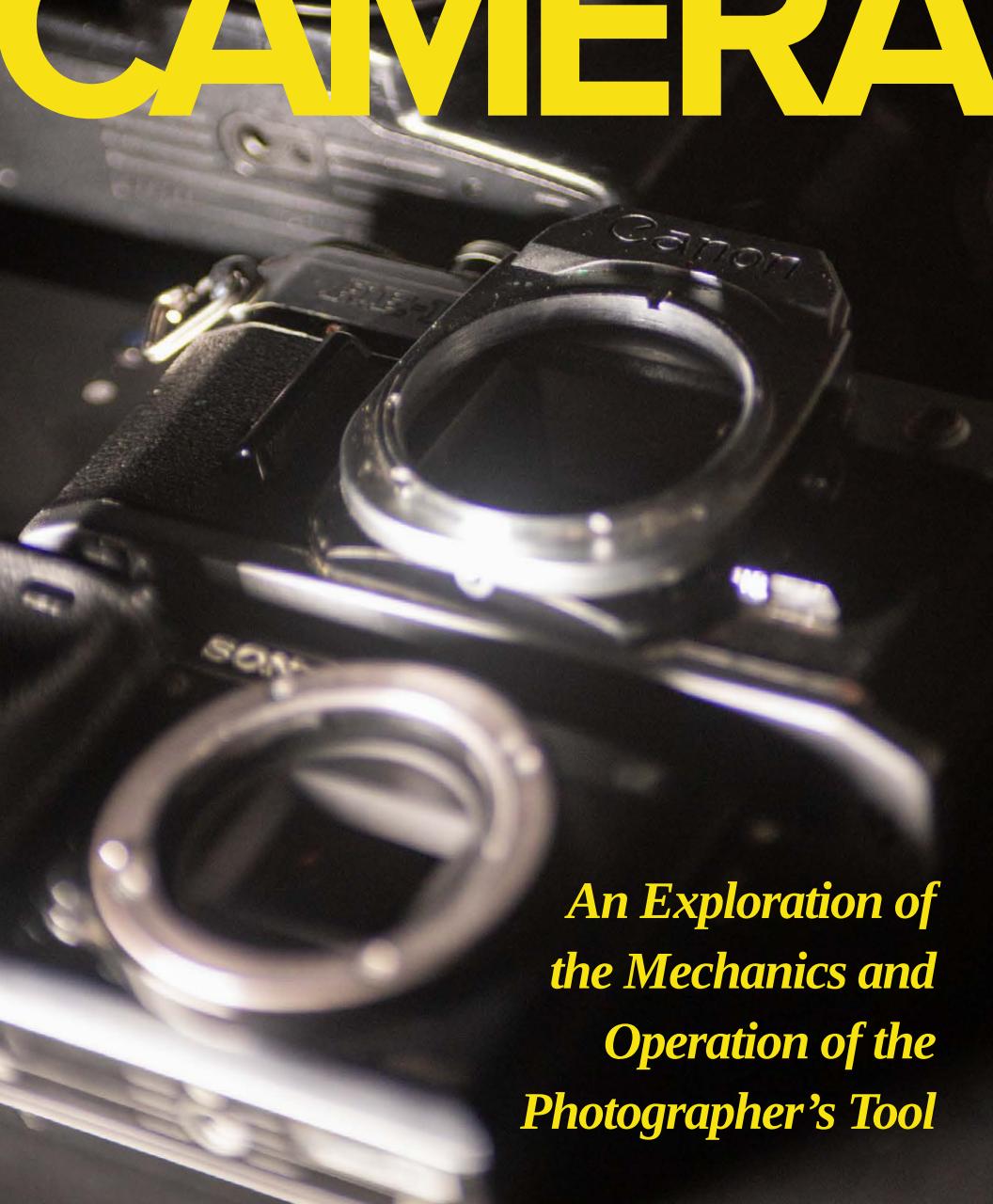


# ANATOMY of the CAMERA



*An Exploration of  
the Mechanics and  
Operation of the  
Photographer's Tool*



# Anatomy of the Camera

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Justin Kresse

# Photography 101

In the brief contents of this publication, it is my intent to describe everything a photographer should know about their camera – arguably the most important tool of their practice. Starting with a brief introduction to the exposure triangle of aperture, shutter speed, and ISO, I will then move on to the different types of cameras, formats of camera sensors, and finally the camera lens. To become a better photographer, it is crucial to understand your tool, and practice is the easiest way to gain that understanding. Keep in mind that a photographer's gear usually does not affect their ability to capture their intended photo, but understanding more about your gear can give you a better understanding of how to work around your tools' limitations or at least let you know when a scenario arises where you might need different gear.

