



CLOSE-UP
AND
MACRO
PHOTOGRAPHY

by Michael Erlewine



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Dedication

This book is dedicated to my father Ralph L. Erlewine who placed a Kodak Retina-2a 35mm camera, tripod, and light meter in my hand in 1956, showed me how to use them, and turned me loose. Thanks dad!

May these books be of benefit to all photographers and nature lovers, and may everyone experience the awe, beauty, and instruction from the natural world as I have.

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The Cosina/Voigtlander 90mm f/3.5 APO Lens

One of the sharpest, most color-corrected, and inexpensive top-quality lenses.



Welcome e-book Readers!

My name is Michael Erlewine. Macro and close-up photography are things I really love to do. I have been photographing since 1956, but have no interest in being a professional photographer because that is a hard way to make a living, especially as a nature photographer.

This is an e-book, one of many that I have created as a way to share information on subjects I care about. It is free and you are welcome to share it with anyone you wish provided there is no fee charged for it.

It is not as finished as I would like it to be and as it would have to be if it were going to be printed, but printing full-color photography books these days is pretty much ancient history. What this book does contain is a wealth of information of all kinds about close-up and macro photography equipment, the techniques, and what motivates someone like me to enjoy it on a regular basis. Also included is the technique of focus stacking and material on creating mini-panoramas.

The book is not designed to be read from front to back; it's not that kind of book. I have included a detailed table of contents so that you can find the areas that most interest you and jump to them. If you have questions, I will try to answer them and I can be reached by email at Michael@erlewine.net.

I apologize in advance for any typos or misspellings. I work a full-time job and do photography and writing as I can. I hope you find this material useful.

-- Michael Erlewine

August 17, 2014

P.S. Don't forget to check out Book Two ("Lenses for Close-Up and Macro Photography) in this series which contains the nitty-gritty on a number of close-up and macro lenses in great detail and with specs. Also books on focus stacking can be found at:

<http://macrostop.com/>

Types of Close-Up Photography

There is little more than general agreement about what we call the various types of near-focus photography, but it is important to at least have a general idea of what we are talking about when we go close to photograph.



Photo Types: Mini-Landscapes

I term this kind of photo a “mini landscape” because it is not actually that close up and certainly not a macro shot. These little dioramas in nature fascinate me with their simple beauty.

When I go nearer than what we could call general landscape photography I term small landscapes “mini- landscapes” or natural dioramas. For me this means I want to include more context or surrounding space to whatever my subject is, like a group of

plants or a shady glen, that idea – a small group shot.



Photo Types: Close-up or Macro

This just means close-up and just short of the full macro 1:1 photography. This makes up most of the photography I do, something broader than 1:1 photography. This distance is pretty typical of many of my shots, in particular if I am photographing live critters. This is probably technically a macro shot, but as mentioned elsewhere the words close-up and macro are now pretty much used to mean the same thing: close. Whether the shot is less than or greater than 1:1 does not matter to me. This particular shot was taken with the Cosina/Voigtlander 125mm f/2.5 APO-Lanthar lens which naturally goes to 1:1.



Photo Types: Macro (life size or larger)

Macro generally means any photo that is 1:1 or greater. "1:1" states that the image on the sensor is the same size as the live image. If it is equal to that or larger, it is a macro. However to most people today macro and close-up photography are the same thing.

This photo of a Digger Bee is definitely life size or larger. It was taken with the Nikon D3s and the Cosina/ Voigtlander 125mm f/2.5 APO-Lanthar lens. This is early morning light as you can see no blown-out areas where a ray of straight sunlight reaches the bee. For me this is the best time to photograph, before the sun breaks through the clouds or, if it already has, then in some shady area



Photo Types: Photomicroscopy or Macro

(larger than life)

Photomicroscopy

The word “macro” generally defines this category because macro refers to anything greater than 1:1. However, I reserve this description for studio work done on a rail with macro lenses. Nothing moves, and live things are usually dead. The word macro photography (photomicroscopy) these days is used as a synonym for what is really close-up photography. Technically macro photography is defined as a photo in which the subject on the sensor is larger than life size, a reproduction ratio that is greater than 1:1. Macro lenses are those lenses that reach a 1:1 ratio or greater.

This image of the head of the Large Yellow Underwing moth was taken by Rik Littlefield, the author of “Zerene Stacker” focus-stacking software, and is 3.5x on sensor, slightly cropped to by about 5 mm wide, and consists of 59 frames or layers. This was taken with an automated focusing rail.



This photo is 3.5x life size. The insert above represents the actual size of the photo.



Photo Types: Microphotography

Here we are definitely in the studio, perhaps on an automated focusing rail, a microscope stage, and using a microscope or at least multiple lenses hooked one to another. From my point of view this is interesting but more clinical or scientific that I am interested in. After seeing a dozen or so compound eyes I am ready for something else.

Microphotography is, as the word suggest, ultra-close- up, as in the use of a microscope or something close to it. This type of photography is usually confined to the studio with the camera/lens mounted on a very finely-graduated focusing rail, studio lights, and (if it is a critter) a dead critter. Everything has to be just right with no wind or movement of any kind.

This same image as used on the previous page of the head of the Large Yellow Underwing moth was taken by Rik Littlefield, the author of “Zerene Stacker” focus- stacking software is 40x life size slightly cropped to by about 5 mm wide and consists of 170 frames or layers at 0.001 mm. This was taken with an automated focusing rail.

We are in the realm of scientific research IMO when we get this close.

Introduction to Close-up and Macro Photography

Macro and close-up photography allow me to get outside in nature and actually walk around. I am one of those people who spend too much time indoors, but still have to have a reason, some mission, to simply go outside where it is nice. Photography is my reason and close-up and macro work is my passion and ticket to the outdoors.

I know there are probably hundreds of macro books out there, so why another? For one, the price is right and there is no reason you have to make all the same mistakes I did. Consider this just some friendly advice and information all gathered in one place. And the format may be a little rough but, hey, as mentioned, I work a full-time job like many of you and just do this in my spare time, that is: when I can. I have no interest in being a professional photographer. I just happen to love nature and looking at it through fine lenses.

These two e-book primers are intended for those of you with an interest in close-up and macro photography who are just getting started and may have questions. The primer is divided into two parts. This first part is a general introduction to close-up and macro photography including equipment, technique, and motivation, while the second part (a separate e-book) contains specifications and photos on close-up macro lenses commonly used with Nikon systems. These books are free and can be downloaded at:

<http://macrostop.com/>

Minimum Equipment Requirements

When you are looking for a camera body for close-up and macro work, what are the minimum features you need and why? Both Nikon and Canon make fine cameras. I am a Nikon lover and proud of it, so you Canon fans will have to translate some of my remarks to your brand. And a lot of this information is not about brands but about photography. So what are the requirements for selecting a camera body? Here are what I look for:

Jumping to the chase, there is one relatively inexpensive Nikon that does almost everything you need for good close-up nature photography. It is the Nikon D7100 which sells for about \$1100. The D7100 has relatively good ISO levels, great megapixels,

interchangeable lenses, a Depth-of-Field Preview button, and the ability to park the Mirror-Up when taking photos, all things that you need. It also has the ability to fire the camera remotely.

Of course I would prefer an FX (full-frame) camera like the D810 which was and is one of the best bargains I have ever seen for doing this kind of work. Personally I use the Nikon D810 for most of my work when I am not being lazy because of the increased file size. Let's discuss the various features we might want in selecting a camera in more detail.

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Of course I would prefer an FX (full-frame) camera like the D700 which was and is one of the best bargains I have ever seen for doing this kind of work. Personally I use the Nikon D3s for most of my work and (when I am not being lazy because of the increased file size) the Nikon D3x. Let's discuss the various features we might want in selecting a camera in more detail.

Megapixels: How Many?

IMO you will want at least 12 megapixels (MP) and perhaps more like 16 MP or 18 MP. Anything smaller than that and I feel the pinch. I believe that 18 MP might be perfect for my work, but 16 MP will do. I work with 36 MP and the D610 now.

However 36MP will greatly slow down my software if I am stacking photos. I know that this is sheer laziness on my part but processing time does have some effect on my ability to patiently wait for results. In other words, my patience has limits and 24 MP or higher files take a long time. I have to feel like I am having fun. That being said, I use 36MP anyway, because I get better results.

Also: how large a file do I need to publish on the web? I never print out photos! The answer is: seldom more than 1024 pixels on the long side, so huge files don't get us much unless we are doing panel and billboard-sized photos. At least that is my rationalization for using mid-sized files and mid-level megapixels rather than 24 MP or higher.

DX or FX Sensor?

Nikon makes two sizes of sensors for its larger DSLRs, DX and FX, so what's the difference? The FX is what is called a full-frame sensor, the same size as traditional 35mm movie or SLR film, while the DX sensor is smaller. The DX sensor is 24x16mm, roughly two-thirds the size of a frame from an old 35mm movie film (36x24mm). A DX camera will have a crop factor of 1.5x relative to 35mm film,

which means that a DX sensor image will be about 50% larger than the 35mm traditional film.

And FX (full-frame) sensors are the size of an actual 35mm movie frame (36x24mm) and about twice the size of the DX sensor. So which do I need and why?

Although there are advantages and disadvantages to both DX and FX, most of us would prefer to have FX sensors over DX for several reasons, although both work fine for many purposes. Here are some reasons:

More on Sensor Size

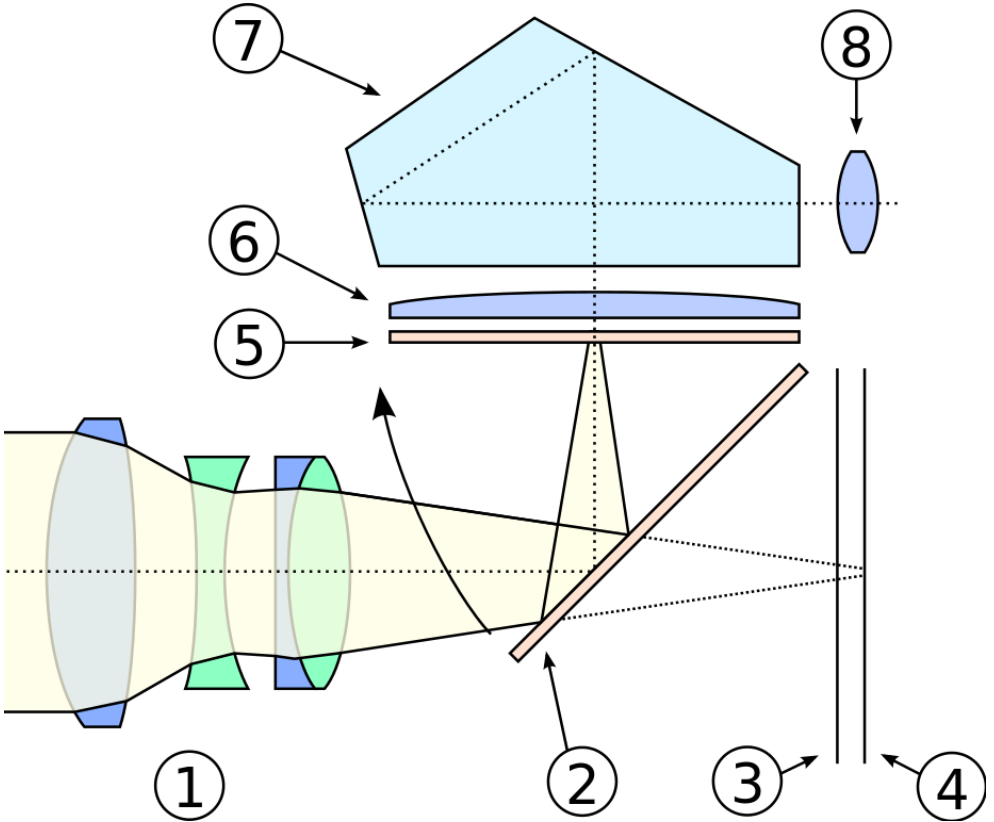
The FX (full-frame, FF) sensor, being physically larger, has more individual pixels, but not necessarily less noise. We have two forces working against one another here. The larger the individual photosites (pixels), offer potentially more light (and less noise). If we are using a 36MP sensor, which is a fixed size (FF), then the pixels can't be that large, so the camera manufacturer has to find some way to reduce the noise other than pixel size. The Sony A7s has a full-frame sensor, but is only 12MP, so it has relatively very large photosites and therefore is (currently) the ultimate low-light camera.

DX sensors are smaller. FX is more sensitive to color IMO and also sharper. FX sensors also have a larger dynamic range than DX and suffer less from lens diffraction so I am told. And last, the smaller viewfinders on DX cameras mean they are not quite as bright as with FX. As a macro shooter, I need a bright viewfinder that lets in lots of light.

In addition FX is compatible with DX cameras, but not vice versa. In other words, you can use all your FX lenses on the smaller DX sensors but not the other way around. Keep in mind that any lens we use on a DX camera will be 50% longer in reach (mm) than if it is used on an FX camera. For example, place a 100mm lens on a DX body and that lens has a reach of 1.5x (150mm) and so on. Some DX users like this because a 200mm telephoto lens is suddenly a 300mm lens. DX lenses are also less expensive, less heavy, and so on. Still, while I have them, I don't use DX them... much.

That being said, the smart money folks are buying FX lenses because they work on both sensor types AND they are a hedge

against the future when (it is believed) more and more cameras will be FX (full sized frames) or even larger. For me the difference in noise and color between DX and FX cameras is dramatic enough for me to prefer FX almost every time. The D7100, which is a DX camera, is an incredible machine at an unbelievable price, and I own one. But I use my D810 (FX) almost all the time.



With mirror-lock-up, the mirror (2) flips up towards (5) well before the shutter (3) opens.

Mirror-Up

When we look through the viewfinder of one of the better DSLRs, we are looking through a prism at the level of the viewfinder that reflects the subject image from a mirror at the level of the lens itself. That mirror stands directly in front of the sensor, the same place (sensor) that film used to be in the old days. Well, in order to take a photo, that mirror has to be moved out of the way and at lightning speed. DSLR cameras do this, but when the mirror is raised up (mirror up) it can't help but slap the top of the camera sending a

vibration resonating through the camera body. For most work this vibration is not a big problem, but for very exact work with longer shutter times (or using a longer lens in macro mode) it takes time for the vibration generated by the mirror slap to dissipate.

This is why the better DSLR cameras have what is called a “Mirror Up” feature that allows you to press a button and have the mirror slap up and resonate, but not take the photo. Pressing the button a second time (after waiting for the mirror-up vibration to die down) actually takes the photo. It is a two-step process. Not all cameras have this, but if you are a macro shooter, you need to have it. I use it for almost every photo I take. To repeat:

Close-up, macro, and especially focus stacking requires that the camera not vibrate or shake. The large DSLRs from Canon and Nikon all have to get the mirror out of the way of the viewfinder when a photo is taken and the ‘slap’ of the mirror slamming up is enough to cause vibrations that affect the quality of the photo especially at long shutter speeds.

So, as mentioned, most high-end camera bodies have what is called a “mirror up” mode which allows you to click the shutter twice, once to move the mirror up and out of the way, and the second time to actually take the photo, after which the mirror slaps back down but too late to affect the photo by causing vibrations. The bottom line is that you want to get a camera body that allows you to park the mirror up before each shot and let the mirror-slap vibrations die down. If your camera does not have this feature, you are at a disadvantage. Look for this feature to be present before you buy a camera for macro work.



Interchangeable Lenses

For close-up and macro work I need access to a variety of lenses depending on the work I am doing. Although I most often use a macro lens, some scenes call for a wide-angle lens, and others for a telephoto or just a standard 50mm lens. If your camera has a single fixed lens, you are stuck with that. Most fixed lenses do not have a macro mode or if they do it is not really very good. And while a fixed lens may work, they do not give you enough flexibility for the best work. So you want a camera with interchangeable lenses. The sad part is that Canon and Nikon lenses are not interchangeable with one another, so this is why we have the Canon users on one side and the Nikon users on the other, each with their hoard of expensive lenses.



Depth of Field Preview Button (upper button)

Lenses have a diaphragm that can be set from wide open (let's in the most light) all the way down to its minimum aperture (let's in the least light). When it is wide open, the lens allows lots of light to fill the viewfinder and you can see your subject. As you close the diaphragm down to higher/ smaller apertures there is less and less light to see in the viewfinder. This is why most lenses automatically allow the camera to open the lens wide open when you are focusing in the viewfinder and then close the diaphragm down to the correct exposure at the moment the photo is taken. This is all invisible to you, the user.

All this is well and good until you want to get some idea of how much depth of field you have by stopping a given lens down to higher aperture. Well, you can't do that because, as I mentioned above, the camera automatically sets the lens wide open when you look through the viewfinder.

This is why the better cameras have a Depth of Field (DOF) Preview Button that when pressed sets the lens to the actual aperture you have chosen so that you can see exactly the DOF you will be getting in that photo. And, as mentioned, when you look through the DOF Preview at high (less light) apertures, the view can be very dark.

The bottom line is that having a DOF Preview Button is very useful at times and is a feature you should inquire about when purchasing a camera body. It is not essential for beginners but it is for experienced users. It is best to have it.



Another feature that is a “must-have” for close-up and macro shooting is the ability for the camera body to take a remote cord or trigger, some way to trigger the shutter remotely. You need that, so don’t purchase a camera for close-up work without it. Most decent cameras have this. You can either plug in a cord or used an infrared remote.

To Flash or Not Flash

Flash for snapshots? Yes. For macro and close-up? Not for me and I have tried it. I used flash extensively for about a year and a half for macro photography and I thought I was getting some good stuff. But some time later, when I started to really look at what I had produced I could see that the earmarks of using flash were all through the photos and made them useless to me.

I know that I need to get back into using flash in a subtler manner, so gently that you would never know that flash was used. I have it on my list, but for now I am so into using natural light that I have yet to find the time when I actually might start using flash again.



Onboard Flash

Some Nikon cameras, like the D7000, the D700, D200, D100, and others have flash built-in. It is there if you want to use it. But onboard flash is really not useful for macro photography because it can't be moved anywhere but where it is. It is too direct and in your face. One thing you can do is find some kind of (or make a) diffuser that will soften that light. That helps. Or you may be able to build some baffles that reflects the light upward, outward, or sidewise to good effect. I have a bunch of Nikon flashes, but don't them.



External Flash (SB-400 shown above)

External flash is the way to go if you want to integrate flash into your close-up and macro work. Flash for focus stacking would require the unit to flash one time for every photo layer, so that might require some careful monitoring to keep everything even. I have never tried it. These years I really am off flash and into natural lighting.

Using less flash is better than more, IMO, so although I have a bunch of flash units, my tiny SB-400 (@ \$200) is very lightweight, uses only two AA batteries, and gives me more light than I need. In fact, I have a bunch of diffusers to tone it down and so on. I also have various arms and other rigs that mount off the tripod and work with the hot shoe on my camera to extend the light away from the camera above or to the side.

I also have a couple SB-600s, an SB-900, and older flash units. Since I don't really use flash except for snapshots at parties, I

don't have all that much to tell you except I don't like the effect. You might want to get the classic macro book by John Shaw "Close-ups in Nature" which covers flash very thoroughly and is probably the classic book on macro photography. You should have a copy at any rate.

Viewfinders Are About Light

A camera with a bright and clear viewfinder is important. Modern DSLR cameras offer viewfinders that are larger and smaller, meaning that some cameras show most (but not all) of the subject frame while better ones do show all of it. If you can, get a camera that will show 100% of the frame. Prism-based viewfinders are called OVF (original view finder), while the newer electronic viewfinders are called EVF.

Electronic viewfinders are still just being perfected so it may be too early to depend on them. The same goes for the LCD preview screen on the back of the camera. These LCD panels when used in LiveView can be helpful for certain kinds of focusing and for enlarging areas of focus but for most work they are not a good substitute for a large and clear viewfinder.

Full frame sensors (FX) tend to have larger viewfinders than the smaller DX sensors, so you may want to keep that in mind.

Recently the Nikon D810 was released, with an updated LiveView that is IMO better than any EVF I have yet seen. With the D810 LiveView I can finally see to focus and magnifying what I am seeing as much as I wish.



DK-17M Magnifying Eye Piece

Many of the larger Nikon DSLRs (D700, D3, D3s, D3x) will take the Nikon DK-17m magnifying eye piece. They cost about \$40 and simply replace the original eye piece. The DK-17M offers 1.2x magnification which I find very helpful for close work. I put them on all my cameras.



