fully lit to fully shadowed. Multiple point-like sources cast multiple shadows and result in multiple zones of varying darkness.

Diffuse

Diffuse light emanates from a large light-emitting or light-reflecting surface. It causes soft shadows and an even gradation from light to dark, emphasizing three-dimensionality and shape. A cylinder in diffuse light looks clearly cylindrical, with the fully shadowed areas completely black, the side directly facing the light source completely white, and the in-between areas shades of gray. The size and softness of the shadows depend on the size and distance of the light source: a diffuse light source that is very far away turns into a point-like light source.

Ambient

Ambient light is usually something of a theoretical concept: the sum of all the light that gets reflected around the scene. For example, there is always some light in the shadows even on the clearest day, due to reflection from surrounding objects. Ambient light casts no shadows; instead, it fills them in. A cylinder illuminated purely by ambient light (you would have to place it inside a milky-white sphere lit evenly from the outside) would appear completely featureless and flat - and so would a cube.

How does light get to the camera?

There are any number of things that can happen to light between the point where it is emitted and when it is absorbed by the film or the sensor. Three of the most important ones are through direct radiation, through reflection, and through scattering.
Direct light makes its way onto the film straight from the emitter. This happens when the light source is actually in the frame: the sun, moon, stars, a lamp, a fire, a candle... If the emitter is bright and point-like, this can lead to problems: it can throw the auto-exposure system out of whack (as the point-like light causes it to underexpose the rest of the picture) or it can cause lens flare (non-image-forming light bouncing around inside the lens and causing blotches, circles, or polygonal shapes). Therefore it's usually better to leave any bright light sources well out of the frame.

Most of the image-forming light is reflected off the scene. Specular or mirror-like reflections act like direct light, posing the same problems with metering and lens flare. Most objects reflect light diffusely. Such objects can also act like diffuse light sources. The photographer may even wish to manipulate objects to act as reflectors and produce more pleasant lighting.

Sometimes light gets scattered on the way towards the camera. This happens when it passes through a medium that contains particles: dust, steam, fog, or smoke, for example. Scattered light mostly appears as haze. This can be desirable or undesirable: haze or fog can make for very unusual and interesting lighting, or it may make pictures look murky and lacking in contrast.

**Different circumstances, different results**

Dealing with different levels of brightness is easy, in principle: just change the exposure value by changing the aperture or shutter speed. In practice, there is an entire art to exposure, with principles, philosophies, and methods, such as Ansel Adams's famous Zone System. In any case it is a topic that's way too complex to tackle here. We will simply note that modern auto-exposure systems handle different levels of light very well, down to a certain point, under which manual metering or experimentation becomes necessary.

**To white balance or not to white balance?**

Colour temperatures are even more complex. In principle, the situation is simple, especially with digital photography: just white balance for the temperature of the ambient light.

In practice, this is a creative as much as a technical decision. White balancing a sunset "correctly" will lead to a very unnatural scene. White balancing a portrait taking during the "magic hour" before sunset or after sunrise will render skin tones correctly... but many people prefer the warm cast the light gives. And, for example, a journalistic photo of a drug addict shooting up in a fluorescent-lit toilet will probably be
much more effective if the sickly green cast of the lighting is rendered as it is, rather than correcting for it and giving the junkie's skin a healthy, ruddy glow.

There are some situations where white balancing (or not) is a natural decision, unless the photographer has some very specific idea in mind. If daylight white balance is the "standard," you should change it for:

- Indoor shots in artificial light (fluorescent or incandescent)
- Portraits (usually)
- Mixed lighting (manually and with great care; bracketing might be a good idea too)

But you should probably leave it as it is for:

- Night landscapes
- Sunsets and sunrises
- Flash photography

Techniques for dealing with varying lighting

Lighting conditions can be classified according to the dominant type of light: direct, diffuse, or ambient.
Each poses its own challenges and has its own opportunities, and demands different approaches from the photographer.

**Direct light dominates**

One of the most difficult lighting situations is when direct light dominates. The typical example is a clear, sunny day. Shadows are sharp and deep, the scene often has too much dynamic range (difference between the darkest and the brightest areas) to be captured without either blowing out the highlights or losing the shadows, and three-dimensional shapes tend to get flattened into paper cutouts. The main challenge is to deal with the dynamic range, though. Three strategies that can work in direct light include:

1. **Backlight.**

   Put your subject between you and the light, and expose for the shadows. The light will outline the subject, and even if the outline gets blown, it won't matter very much. The ambient light will fill in the shadows, and the outline will give it contrast and liveliness. In addition, if your subject is a person, their expression will be more natural from not squinting at the bright light source.