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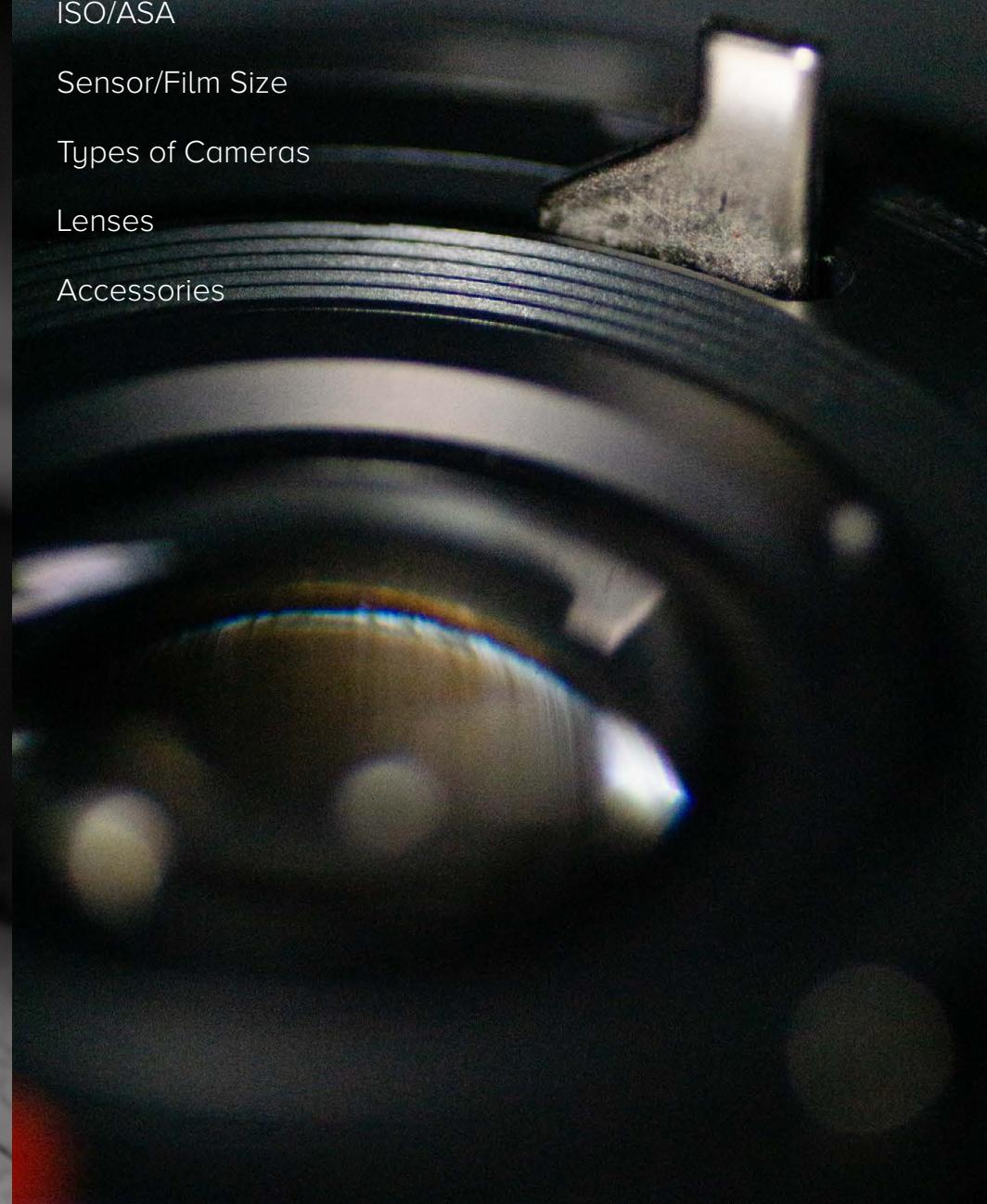
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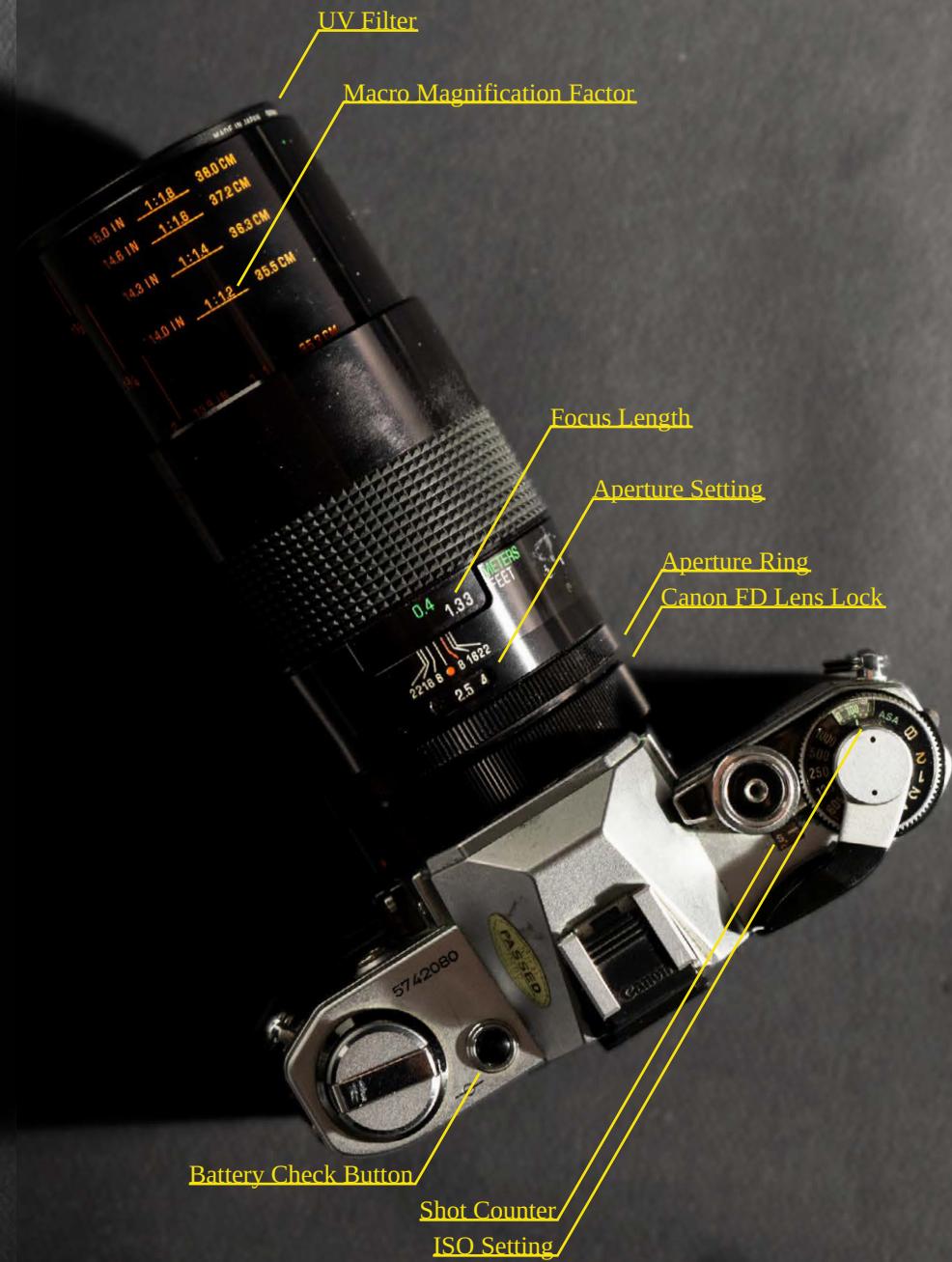
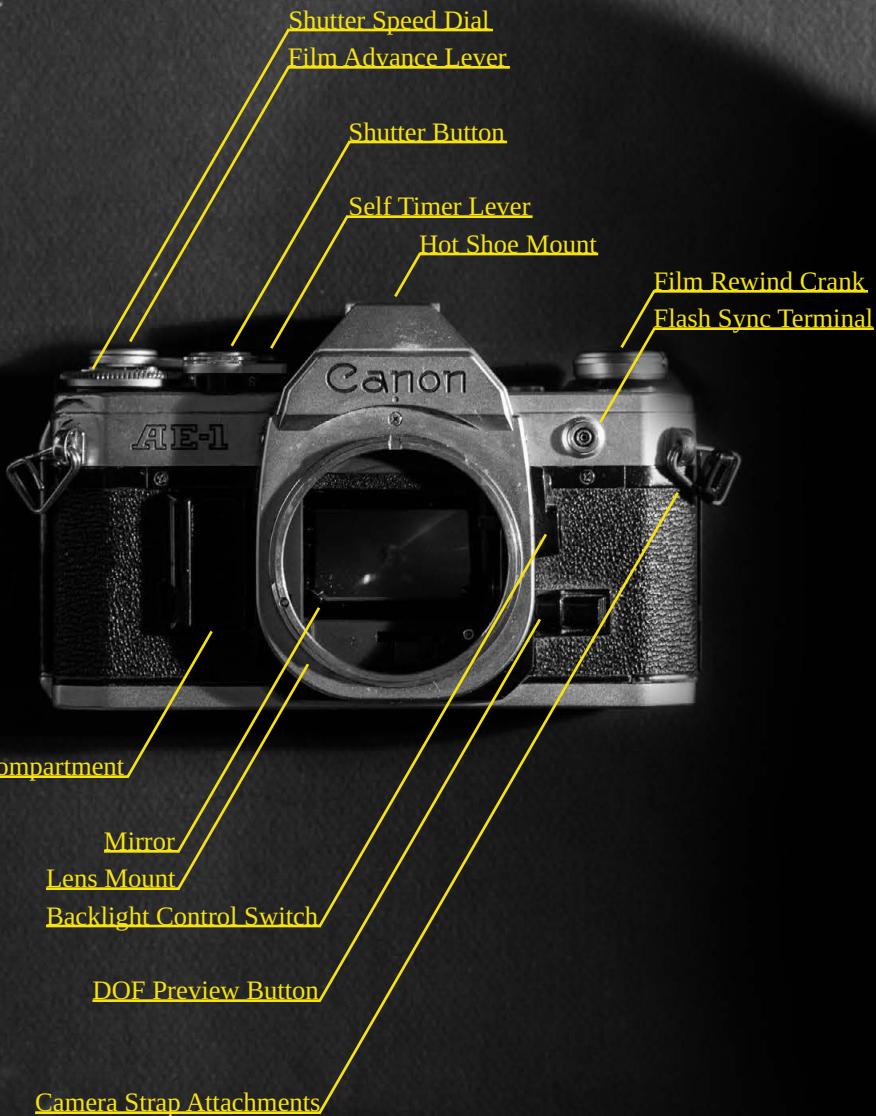
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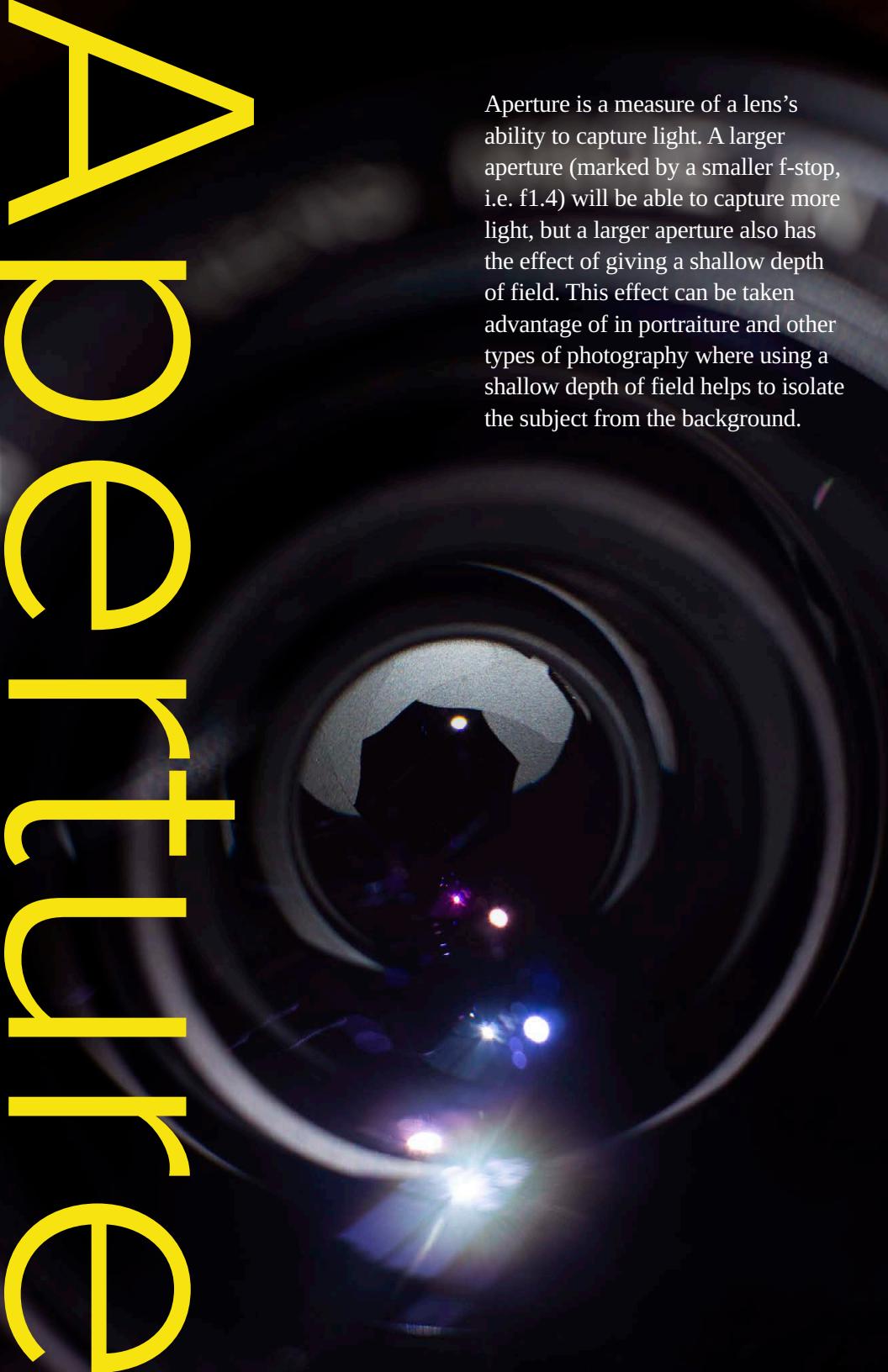
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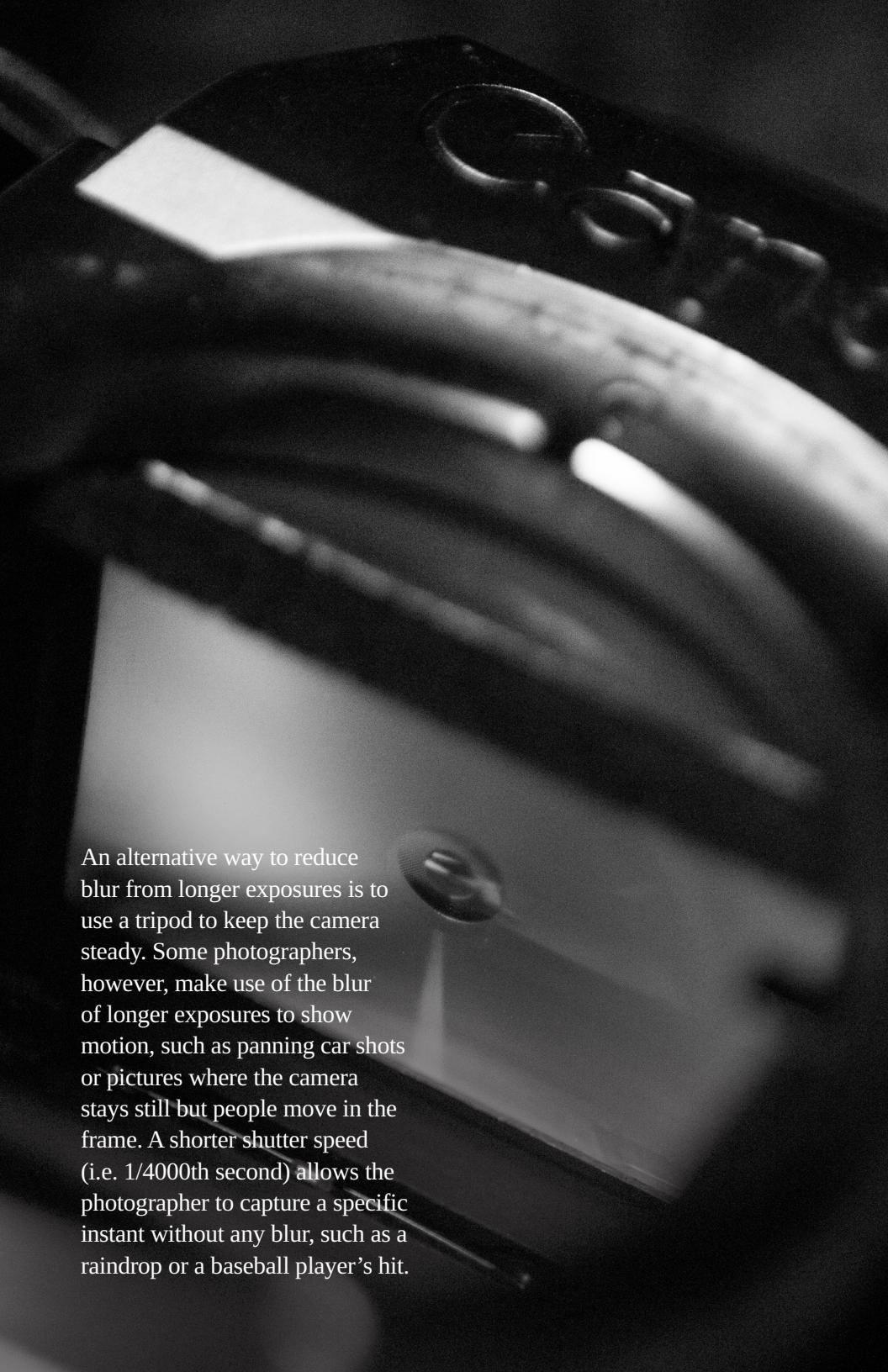
Aperture is a measure of a lens's ability to capture light. A larger aperture (marked by a smaller f-stop, i.e. f1.4) will be able to capture more light, but a larger aperture also has the effect of giving a shallow depth of field. This effect can be taken advantage of in portraiture and other types of photography where using a shallow depth of field helps to isolate the subject from the background.