Histograms: Our Light Meter

I have been photographing since around 1956 when my father loaned me his Kodak Retina 2A camera for a summer trip. Of course I was shooting film and dad paid for that and the developing. But the expense of film and the fact that you had to wait days to find out if your photo even came out were great inhibitors to my photography experimentation. Back then I used a light meter to determine how to set my exposure, but even that device (or my ineptitude) did not always guarantee me a decent photo.

In general in those days I wouldn't spend the money (didn't have it) for film/developing and I hated the guesswork involved in having no immediate visible feedback from each shot I took. With the advent of digital cameras all that changed.

With digital I can afford to shoot as much as I like and the histograms on the LCD preview screen gives me instant feedback as to whether I am in or out of focus, whether I have too much or too little light, and so on. There is one feature in these new cameras that is VERY important to have and that is visible histograms that evaluate exposure. The RGB histograms amount to a 21st Century version of the light meter, one built into the

camera itself.

Using RGB histograms allows us to tell at a glance whether the photo we just shot is exposed properly for our purposes or whether it is too dark or too light. Histograms make it clear whether we have a lot of clipping going on which means we have lost photo information that can't be retrieved later in Photoshop or other post- processing software. This is something we really need to know because if I spend an hour shooting an important subject only to find out later that all images were severely overexposed, it is a heartbreaker if I can't repeat the shoot due to circumstances, etc.

This is not the place to explain how best to use histograms. There are dozens of good tutorials on using histograms on the web. Just note: when shopping for a camera, get one that does show you an RGB histogram. Ideally the histogram graph should have a color display with one graph each for red, blue, and green all displayed on the same screen. Given this, you can see instantly if any of the colors have overflowed to the right which suggests clipping and the loss of important photograph information.

Note that most in-camera histograms use the internal .JPG and not the raw image for their calculation. While there is not usually that much difference between the two, it is something to be aware of. Since I use only the manual program mode and don't use automatic focus, shutter, or aperture modes, I would be lost without histograms. Read more about histograms here:

<http://www.bythom.com/histogram.htm>



Quick Release Clamps

Before I get started, let me make it clear how important (for my works) a quick-release clamp is, and the only kind I have found reliable is the Swiss-Arca-Style quick-release clamps. I have a whole box of old Manfrotto quick-release clamps that have at times failed, meaning the camera suddenly fell off the head. That is a no-go for me, so, as mentioned, want a box of Manfrotto quick-release clamps?

Another factor involves how the quick-release clamp is secured to the tripod head? More and more companies have what they call a "compact lever-release clamp," a little level that is pushed open until the clamp pops open. I never use these and am very careful to only purchase quick-release clamps with the old-fashioned knob which is tightened by hand. I like to hand-tighten my quick-release clamps, and tight at that. That way if the camera falls off, it is my

own fault and not some lever that has decided to pop open. By hand tightening I have never yet had one fail.

All of my equipment, still and video photography, is based on Swiss-Arca-Style quick release clamps and plates, so it can be put on or taken off in seconds. Without some kind of quick-release clamp you are endangering your 1/4-20 screw socket on the base of your camera by endlessly putting it on and taking it off.



The Four Camera Modes

Most cameras nowadays offer you the option of several shooting modes, typically:

Program Mode

The camera does everything for you and decides what is your best shot. It sets the shutter speed and aperture automatically so all we have to do is point, focus, and shoot. I never use this mode unless I am at a family gathering or party where all I want are snapshots. This mode makes too many decisions for me.

Shutter Priority Mode

You set the shutter to what you need and the camera does the rest. For example, in sports events, you need a high (fast) shutter speed to capture the action, while in still life photography you can use a much lower shutter speed.

If things are in motion you want at least a shutter speed of 250 or higher. If you are photographing still life, adjust the aperture to the right amount of light and let the shutter speed fall wherever it may.

Aperture Priority Mode

Here you set the aperture yourself to gather more or less light or to get less or greater depth of field and let the camera do the rest. For example: if you want a razor thin depth of field on the subject with everything else being out of focus, set the aperture as wide as possible (f/1.4, f/2.8, etc.), but if you want as much as possible in focus, set it to f/11, f/22 or higher. Read about the effects of “diffraction.”

Manual Mode

In this mode the photographer sets everything: the shutter speed, the aperture, and the focus. THIS is the mode I generally use and recommend although you can use any of the above-mentioned modes with the exception of auto-focus for macro work. Setting aperture, shutter speed, and ISO limits becomes natural very quickly. Using manual mode I depend on viewing the in-camera histogram to see whether any of the image is blown out.

Manual mode is a simple process of trial and error. Take a photo of the subject and look at the histogram screen. If the histogram has blown highlights (too far to the right) then increase the shutter speed a notch or two and try again. If there is not enough light then decrease the shutter speed a bit and keep shooting.

Again: after each shot check out the histogram screen to see if the light is within bounds. When it is, you have a photograph that you can keep. In this way your histogram screen replaces the light meter we had to use in the days of film. Using this method we don't need any of the standard program modes. For macro work it is essential and, although it will take you a few days to be comfortable making your own settings, once you learn it you will never go back.

Below is the Nikon 105mm Macro lens, perhaps the most popular macro lens of them all and a solid worker.



Micro-Nikkor 105mm f/2.8 VR



For many years, my very most favorite macro lens, the Cosina/Voigtlander 125mm f/2.5 APO-Lanthar.

Lenses Are What I Like

What's photography all about? If I put aside the spiritual side of photography (which would be another entire conversation,) for me it is all about lenses and of course 'seeing' through those lenses. Initially it was not the photographic results of those lenses that had my interest, but rather the very clear, the pristine, 'seeing' that fine lenses make possible. And of course fine lenses are linked to fine photographs, but that was never my first thought. That first thought was the incredible seeing of the macro or micro worlds that great lenses enable. That's what got me.

And while my particular take on this may be unusual or even almost unique, I share with many (perhaps most) macro photographers a fascination with quality lenses. Nikon lovers call it NAS which stands for Nikon Acquisition Syndrome, and a very infectious disease it is. And while I love good cameras, tripods, and the like, it is lenses that capture my complete attention. As mentioned, actually it is 'seeing' through fine lenses that is at the heart of it, but seeing requires lenses to see through, so there you have it. A little crazy? You bet.

So when we discuss what lenses are the best for close-up and macro work, I have very definite opinions. All of the fine details on lenses I have put in the second volume of this series, so I refer you to that. Here let's just talk in a more general way about lenses that work well for close-up and macro photography.

There are many macro lenses, thus many entrances into close-up and macro photography. A good principle might be "use the macro lens you have rather than yearn after those you don't have." Of course, that is not how I do things. I have almost all of the most well-known macro lenses, but end up only actually using a very few. I will tell you what those very few are along with my reasons for using them, but I warn that this may not work for you. My advice?

Learn at least one macro lens well before starting to play around with other lenses. If you know one well, then you have something to compare to. Otherwise you don't know what is causing what and may never be sure you know what you think you know. You need the anchor of real experience with a single lens to get started.

In any case you will have to start somewhere and in the beginning

learning to use the lens you have is more important than switching lenses to find the “perfect” one for your work. Almost any decent macro lens in the hands of an experienced close-up photographer will produce marvelous images so that should make clear what I am pointing out here: lenses are important but learning to use them properly is even more important.

While any lens will do for starters, in my experience the actual process of doing close-up and macro photography quickly sorts itself out in favor of better and better lenses, and better cameras too. You have been warned.

How to Pick a Lens

There are a number of key factors that figure into what makes a good close-up or macro lens. Not all lenses have all the desired factors and it also depends on the particular kind of photography you want to do. No lens (or very few anyway) seem to have everything. Some lenses will have better sharpness, some better color, and so on. As you read about the factors and qualities of various lenses you will want to keep your eye on the qualities that are most important to your work. If you don't have any particular work yet then just do a lot of photography and you will gradually discover what that work is. The lenses I use most often include:

Zeiss Otus 55mm f/1.4 APO (mini-landscapes)

Zeiss 135mm APO f/2 (close-up)

Cosina/Voigtlander 125mm f/2.5 APO Lanthar (CV-125)

Nikon 16mm Fisheye f/2.8 or f/3.5

Mostly I use the two Zeiss lenses and the CV-125.

Passion and Persistence

Passion is what makes for experience. If we are not motivated to get out there and experiment with our gear, learning will be at best very slow. Something has to be driving us. We have to be persistent.

What motivates us is where photographers agree to differ and also find their differences. Let me tell you something about what in my opinion I look for in a good close-up or macro lens. First a little history.

My first attempts at macro photography took place around the year 1956 when armed with a Kodak Retina 2a and a close-up lens I began to take some macro shots in nature. They were not too successful but I was only fifteen years old. In recent years I have spent a lot of time doing close-up and macro nature photography. In my search for the right lenses I have tried a good number of them. Here is what I value most in a lens for near focus:

Sharpness(Zeiss Otus 55mm, f/1.4 APO)

Of course I want a sharp lens but the more I work with lenses the less I am concerned about 'absolute' sharpness, whatever that is. There are a lot of very fine sharp lenses available in the Nikon mount or that can be converted to that mount. Most of the lenses mentioned in Book Two of this series, plenty "sharp enough" for good macro work.

And sharpness is not the only consideration. A lens can be very sharp but difficult to use for other reasons; it can be too sensitive to light or the widest aperture doesn't give enough light in the viewfinder, etc.

Sharpness can also be a matter of opinion to a degree. You will know when you find what 'you' consider a sharp lens. And my own investigation into sharper and sharper lenses ended in the factors that obscured sharpness from appearing, like diffraction of course, but more subtle yet were the various kinds of aberration, distortions that blurred or obscured sharpness.

In the last analysis sharpness became for me a study of APO (Apochromatic) lenses, literally a matter of the distortions of color, the way color can be messed with. In a word, my search for sharpness left me looking at lenses with less and less distortion so that I could better see whatever it was I was calling sharpness. Eventually sharpness became an almost meaningless word to me because the only lenses I used were very sharp and that 'sharpness' turned on subtle coloring, finally a matter of personal taste. Interesting?

Anyway, sorry to take you on a sidetrack, but for the record I just thought I should point out a little about my journey to sharpness.



Fast Lens (Nikor 50mm f/1.2

I value a fast lens (one with very small f-stop numbers like f/1.4, f/2.8, etc.) not because I shoot wide open, but because I need to have maximum light in my viewfinder for focusing well. Since I often am photographing around dawn or when the light is still fairly dim (but nice), I need to see what I am doing. The bright light of full sun is seldom what I am looking for, hardly ever. I avoid open sun.

Also, I do a lot of focus stacking and therefore need to see what to focus on at each step. I don't entirely agree with those who say that to focus stack you just need to get to the front of the subject and then automatically click on through and not focus on anything in particular but just make sure to have regular intervals. That does not work for me, especially when photographing spherical objects.

Of course I understand what they are pointing at, but in my experience this is not enough. For example round (spherical) objects in the frame do not stack well. One's increments have to be much finer (shorter) than otherwise if the subject is round. In fact, in many subjects there are key points that you don't want to just auto-increment and march past, but rather be very careful to be sure to

get them in extreme focus. In other words: if I am blindly incrementing along with a stack and reach a key point I do finer increments before, at, and after that point to make sure that area is in prime focus. Remember that in focus stacking whatever is within the interval between incremental photos is to some degree lost. Focus stacking is a sampling technique like audio CDs and DVDs. These are impressionistic techniques that have great gaps or holes beneath our human threshold.

There often are several such points in the series and I need to be able to see to focus in the viewfinder to do that and therefore I want a fast lens for visibility. For example: someone commented recently about the Nikon 70-180 Zoom Macro and what a great lens it is. I spent a couple of years intensely using that lens but gradually abandoned it because its widest aperture is f/4.5 and that can be dim. This morning I got that lens out in case I had made a misjudgment or might see it differently today. It was about 8:30 AM here and the sun had not really yet gotten strong.



The Micro-Nikkor 70-180mm ZOOM

Looking through the 70-180mm, it was very dim indeed and not at all bright enough for my work. On a bright day the lens would be fine but I don't shoot in bright sun and even tend to avoid bare sunlight in streams, photographing more in shadows or light haze. The 70-180mm is a wonderful lens but not for me for the reasons mentioned. In the first light of dawn that lens is way too dark in the viewfinder for me to stack properly. IMO 'macros in full sun' is an oxymoron.



Focus Throw (Leica 100mm 100mm Elmarit R)

Something not often mentioned is the focus throw of a lens, how many degrees does the lens barrel have to rotate to go from close up to infinity. I was surprised that some of the finest macro lenses have a short focus throw. For macro work and especially for focus stacking I need a longish focus throw or else put the

camera on a focusing rail. I prefer the long focus throw on a lens to carrying a focusing rail around with me.

I was shocked to find that the very expensive Coastal Optics 60mm f/4 APO macro lens has a focus throw of only 210 degrees. For example the CV-125 APO has a focus throw of 630 degrees and the Leica 100mm Elmarit has one of 710 degrees. However, the old Micro-Nikkor 60mm f/2.8 D macro has a throw of only 120 degrees and that is not desirable.

The wider the angle macro lens (50mm, 60mm, etc.), the more important it is to have a long focus throw. Macro work is just the opposite of sports photography where you want a short focus throw. In macro and most of all in focus stacking a long focus throw is a big advantage. You need a long throw or use a focusing rail. Some of the finer macro lenses (Coastal Optics 60mm) with a short focus throw would be better used on a focusing rail.

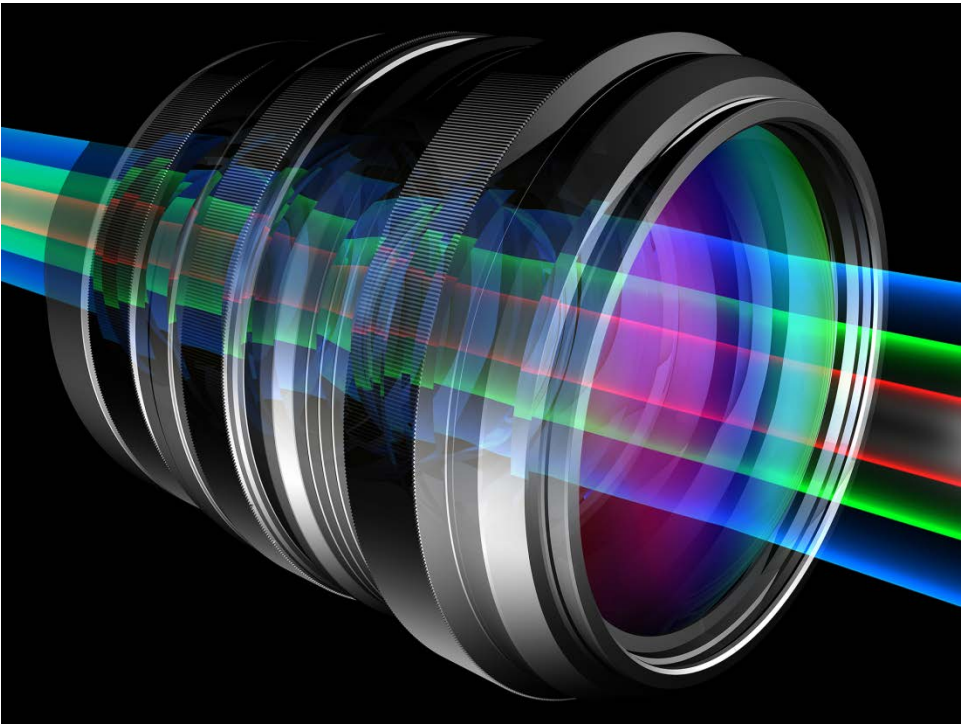
The wider the lens the more you need a long focus throw, but the reality is just the reverse. Most wide angle lenses have a very short focus throw which means even a tiny movement of the lens will have a large effect. Putting these lenses on a focusing rail would make them more useful.

Reproduction Ratio

Another feature to keep in mind is the reproduction ratio. How large is the image in the frame? Most macro aficionados prefer a macro lens that goes to 1:1. Here "1:1" means that the image in the sensor and the subject image are the same size. Not too many good macro lenses get to 1:1. In fact there is a whole side- businesses (extension tubes, diopters, etc.) that help you get from smaller ratios (like 1:2) to 1:1 image size.

There are not all that many lenses that will give you the 1:1 ratio straight away and my view of putting close-up diopters on the front of my lenses or extension tubes on the rear of my lenses is not flattering. I have all the key diopters, tubes, etc., but I use them only as a very last resort. Actually I hardly ever use them at all. I know that many photographers love tubes and diopters but I feel a lens just as it is sold is a perfectly balanced thing and anything added to it can only lead to a degraded image. In my experience, this is a fact.

Luckily for a lot of my work I don't always need to have a 1:1 reproduction ratio. I shoot a lot of close-up work, what I call mini landscapes or dioramas and therefore can use lenses that are not ultra-close.



APO (Apochromatic) Lenses

Not absolutely required but very helpful are lenses that are APO corrected. Apochromatic lenses are corrected for chromatic and spherical aberration more than the common achromatic lenses. There are not many good APO lenses, the most well-known in the Nikon format being the Cosina/Voigtlander 125mm APO-Lanthar, the Leica 100mm APO Elmarit, the Coastal Optics 60mm APO, and the two new Zeiss APOs, the 55mm and the 135mm. There is a relationship between sharpness in a lens and the absence of distortion, so I prefer APO lenses in my work most of the time. IMO the differences in subtle coloring can be dramatic.

Minimum Focus Distance

Most lenses used for macro work have a very short minimum focus distance. In fact many can appear too short if working with live critters, like 50-60mm lenses.

If you are shooting insects or live 'whatever', some lenses require you to be so close to the subject that the end of the lens actually blocks the light or the close proximity of the lens scares off whatever you are photographing. The 60mm range of macro lenses are in this category. And while the 100mm to 105mm macro lenses are very popular, many photographers would rather work with lenses in the 200mm range because it gives them just enough extra distance to not disturb their subjects. If you are really into photographing critters then a lens in the 200mm range may be what you are looking for. When you get to longer telephoto lenses then you want a close-focus distance, especially if the lens is not a macro lens.

One odd technique I like is to use a telephoto like the Nikon 300m F/4 ED-IF lens (which has a minimum focus distance of something like 4.9 feet) on the Nikon D3x (which has 24 MP) and crop out a photo. I can photograph a frog out in the middle of the pond, crop it out, and still have enough pixels left for a fine photo.

Close-focus distance for many lenses is listed in the second volume in this series "Lenses for Close-Up and Macro Photography."

Lens Summary

Those are some of my main considerations when choosing a macro lens. I don't care how heavy or bulky a lens is. Carting these things around is second nature to me now. It is easy to see that if we insist on having all of the above points in a single lens we quickly are down to almost none. In fact the one lens I have that is sharp, fast, has a long focus throw, goes to 1:1, and has APO is the Voigtlander 125mm f/2.5 APO-Lanthar. Even better are the two new Zeiss APO lenses, which while very expensive, have it all.

No other lens has all of these features without adding diopters or settling for a short focus throw, etc. It is no wonder that this lens is in great demand and very expensive. The Nikon 105mm VR macro is pretty good as well in terms of having many of the important features.

Please refer to the second book in this series which is on lenses. There you will find photos, specs on many lenses that are useful for macro, close-up, and mini-landscape photography.

The Lens Is the Thing

Lenses are the heart of photography, IMO, and certainly a good sharp lens is required for decent focus stacking. And lenses can be expensive, to say the least. Fortunately for macro and close-up photography, where we must focus manually anyway, we can use older lenses which are often readily available at reasonable prices. Today everyone wants autofocus lenses, so for those of us who require manual focusing, bargains are all around us.

The kind of lens you need depends on the kind of close-up photographing you intend to do. Are you just taking single photographs or do you want to focus stack a series of photos? While focus stacking can also be used for landscape and intermediate distance photography, much of it tends to be done in close-up and macro photography.

Speaking very generally, most macro and close-up work is done with short telephoto lenses rather than wide angle lenses. Traditionally the 50mm lens has been set as the standard or "normal lens and any lenses smaller than that (24mm, 35mm, etc.)

are considered wide angle lenses, while any lenses longer than 50mm (105mm, 200mm) are considered telephoto lenses.