2. **Reflector.**

   Position your subject near a white or neutral gray object lit by the light source. This will work as a diffuse light, giving three-dimensionality and generally much more pleasant lighting. If you have one, use a movable reflector, such as a big white chunk of styrofoam.
3. *Fill-in flash.*

Use your camera’s flash (built-in or separate) directly on the subject. This will decrease contrast and make for a better tonal balance, although the picture will still look flat and rather two-dimensional.
In addition, black and white negative film is a good choice for sunny days: it has up to fifteen stops of dynamic range, which is enough for almost any lighting situation.

Ambient light dominates

A typical situation where ambient light dominates is an evenly overcast day. Shadows are not readily apparent and objects appear somewhat two-dimensional. This light is technically easy, as there is little contrast: the camera's auto-exposure system will get the exposure on the nose every time. However, the pictures will easily turn out boring and flat-looking.

The trick to taking good pictures in ambient-light situations is to find things that stand out in spite of the light rather than because of it. Instead of trying to bring down contrast, you should find subjects that have more of it. Look for objects with bold color or shape, or deeply shadowed areas such as gateways or windows - this way, you can turn the ambient light into a diffuse light source, which is usually much more
interesting.

Diffuse light dominates

Diffuse light is "good light." Contrast levels are manageable, the light brings out three-dimensionality, and the pictures have a very pleasant, soft quality. A photographer usually actively seeks out diffuse light: the famous "magic hour" before sunset or after sunrise is just such a situation - the sunlit horizon acts as a huge diffuse light source, with a lovely, warm color cast to boot. Diffuse light is at its best coming from an angle to the subject: neither fully backlit nor front-lit. Carefully engineered light is usually dominantly diffuse: when you see a studio scene, over nine times out of ten, it is carefully lit with diffuse light, possibly from multiple sources.

Scattered light

Light scattered by dust, raindrops, fog, clouds, haze, or smoke is something of a special case. Sometimes it is undesirable, such as for a high-altitude landscape. Haze makes it look murky and flat. UV filters and especially polarizers can help cut through haze and make the scene clearer. However, more often it's better to make a virtue out of a weakness and actively seek to exploit scattered light. It can show up light beams, create a wonderful sense of distance and depth, and create a great deal of atmosphere. Don't try to take a picture through the fog or the haze: take a picture of the light flowing through the fog or haze.
Conclusion

Photographers spend much of their time chasing after the proverbial "good light." Architecture and landscape photographer are particularly enthusiastic about it; portrait and fashion photographers often make their own... and situational photographers and photojournalists make do with what they have, filling in with a flash where absolutely necessary. What, then, is "good light?"

A part of the answer was already given above: diffuse but directional light is "good light": it shows up three-dimensionality and brings down contrast to a manageable level. However, it is certainly not the "best light": light is as varied as scenery, and many kinds of light can be "good" for it. Usually it involves dominant diffuse light with enough direct light to add zing to an otherwise over-soft scene: eyelights for portraits, oblique, late afternoon sunlight to bring out texture in architecture shots or long shadows in landscapes... There are as many kinds of "good light" as there are scenes and photographers.

It is much easier to define what is "bad light," which means that anything else is "good." Direct sunlight or flat ambient light such as on an overcast but hazeless and rainless day are "bad" - they do not add anything much to the scene, and can even make the photographer's light rather difficult.
Good photos can be had even in "bad" light - but this is more in despite of the light than because of it. Don't let "bad" light stop you from taking an otherwise interesting photo... but consider returning to the scene in "better" light. Be alert if you see unusual lighting conditions: sun peeking through the clouds or shining through fog or rain, sunrises or sunsets, light pouring into a room through a curtained window, a night scene with moonlight, starlight, or city light, a scene lit by a whitewashed wall reflecting sunlight into it. Keep your eyes open and have your camera ready so you can seize it where you see it... and consider getting up really early one morning, and seeing how your neighborhood looks just before and after dawn.

And remember: rainy days make for unusual lighting conditions, and interesting pictures.

**Assignments**

1. Shoot a scene in your neighborhood under unusual lighting - fog, rain, dusk, dawn, nighttime: bright sunlight or flat overcast do not qualify. Try to match the scene with the lighting. Discuss your choices.

2. Shoot a scene in your neighborhood with bad light - on a clear, sunny day or overcast, rainless and fogless day. Use a specific technique to deal with the bad light - one of the ones discussed in this Lesson, or some other technique. Discuss the conditions and the techniques you used to deal with them.

3. Make your own light: shoot an interior scene where you've manipulated the light to create a specific effect. Discuss what you wanted to achieve and how you achieved it.

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