Inversely, a photographer looking to get both the subject and objects in the background or foreground in focus should use a narrower aperture (marked by a bigger f-stop, i.e. f8). This will of course also allow less light into the camera, so the photographer may have to compensate by changing shutter speed or ISO – or they might be able to artificially change the lighting of the scene. Older and/or lower-quality lenses sometimes have chromatic aberration which can be especially prominent when the aperture is wide open. To reduce the effects of CA, a photographer can stop the lens down to a narrower aperture.

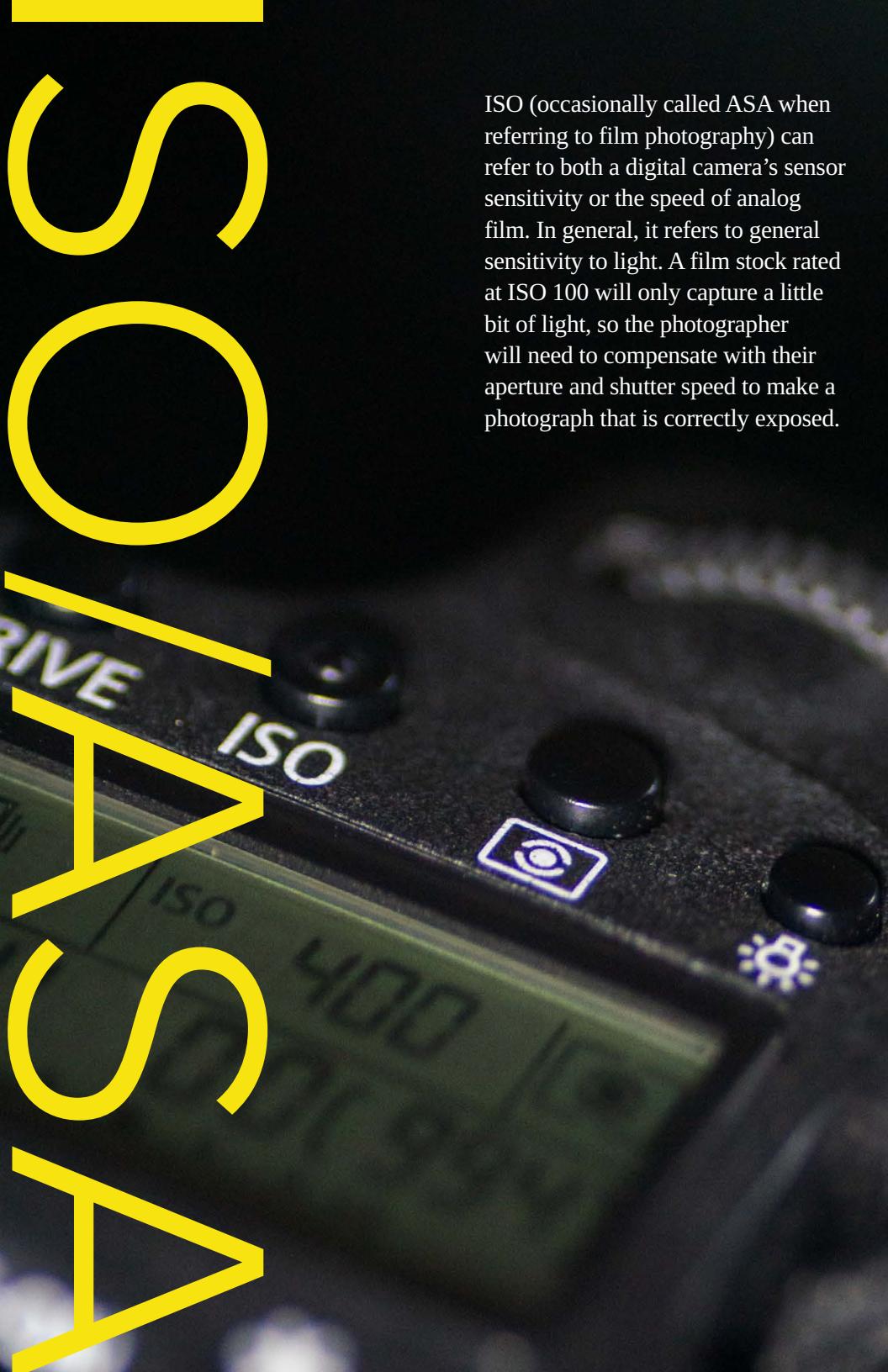
Each lens you buy has a different minimum aperture value, so some lenses can open wider than others and let in more light.