You can do focus stacking with almost any kind of lens (including wide angle lenses) with the exception perhaps of fisheye lenses. They are tough, although I have done it. And we should differentiate between standard lenses and macro lenses. A macro lens allows you to focus down to very short distances from your subject, providing you with greater magnification and thus huge images of tiny critters like ants, as well as flowers, leaves, etc. Standard lenses don't usually have a focus distance close enough to do macro photography, so take note before you purchase.

Close-up and macro lenses generally are labeled as such, using the words "macro" or "micro," so you need to differentiate between (for example) a 105mm portrait lens from a 105mm macro lens, although the macro lens can also shoot portraits, but not vice versa. A 105mm portrait lens will not shoot macro subjects because its closest-focus distance is too far away for close work. You can't get close enough to your subject. So, you will probably want to get yourself a lens with at least some macro capability.

The Quest for Depth of Field

As long as there have been cameras and lenses photographers have struggled to achieve greater depth of field (DOF). When a lens is wide open, the DOF is very shallow which means that, at best, you can expect to have sharp focus only in one plane of the photo. The rest of the frame will be more or less out of focus. With extremely fast lenses (f/1.2, f/1.4) the depth of field can be razor thin. Everything else is out-of-focus (OOF).

As we close down the lens (smaller openings) we achieve greater and greater DOF until a point is reached where the effects of diffraction (which see) set in and begin to destroy the overall sharpness of the photo. Photographers are caught between the devil and the deep blue sea, trapped by almost no DOF at wide apertures and a loss of sharpness at narrow apertures, when stopped down too far. That has been the traditional problem.

We all seem to like to see photos that embrace greater DOF and, with the advent of focus stacking, this is becoming increasingly possible. Focus stacking has been going on for a long time but until

recently was limited to those photographers with enough technical expertise in Photoshop (or other software) to painstakingly stack layers of photos and then gradually erase parts of different layers to reveal those areas of greatest sharpness, etc. Each photo becomes a real labor of love and is very time intensive.

Now that programs like Zerene Stacker (also Photoshop CS4 and other software) can do this more automatically, focus stacking is increasingly coming into its own. Today (using Photoshop as an example) all that is necessary is to place the stack of photos (at different focus points) as individual layers and apply two commands to that stack, Align and Blend.

The “Align” command automatically works through the layers and aligns the subject in each layer so they line up. Once that is done, the “Blend” layer blends the aligned layers into a single photo, automatically doing what previous photographers laboriously did by hand. The resulting image is a stacked photo, where the stack of individual photos has been aligned, blended, and reduced to a single photo that appears to have great depth of field if all has been done correctly.

Users of Adobe Lightroom 2.0 (and higher) can select a series of photos in Lightroom and send them to Photoshop where they can be aligned, blended, and automatically saved back into Lightroom, including any adjustments made to the photos in Lightroom. What this means is that focus stacking is now available to a much wider group of users than in the past. Just as HDR- stitched photos have become very popular and have their own special “look,” we can expect to see focus stacking following on the same path to more common usage. Focus stacking too has a certain look that differentiates it from standard photos.

Perhaps camera makers like Nikon may include focus stacking (focus bracketing) in future camera bodies just like they did with aperture bracketing, which is now available. The user would focus at the front and the rear of a subject, indicate how many photos should be stacked (or an increment) and the camera would do the rest. Of course, this sounds like a job that would require a tripod. For shots of live subjects, in-camera focus stacking would further open up this technique since the stacked series would happen at maximum speed. A dampener on this idea is the fact that many of the best macro lenses do not even

have auto-focus. Although I used Adobe Photoshop in the above example because many of you may already have, it is not very good at focus stacking and I can't recommend it. Instead I use and recommend Zerene Stacker, and more information on that program can be found here, It is a far superior product:

<http://www.zerene.com/>

Diffraction Fears

When your camera lens is wide open (like at F/2.8) there is plenty of room for light to enter and the parallel rays of light more or less stay parallel, with minimal divergence. However, when you narrow the lens to a tiny opening like f/22, not only does less light come through but after passing through such a small aperture parallel light rays begin to diverge, spread out, and interfere with one another.

At small apertures the light waves get out-of-phase with one another, pile up in some areas, and cancel each other out in other areas. The net result is that they create a pattern of bands called the "diffraction pattern" and this pattern impacts the photo image we are trying to create causing it to deteriorate and lose sharpness.

The long and the short of it is that no matter how fine a lens you have or how many megapixels your camera sensor has, diffraction imposes an absolute resolution limit for photo detail that cannot be gone beyond. Diffraction automatically smooths or blurs detail that we have resolved with the higher f/stop of the lens. Diffraction is not present when a lens is wide open (lowest aperture) but begins to rear its ugly head in most lenses somewhere around f/8. By f/11 most lenses are reading considerable diffraction and by f/16 and higher it can be a serious problem.

In other words, just when we are starting to resolve depth-of-field by selecting higher and higher apertures, diffraction steps in and destroys the clarity we are trying to gain. For less detailed photos this may not affect the photo (may not matter to us), but for others it means we have to look elsewhere to get more apparent depth of field. This is a main reason why focus stacking is getting so popular: it simulates greater depth of field by putting more of the subject in focus.

I find that the two new Zeiss APO lenses, which are the most

corrected lenses I have ever used, are more tolerant of diffraction at higher (smaller) apertures. I can't explain it, but my eyes tell me it is so.

Sidebar: Cosina and Zeiss

It is important to know that the world-famous Zeiss lenses are made in Japan by Cosina, the company that makes my favorite Voigtlander CV-125 lens and others. The Japanese bought the German company's name. In fact both Zeiss and Voigtlander are made in the same building I am told, just on opposite sides. My point? Simple, these guys make good lenses and not just the Zeiss half of the building, but IMO the Voigtlander factory produces the most remarkable lenses I have ever used.



Voigtlander 125mm, f/2.5 APO-Lanther

The Three Wise Lens-men

The internet forums are filled with lens advice and you can pretty much find anything you want to prove claimed somewhere, either for or against a given lens. Finding good advice that is also true can be tricky. Here are the three main sources I trust for true advice about lenses. I list them in the order I discovered them, which has turned out to also be the order of their importance to me so far.

Björn Rørslett

This is the gentleman whose site taught me about macro lenses and I salute him! He has a wonderful area of lens reviews for Nikon-format lenses at this URL:

<http://www.naturfotograf.com>

He also can be found posting at NikonGear.com where he refers to himself as the “Fierce Bear of the North,” which is also true. He certainly growls a lot and has been on occasion known to bite. When it comes to the mechanics of lenses (and more than that too), this is the man to read carefully.

Thom Hogan

Thom Hogan is another living treasure for lens lovers. He appears to be more in my style, being also a software engineer and general techie as am I. His web site, which is worth checking on a daily basis, is:

<http://www.bythom.com/>

Hogan not only had spot-on lens reviews but his site is the best way to keep up on what is happening with all of the larger camera manufacturers. Articles of all kinds are also available, like how to clean your sensor, etc. from the Hogan site.

Lloyd Chambers

Lloyd Chambers offers a smorgasbord of treats for DSLR users and lens fanatics like myself, a lot of it free and some of it by subscription. You can find his site here:

<http://digilloyd.com>

By all means read the free stuff. I also subscribe to Advanced Photography (DAP) and “Making Sharp Images.” I am only sorry I

waited so long to subscribe out of sheer miserliness. “Making Sharp Images” is the best concise tutorial on all facets of photography I have ever read and worth every penny. All of the books I own don’t give me this kind of info in a convenient-to-read format.

Web Sites: Fotozones.com

I have given you my favorite three photography sites above, so those sites I check out as often as I have time. I also am registered at a number of other photography forums but I only really hang out at one and that is Fotozones.com.

IMO some of the world’s best lens experts can be found there and it is there that I go for up-to-the-minute reviews and tests of the latest lenses. This forum is not for novices and even somewhat experienced photographers like me get bitten by the experts when we say something really dumb, but a nip now and then is worth it to be in the company of technical experts of this caliber. I highly recommend Fotozones.com and I am a lifetime subscriber. I was for years the resident mentor of the macro forum.



Extensions, Close-up Dipoters, and Teleconverters

What do all these things have in common? They are devices that fit on the front or back of a lens to give it more magnification or

something. Many of them are manufactured in an attempt to bring macro lenses that have less than a one-to-one reproduction ratio up to that standard: 1:1. It is no secret that macro shooters prefer a lens that can reach 1:1, meaning the size of the image on your sensor is the same as that of the subject itself. Very few fine macro lenses can do this without help and helping them with add-ons is really no help at all. I own almost all of these and have tried each of them. It would be more correct to say that I have tried to try them and have been fairly disgusted at every turn with the results. So I have little to nothing positive to say about these add-ons except if the lens manufacturer had wanted this kind of enhancement they would have included it. A better way to say it is that I have never seen any of these devices that improved the quality of a lens. Invariably they degrade lens quality and it is obvious by just trying it out.

Lenses are carefully made and balanced to the nth degree just to make them as good as they are. To add on something else is like throwing a piece of lead on a scale that is perfectly balanced. It is suddenly unbalanced. Yes I have bought them because I am the kind of person who has to see for myself the effect of these things thinking that perhaps I could fiddle them into being worthwhile, but in this case it did not happen. My opinion is that you are much better off using a lens just as it is instead of trying to make it perform beyond its reach. Sure, you get photos, but something precious is lost, at least in my experience. I am not going to spend a lot of time of these, but I will go over the basics just so you know.



Close-up Adaptors and Diopters

Close-up adaptors are lenses that screw on the front of your lens that give them greater magnification, and there are two general types. The single lens adaptors (one piece of glass) are dirt cheap on Ebay and they are worthless. They simply degrade your lens. Yes, you get a photo but it suddenly is a photo taken with one of

the worst lenses in the world, with all kinds of color fringing and what-have-you. Better are the achromat diopters which are highly corrected two-element lenses that enable the lens to focus more closely on small objects. Nikon even made some fine diopters for a while but they have been discontinued. I have all the Nikon diopters and have tried them. They are OK at best but not good enough for me to use them regularly or... ever. Why do all these things exist? The simple answer is to save money over having to purchase different lenses, to stretch the use of any single lens beyond what it was designed for, and the results prove this. I can think of no other reason. I even have the highly-thought of Canon achromats and they are no better. And the single-element add-on lenses are only good as paperweights.



Extension Tubes

Extension Tubes Extension tubes are just that, hollow tubes that are mounted at the back of a lens to make them higher powered. A 200mm lens is just a lens with a built-in extension tube but it is a tube that was factored into the actual lens design from the get-go and carefully balanced. It is said in defense of extension tubes that they do not mess with the lens quality because they contain no lens elements themselves and that they only add 'extension'.

Well, not quite. The long and the short of that argument is that extension tubes throw a lens out of balance just as add-on close-up lenses do. The result, once again, is a degraded image. An extension tube added to a lens to bring it to 200mm is not the same as a 200mm lens with built-in extension. Try it for yourself. The sad part is that before I could try it for myself I had to go and buy these things and I got all of them I could find. Yes they work, but I never use them, not even ever. I have been there and done that and it was not nice.



Extension Tubes



Extension Tubes



On the above pages: Various extension tubes, K-rings, and other connectors that either add extension to a lens or help to connect lenses to one another.



Nikon Teleconverter TC-14E II 1.4x



Nikon Teleconverter TC-201 2x



Nikon Teleconverter TC-14EII 1.7x



Nikon Teleconverter TC-20EIII 2x

Teleconverters

And to make things even worse there are the teleconverters. These are lenses that are added to the back of a normal lens to increase their reach, to add magnification and reach. For instance, a 2x teleconverters will double the reach of a lens, turning a 100mm lens into a 200mm lens and so on. Nikon has produced them in 1.4x, 1.7x, and 2x sizes and I have them all. Like the other types of adaptors, of course they work but how well is the question. Not well is the answer if you like quality photos. I have the TC-17E II 1.7x, the TC-14E 1.4x, and the TC-20 E 2x teleconverters from Nikon. Perhaps the most recent Nikon TC-20E III 2x teleconverter, which I also have, is better than the rest but still not good enough IMO for prime time. The sole use for these is to save you from having to buy a 400mm (or higher magnification) quality telephoto lens. I don't blame those who try. Those big lenses that are quality cost a fortune. Luckily I am a macro shooter. If you must have the added reach, try them, but I wager that you will be disappointed or at least end up holding your nose. So I apologize to adaptor fans for my opinion, which is all it is. I don't like em'; I don't use em'.

Accessories and Other Topics



Lens Hoods Hoods?

Most all lenses benefit from hoods. While some lenses are deeply recessed and form a kind of natural hood, many are not and need the hood to block extraneous light from making your work more

difficult. We need hoods and should use them. They also help to prevent 'whatever' from damaging your lens. If you have a Nikon lens and want to know what hood fits that lens, use this site by lensman Roland Vink:

<http://www.photosynthesis.co.nz/nikon/accessory.html>



Extra Batteries

I am a little obsessive about having extra batteries for my camera. I try to carry an extra one in the car but seldom on my person when I photograph. I don't often shoot more than 1000 photos at one shooting so the new Lithium batteries are enough for one outing and then some. My suggestion is that you have a total of three batteries for your camera, one in it and the other two charged and ready to go. Of course I tend to have four or five, just to be safe.



Flash Cards: How Large?

Flashcards, also called CompactFlash (the larger size) are readily available now up to at least 128 GB. The smaller SD and SDHC cards are less expensive and also come in sizes to 128GB.

Your DSLR may take either or both of the above sizes but be sure to read the fine print (often available on the camera maker's web site) as to which speeds and versions work best in your camera. The SD cards come in different formats (SD, SDHC, SDXC), so take the time to check it out. My cameras have two card slots, so I like to use two 32GB cards. I have yet to take more photos that this, even after a couple of days, and despite focus stacking which eats up a lot of memory.

Dust Bunnies

Particles of dust, sticky pollen, hairs, and what-not somehow worm their way inside the camera and cling to the sensor. The results are little persistent spots on each and every photo you take. This is particularly bad with focus stacking because as you focus closer in through multiple layers that little dust-bunny spot becomes a long line on the finished stacked photo or a bunch of lines which can be

hard to remove. You must keep your sensor clean for focus stacking.



Sensor Cleaning

This is the ugliest part of digital camera work but you have to do it. There are different levels of cleaning the sensor. On my Nikon cameras I have to lock the mirror up, take off the lens, and look inside. Behind where the mirror was (before it was locked up) is the sensor which is actually covered by an AA (Anti-aliasing) Lithium Niobate filter that is pretty tough and does not scratch easily. Still doing anything with the sensor area requires care and can be really nerve wracking.

For beginners (and occasionally for any of us) cleaning the sensor is not only difficult but often fraught with worry about damaging the camera's sensor. It is no fun at all. The single most-important tool for cleaning the sensor is some way to know if you have it clean. The traditional way is to go outside, point the camera/ lens at the sky and take a photo. Then get the photo image off the card, put it in Photoshop (or somewhere), expand the photo, and minutely inspect it for dust, what are called "dust bunnies."

This is a horrible method and can take a very long time, going outside and in, etc. It is easy to spend an hour doing this if you fail to remove the dust you can't really see well. This is a solution:

The best money I EVER SPENT in regard to this was to buy a BriteVue Quasar Sensor Loupe which costs a whopping \$88 but is worth every penny. You can get them from VisibleDust. This is a 7x round magnifier that fits over your open lens hole (when the lens is off) and is lit by six bright LED lights. By looking through it you can easily see every speck of dust on the sensor. What a relief to just be able to see the dust devils!

No more taking photos endlessly. If you value peace of mind and don't want to be ritually humiliated by the previously-mentioned process, just buy one. I know it is expensive, but you won't regret it. That said, here in general is what has to be done to clean a sensor. Please refer to your camera manual for exact details. This is just an overview so you know what you are up against and not a step-by-stop instruction. The first thing is to place the LED sensor loupe you bought on the camera and look inside. What is there? Is it a piece of hair, tiny dust bunnies, or a gooey piece of pollen? With the LED loupe you can see it all.



Sensor Blower

Next, take a special hand sensor blower and blow air on the sensor to remove any dust particles that can be removed. Be sure to hold the camera with the lens- hole pointing to the ground so the dust stirred up by the blower will float down and out of the camera. Then look again at the sensor. It may be gone or it may not. Try this several times. And remember: Every time the mirror inside your camera slaps down it makes wind that blows dust and what-not all around the place. The blower does the same and after blowing a few times, if there is still something there, then try a special sensor brush (I use the one by VisibleDust, called the Arctic Butterfly).

These battery-operated brushes whirl around and become electrostatically charged so they pick up dust on contact. You don't vibrate the brush in the camera! Very carefully brush the sensor WITHOUT going beyond the sensor and touching the sides which can have grease. If you pick up the grease and then wipe it on the sensor you are in for real problems and may have to buy a new brush or figure out how to clear the grease off that brush. Using the LED loupe, see if this did the trick.

And the last and most scary resort is to use a special fluid and a special swab to actually clean the sensor manually. Again: I use swabs and fluid by Visible Dust made for my Nikon cameras. This may have to be done repeatedly and it is very tricky. Too little fluid and you don't get it all, too much and it leaves a residue. Also different types of sensors take different cleaning fluids so be sure to check on that. This is no fun at all folks. If all of the above do not work, you will have to send the camera back to the manufacturer. I have never had to do that yet. The above is a very general description of the process and is not definitive. You must refer to your camera manual for precise instructions. I cannot be responsible for errors you might make in attempts to clean your sensor. Use the procedures listed above at your own risk. Before doing anything please read this excellent article on sensor cleaning by expert photographer Thom Hogan:

<http://www.bythom.com/cleaning.htm>



Wet Sensor Swab



Arctic Butterfly: Dry Sensor Brush

Hand Blowers

Hand blowers are helpful. They can blow dust off lenses but are also used to blow dust off sensors. When blowing dust off sensors I find it wise to make sure to blow out whatever is in the blower before blowing on the sensor lest you blow residual dust on the sensor, which I have done. Worse are hairs that tend to be attracted to the rubber on some blowers and can work themselves inside the blower... ending up, you guessed it, on your sensors. Hairs can also suddenly appear inside the camera, not on the sensor, but wedged in a crack between the sensor and the outside. A fine pair of tweezers (not touching the sensor) can remove them.



Step-down Rings

Step-down rings allow you to repurpose one filter or another by stepping it down to fit a smaller lens. Otherwise you need an expensive filter (such as a polarizer) for each size lens diameter you might have. Typically the smart move is to buy filters in the largest size (say 77 mm) and then use just one filter with a series of step-down rings to fit the rest of your lenses.



Polarizers

Polarizers are helpful in removing the shine of tree leaves, the specular highlights on lakes, wavers, running water, snow, etc. I have them in varying sizes but seldom use them. I tend not to shoot in the kind of light that polarizers are designed for. I am a seeker of shadows and even light, not bright light.



Hot-Shoe Bubble Level

For some camera work, like panoramic heads, it is important to level your tripod. Trying to level a tripod by adjusting the legs seems like a never-ending process. Some tripods have a half-ball that replaces a column and can be instantly adjusted from underneath the tripod. This is mostly present in video tripods. Then there are all kinds of leveling heads that fit between the top of the tripod and your camera base. These can be heavy and awkward. I find the easiest way to level a camera is by using a standard ball head that either has a level built into it or place a little bubble level (shown above) in the camera hot-shoe where a flash usually goes.

Once you have any kind of level on a ball head it is child's play to quickly level the thing.



LED Flashlight

Many photographers carry one of those small LED flashlights like those made by Fenix. I have one that takes only one AA battery and is very compact. And I purchased a tiny diffuser that fits on the end of the lens and flips on an off. What are these good for?

I use them to (on rare occasions) shed a little extra light on the subject. At those times I wish I had another arm and it is best to hold the flashlight quite far back. A little light means a lot which is why I don't generally use a flash. I don't like the invasive look that a flash brings to a natural subject. But a tiny bit of backlight through a leaf or flower is helpful from time to time.



UV-Filters

I like the argument: why put a cheap piece of glass on a \$1000-dollar lens. It can't help but degrade the performance. All of the best pro photographers don't use prophylactic filters, but I still do. For me it is that I hate cleaning lenses or touching them at all. No matter what you say, sooner or later dirt, dust, specks, goo is going to get on the front of your lenses. So I still (for the most part) use UV or clear lens filters on my expensive lenses. I know I shouldn't, but I do.



Lens Cloths

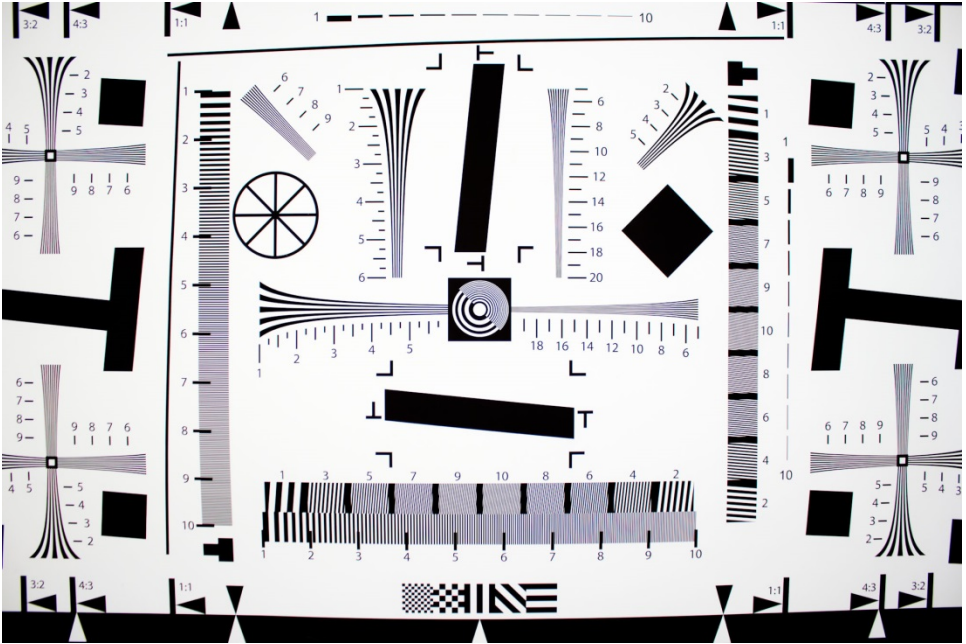
Lens cloths? You need them. We all hate to touch our lenses which is why so many of us use clear or UV filters on every lens. Let those filters get dirty. We can always buy another filter, but if we scratch the lens, there is no remedy. Still, you need something around that those-in-charge tell us is safe to touch the lenses with. Micro-fiber cloths are easy to come by and various products keep giving me free ones. But how do I know that once I have used these cloths they have not picked up some piece of sand that will scratch the lens the next time I use it. I don't. That is why I buy packs of certified lens cleaning tissue by Tiffen or Adorama and what I use most are called Pec-Pads and they come 100 in a package, each 4"x4".

You use one and you throw it away. You don't put it on the shelf because you can't see anything wrong with it and use it again. You toss it out.

There are dozens of lens-cleaning tutorials on the Internet. Just Google for "How to Clean A Camera Lens" and read carefully.

Velvet

If you are doing a lot of studio still-life photos, pick up a piece of black velvet to have around. It makes a great almost invisible background for bright shiny things.



Lens Resolution Tests

Want to test the sharpness of your lens? Download and print out (or take it to Staples) a test chart, pin it to the wall, light it, and take some test shots. One such free test chart can be found here:

<http://members.cox.net/lenstestr1/reschrt3.gif>



Light Box

If you are shooting objects in the studio and don't have the budget for some fancy lights, just pick up a Light Box on Ebay for almost nothing. Light boxes or Softboxes are collapsible cubes made out of translucent white cloth in which you can place whatever you want to photograph. They diffuse light from all directions and give you very soft light to remove the specular highlights. I not only use them in the studio but I cut the bottom out of them and use them in the field to cut the wind. Check them out.



Pinch Cap



Z-Finder

Z-Finder at Zacuto.com

If you are using your DSLR to take video you want to look into getting one of the Z-Finder optical viewfinders from Zacuto. These mount on the LCD screen on the back of your Nikon and turn it into a giant viewfinder, actually like a camcorder. There are different

types of these on the market but I find the Z-Finder to be the best. It gives me a very clear (and very large) focusing screen.



Screw Drivers JIS

Most Japanese camera gear don't simply take any old Phillips screwdrivers, so take note. They use instead JIS Type-S screwdrivers. You can find them online, on Ebay and Amazon, so think ahead and pick some up.



Lens Caps

Not all lens caps are equal. Even some very expensive lenses come with crappy caps. I just throw them in a drawer. What you need is what is called “Inner Pinch” caps or just pinch caps. They are inexpensive and I find it worthwhile to replace all the caps that demand that you pinch the outer edges with inner-pinch caps. Much easier to use and keeps your fingers away from the edge of the lens.

McClamp, Plamps, and Articulated Arms

There are a number of articulated arms available with a clip of some sort on each end that clamp onto your tripod or whatever. They give you an extra arm to hold a reflector or whatever you want to use. The problem with most of them is they are not very strong,

certainly not strong enough to even hold a small 12-inch diffuser up in front of a light or flash.

I purchased both the McClamp and the Plamp and neither were strong enough to do anything worthwhile. I even purchased the Loc-Line segments these products are made out of and determined for myself that there is no real strength there. I clamped them to my tripod, to chairs, to bookcases and, while they could hold their own weight, nothing I asked them to hold beyond that was held without sagging down. As mentioned, the smallest diffuser I have is a 12-inch round diffuser and even that was too heavy to be held up. So what good are they? I have no use for them. But I do use the Flowerpod all the time.



Allen Wrenches

Things that attach to camera bodies like L-Brackets, various tripod heads, flash extenders, and all kinds of other equipment are often fastened by Allen wrenches, so have a set and always carry the one you need to tighten your L-Bracket or whatever in your field kit bag. One of the more unpleasant experiences is to be two miles out in the woods and have the L-Bracket suddenly come loose or something similar.

Stuck Filters

Occasionally when I screw in a filter of one kind or another on a lens, the darned thing gets stuck or somewhere wedged in there. Nothing is worse than a tiny close-up filter with a stuck UV filter on it. You can't get your hands on both rings to get enough leverage. Wrapping a rubber band around each gives you some traction, but not always enough.

One trick that so far has worked every time is the following: Find a piece of flat hard rubber like the sole of a shoe. Place the stuck filter flat against the hard rubber surface and just turn. Usually you don't even have to apply much strength. The stuck filter just comes right off.



Super Magnets

You don't need these UNLESS you plan to take apart your camera or a lens, in which case you might want to have a few. Neodymium disc magnets are some kind of rare-earth magnets that are super strong. What they are good for is attaching to your tiny screwdriver's shaft so that when you finally unscrew something, that "something" will cling to the screwdriver as opposed to falling deep inside whatever you are taking apart. You don't want a teeny-

tiny screw lost somewhere inside your lens. I never thought I needed these until I actually started disassembling lens parts to change mounts and what-not, at which point they seemed indispensable.

Threadlocker

A perennial problem is that the base of the ball head, which is screwed on to the 3/8" screw in the tripod base loosens in the field. This is very annoying when as you are flipping all the other levers on the ball head, it suddenly starts to become loose. The only solution I have found is to apply some ThreadLocker to the tripod screw and the thread in the base of the Ball Head. Threadlocker makes it very difficult (but not impossible) to remove the ball head from the top of the tripod.

I leave my ball head permanently on the tripod so ThreadLocker is a great help. No more need to worry about it coming loose until I want it to.

Tools That Help

For older folks like myself, a good folding lawn chair is a big help, also perhaps a good magnifying glass, because the mini-dramas are at least as interesting as the more obvious larger ones. In my case, I like to do macro (close-up) photography, so I have some incredible lenses that let me see what is going on out there, up close and personal.

And I don't always go miles out in the brush. My own backyard is a wonderful place to observe much of the time. There are also some nice nature parks close to me that I can drive to and wander in. The local cemetery is perhaps my favorite place of all. It has tons of shrubs and flowers where all kinds of insects hang out.

Better yet, this cemetery ends in a wonderful open field with paths I can take. If things are too wet, I can always walk along the mowed edge of the cemetery and look into the field next to it.

And I do make special trips from time to time to one nature sanctuary or another, and those are fun too, but most days it is very local, like outside my back door. And the change in perspective achieved through all this is gradual, slow. Letting the mind rest and the compassion that naturally arises from what we see does not

happen all at once, but takes time. It is an investment in reality, one that I find more than worth the effort. See for yourself.



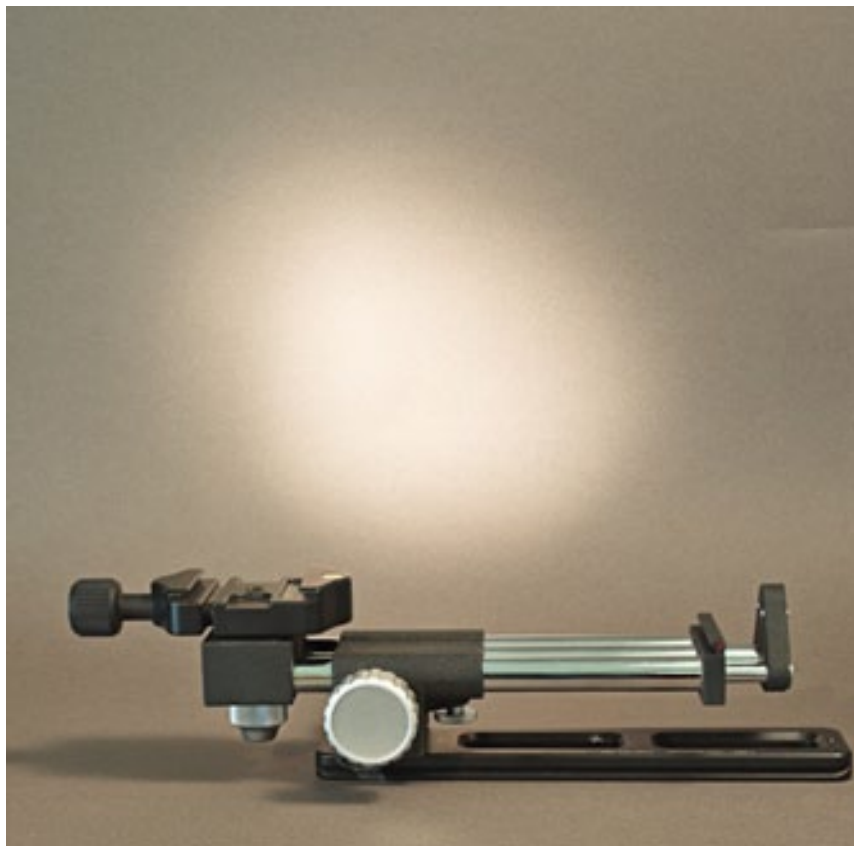
Storing Photo Accessories

Once you start buying cameras, lenses, tripods, and what-not, you accumulate all kinds of pieces and parts and things that you don't dare lose. For years I stuck them in this drawer or that, and then later (when that was obviously out-of-control) I tried to store them each within their individual original package. But of course I promptly forgot all about them and never saw them again. I even kept buying some again and again. This was not working. Here is what does work for me:



Go to your nearest Home Depot or Lowes and pick up a few of those carry-around plastic organizers as shown here. They are perfect. I have at least six of them full already and the best part is I can actually find stuff when the need comes. I store everything that will fit in them: wrenches, tapes, cleaning stuff, eyepieces, filters, caps, magnets, mirrors, extra parts, remotes, tubes, extensions, polarizers, close-up lenses, Teleconverters, and of course small lenses. I even have one case just for flash stuff.

Everything is safe and findable plus I can carry them around anywhere I wish. If you have too many small parts, give these cases a go.



Minolta Focusing Rail

Focus Rails

A focusing rail is what most beginning macro students think they need when in fact they would be better off with a macro lens with a longer focus throw. A focus rail sits on the top of your tripod and your camera body and lens sits on the focus rail. By turning knobs on the focus rail you can incrementally move the camera/ lens forward and backward (some also move left and right) by small movements. In other words you replace turning the barrel of your lens with turning a knob on the focus rail. And while focusing with the lens barrel is never totally precise, with the focus rail you can be evenly precise in the increment the camera/lens is moved. There are even powered focus rails that do it all automatically for you.

There are two main types of focusing rails, ones that move only forward and backward and those that in addition move from side-to-side, in other words two- way and four-way. I am not an expert with

focusing rails. I have four or five of them but seldom use them. If you are into photomicroscopy (microscopic focus stacking) you may need a focus rail. Period. If you are a close-up or a macro photographer you probably don't really need one.

Here is what I know about these rails: If you are a nature photographer in the field then they are one more thing (and weight) to lug around. I will skip over here there endless on-line debate about the difference in stacked layers obtained by moving the lens barrel while the camera stays fixed (standard photography) and moving both the camera and lens as one piece (focus rails). Moving the lens changes your magnification while using the focus rail changes your perspective. For stacked photos, which method you use can affect how easy it is for your focus-stacking software to process your stack of images. In order of quality (the best), here are the three main methods.

(1) Mount the lens on the front standard of a bellows and lock it. Mount the camera on the back standard of the bellows and move it. This produces the best stacked images, but will not work for many lenses.

(2) Use the focus ring on the lens. This is a good way to go IF the focus throw of the lens is long enough.

(3) Last choice is mount the camera/lens on a focus rail and move the whole thing.

And most of the focus rails on the market, pardon my French, really suck. I hope you speak French. There are gobs of them on Ebay and elsewhere on sale for next to nothing (or for a lot) and most of them, even brand names, are terrible. Focusing rails are one of the few pieces of equipment that paying more money for will not necessarily get you a better product. I am not going to get into trashing them brand by brand too much but if you read the web carefully, user reviews will tell you all you need to know. Both the RSS and Kirk rails are routinely trashed by critics. Many focus rails are cheaply made, move in a jerk-like manner (which is just not tolerable even if it works), are too lightweight, and on and on.

I own a bunch of them, three of which are pictured here, including the much applauded Novoflex Mini Castel focusing rail (newer model) and the Velbon Super Slider macro rail. The Velbon is not a quality piece of work and the Novoflex is too lightweight IMO

qualify. The only focus rail that I have liked (and own) is the Minolta rail. It is really heavy, works smoothly, and is a pleasure to have and own. They turn up on Ebay fairly often and can be had for a reasonable price. But before you run out and buy one, consider this:

Focus rails are not a cure-all for anything. Unless you are photographing angels on the head of a pin you probably don't need one. What you may need is simply a macro lens with a long or longish focus throw. Having a long focus throw like the Cosina/Voigtlander 125mm f/2.5 APO lens or the Leica 100mm f/2.8 APO Elmarit R lens is like having a lens with a built-in rail. Both of these lenses have a very long focus throw. Even the Nikon 105mm macro VR has a focus throw that is long enough.

Lenses with a long focus throw allow you to incrementally move the lens by fractions of a movement while sharper lenses like the Coastal Optics 60mm f/4 APO lens have such a short focus throw that they are really only useful on a focusing rail for very close work.



Velbon Super Mag Slider



Novoflex Mini Castel Rail



Novoflex Castel-Q with Swis-Arca Rail and Clamp

This is the best I have, and the one I use most of the time.

The Wind is No Friend to Macro Work

Michigan is for the most part just flat since the glaciers moved across it like a snow plow (way back then) and scraped it flat. With nothing to stop it, like mountains and valleys, we have wind and have it more often than not.

Wind is a problem for any macro photographer but a much greater problem if you are trying to stack photos since even a tiny movement results in halos and other artifacts. The proverbial advice for shooting in wind is either don't shoot at all or be patient and wait for a lull.

This is good advice except where you need to shoot five or ten photos each at a different focal point. What happens is that you get two or three shots off and the wind moves the subject (or parts of the subject) a tiny bit. You don't even see it because you have your eye to the viewfinder, your hand focusing, and your mind busy coordinating it all.

It actually is worse than this. The wind doesn't usually just move one blade of grass or whatever. It moves all kinds of things ever so slightly, often too subtle for you to even catch but not too subtle for your lens not to catch. The result is that all kinds of stuff moves around.

Where you figure this out is back home on the computer while processing the stacks. Photo after photo has some movement flaw or all kinds of little wind-generated artifacts. Some can be fixed in Photoshop but a lot are not worth fixing unless you like being a photo-touchup artist for hours at a time.

To make things worse, if you are shooting seasonal flowers the season does not wait for the wind to die down. Many flowers are in and gone in a few days. We can schedule time for shooting but we can't control the wind which sometimes is strong enough to keep all of the plants dancing for days at a time. What to do?

One thing we can do (although not focus stacking) is just use a higher shutter speed (one that stops motion) and just shoot traditional one-shot photos with as much depth of field as we can push the aperture. There is always that. Or, if you are shooting something like an entire flower that moves slowly in the wind and can push the shutter speed up so that the whole flower is caught, SOME stacks will work, because Photoshop will align the whole

flower, shot by shot. Although this approach sometimes works, it seldom works well and is hardly worth the effort.

Another thing I have tried is to make little stakes and string little panels of cloth on them in an attempt to stop the wind from coming in. I even bought some small collapsible car antennae so the whole thing could be portable but the wind came in from above, below, or from anywhere that was not covered and did its thing, so this was not a satisfying solution. For really good stacked photos of very small flowers wind is pretty much a deal breaker.

There is an inexpensive way out of this, although it is a real PITA to haul around and that is: a Light Tent. Light Tents are expandable cubes of translucent material that are used for product photography.

They diffuse light on whatever is inside the cube AND they stop wind. These light tents are all over Ebay and you can get a 24" or 30" Light Tent for around \$30. You will have to cut the bottom out of one of the flat sides of the tent for it to be used outdoors and resign to dedicate the tent for field work since it is going to get dinged and smudged no matter how careful you are.

Simply place the tent over the area on the ground where the flowers are and start shooting. The tents even come with a Velcro cover for the front (with a slit for the camera lens) if the wind is trying to get in the front direction, so you have five sides that are closed and one side (the bottom) that is open. These light tents work great for ground work provided you resign yourself to carting them around in the woods, in addition to your tripod, camera, lenses, and what-not. But this is a real solution worth trying if you really want those good stacked photos.

I had my daughter sew a skirt on the bottom of the light tent so that I could feather it out to further stop wind from coming in from the bottom.



Light Tents

On the next page is an inexpensive Light Tent that I have cut the bottom (cut on one of the flat sides) out of. I then place the light tent over the subject as you can see. Here the subject is the Mullein plant. In this photo I have partially bent the detachable (velcro) front panel back so that you can see into the tent. I usually just poke the camera lens through the slit in the front or pull back the velcro from the top and shoot downward from there. This is my smaller tent. I also have a 48" tent that kids could play in. I use it to place over whole sections of plants, like in a field so that I can stop the wind and concentrate on the flowers or the insects on the flowers, etc. This approach is a little extreme and cumbersome but it does work well.

Here you see a Nikon D3s on a Gitzo GT2531 tripod, with a Markins Q3 ball head, and a Nikon MC-30 remote shutter release. These and the following shots are kind of sloppy because I was fighting rain that was only minutes away.

Either from the slit in the front of the tent or by pulling back the Velcro strips along the top of the front. If you can blur the white tent as background it works well for some subjects. Larger light tents give you more freedom in this regard but are even more awkward to move around.

I find that using light tents is well worth the extra effort and hassle involved. And the larger (48") tent can be used in a field of flowers or plants, placed over an entire section allowing you not only to work with plants but to remove the wind factor on the top of plants (like Queen Anne's Lace) and concentrate on the many interesting insects that are wandering around on the flower heads. Moving insects AND moving flowers due to wind usually manage to make any stacked photo almost impossible but remove the wind and the insects may pause long enough to get some depth from stacking a few shots.



Light Tents in the Field

Light Tents fold up flat or can be twisted into a small round package but as you get to the larger sizes it becomes more difficult to twist them into their smallest form. Let's face it, light tents are a hassle to drag around but if you live in an area where wind is the default and not the exception (like Michigan) your choice is either waiting a long time for the chance to make a stacked photo or using a light tent. And I mean a long time.

As mentioned earlier, taking a traditional one-shot photo is not too much of a problem in wind. Just push up the shutter speed or lower

the aperture, or both. Forget about getting a stacked photo that day. However, if you stack photos then wind will seldom let you get more than a couple of shots off before it starts to move things around within the frame.

Even with a light tent you have wind. It creeps in through the bottom of the tent, although using a couple of rocks or large sticks to weigh down the sides can lessen it a bit. Still, if the wind is up and the flower (or whatever) is delicate and on an attenuated stem, you are going to find movement and be waiting for the wind to die down. Light tents can greatly speed up an outing, allowing you to get many more photos on a windy day.