# Shutter Speed

Shutter Speed measures how long a camera's sensor or film negative is exposed to light. It references the shutter mechanism inside the camera that acts as a curtain, opening and closing to expose the image to light. A longer shutter speed (i.e. 1/5th second) will allow the camera to capture more light, but can result in a blurry image if the camera or subject moves during the time the shutter is open. When shooting hand-held, it is recommended to use a shutter speed no slower than one over the lens's focal length.



An alternative way to reduce blur from longer exposures is to use a tripod to keep the camera steady. Some photographers, however, make use of the blur of longer exposures to show motion, such as panning car shots or pictures where the camera stays still but people move in the frame. A shorter shutter speed (i.e. 1/4000th second) allows the photographer to capture a specific instant without any blur, such as a raindrop or a baseball player's hit.



ISO (occasionally called ASA when referring to film photography) can refer to both a digital camera's sensor sensitivity or the speed of analog film. In general, it refers to general sensitivity to light. A film stock rated at ISO 100 will only capture a little bit of light, so the photographer will need to compensate with their aperture and shutter speed to make a photograph that is correctly exposed.

Digital cameras use the same ISO numbers as film, so a photographer could take a digital camera set at ISO 100 with the same aperture and shutter speed and get a very similarly-exposed picture when using those same settings on a film camera with a 100 ISO film. If, however, the photographer chose an ISO setting of 800, the camera would take in more light, so a faster shutter speed or a narrower f-stop could be used to compensate.



One side effect of using a higher ISO speed is an added grain to photos. Especially with film photography, ISO stocks that are rated at 800 or 1600 will usually be quite grainy. With digital cameras, it varies depending on how new a camera is and what noise-reduction the camera applies, but in general, higher ISO settings will come at the cost of more grain and therefore less detail. Also, modern digital cameras have ISO options that go much higher than film stocks, sometimes going up to 102,400 (film stocks only go up to ISO 3200).