I have 24" and 48" light cubes and usually always have the smaller one in my car. Using light tents can mean that I range in a smaller radius from my car than I otherwise might but the results are more than worth it. With care and setup (weighting the sides if the wind is up), I can shoot fairly large stacks most of the time.

Of course, to avoid getting the white sides of the tent in the photo you will have to shoot at some angle,



Light Diffusers

Diffusers and reflectors are readily available on Ebay, B&H, Adorama, and other providers of photography accessories and there are many tutorials on the Internet as to how to use them. There are gold, silver, and white reflectors, and usually one type of opaque diffuser. My problem is with the diffusers currently on the market.

While they may be useful in full sun, I find that for any more delicate sun-shade condition, they block too much light. For example, in a woods situation, where some streaming sunlight is coming through the forest canopy that is too harsh and needs to be toned down, the standard diffuser more or less creates yet more shade rather than diffuse the light. Here is a solution: I bought one of the regular diffusers. I use the 22" round diffuser because I can collapse it and (with effort) jam it into my coat pocket, which pocket acts like a

carrying case. I then went to Wal-Mart and picked out a somewhat sheer fabric that lets a lot more of light through than the original diffuser panel. Silk screen material also is perfect.

I stretched this new fabric over the open diffuser and (temporarily) clamped it in place. I then had my daughter (I can't sew) sew around the rim, fixing the new fabric. Then, with the new fabric firmly sewed on, I carefully cut out the original translucent panel. The result is a diffusing panel that is actually helpful in more situations. It folds up and fits in my coat pocket or the little round bag it came in. I also stuff it in a holster-type camera bag which holds it without any additional sleeve and pop it out whenever I need it. It screens and softens the light so I don't have glaring patches of sun that blow out the highlights. I prop it up somehow, by any means I can - sticks, holding it, hanging it from its one loop from my tripod, etc. This diffuser acts as a filter to bring down the light to a manageable level.



Home made diffuser.

Higher Apertures

Typically a lens is most sharp around $f/4$ or $f/5.6$. Better lenses can still resolve sharpness (despite the onset of diffraction) at $f/8$ and even $f/11$. Beyond that, few lenses hold up. This does not mean that we don't use higher apertures but just that we have to consider whether sharpness is absolutely important in any particular shot. With my best lenses I typically push the aperture to $f/8$ and $f/11$ to get greater sharpness and depth of field. The modern digital SLR (DSLR) evolved from the 35mm-format film camera and that format essentially covers a range from 35mm to 65mm, with 50mm being the center of that range. The 35mm format was designed around the fact that the 50mm lens is considered the "normal" lens because the human eye sees at a focal length of about 50mm. Any lens less than 35mm is considered wide-angle and any lens larger than 65mm is considered a telephoto.

Sharpness

Sharpness is a topic that photographers endlessly discuss on Internet forums. To understand sharpness we only need to consider the term "acceptable sharpness," as in: what degree of sharpness is acceptable to you. Every analog (non-stacked) photo has one and only one plane in the photograph where things are exactly sharp. Every other plane in that photo (on either side) is gradually relatively less sharp until it becomes blurred. Even a wide-angle lens, where most everything may seem to be in focus, there still is only one plane that actually is in exact focus. All other parts of the photo are relatively blurred. It is a question of what you consider acceptable sharpness, sharpness good enough for you. Only in non-analog photos such as focus stacking do we find more than one plane sharp.

The plane of focus is always at right angles to the plane of the camera sensor unless we explore "view cameras" or tilt/shift lenses for DSLRs that let us twist and angle that one focal plane this-way-and-that to achieve very interesting effects.

So we have one plane of focus in every photo and the areas in front of and behind that plane that are also in "acceptable focus" make up our depth-of-field, which may be very shallow or very deep. Obviously a lens set to infinity shooting a landscape has a very

deep DOF while in general a lens focused close-up has a more shallow DOF.

And we don't always want everything in focus. In fact, aside from "sharpness," the other term often discussed by photographers is "bokeh," which refers to the lovely out-of-focus areas behind your subject. Lenses have a good or poor "bokeh" and the relative bokeh of various lenses is fiercely contested. Bokeh is like the difference between the harsh camera shots of a newscast and the soft feathery feel of many movies, where the subject is in focus against a wash of blurry and lovely pastels.

In taking a photo, we first select a focus point; we focus. Then, and only then, we decide on how much depth of field we need by adjusting the aperture. Of course, due to various light and other conditions we don't always have much choice in the real world. But theoretically we do.

If we go wide-angle, we have more depth of field and if we go telephoto we have a more narrow depth of field. That is why with wide-angle lenses there is often little to no bokeh because everything is too much in focus. And with telephoto lenses we can have the subject in exact focus against a nice blurry background – good bokeh.

When we are close up, we tend to have a very narrow DOF, while shooting at a distance with a narrow aperture gives us a wider depth of field -- more of the subject is in focus.

And while this topic is too complex to go into here in detail, there are three factors that help to determine your depth of field: aperture, focal length of the lens, and distance to subject.

Narrow DOF Greater DOF

We can get greater DOF by using a small aperture, a wide angle lens, and by standing far back. However these three factors don't all work together smoothly for close-up work. If we stand far back with a wide-angle lens set to a small aperture we get a great depth of field of whatever is at infinity but it won't help us in macro and close-up photography.

For close-up work we have to mix and match techniques to get any kind of depth of field and the history of photography is filled with

attempts to push any of these approach as far as possible, which brings us to “Focus Stacking.”

Focus stacking is a non-analog (digital) approach to taking photos with increased sharpness and the appearance of greater depth-of-field. Actually, focus stacking is a sampling technique similar in approach to CDs and DVDS in that an analog (reality) source is sampled with enough layers to approximate a desired result. With CDs the desired result is music, with DVDs it is movies, and with focus stacking it is a composite photo with enough samples to give the impression of greater sharpness and depth of field.

Beginning with Focus Stacking

It has been many years now since I intensively began to work with focus stacking to achieve better all-around focus and at least the illusion of greater depth of field. For myself I have learned a lot about this apparently simple but demanding technique. Focus stacking originally arose as an in-studio technique where bellows and incremental focusing rails were used to take hundreds of micro-stop photos that were combined to create a single ultra-close-up photo of something like the compound eye of a bee or dragonfly or whatever. Since I already spend enough time indoors, that approach was not all that appealing to me. Also, a couple of dozen images of various compound insect eyes were plenty for me. I got the idea.

I was more interested in how focus stacking might be applied to outdoor nature photography using a much smaller series of photos and doing away with the bellows, focusing rails, and what-not. I was not so interested in ultra-close-ups of anything as I was in getting a little more depth of field out of whatever I was photographing, whether it was an insect, a flower, plant, and so on. I wanted more of whatever I was photographing to be in focus. I like what I call “mini- landscapes,” small worlds where everything is pristine and... in focus. That was the intention.

I use Nikon systems and back then I happened to have the Nikon 105mm f/2.8 macro lens and that is where I began. Any lens can be used to stack photos, but generally this technique excels at close-up and macro ranges. You can stack landscape photos (and to good effect) but of course at a distance even the tiniest of change in the focus has a huge effect. In other words, once you get out

toward infinity the number of the stacked photo images that are effective are few to none. This is generally true of many wide-angle lenses as well.

Wide-angle lenses by their nature have greater depth of field, and turning the focus even a small amount changes the image greatly. Although I am learning to stack photos using wide-angle lenses, you really need a wide-angle lens with a long focus throw to do this easily or mount the lens on a focus rail and do it that way. Few wide-angle lenses have a long focus throw.

In general, the focal length range of lenses that works well for focus stacking in my experience are from 60mm to 200mm and then only if these lenses are dedicated macro lenses. Keep in mind that there are Nikon 105mm lenses that are not macro lenses and that do not get close enough to smaller subjects to make them worthwhile. So do be careful when purchasing a lens for macro work to make sure it is a true macro lens and not just a standard lens. Also some lenses claim to have a macro option, but I suggest you avoid these as well. If you love macro and close-up photography, just get a standard macro lens.

Additional Considerations:

Investment

Macro lenses can be had on the cheap, so to speak, because in macro photography (and absolutely in focus stacking) only manual focusing is used. Auto focus is not needed or desired. Because most photographers today think only in terms of auto-focus lenses, a good Nikon 105mm f/2.8 lens can be found on Ebay for between \$200-\$300. Of course you can pay a lot more, but you can do fine macros with the Nikon 105mm macro lens or the Canon equivalent.

Playing With Stacks

Back on the computer, after a day's shoot, you process a stack in Photoshop and look at the results. Some stacks work and some have too many artifacts, motion that you didn't see at the time, areas that Photoshop could not distinguish properly, etc.

Some stacks are simply beyond use or repair but most are not, so don't just give up on a stack because at first glance it has problems. Try to see what is causing the problem. Here are some things you should check out before giving up on a stack.

Inherently Flawed

Don't forget that unless you are on a focus rack and taking a huge number of photos under essentially laboratory conditions that photo stacking, by definition, is flawed. Focusing using a short-stack means you are sampling the focus here and there rather than seamlessly photographing and merging the entire frame. By design you are leaving out many areas of the photo which are not treated as a focus point. This is a choice we make when we stack photos. Focus stacking is by definition impressionistic.

An Art, Not a Science

There will be areas that are (how ever so slightly) out of focus. The art of focus stacking is to make these areas as unobtrusive as possible, selecting what you feel are the key areas in the photo that tell the story as you see it, areas that you want to be in sharp focus.

Focus stacking, at least in my experience, is more of an art rather than a science. Slavishly using a focus rack to obtain perfect focus through a stack of a hundred or so photos simply is not interesting to me and way too time consuming. I am happy to look at the deep

stack photos that others make. Most of all, rack-focusing is more suited to the studio and not the woods and fields. I need to be out there in nature and without too much gear. Keep in mind that IMO the process and experience of photographing nature is as important or more important than the resulting photos.

The art in focus stacking is learning how to give your impression of a subject in a few carefully-chosen frames, merging them into a single unified photo that expresses that impression. That is why focus stacking is an art and not a science.

Focus Stacking Problems

The Bad Frame

Did you include a frame that does not belong in the series by mistake? I am surprised at how often I manage to do this and, of course, a frame from a different series will seriously screw up a stack and make it appear unusable.

Too Many Frames

Just because you took ten frames of the subject does not mean you need all ten or that all ten will resolve well, especially when the result shows problems. Try dropping layers, usually from the back where they matter least and can serve as bokeh (nicely out of focus). Shorten the stack and run it again. Often the result can be different enough to save the shot.

Minimal Frames

Forget about the whole sequence. Go into the layers and find just the layers that best put the subject into focus. Use those, often just two or three. You end up with a more normal photograph, but one with the essential subject remarkably in focus. This is still better than just the one area in focus of a traditional one-shot DOF photo.

Run It Again

Sometimes if I just run the whole stack again I will get a good result. I have no idea why this is so but it is worth a try if you love the subject.

Don't Forget the Traditional Photo

And as a last result, use a single frame. Forget about stacking. One virtue of taking bracketed focus shots is that, more often than not at

least one of the frames will be the shot you would have taken if you only had one shot – the traditional photo with one point of focus. When all else does not work, usually there may be a single photo that will do the job.

In summary, it is well worth it to spend some time tinkering with the stack before you abandon the shot, especially if it is a photo you really like.

Short Stacks for Macro, Not Micro

How close is too close? That is a question you will find yourself answering as you get into focus stacking. Of course, it depends a lot on what lens you are using but I have found that trying to focus on too tiny a part of a flower generally shows poor results. Let's take some examples.

The advantage of traditional one-shot photography is that you don't have artifacts but unless you are photographing a two dimensional subject (like a page from the newspaper) and even then, unless that newspaper is flat and exactly parallel to the plane of the camera's sensor, you automatically have distortion from perspective. That perspective puts one area of the photo in focus and throws another out of focus to some degree.

And of course the eternal quest for the holy grail of depth-of-field by photographers meets with disappointment as diffraction exacts its toll of resolution at smaller apertures, thus the main reason for focus stacking. Yet focus stacking, as we have pointed out, cannot but fail to capture every bit of the subject but it can manage to fail successfully if we are careful, resulting in a photo that has the appearance of real depth of field.

Landscapes

Focus stacking is probably 'more' successful in enhancing focus in non-close-up shots like mid-range and distant subjects such as landscapes, where adding even a little more depth of field dramatically enhances the shot. Look at the landscape shots elsewhere in this book for an example of this

Close-up, Macro, and Micro

Where focus stacking breaks down most visibly is in extreme close-up shots, what we would call micro, rather than macro shots. When

you get this close, you really do need a focusing rail, studio, lights, and all of that. You can get great shots using a rail and micro-stepping the focus, but for me this is a whole other kind of photography than that being presented here. It really is a science and not so much an art, although art is involved there too.

Not for Micro Work

For example, shooting a very tiny flower: Being so close to a subject shows not only any weakness in the lens but also weakness in the technique of short-stack focus photography. By not covering every millimeter of that scene we are opening ourselves up to tiny movements of wind and simply extremes of perspective within the subject matter itself. The result is that artifacts are more visible up close than when we stand back, just like some of the French Impressionist painters like Monet or Pissarro, which are best viewed from a few feet back, rather than right up close. The artifacts or artifice is absorbed at a distance but obvious when you get too close. The same goes for focus stacking that is not rail mounted and studio bound.

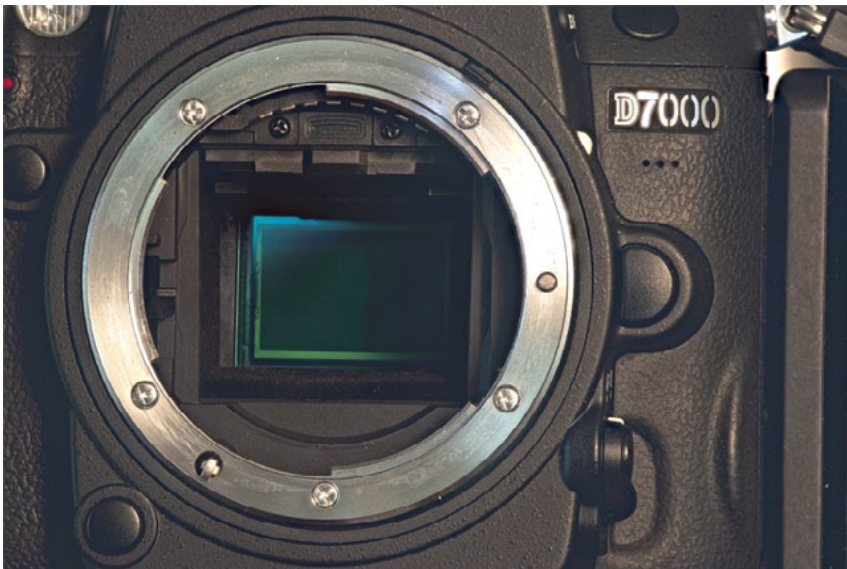
I find this out by trial and error. Sometimes I can get away with a lot and at other times the technique itself shows its flaws. The take away is there are limits to what short-stack focusing will allow. As you get closer and closer, going from close-up photography to macro photography or even closer to micro photography, you need more precise control, preferably in exact micro increments to get results. Impressionist focus sampling as we are discussing here doesn't cut it. We would need to be more exact than that.

As mentioned, the science of stepped-rail focusing does not interest me, so I refer you to Google where you can find any number of tutorials on rail stacks – requiring both science and art. Striking photographs, yes, but sometimes a little too 'clinical' for my taste.

Looking Close

If you look very closely at any stacked photo, you can find its flaws, however minute. This is the nature of the beast and just part of the deal when you use short stacks. Most such flaws are usually embraced by the overall enhanced sharpness of the stacked photo and don't stand out. Some are glaring and cause the photo to be rejected. Still others can be fixed in Photoshop easily, if they are

few. If they are legion, there is not much you can do but enjoy it in the abstract, flaws and all. Then you really are an impressionist! Frankly I am continually amazed at how well most stacked photos work out if you take some care with the original shots.

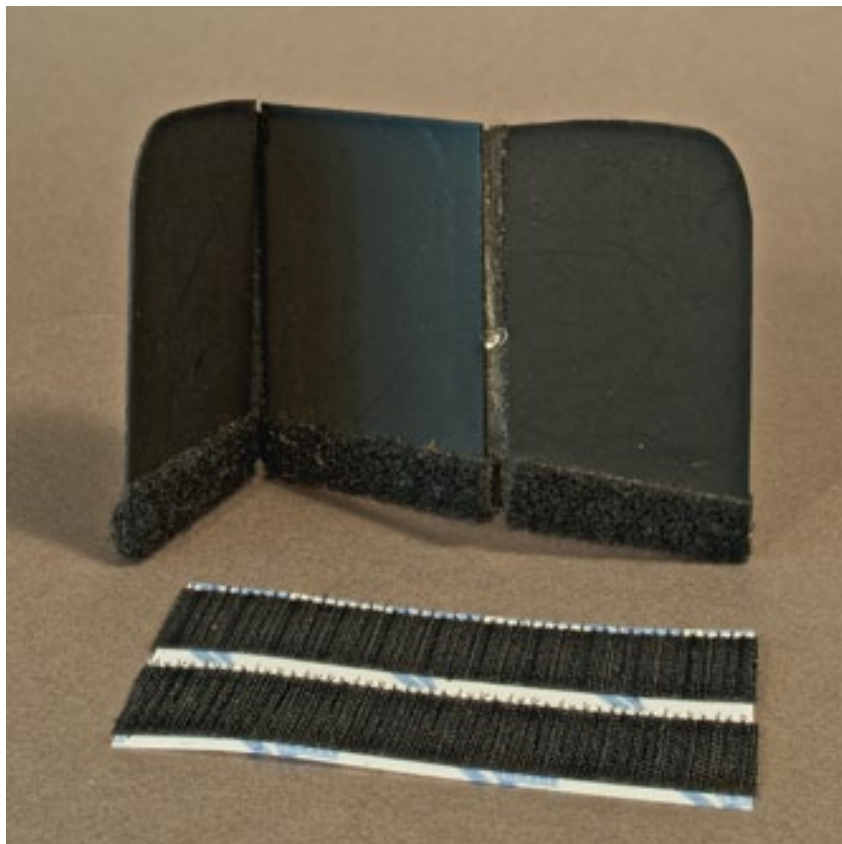


A peek at the sensor on the Nikon D7000 camera.



The Classic Nikon 70-180 Macro Zoom

The only macro zoom of any quality. I used it for almost two years exclusively because it was like have a focusing rail built into the lens, but moved on when I needed more light for the viewfinder.



Velcro Strips Can Rig Almost Anything

Far is Now Near

Years ago I travelled relatively far to get my shots. I would pack up the car and head out here or there for an all-day or half-day trip. I was always after this and that, here and there. I must confess at that time I was something of a “gotcha” photographer. In fact I can graph my transition over time from far away to near home as an ever-converging spiral ending right at my home or very close to it.

It would be wrong (and a cheap shot) to say that it is just because I am getting older. That plays a part but not a great one. My enthusiasm would get me “far” as I had a mind to.

The way I explain it to myself is that my eye for beauty has developed over the years. Where before I had all kinds of expectations and demands about what I wanted to shoot, what was

beautiful and what was not, that my punishment was that I had to drive all over hell and back to keep face with myself.

That position not only has softened; it actually has changed. For whatever reason, everywhere I look now is filled with beauty. I find good photos all around. My eye for beauty does get “tired” after a while and that is when I know it is time to head back and process stuff.

Beauty Begets Beauty

And beauty begets beauty. If I am inspired by a flower or something, often in the process of taking photos of that scene my eye for beauty becomes enhanced. In other words, my eye for photos expands on inspiration and suddenly I begin to see the beautiful in almost everything around me. And if I shoot that inspired beauty, it holds up over time. They are good shots.

However, what is incredible to my eye is not necessarily so for another. I can remember one poster on a popular forum who looked at what I considered a wonderful flower shot and replied “It looks like a picture of a flower to me.” There is no accounting for taste. I have learned to please myself and others should do the same. There is some truth to the old maxim “Touch one, touch all” in that if you can move yourself, often others are moved too.

What Do All These Photos Mean?

I find it difficult to look at page after page of test images and come up with any take-away from the process. What I learned from doing a lot of test shots lately is that most all of the 40 or so lenses I examined are very sharp, sharp enough for just about anything I might want to do close-up. What then are the differences?

The differences for me are at the boundaries where differences in sharpness become differences in color correction. Perhaps it is the presence or absence of the various forms of color aberration that I am seeing. All that I know, not being a scientific tester, is that APO (apochromatic) lenses are less harsh to my eyes and open up another frontier of subtle shades of coloring.

I feel I can see the differences and over time I have gravitated toward those lenses that have systematically removed various color imperfections. If you don't see the differences, fine. Your pocketbook at least will be the better for it. Since I do see (at least

think I see) subtle differences, I tend to migrate away from harsh contrast-heavy lenses and toward lenses with softer shades of color. In summary, my quest to find sharpness in the end seems to depend on how lens color imperfections are handled. Ultimate sharpness IMO is not so much anything discrete or findable in itself as much as it is dictated by the absence of the various kinds of aberrations and lens imperfections. In other words, APO lenses appear sharper to me (or perhaps the word “truer” is a better description) than non-corrected lenses. My quest for the Holy Grail of ultimate sharpness is seemingly satisfied by nuances of color rather than the traditional tack-sharp spot-on concept of “sharpness.” Considerations of sharpness turn into considerations of coloring. I would like to hear what the experts here have to say on this. What are your thoughts on this? So, color me crazy!

Get Out There!

Almost any excuse for a camera is enough to get started. Just getting out in the crisp early morning air with or without a camera is worthwhile. For me a camera is a pretext to get outside, feel the air and fog on my skin, smell the fields, see the sun come up, and watch the sunlight filter in. If I can't experience things like this along the way I have no idea what the goal of life is about or where I am heading to. My goal in those early mornings is just to be there.

If you don't have a camera, just go out without one and look at the world close-up. That is at least half of what this is all about for me anyway. Of course, if you have a camera, any kind of camera, that is even better. It sure does not matter what your photos look like in the beginning. I did not start caring about my photo results for some years. It was the experience of seeing nature close-up through the lenses that captivated me. The quality of my photos only improved much later, so the photo results should not be your goal when you begin.



The Passport from ColorChecker

The most convenient color IMO for field use.



In the Field

What's in the Macro Field Bag?

As a macro shooter, what do I take with me on a shoot and how do I carry it? I thought it could be fun to revisit the “What’s in the Bag?” theme with macro shooters in mind. We all might learn something and it is always interesting to see what other photographers feel is important to have with them.

First of all, like most photographers, I have too many gear bags. Most are pipe-dreams that cost a lot of money and didn’t do the trick or did it only for a short while. I have a small closet full of bags. I have ones with wheels that go on airplanes, ones that go on my back, on my hip, over my shoulder, and even weeny- teeny bags that can carry almost nothing. I also have large rock-concert-style hard cases if I need them. I haven’t lately. <G>

Then I have the one bag I actually use. It costs less than \$20 and filled with my stuff weighs only three pounds. It is an over the shoulder bag (I wear it fairly high up) and I hardly notice it when I am in the field.

Here is a photo of my standard bag. It is only 10x10 inches square and has one large main pocket within which is a single zipped smaller pocket for small stuff, cell phone, etc. On the back and in the front are two more large thin pockets where I carry my diffusers. By adjusting the over-the-shoulder strap higher the kit is not so low that it bangs on my hip, making me always aware of it. By wearing it higher I can feel it but it kind of hugs my back, which is where I

wear it... behind me. Since I do need to have things with me when I shoot, this is a pretty good compromise.

I carry one camera, often the Nikon D3s with two 32BG cards in it. I have never filled them all up. I usually carry a Gitzo GT-3531s Carbon-fiber Tripod (3.7 lbs.) with a RRS BH-40 PCL ball head with a Swiss-Arca type panning clamp (1.45 lbs). The Nikon D3s weighs 2 lbs. 12 oz, my CV-125 APO Lanthar lens weighs 28 oz., and my tripod with ball and panoramic head weighs 5.15 lbs. So my total camera, lens, tripod, and heads weighs 9.65 lbs. Add to that my camera bag which is 3 lbs., I have 12.65 lbs. or 5.74 kilograms. That is what I cart around.

Here is a shot with everything in the bag laid out so you can see it. I will name each item and try to explain why it is there.

(1) 22-inch Translucent Diffuser (use in bright sun)

(2) 22-inch Home-made Gauze Diffuser (use in mottled light) I have explained elsewhere on this site how to make your own diffuser that is not so opaque as the commercial ones.

(3) Flowerpod Expandable Tripod and Short Arm

Here in Michigan I am completely "WindDependent" if we can invent such a word. The Flowerpod allows me to hold a flower or leaf still enough to (sometimes) stack photos.

(4) Longer Flowerpod Extension Arm I built this and use it for greater extension. Sometimes I take two Flowerpods in the bag.

(5) Flowerpod Ground Spike

This goes in the ground and the Flowerpod arm has a magnetic end that fixes to this for low ground-level shots. (

6) Extra Clamps

Need them for clamping diffusers to branches and generally to give myself some extra arms.

(7) Shower Cap for Camera/Lens if Rain

Cost less than a dollar and protects your gear if a sudden rain shower comes up, and they do.

(8) Fenix 1-AA Battery with Diffuser Cap.

Many photographers carry one of those small LED flashlights like those made by Fenix. I have one that takes only one AA battery and is very compact. And I purchased a tiny diffuser that fits on the end of the lens and flips open and closed. What are these good for? I use them to (on rare occasions) shed a little extra light on the subject. At those times I wish I had another arm and it is best to hold the flashlight quite far back. A little is extra light enough, which is why I don't generally use a flash. I don't like the invasive look that a flash brings to a natural subject. But a tiny bit of backlight through a leaf or flower is helpful from time to time. The Flowerpod can hold the flashlight.

(9) Knee Protectors.

These cost almost nothing and save my kneecaps when on rocks, twigs, wet spots, etc., which is most of the time. They are foam and weigh nothing and very handy to have. I can carry them in my kit, but I usually just wear them if I am in areas that are rough. I hardly notice them anymore.

Where Are My Lenses?

I tend to use one lens at a time and try to get behind that concept. I sometimes carry one extra lens, usually a small wide angle (perhaps the 16mm Fisheye), but sometimes a heavy PC-E lens too.

What's in my Car

I will not follow nfoto's lead and show you a photo of my car. Let's say my car also looks full of stuff and aside from the passenger seat up front, the backseat and hatchback-trunk are, well, taken. Some of it is muddy (like hip boots) and the whole lot is piled all over. I don't carry lenses in my car and only sometimes an extra camera body, like the D3x.

Range Roving

I don't enjoy long all-day photo trips or big hikes much anymore, not because I am too old for it but because my "eye for natural beauty" usually last about two hours and gets tired. I stop seeing things I want to photography or worse I stop photographing things because I am tired. I guess I am getting old. In the car I usually carry the following:

- (1) An extra tripod for wet work.
- (2) Hip boots
- (3) Light Tent
- (4) Coats, hats, pullovers, etc.
- (5) Maps, Water, sometimes food.

There you have it. How about you? Let's hear (and see photos) of what you go into the field with.

Windependent

Where I live, here in central Michigan, wind is almost a constant. This is good for fresh air but tough on macro photographers, especially if they want to stack focus. It is one thing to wait for the wind to die down for a second and snap a shot but quite another thing to wait for the wind to die down long enough to focus and shoot 15-20 shots with no movement.

Because of the scarcity of calm moments I tend to keep my eye on the weather channel as regards wind speed. Typically there is sometimes a period of calm around dawn and just after, with the wind picking up as the Sun rises and starts to heat the day. That is the time for me to get outside and photograph because when the wind is above say 4-5 mph I might as well forget stacking photos and turn to single-shot images for a while.

Of course I can't wait forever and so sometimes I carry a little light tent with me although it is a bit of a pain to lug it through the woods. However, it does the job and shuts out the wind. Since I seem to need my photography fix almost daily, I have been doing a little more in my make-shift studio and am eyeing doing more of that yet.

Flowerpod

A much better and more-intelligently thought out product is the Flowerpod. It has a telescoping mini- tripod and a very short articulated arm that can hold diffusers, etc. It not only can hold things up but you can hang heavier things from it. I use it all the time to support larger items like 22-inch diffusers and you can lean even larger reflectors against the tripod and secure them with the small articulated arm from above. The tripod effortlessly expands to something like 45 inches. The Flowerpod (I have two) is available here:

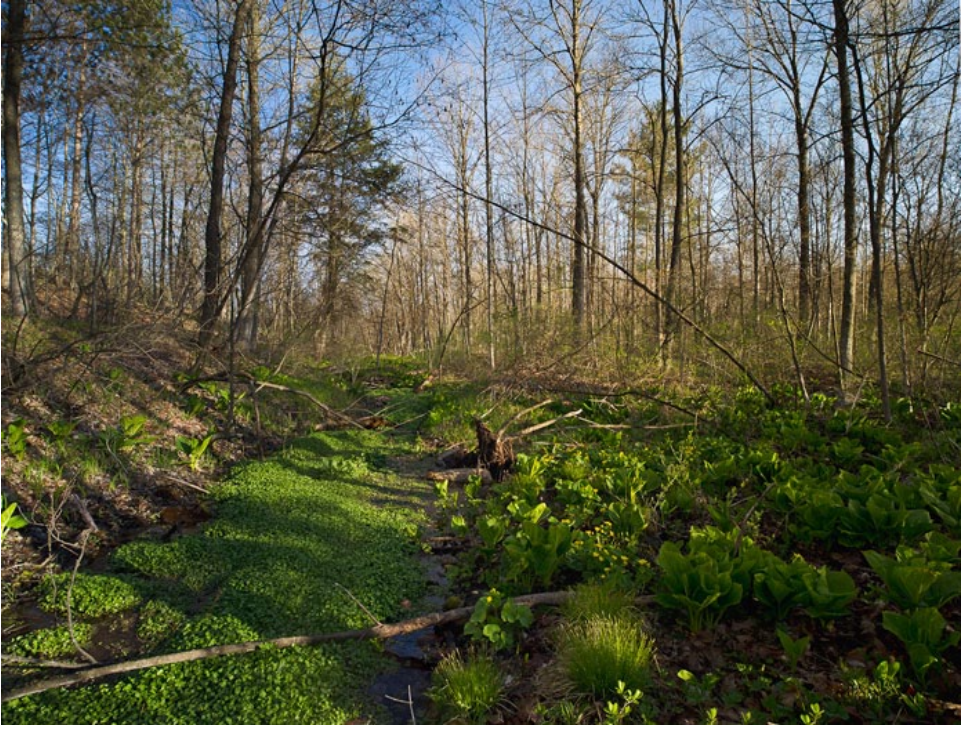
Close-Up Photography

I like close-up photography, especially nature photography. Seeing how perfect everything is. It is almost like proving to myself that no matter how close I look, things are flawless. In fact, photographing a perfect flower or bug is a welcome reprieve for me from the obviously flawed scenes I see in the larger world around me. A pristine leaf covered with dew in the very early morning or a dragonfly just waking up in a field somehow satisfies me in a way that is hard to describe.

Peering Through a Really Fine Macro Lens

First, I can see whatever I am looking at through the lens ever so clearly. The mere act of looking clearly into this macro world transports me into a state of mind that I seem to need on almost a daily basis. An hour or so of shooting close-up photos somehow allows me to get my mind right for the day. That sense of clearly seeing is why I am a close-up photographer; it is not about the resulting photos I take but the process and state of mind of the 'taking' of the photos that captures me. And it is addictive.

If I don't photograph something, if I don't spend some time peering through a perfect lens at something beautiful and pristine each day, I am at a loss. I have lost something.



Panoramas

Single shot close-up ($\leq 1:1$) or macro ($>1:1$) photography is one thing. The moment you add focus stacking to it the requirements change in terms of tripod stability, wind, and so on. Focus stacking is, among other things, wind-dependent.

If you then add multi-tier panoramas to the mix (and each frame is also focus stacked), the requirements change even more, including requiring a very stable tripod and head. It becomes harder to consider long hikes as the heavier tripod that is needed, an unyielding ball head, and the sturdier gear-systems needed for multi-tier panos that can support a large Nikon DSLR and lens, etc. suggest getting as close to the shoot by car as possible and then carrying the gear from there.

It is no secret that complex stacking and tiered panos are best done in a studio or in an environment where some of the variables can be controlled. I work outside but have to have patience because the wind is active where I live most of the time. My eye is forever peeled to the weather report and the wind speed. If there is an indicated calm, I am outside in a flash.

In a very real sense focus stacking and especially stacked tiered panos are an exercise in patience, so if you don't need to develop patience, you probably won't like this type of photography.

[Note: The above photo is what we could agree is a panorama but what I call a partial panorama because it approximates the size of a standard photo but has (somehow) a sense of greater spaciousness. This was taken with the Nikon D3x and the Nikon 24mm PC-E lens using the shift-lens feature. Of course this is a sad size to view it at. The original is very large and the fine detail of any part is quite visible. In the macro- panoramas on the next pages this idea is applied to a much smaller view.]

Single and Multi-row Panos

There is a big difference between single and multi-row panoramas both as to equipment and approach. With single-row panos I can almost get away without having a panoramic head. That is how good the stitching software like PTgui is. And I don't really have to worry about the so-called nodal point for the lens I am using. I can take three, four, five... whatever number of shots in a horizontal direction, left to right, and the stitching software just handles. And I can stack each photo.

However even with these single-row panoramas it is better to have both a pano head and a correctly adjusted nodal point slide.

However, the moment I want to have two or more horizontal rows on top of one another (two tiers), it is a different story. At that point I not only need a panoramic head but a very special one at that, one that can manage more than one row at a time. And for multi-row panos I need to find the exact (or near to it) nodal point for the lens I am using. The "nodal point" refers to the adjusting of your lens for parallax so that as you turn it sideways or up and down on the tripod, the point of view does not shift.

I won't try to explain it in too much detail here, but you can see it for yourself by just holding a finger up before your eyes, looking at your finger, and closing one eye at a time. Look how your finger moves against whatever is in the background. That is the idea of parallax. In order for the finger and the background not to move we would have to bring our two eyes to the same point and have but a single view.

When making panoramas we have to do the same thing with the lens and its position on the tripod. There is one and only one position that allows you to pivot the camera and lens around on the ball head and have no parallax. That is the nodal point. You can read more about finding the nodal point on any lens on the Internet. There are many tutorials.

If you attempt to stitch multiple rows together without having found the correct nodal point there will be an jog or offset when the rows are stitched together that is visible. You only need the nodal point for a given lens once, write it down, and use that position on your gear from then on.



[Note: This photo is also a panorama but now we have restricted the view to what we might call close-up range. I call these mini-landscapes. This panorama is focus stacked, so that each section is individually stacked and the resulting pieces are stitched together to create the finished panorama. Notice how we have essentially a wide-angle photo but one with very great detail (if we could zoom in or show this image at its true size). While I could have taken this shot with a wide-angle lens, the detail would not be there. It does not matter so much whether we can see that detail in 'detail'

because our eyes can see it is there even if we can't zero in on the focus. One has to decide whether you like this effect or not. I like it.]

The camera was the D3s, the lens the CV-125, the stacking software was Zerene Stacker, and the stitching software was PTgui. The pano head was by RSS (Really Right Stuff).

Panorama Problems

If your panorama comes back with a big piece missing in the middle of it, that usually means you managed to lose one of the images along the way. Usually if you look for the missing image or stack, add it back in, that will clear it up.



Summary

It is quite feasible to take a single row panorama (at least a mini one) with no panoramic-dial head. As long as your tripod is stable and your ball-head has a base-plate dial that allows you to turn the head pano-style, you can take a few photos, starting from the left and moving to the right, with no special head.

If you have a special panoramic head with really good controls, that is even better for single-row panos. However, if you are trying to do

multi-row panos, you need a special rig that fits on top of your ball head. Both NodalNinja.com and ReallyRightStuff.com (RRS) make good panoramic heads, in particular the RRS is great because it has the Swiss-Arca quick release clamps. I use the knob-style quick release, not the lever-style. IMO it is safer.

[Note: Here we have moved in even a little closer yet. The subject is a patch of Oregano and this panorama is focus stacked, although care was used to highlight focus in the foreground and let it go soft in the back. Again, this looks like an ordinary photo except it is very detailed up front and the spread of it is what you would expect to find using a wide-angle lens, only I don't have any wide angle lens that is this sharp.]

Tripods for Stacking and Panoramas

The main tripods I use are all three-section (as opposed to four-section) tripods. I find that three sections are more stable than four sections. The only advantage to the four-section tripods (that I care about) are that they fold up smaller and this is not a concern for me whatsoever. And since my three-section Gitzo tripods go flat to the ground, I have what I need for my work.

In addition, although I have a tripod with a center column, I seldom ever use it because the center column makes the tripod less stable than simply working off a flat plate at the top of the tripod legs.

This may seem like overkill but you have to remember that mostly I am stacking focus and doing mini-panoramas and for those I need great stability, which IMO center columns and four-section tripods don't provide.

The Background in Stacked Panos

If you are going to stack a panorama, be sure to pick an area in the background where the focus stops. I have some wonderful pano shots that have- mismatched background focus, that is: the line where the images were stitched together is focused to the left of the line and abruptly blurred on the other side. This is something that can be avoided with a little forethought.



A macro-panorama that combines fine detail in the context of a larger frame than most macro lenses would allow.



Combining Focus Stacking with Panoramas

I am gradually starting to combine focus stacking with partial panoramas in order to get close focus plus a wider angle, in essence approximating medium-format macro or close-ups.

The result is in reality a somewhat different animal than straight focus stacking. For one, focus stacking itself is a compromise, an “impression” of the subject. The mechanical part of focus stacking by definition loses definition much like a JPG file is a compressed or approximation of the RAW or TIFF file. Because focus stacking is a sampling technique, that means that something is sampled and something else is left out.

When we combine focus stacking with the blending or merging of stitching panoramas, yet more is lost. The resulting stacked panorama really is a breed unto itself, a technique all its own. What is gained?

A stacked panorama can give us detailed focus and at the same time the breath of what a wide-angle lens provides or that perhaps a medium-format might provide. I have many wide-angle lenses but none of them give me the detail I can get by stacking a partial panorama, at least so far.

Stacking panoramas is painstaking and deliberate, so not all of us enjoy this technique. Many don't like the patience of macro or close-up shooting. Still fewer enjoy the repetitive nature of focus stacking. And still fewer yet will want to create stacked macro partial- panoramas. There are times I don't have the patience for this either.

The above photo of a patch of Poison Ivey gives you an idea of the scope and detail available to us with this technique. Being able to detail a subject and at the same time embrace it with enough space to make it pop out is interesting to me. I know how to do a close-up or macro shot in great detail. This is not that, but rather that plus the context in which that detail resides. This is a technique for what I call mini- landscapes, the landscape of small worlds.

The enclosed shot is a single row panorama of several frames created with the Nikon D3s in portrait or vertical position with the CV-125mm lens. Multi- tiered shots (not this one) are more difficult and require more sophisticated equipment. Modern stitching software like PTgui is very flexible and as long as you overlap your frames by about 20%, you can pretty much get away without even a panoramic head. Photoshop also does a good job of blending frames. Taking photos couldn't be easier. Of course I suggest a solid tripod and an actual panoramic head and lots of practice.

Just start from the left, take a photo, pan the camera to the right being sure to overlap the preceding photo by about 20% and so on. Of course, before you start shooting check your exposure and also pre-pan the camera to make sure that as you pan you will get into the frame whatever you need AND that the light levels don't change in the pan.

An Approach to Macro Landscapes

"Macro Landscapes," almost an oxymoron at least in principle but I imagine you know what I mean by the term. I have been mostly a close-up and macro photographer for many years. In recent years I have been learning about focus stacking and always looking for that holy grail of... hmmm... well sharpness, and that search turned into examining color and APO, and now another twist yet which I will relate here.

Whatever I have been looking for I know it involves seeing things real close up and also the quest to find the really good lenses in

order to see life even better, whatever sense that makes. Sometimes I believe I want to duplicate the experience of seeing things as our eyes see them, where everywhere we look things are in focus and at the same time our peripheral vision holds things just out of sight and always beckoning for focus. There is a mystery in the way our eyes work IMO. It is hard to put into words but I am confident I am not the only photographer with this goal. My interest in close-up nature photography started in the mid-1950s but it was not until many years later that it really took hold and these last many years it has been a real passion.