# SEN S O U E N I Z I S E



There are digital cameras available with different sensor sizes depending on their application, and there are different film cameras that accept different-sized film. For digital cameras, the most popular sensor size available in entry-level cameras by companies like Canon is called APS-C and is 22.3mm x 14.9mm. However, many professional digital cameras use what is called a full-frame sensor (36mm x 24mm), which is made to be the same size as 35mm film.



The advantages to a bigger sensor are that it lets in a little bit more light and gives a more shallow depth of field. However, cameras with bigger sensors often require bigger and more expensive lenses. When switching between cameras with different sensor sizes, photographers can use the crop factor of each camera to determine their desired focal length and aperture. For instance, a 50mm f1.8 lens on a full-frame camera would end up acting like an 80mm f2.8 lens on a Canon APS-C camera because the crop factor of Canon's APS-C cameras are 1.6 compared to full frame. Film uses the same concept but the most common formats for film are 35mm and 120. 35mm is the same size as full frame, but 120 film is actually larger, so it has a crop factor of 0.62. The most common digital sensor sizes are medium format, full frame, APS-C, and Micro-Four-Thirds.

# Types of cameras

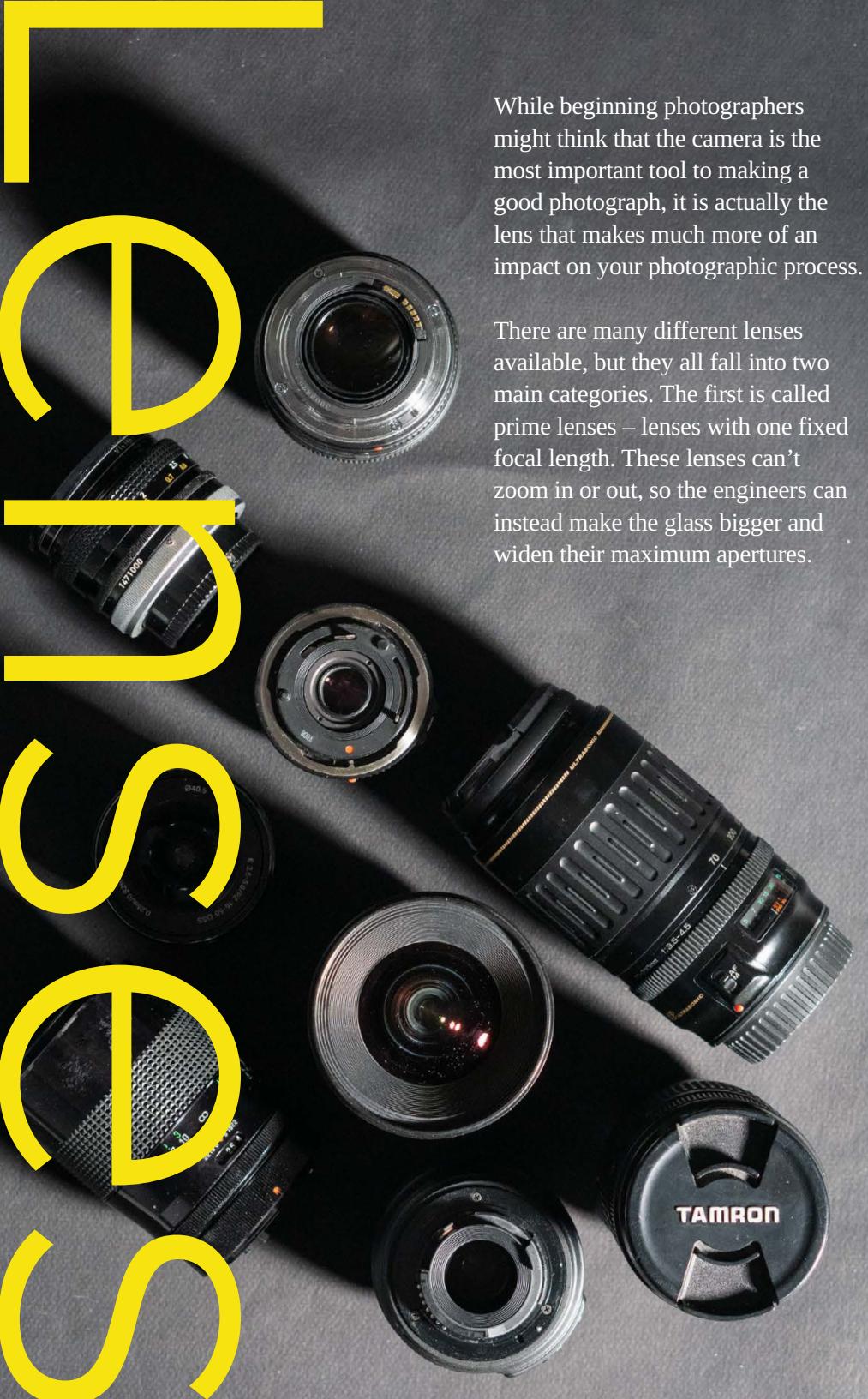
There are essentially 3 different types of cameras. The first and most common is SLR's, or single-lens reflex cameras. These devices use a mirror system to let the photographer preview their shot in a viewfinder before exposing the film or digital sensor. They allow real-time viewing through the lens to get an accurate view of the composition, but their viewfinders can be hard to see through in low-light conditions or when using the depth-of-field preview.

For film cameras, there is another type of camera called a rangefinder, which – instead of using mirrors to let you look through the lens – uses a secondary viewfinder that gives you a general idea of the composition but is not exact. Focussing can also be more difficult with rangefinders, though some have mechanisms to measure focus. Rangefinders' main advantage is that they can be lighter and smaller because they don't need room for the mirror inside.

In terms of digital cameras, the SLR camera was common for digital as well for a long time, but it has more recently been superseded by mirrorless cameras, which ditch the mirror in favor of a digital viewfinder. This fixes the problems of the SLR because the digital viewfinder can increase the exposure to make a preview more visible in the viewfinder.