When I was not satisfied with traditional single-shot photos I wandered into focus stacking which had the side-effect (an expensive one) of demanding better and better lenses. At first it was just sharpness I yearned for but I found out that sharpness finally depends on color and so I soon was collecting APO lenses that would fit on a Nikon mount. And so it went.

But that too ran its course and while I was finally happy with the resolution and sharpness I was getting with focus stacking, the resulting photos (however sharp) were too confined. In other words, by getting closer in on the subject I no longer had enough surrounding space. Makes sense? The subjects were perfect but the context, the space around them, was not broad enough to tell their story fully.

This led to wide-angle lenses like the Nikon 14-24mm and the new Nikon 35mm G f/1.4 and so on in an attempt to get a wider view but still hold the detail. These wide-angles are great lenses and they were wide enough but I felt that the sharpness of the subject was not detailed or fine enough IMO. Obviously I was trying to make two opposites meet, thus the use of the term ‘oxymoron’ earlier. I couldn’t eat my cake and still have it too. Frustrating.

Then I saw the wonderful photography of Fred Nirque posted on the NikonGear.com forum. Nirque was getting something like I had imagined only he was doing whole landscapes and my dream was more about mini-landscapes, dioramas, what I call “macro landscapes” or just “small worlds.”

Nirque pointed out to me the value of the 16mm Nikon rectilinear fisheye and I played with that for a while. The rectilinear 16mm fisheye (when straightened out) had the space I was yearning for but the details were not in-focus enough for me. More recently

Nirque has begun using multi row panoramas (stacking them too) and they look great. Now this is a lot of work as I well know because I have done a lot of focus stacking. I needed to find a panoramic head and see what it would do for my languishing dream of small worlds – macro landscapes. I ordered a panoramic head but it took a while to arrive. In the meantime it occurred to me that the three Nikon

PC lenses I have (45mm, 85mm, and 24mm) had not only a tilt feature (which is why I bought them in the first place) but also a shift feature which I had done little to nothing with up until now. These lenses have a much larger image circle than normal lenses which is what allows one to shift left or right and still have some subject in view. I thought: why not take shift left, middle, and right photos and then stitch them together with Photoshop or PTgui. And so I did. Of course this was not a new idea.

And sure enough, they worked pretty well. Photos taken with the shift feature of PC lenses certainly stitch easily because they are all from the same image circle. And why not stack each of the three photos, retouch them if needed, and then stitch them into a panorama. The result was relatively great (at least eye opening) and did not require a lot of special equipment or even a panoramic head. Plus I could take three photos (left, middle, right) and then two more, above and below, and stitch them all together into a single photo. Those of you with PC lenses might want to check it out. That is the good news. There is some bad news as well.

The shift on Nikon PC lenses goes 11 degrees both to the left and the right as a maximum. This works pretty well for the resolution but not as well for handling light. There is moderate to severe vignetting at 11 degrees. For some reason it seems to be worse on the left side than the right. It may just be my lens or perhaps some of our tech folks can explain that. Although the shift can go 11 degrees on either side, Nikon suggests (and gives marks for) half that range, about 5 ½ degrees left and right. This is a lot safer and produced relatively little (certainly less) vignetting.

Another problem with the PC lenses is the focus throw on these lenses is extremely short, something like 120 degrees and a far cry from my CV-125 which approaches 720 degrees in focus throw. The downside of this is that you must focus very, very carefully. Even a little movement moves the lens a lot, especially on the

24mm PC. Mounting PC lenses on a focus rail might help. I like the results but they are not quite (when looked at close) up to my standards. And the PC lenses (as sharp as they are) don't compare (due to several reasons) with lenses like the Voigtlander 125mm APO- Lanthar, at least IMO but the PC lenses are very, very good lenses.

The Nikon PC lenses were a quick and dirty way to get decent macro panoramas, and regular landscapes too for that matter. However, I burnt through the possibilities of the PC lenses fairly quickly. I then moved on to something more useful to me, the panoramic head. I wanted to try a regular panorama head with my CV- 125 and see whether that worked well. I finally received my RRS panoramic head and a nodal slide. As it is I can attach the bottom of the pan head to my standard ball head using a Swiss-Arca clamp and then attach my L-Bracket/Camera to the top of the nodal slide, also to a Swiss-Arca clamp available there. This allows me to easily level the camera by leveling my regular ball head. It sounds like it might be unstable but it is not. It is stable enough for my purposes.

I then put my Nikon D3s with CV-125 macro lens on the nodal slide, adjusted it for parallax, and began taking photos. For starters I took three photos at five or ten degrees from one another and stacked each of those three views as only the CV-125 can stack. I then processed the stacks, touched them up where needed, threw them into PTgui, and out came a panorama. And they look pretty good so far.

This appears to be the answer to my prayers and I like the way my in-focus subject is now embedded in surrounding space that shows something of the context (tells the story) of what this shot is all about.

And while I am still getting into this it actually looks like it could be the end of a long journey to find a technique that shows the subject the way my eyes (my mind) see it. No, it is not perfect but it is more perfect than anything else I have tried to date. With this approach I am working away from close macro shots toward embedding those shots in context and creating the macro landscapes I have been envisioning for all these years. In some ways I am back to square one with a lot of learning and experimenting to do, which seems to be the way I like it.

In summary, what I am in-effect doing (at least in my busy little mind) is approximating the medium format camera. I like the detail that macro lenses like the CV-125 offer but I need that macro shot embedded in greater context, a larger image. Way back when I tried to get this effect out of wide-angle lenses like the Nikon 14-24mm.

Wide-Angle Lenses and Panoramas

The idea of wide-angle lenses is to take in a wider area, cram more of the subject into the front of the frame but include much of the background as well. The problem for me is that the farther back you pull a wide-angle lens the less actual detail or sharpness you can see. These macro landscapes (partial panorama macro shots) take a different approach. You drill down to the detail either in a single-shot panorama or in a series of stacked shots, each one in extreme detail. You don't really step back from the subject but instead include more of the subject on the right and left, and perhaps above and below.

Even if the net effect is reduced to the size of a wide-angle shot, the eye can see that the detail is there, the sharpness captured and if you zoomed in, there it would be. As mentioned, it seems what I need would be satisfied by a medium-format camera, but I am loathe to give up all my lenses and buy them all over again, not to mention camera bodies, digital backs, and all of that. Instead I am (so far) impressed what a decent panoramic head will do to give me the context I want, that peripheral feeling but still be zeroed in on the detail.



The Classic Nikon 200mm f/4 Macro Lens

In great demand because it allows for significantly more room between the photographer and the subject.



Plastic Lens Caps

These cheap translucent plastic lens caps is what Nikon is now sending out with new lenses for the back-end cap on our lens. Sad.



The Nikon D3x, 24MP Camera

This camera has two slots for high- capacity Flashcards.

To Stack or Not to Stack Panoramas

The CV-125 is very sharp at mid-distances as well as very close up. Putting a three-shot panorama together with a choice of three un-stacked photos and three stacked photos at a mid-distance favors the un-stacked version because of lack of halos and need for any retouching.

When considering panoramas it may well be better to not stack the results for mid-range photos and rely on the panorama to bring the effect of 3D or whatever we want to call it.

My original excursion into focus stacking favored a few shots, just enough to capture the situation, more like a snapshot than a

finished photo. The lack of finish led to larger and larger stacks but also to more and more artifacts and complications. There is no such thing as a free lunch.

Now with the entrance of limited panoramas into my work I have been forced to rethink focus stacking as the prime solution, especially long stacks. Perhaps using panos and a short stack may produce better images.

Three-shot panoramas with no stacking work pretty well if the subject is more or less flat and you are using a higher aperture like f/8 or f/11. Then it picks up enough DOF to reveal sharpness. However, it might be better if there was some light focus stacking, like making sure to focus on the highest things sticking up, then a couple more layers going in evenly.

Effectively these kind of panoramas have allowed me to add on to the right and left sides of this image more of the subject, all in good detail. Looking at one-third of a shot with the CV-125 would lose the effect. Pulling back with the CV-125 and shooting horizontal would be better, but would also take away from the effect.

Anyway this is what I am experimenting with these days, approximating what perhaps a medium-format camera might produce.

Problems with focus stacking macros in my experience depend upon how you chose your subject. If the subject is mostly flat and parallel to the plane of the camera sensor there are no big problems. If you want to catch a leaf close to the lens, a flower some distance beyond that, and some background leaves in the way back, there are usually problems.

Where objects in the foreground overlap the backgrounds are the perhaps the most problematic. The near object has a blurry background (good bokeh) but the background itself is more or less in focus. Where the near object overlaps the background the two backgrounds (near and far) can never mix. This leaves a halo or ghost along the edge of the near object for the obvious reason that the two backgrounds (one blurred and the other in focus) have to meet somewhere and that meeting can't be nice.

By hand retouching you can try to paint over the area near the edge of the near object and in Photoshop you can use the Clone Tool to paint in the sharp background right up to the edges... in some

cases. However if the forward object has hairs, spikes, or any find fringe this becomes near to impossible or just not worth the effort. Better to take a single-shot photo and leave it at that.

If your dream of focus stacking is to stack images with no retouching, good luck! Sooner or later you will find yourself entering the world of retouching stacks and it can be a tricky business. That goodness that Zerene Stacker has such powerful and easy-to-use retouching features. Otherwise, I doubt that I would bother.

The 24mm PC-E is a great lens and the woodland scene (landscape) I posted was done with that lens and a pano head. As for primary and secondary subject, that is different than I see it. I see it as primary subject and 'context', rather than anything else as the subject, secondary, etc. Think of it as a pictorial vignette. You know how a little vignette can make a subject pop. Well this technique can do that as well, just differently. That is my guess.

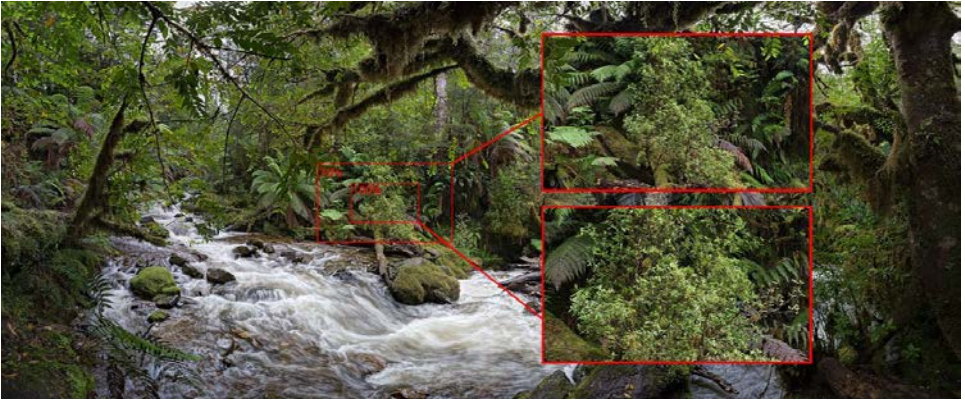
All this is very speculative for me as well. Expectations keep dreams alive and sometimes our dreams are even met with reality. I like exploring these techniques and I sincerely feel that combining focus stacking and a pano head is the key to what I have been looking for all along, hopefully not in some garish way and I have no real use for 360-degree panoramas other than they are interesting. I just want mini panoramas, dioramas, macro-landscapes, or "small worlds" as I call them. I just want them to reflect what I see in the mind. Keeps me taking photos! The D700 is a great camera and I keep regretting that I sold mine until I realize the D3s is just as good. Still, the D700 was a landmark lens in my work and a real beauty. I had a small view camera which I sold, a Linhof. If there was one view camera that took Nikon lenses (which would miss the point of medium-format) and I could afford a digital back, I might go there. Yet I believe the lenses I have and a decent pano head is all I really need, at least right now. Who knows where this will lead?



A Multi-tier Pano Rig from Really-Right-Stuff



The “Growling Swallet” Panorama by Fred Nirque



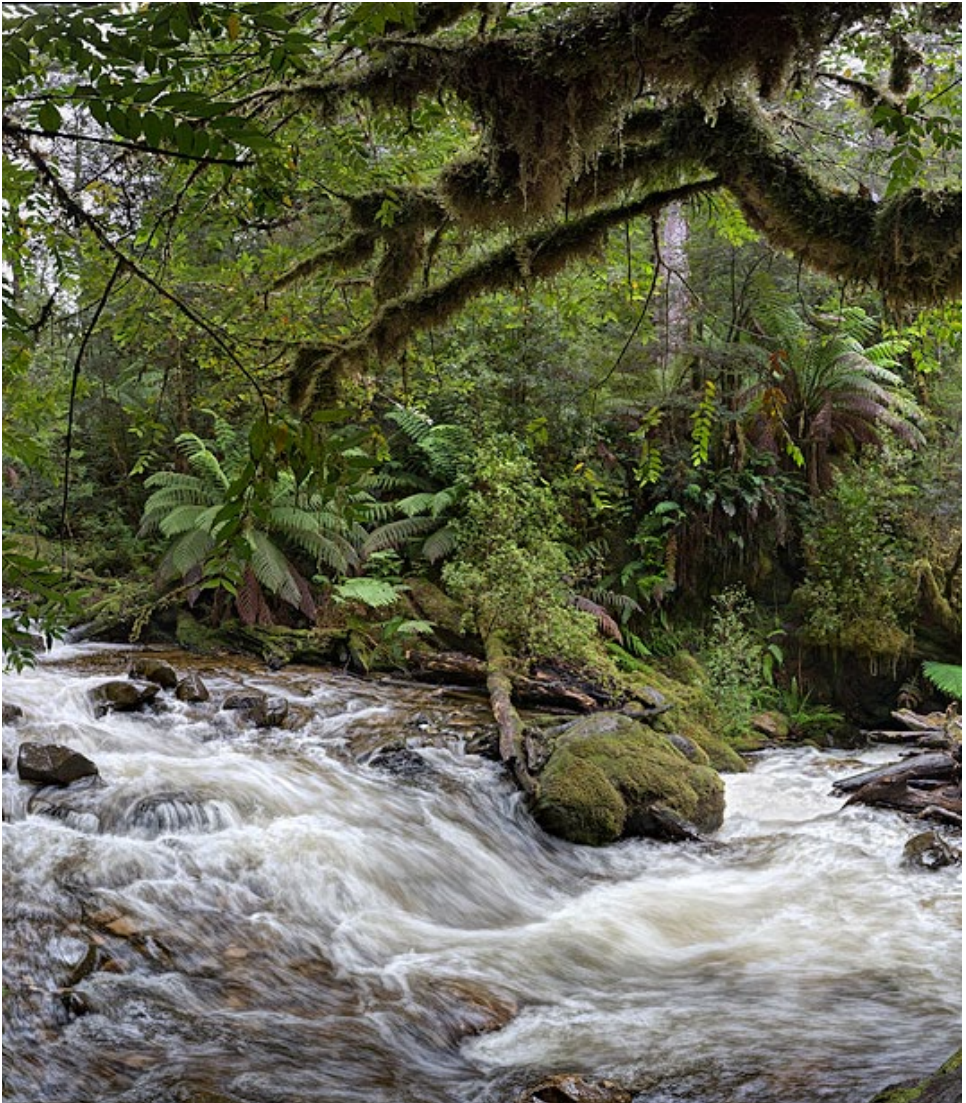
The Focus-Stacked Panoramas of Fred Nirque

One photographer that has been very inspirational to me is Fred Nirque who lives “down under” Australia where he photographs the ancient forests in the Upper Florentine Valley of Southern Tasmania. These ancient forests are in danger of being destroyed and Nirque has worked tirelessly to document these vast primeval areas before they are logged out. Carrying photography equipment Nirque has backpacked far from roads into the deep wilderness to take some incredible panoramic photos. And these are not your normal panoramas.

It is a shame that there is no room here to show you what these photos look like large. I haven’t even seen the originals myself because they are huge. I term this type of photography “partial” or mini-panoramas because their intent is not to do a 360-degree view but to expand and deepen one section of it all. Nirque not only creates panoramas but these are multi-tiered (multi-row) stacked panoramas in the order of 150 to 250 megapixels on average. This photo, “Growling Swallet,” by Nirque was taken with the Nikon 50mm f/1.8 lens, some 616 exposures that took an entire day to stitch together. This shot involves tiered rows of panoramas, one on top of the other, each exposure in a row itself stacked from front to back. In this way in every bit of the photo, wherever you look, you can see the finest detail. Work like this involves a very sturdy tripod and a multi-tiered panoramic rig installed on the tripod head. Then the position of each photo has to be precisely measured and within that single photo, layers of focus stacking have to be done. The panoramic head has to be moved just the right amount and this

goes on for the entire sequence. It can take a long time. And that is just the beginning.

Once all these photos are taken and brought back to the studio, they have to be kept track of. The sequences of each sequence have to be stacked and the resulting stacked photos sequenced in their particular row and column. When all that is done, the entire set of photos has to be seamlessly stitched together to form the one huge panorama that you see here.

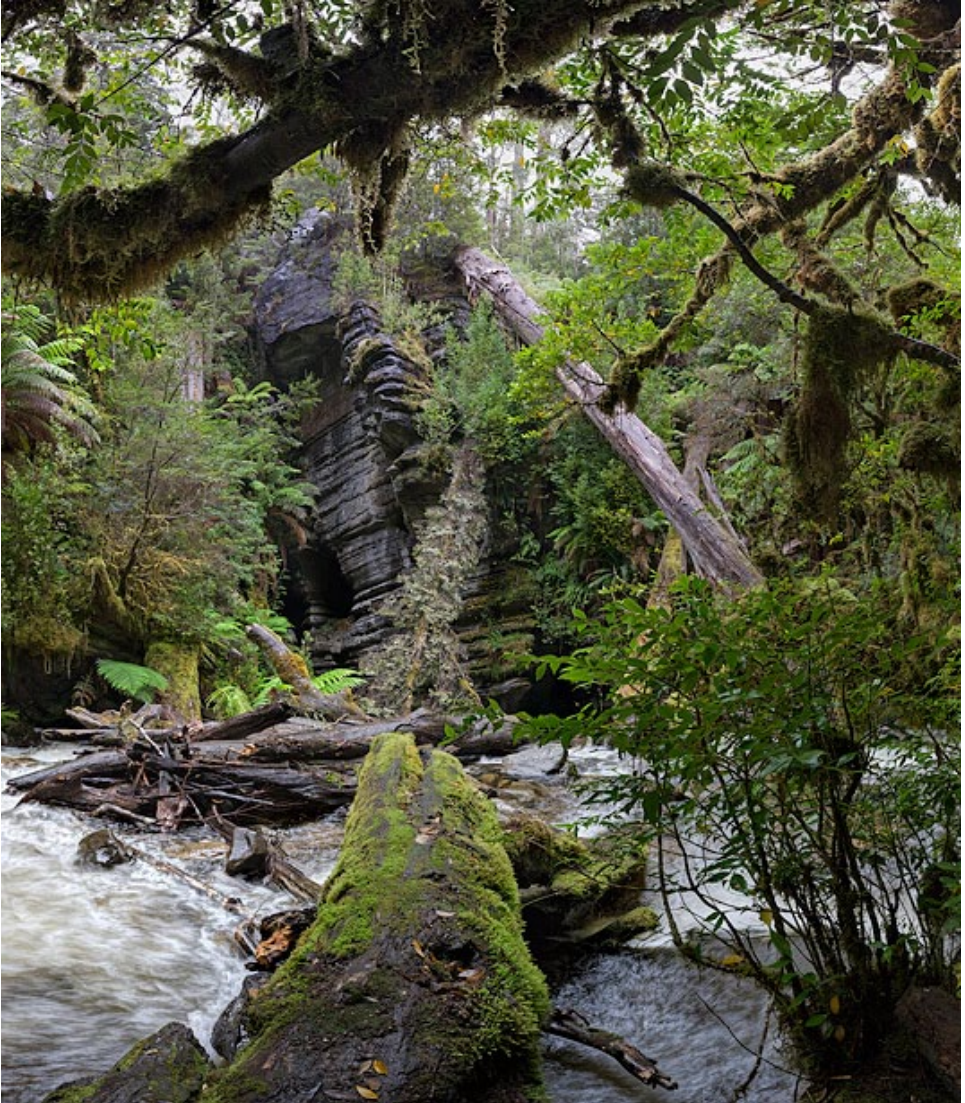


Section “Growling Swallet” Panorama by Fred Nirque

Why not just use a wide angle lens?

No wide angle lens other than a fisheye lens could capture this wide a view and fisheyes are not sharp enough to give you this kind of detail. This is the kind of detail that only our mind and vision can take in. It is like being there.