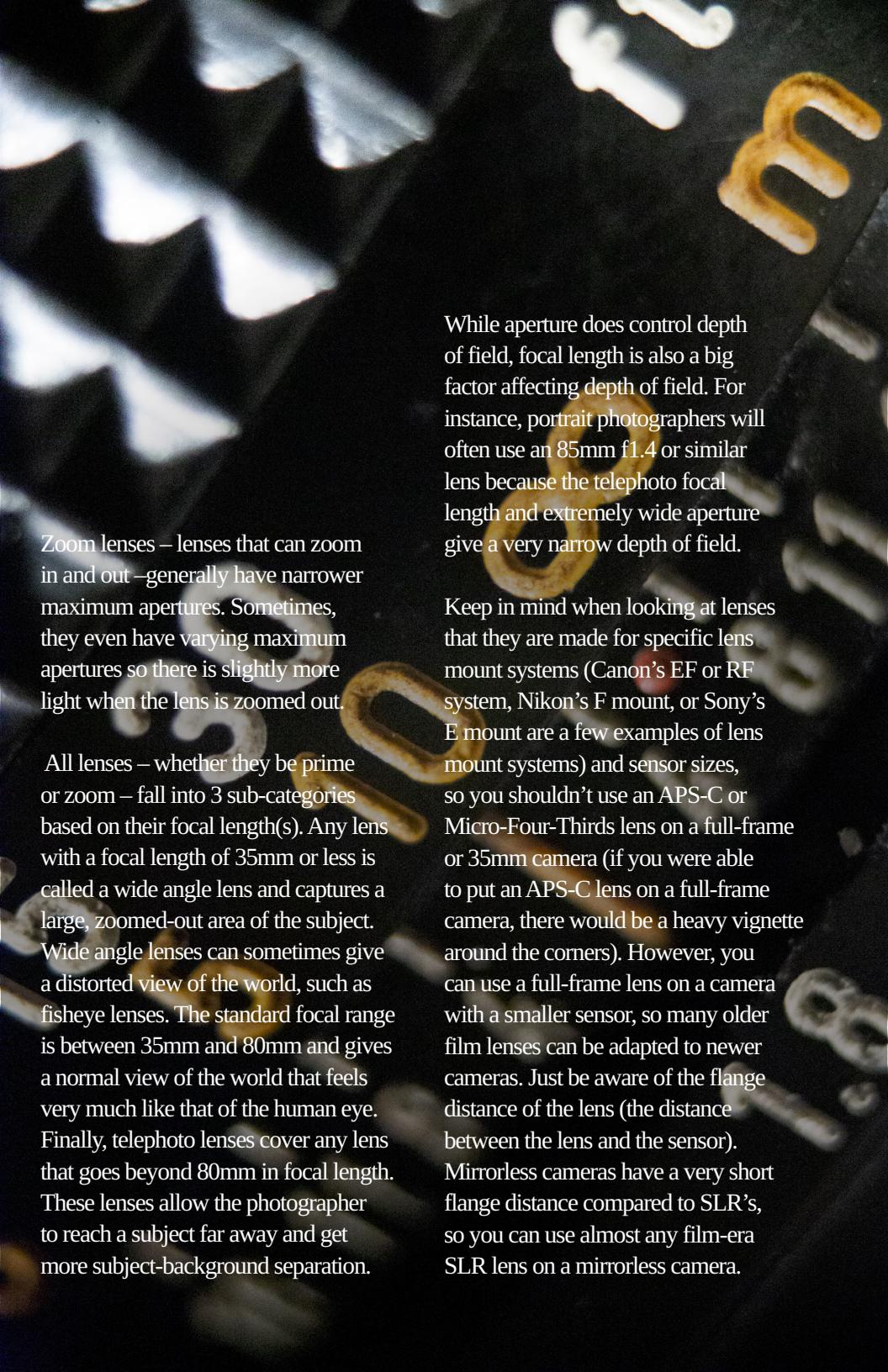
The only problem with mirrorless cameras is that the viewfinders are digital displays, and can have latency or other technical issues. They do however offer better auto-focusing capabilities compared to DSLR's.





While beginning photographers might think that the camera is the most important tool to making a good photograph, it is actually the lens that makes much more of an impact on your photographic process.

There are many different lenses available, but they all fall into two main categories. The first is called prime lenses – lenses with one fixed focal length. These lenses can't zoom in or out, so the engineers can instead make the glass bigger and widen their maximum apertures.



Zoom lenses – lenses that can zoom in and out – generally have narrower maximum apertures. Sometimes, they even have varying maximum apertures so there is slightly more light when the lens is zoomed out.

All lenses – whether they be prime or zoom – fall into 3 sub-categories based on their focal length(s). Any lens with a focal length of 35mm or less is called a wide angle lens and captures a large, zoomed-out area of the subject. Wide angle lenses can sometimes give a distorted view of the world, such as fisheye lenses. The standard focal range is between 35mm and 80mm and gives a normal view of the world that feels very much like that of the human eye. Finally, telephoto lenses cover any lens that goes beyond 80mm in focal length. These lenses allow the photographer to reach a subject far away and get more subject-background separation.

While aperture does control depth of field, focal length is also a big factor affecting depth of field. For instance, portrait photographers will often use an 85mm f1.4 or similar lens because the telephoto focal length and extremely wide aperture give a very narrow depth of field.

Keep in mind when looking at lenses that they are made for specific lens mount systems (Canon's EF or RF system, Nikon's F mount, or Sony's E mount are a few examples of lens mount systems) and sensor sizes, so you shouldn't use an APS-C or Micro-Four-Thirds lens on a full-frame or 35mm camera (if you were able to put an APS-C lens on a full-frame camera, there would be a heavy vignette around the corners). However, you can use a full-frame lens on a camera with a smaller sensor, so many older film lenses can be adapted to newer cameras. Just be aware of the flange distance of the lens (the distance between the lens and the sensor). Mirrorless cameras have a very short flange distance compared to SLR's, so you can use almost any film-era SLR lens on a mirrorless camera.

# Accessories

There are many accessories a photographer can use with their camera to achieve a certain look or improve their process. One of the most common is a tripod, which is used to stabilize the camera (especially for long exposures). When using a tripod, it is also recommended to use a remote shutter release to minimize camera shake when pressing the shutter (or some newer cameras let you operate them through your phone).

Other accessories include lens adapters for using older lenses on newer cameras (especially mirrorless cameras with short flange distances) and lens filters that block certain light coming into the lens (polarized light, yellow light, etc.). There are also flashes, which can be used to add a lot of light to your scene for a moment. An alternative to flashes is setting up studio lights, which can be better controlled, but are much bulkier and not practical for photographers not in a studio.

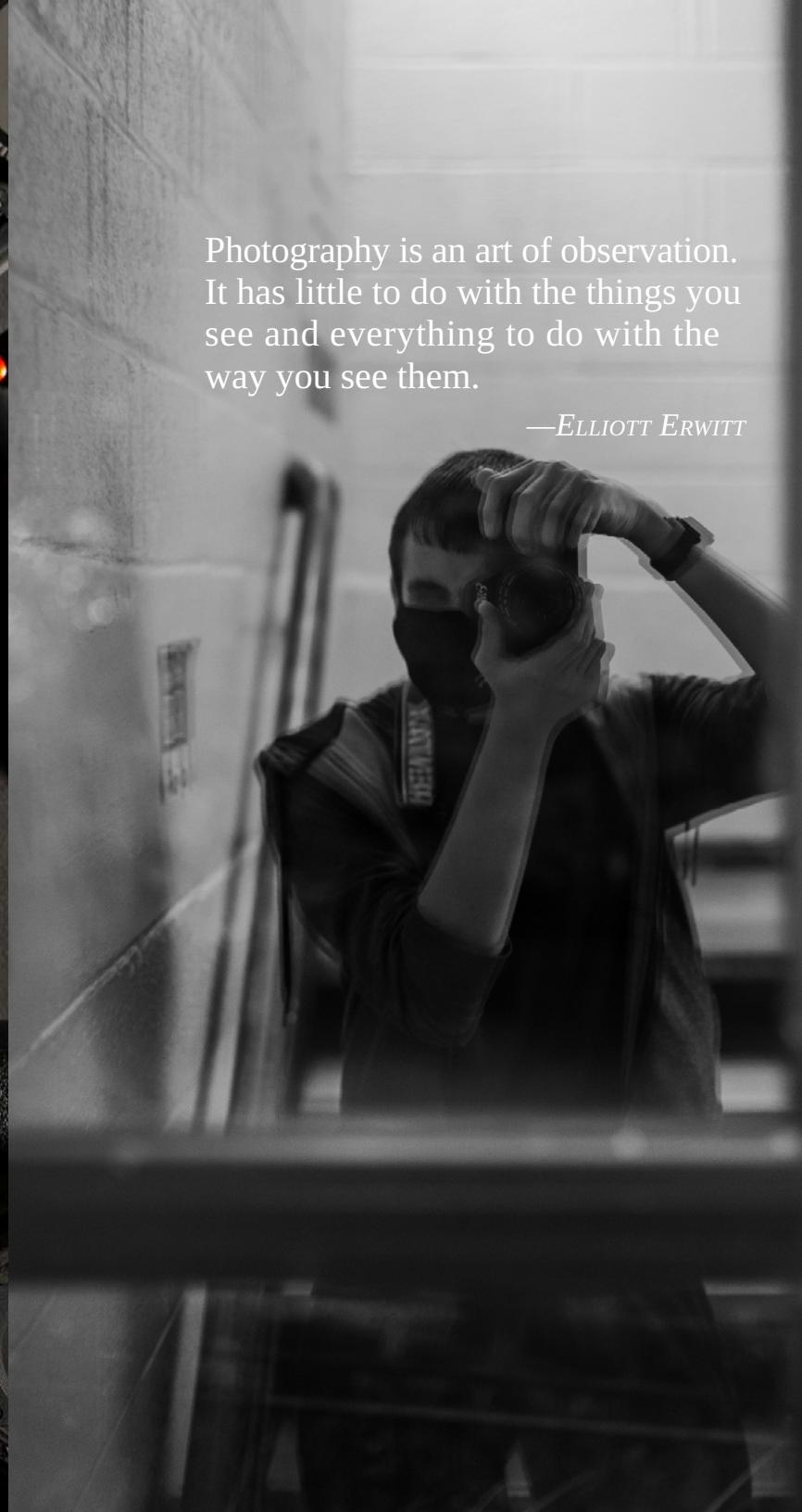




*Shutter Speed · Camera · Sigma · Tripod · Filter  
Film · F-Stop · 120 · Flange Distance · Exposure  
Manual · Depth of Field · Hasselblad · Focal  
Length · Flash · Bokeh · Macro · Daguerreotype  
Darkroom · Sony · C41 · Zoom Lens · Digital  
Fisheye · Focus · Grain · Resolution · Medium  
Format · Nikon · Canon · Medium Format · Minolta  
Portrait · 35mm · Aperture · Film Negative  
Optical Zoom · Photograph · Leica · Photographer  
Pinhole Camera · Portrait · DSLR · Develop  
Mirrorless · Bellows · Under-Exposed · Viewfinder  
Stills · Prime Lens · Sensor · Polaroid · Color  
Lens Cap · Cyanotype · Lens Hood · Camera  
Strap · Wide-Angle · Megapixels · Lens Mount  
Bell & Howell · APS-C · Lightroom · Digital Zoom  
Photoshop · Tamron · Full-Frame · Rangefinder  
Carl Zeiss · Micro-Four Thirds · Lens · Canon  
Telephoto · Fujifilm · Focus · Candid · Photogenic  
Still-Life · Panasonic · Over-Exposed · Light Meter  
Aperture Priority · ISO · Shutter Priority  
Program Mode · Auto Mode · Camera-Phone  
Pentax · Freeze-Frame · Kodak · Grayscale  
Field of View · Rolleiflex · Auto-Focus · Diaphragm  
Standard Zoom · ASA · Emulsion · SLR  
Olympus · Vivitar · Point-and-Shoot · Film Speed*

Photography is an art of observation.  
It has little to do with the things you  
see and everything to do with the  
way you see them.

—ELLIOTT ERWITT





*Writing, Photography  
and Design by Justin Kresse*