The chances of you and I getting to Australia, much less to Tasmania are slim. Even if we got there, getting from the roads back into the deep forests are even less likely. A simple snapshot does not represent the reality of being there. Nothing does but being there. Still, a wide stacked panorama like this one perhaps begins to give a sense of what that wild area is like – the reality.



Section of the “Growling Swallet” Panorama by Fred Nirque Who knows what motivates a photographer to go to this trouble to represent an experience that only a very few will ever see live. In my own work it is the ‘seeing’ of reality, not just the sight seen. The seeing of the sight seen, the experience of seeing is what I am referring to here, the being there. No, I have not been to the “Growling Swallet” but I do get a sense, however rough, of the reality. This is great photography thanks to Fred Nirque!

Focus Stacking

Interest in 'focus stacking' is increasing rapidly. In this short article I would like to suggest some reasons why this might be. For those of you unfamiliar with focus stacking, let's make clear what it is.

Just as exposure bracketing and HDR (High Dynamic Range), techniques (where a number of photos are taken at different exposures and then seamlessly combined into a final photograph) are popular so focus stacking takes a series of photos of an object each taken at slightly different focus points and combines these photos seamlessly into a final photo that represents the object with everything in focus, as if it naturally had greater depth of field (DOF).

Focus Stacking is essentially 'focus bracketing' and the result is a photo where everything (or more than you might expect) appears to be in focus as opposed to the traditional photograph where there is only a single point of focus and anything not at the point is to some degree out of focus, however slightly. The resulting stacked photo (from combining the images at different focal distances) can be remarkable and advances in software like Zerene Stacker, Helicon Focus, Adobe's Photoshop CS4 are perfecting this technique.

Two Types of Focus Stacking

There are two general types of focus stacking being used today with perhaps the most common idea of this technique including a camera mounted on a focusing rail (or a lens with bellows attached) and the photographer taking many dozens (sometimes up to 150-200) photographs, each photo just a few millimeters apart from one another. This first technique is used mostly for scientific, product photography, and by a few naturalists who carefully create deep stacks, usually in a studio, like the one a few pages down, which is very interesting.

And while this more elaborate form of focus stacking is wonderful in its own way it requires more specialized equipment and does not readily lend itself to being used outside in the fields and woods or at least is more difficult to take outside. There are many tutorials on the web for this more technical type or style of focus stacking available so I refer you to Google to find those. For myself, I am not much interested in that method because I don't want to haul all that

equipment around and the more “scientific’ approach does not interest me that much.

It is also possible to stack photos and get excellent results armed with just a camera and a tripod. That will be the method presented here. In this brief article I will present some guidelines to what I call Short-Stacking where instead of 100 layers painstakingly shot to achieve perfect incremental focus (a science in itself), we shoot just a few (let’s say from two to a dozen or so) photos and combine those to achieve the effect of seeming greater focus and depth of field (DOF). This less-technical approach is, by definition, somewhat more impressionistic than the first method I described because no attempt is made to get every possible micro-layer step photographed, which in nature (as we know) is very difficult due to wind, changing light, moving creatures, and so on.

With short-stacking we shoot fewer photos, choosing which layers in the scene we want to capture and have in focus, layers that represent our impression of what is key or beautiful about the particular shot. To my mind, although less demanding, there is somewhat more art in this method but that is just my opinion. I like it because I can be out in the wilds of nature without a lot of equipment and still produce photos with an apparent greater focus and depth of field, thus: ‘focus stacking’.

The Equipment Needed

While theoretically you can stack focus with any digital camera, in reality the process quickly sorts itself out in favor of better cameras and (for sure) sharp lenses. After all, the ‘focus’ in focus stacking means trying to get things sharp and that requires a lens that is actually sharp and a camera that can process the light from the lens efficiently. In practice any decent digital camera with a sharp lens will work but like everything else it is easy to fall into the pattern of wanting a better camera and (in particular) better and sharper lenses. And let’s not forget about tripods.

While some few photographers who focus stack make a virtue out of hand-holding their shots (Look mom, no tripod!), the rest of us will find that we want our camera and lens mounted on a stable tripod. With all of the other variables in this technique, trying to hand- hold the camera is not something I would choose to do. Therefore in this presentation good focus stacking requires a tripod.

After all, we want the scene to hold perfectly still while we sample shots at different focal distances. Having the camera also shake and move around simply because I am holding it does not interest me. I suggest we need a camera, a good lens, with both of those mounted on a sturdy tripod.

The Actual Technique

Given that you have the camera securely mounted on a tripod, the technique is quite straight forward. You aim the camera at a scene you like, whether close-up (as in macro photography) or farther away (as with landscape), and proceed to take several carefully-focused photos at various focal distances. You will need to decide what part of the scene you want to have in focus which for a landscape shot may be the whole thing, but for a close-up shot it could be just a flower. Let's use a flower or a leaf as an example.

Starting at the very front most part of the flower, carefully focus at the front edge and take a shot. Next, using the focus ring on your camera, move it just enough to focus a little deeper into the subject and take a second shot, and so on, until your final shot is one of the far (rear) edge of the subject.

You now have a series of photos, each with a different focus point, running from the front to the back of the subject. In each shot ,part of the flower is in perfect focus while the rest of the shot (to some degree) lacks focus. You might have as few photos as two or as many as you like or feel you need. As mentioned earlier, if you get into dozens or hundreds of shots, you probably need to have special equipment, chiefly some kind of focusing rack to mount your camera on that allows tiny evenly-spaced incremental movements, etc. For reasons given above I am not going there in this article but instead working with just a camera and tripod.

Once you have taken several layers of shots you are ready to process the layers into a single photograph. You do this back home on your computer using special software which you will need to have. Some brands of focus-stacking software include:

Zerene Stacker (best)
Helicon Focus
Adobe Photoshop CS4
CombineZM

I have tried all of the above software and, while they all seem to work, each has its quirks. CombineZM is free (GPL) so you might want to download a copy, but it lacks the polish and ease of use (IMO) that I look for in a program. The most well-known application that can process photo stacks is Adobe Photoshop CS4 (and higher), which is easy to use, but it is not free and also runs very slowly when building stacks. Photoshop's results are not up to some of the other software. There is a general review of focus-stacking software later in this article, including how to stack in Photoshop, but all of the above-listed software do more or less the same thing, which is to align your stack of photos and merge them. The program I use almost all the time is Zerene Stacker but all of the above can do the job.

Software to Align and Merge

Using the software, the stack of photos taken of a subject, each at a different focus point, need to be lined up. Every time we turn the focus ring the whole image is enlarged (or shrunk) depending on which way we turn it. While each layer is a photo of the same object, these photos are enough different that they don't just automatically line up. They have to be aligned, one with the other. Once the stack of photos are in the stacking software (each one in a different layer), the program has to do two things and in this order. First the program will align all of the different photos so they line up with one another internally. This can take a long while in Photoshop but Helicon Focus and Zerene Stacker are very fast.

Once the layers are aligned, then the aligned layers are blended to merge the separate layers into a single photo which is then flattened and saved to a hard drive. It is as simple as that although these operations can take a long time depending on the number of layers and the subject matter. Something with a lot of contrast and detail is easier for the software to align than say a pile of sand where there are not many reference objects. It all depends. Some take seconds while others can take 30 minutes or more. Photo stacking, like macro photography itself, is a lesson in patience, so if you are in a hurry, I don't suggest it. For me it has been good, because I need to learn to have more patience and this is a fun way to do that.

Focus Stacking Results

So there you have the general technique which as you see is actually pretty simple. The tricky part is learning how to get the results you imagine rather than the results you actually get. Focus stacking is a natural teacher about expectations and real-world experience. You don't always or easily get what you want. At least I don't.

However, focus stacking can deliver stunning results when all goes well. I find it worth the effort but don't imagine that focus stacking is the only kind of photography I do. There are subjects that lend themselves to stacking and those that do not. I already knew something about traditional depth-of-field photography and wanted to add this new technique to my skills. In this article I will try to discuss some of the ins and outs of focus stacking, hopefully to make your experience of this fascinating technique easier.

Before we get into some of the technique of focus stacking, I would like to present a possible reason why focus stacking is so appealing to the eye.

A Possible Theory

Human vision can only focus on one area of a scene at a time. No matter how much we take in, no matter how much is going on around us, our eyes can only focus at one point at any given time. Everything but that point of focus is, to some degree, out of focus. Just try it now. Look across the room at an object and note how your peripheral vision on either side of the object is slightly out of focus. We are so used to this phenomenon that we are seldom even aware of it.

Although everything around us actually is not in focus, except where we look, this does not affect us because wherever we look, things are in focus. The mind automatically behaves as if we live in a world where everything is always in focus because as we look here or there, things 'are' always in focus, which brings me to my point:

The photos we take, at least at near distances, are seldom in complete focus. In fact we have no choice but to focus on one area of a scene or another, and all other areas will be at least somewhat out of focus. This is why photographers make such a big deal out of

depth of field (DOF). In particular, macro photographers struggle to get this beetle or that butterfly (in its entirety) in focus. We push our f-stops so high that diffraction often destroys our resolution before we can get everything in focus. Enter focus stacking.

Focus Stacking creates a photo image where most everything is in focus just like our mind assumes the world out there is, as well - in focus. While with most photos we are drawn to wherever the photographer happened to focus, given a stacked photo, we are free to look anywhere we want. The photographer no longer dictates where our eye should go by his point of focus and we are at liberty to just kind of look around as we like.

This newfound freedom brings a kind of spaciousness to the mind and stacked photos have an almost 3D quality when really the only thing new is that the whole picture (or at least the main subject) is more in focus than we are used to. Let's look at examples of stack photos and some of the things to keep in mind.

Focus Stacking Apertures

There are two methods of setting the aperture that I use when focus stacking. If there is no wind and the subject is rock-solid-still it is best to set the aperture for the lens to its sharpest setting which usually is somewhere around f/f.6. With this setting, then shoot layers in tight increments (in small steps). This insures that each shot is as sharp as possible and the combined stacked image will be also.

There is no point in shooting stacked photos at higher apertures like f/11 or f/16 because you will only be stacking less than the sharpest focus. You will be stacking diffraction. However, there is an exception to this general rule and I use it quite often.

If the subject is moving, wind or whatever, and you don't have the time to shoot 15-20 exposures carefully stacked then I push the aperture to f/11 or somewhere beyond the optimum and make a smaller stack, say four or five images. These often will stack pretty well AND if there is too much wind or motion there is the chance that at least one of these stacked layers is sharp enough to use as a single photo. And last, if all else fails and the wind is bad, I shoot only single-shot photos and forget about focus stacking for that day. In that case I will up the ISO and get a faster shutter speed plus also push the aperture to f/11 or higher and go for single shots.



Stacking Issues

If it is anything but a short stack, leave plenty of space on all four sides of the subject because the longer the stack, the more chance that some part of your subject will be truncated and lost. When a large stack is processed, more and more of the sides are cut off. I have any number of great photos that have been decapitated because I framed my shot too tightly using only the first layer as a frame and not checking to see as I focus closer how much of the edge would be lost. In other words, stacked photos need extra room around the subject.

Background Too Much in Focus

If the foreground subject is busy and the background is also very busy AND you have the foreground and background all in sharp focus, the foreground subject receives no relief and the whole

image is too busy and hard for the eye to pick out the foreground from the background. This is easy to cure by only stacking the foreground and deliberately not stacking the last five or ten layers that make up the background. Focus stacking is more effective if used sparingly.

Tripods for Macro Use

For general snap-shot photography tripods are seldom used but for close-up and macro photography they are almost always used and for focus stacking they are pretty much mandatory. Tripods are three-legged devices that serve to elevate the camera at a given height and stabilize it. On the top of the three legs the camera is mounted to a plate on that usually has a 1/4" or 3/8" mounting screw protruding upward to receive a tripod head on which sits the camera body.

Although camera bodies can be screwed directly to the mounting plate on the top of the tripod, most often the camera is fastened to a mounting head (ball head, pan-tilt head, etc.) which itself is fastened to the plate on the top of the tripod. The ball head usually has some form of quick-release clamp to mount and remove the camera body in seconds.

There are all kinds of tripods made from all manner of materials and designed for all kinds of purposes. Some are very heavy and used mostly for studio work and others are lightweight and suitable for travel or field work. Here we are mostly concerned with tripods fit for carrying into the field and used in macro and close-up work. We will concentrate on those.

Tripods come in two general formats, with and without a center column to which the ball head and camera are attached that can be raised and lowered. The consensus among macro shooters that I know is that tripods with a center column are inherently less stable than those without one. This has been my experience as well.

Having used both types, I only use center-column type tripods in the studio and these are very heavy tripods that you would not want to carry in the field. In the case of a very heavy tripod the center column is perfectly usable, especially in a studio situation.

Field tripods, on the other hand, need to be both lightweight and sturdy, two opposite qualities. In other words macro photographers

are always searching for a field tripod that is both lightweight and sturdy at the same time.

My Experience with Tripods

Although it took me many years to take this advice myself, nevertheless I pass it on to you. It is far, far better to buy a really good-quality tripod for macro use than to try and get by on a beater or a cheap one. The common thought appears to be that the camera and lens cost a lot, so let's save money on the tripod and get a better one later. This is not a good idea and for several reasons.

For one, a cheap tripod generally will not give you the stability you need for close-up work, in particular if you are focus stacking or doing multi-tier panoramas. You need a rock-solid tripod for this kind of work.

Secondly, if you purchase a really good tripod you can almost always sell it for a goodly amount later if you fall out of love with photography. I have a whole closet full of cheap aluminum tripods (they won't sell) that I purchased trying to avoid buying one good tripod. They are and were worthless. Worse, their inherent instability and heavier weight set my learning curve back I don't know how long, but it was a lot – a big mistake on my part. That being said, what do we need in the way of a tripod for close-up, macro, and focus-stacking work?

Lightweight Tripods

Carbon-fiber tripods (or other ultra-light alloys) are what you want for field work. Similar to fiber-glass, carbon fiber is both strong and lightweight and, as more and more manufacturers are now producing them, they continue to be less expensive. And more appear on the used market all the time.

Strength

Carbon fiber alone is not the whole answer because there are many carbon fiber tripods that are too small or weak for constant field work, especially if you are mounting a large ball head, DSLR, and hefty lens on them. Get one that will hold your rig easily, not barely.

Three or Four Leg Sections?

Most tripods come with legs that have three or four adjustable-sections. The only reason for having four rather than three leg sections (to my knowledge) is because the tripod folds up into a more compact package for hiking or storage. Having used both types, I always opt of the three-legged version. They weigh less and are inherently more stable and solid. I no longer consider four-section legs when I purchase a tripod, only those with three-section legs.

Center Columns

For a similar reason I no longer will purchase a tripod for field work with a center column or, if it has one, I remove it at once and consign it to the closet. No matter how strong that center column is (in a lightweight tripod) it will never be as sturdy as a simple three-legged tripod with a mounting plate and no column. Those columns invariable wiggle and wobble just when you don't want that. Develop the discipline of not using a center column except, as mentioned earlier, in the studio and with heavy tripods. So what to buy? I can only tell you my experience.

Using Tripods in the Field

I use Gitzo tripods for most of my work. An example of a nice but finally not-quite-sturdy-enough tripod is the Gitzo G1228 Mountaineer Reporter MK2. This carbon fiber tripod is quite lightweight (around 3.4 lbs (1.54 kg) and is easy to carry in the field. It is rated to carry a 17.6 lbs. (7.98 kg) load. However, with a big DSLR (Nikion D3s, D3s, etc.) and a good-sized lens (Nikon 70-200 f/2.8) it is not sturdy enough for the best macro work, especially if you add something like a multi-tier panning rig or whatever else you might attach. They run about \$600 but have been discontinued. It comes close to being usable but clearly does not cut it. What I use now is the Gitzo GT3531s Systematic 6x Carbon Fiber tripod with three-section legs and no center column. It weighs 3.7 lbs (1.7 kg) and the diameter of the individual legs are wide enough for real stability. It is rated to support 39.6 lbs. (18kg). This tripod can support a big DSLR, a big lens, and a full multi-tier pano rig. As of October 22, 2011 they cost \$780 at B&H Photo.

Reflections

While I like the idea of ultra-lightweight tripods, when the chips are down, the wind is blowing, and I have a fully tricked-out camera rig on a light tripod, they are just too unsteady to warrant their use. The Gitzo GT3531s is a little heavier and a little more expensive but I always feel the stability it provides when I am out shooting. I would never go back to the lighter tripods just to save money or a pound or so.

Carrying Tripods

I am no longer a long-distance hiker so I don't carry a tripod in a backpack. I carry a tripod with ball-head and DSLR attached firmly over my shoulder. I usually stay within a mile of where I am parked so, although it gets heavy as time passes, it is not problem. Those of you who hike great distances may prefer to compromise the weight and style of the tripod you carry.

As mentioned, I carry my rig in my hands or with the DSLR protruding over my right shoulder and behind my back. I have done this for many years and never had an accident, never had the DSLR become detached or hit anything. I also have my lens cover in my pocket as I walk, not on the camera. I do tend to use a clear or UV filter over the lens.

Using Tripods

The tripods I use have quick-lock legs, so extending them and retracting them is easy and by now quite automatic. I hold the rig against my body or by one hand and open or close each leg section. Sometimes I will place the longest extended leg on the ground while I adjust the other legs. Opening, closing, and adjusting tripod logs I consider good exercise.

Of course I make use of the fact that the legs not only can be adjusted by sections but that each leg can be spread out to 24, 55, and 90-degrees from vertical so that many strange places can be accommodated.

As a general rule I try not to have the legs open any longer than I have to in order to maximize stability. In other words, if I have the legs splayed to say the 90-degree position I try not to have the leg sections also extended any more than necessary.

Keep It Tight

Some tripods have removable leg tips and or a hook (to hang weights from for even greater stability) that extends under that main plate. Since these parts can be loosened and tightened, they invariably become loose and fall off. To avoid this I apply a thread-locking paste to the threads on these parts to make sure they just won't vibrate off. Take note.

Tripods I Use

I have several different styles of tripods I use for various purposes. The Gitzo GT3531s described above is my main tripod and I call it my 'dry' tripod. I have another older Gitzo that is my "wet" tripod. I use it in streams, swamps, and wherever the tripod is going to get wet. Why two types? For one, Gitzos are not even a little bit of fun clean. If I use the wet Gitzo in swamps all summer, it requires a real cleaning before winter sets in. I try to keep these two separate.

I have a very heavy aluminum Gitzo with a big-old center column I use in the studio. It is too heavy to cart around in the field but is just perfect for studio work. I keep it set up with a ball head on it, and so on.

Then I have a Gitzo monopod. I don't use it a lot, but I do use it when I am doing macro shots of fast-moving insects and so on. It gives me just enough stability to catch one-off shots of bees, wasps, and whatever is moving too fast for a still-life.

And I have several tripods that are designed for video work, chiefly two Sachtlers and a Cartoni. These are larger tripods that coupled with fluid heads make video work easy.

That's about it for tripods. Since mostly I do macro and close-up photography combined with focus stacking,

I use a tripod all the time. I also do some landscape photography and that requires a tripod as well.



The Lester A. Dine 100mm macro f/2.8 Macro

This lens has all of the features needed for a good macro, including going to 1:1 and can be found used on Ebay for not a lot of money.



Camera Body Cap

The “good” or original Nikon cap for the back of lenses.

Fighting the Wind and the Light

I have a number of very fine lenses but not always the conditions to put them to use. The following will no- doubt be too much trouble for many readers but where I live we have a lot of wind and, of course, bright sun at times. While the traditional cure for wind is “wait,” here in Michigan which is mostly flat, that could be mean waiting a long time. And when the sun peaks over the treetops and sends the first shaft of sunlight to ground, even that can be too strong at times for the more subtle shades of color.

That coupled with the fact that focus stacking requires two hands and some coordination, not to mention that I don’t have an assistant, leaves me two arms short of four arms. What to do?

Of course I can wait for the wind to die down and work only at the crack of the crack dawn but that cuts down my time for photography by too large a percentage.

The “Flowerpod” has been a lifesaver when I feel like photography and the conditions are not working with me. The Flowerpod is 10 inches long and weighs about one pound. I carry two of them in my little 10x10-inch over-the-shoulder bag. The Flowerpod consists of a very-well tooled collapsible tripod that expands to 44 inches not counting the flexible arm that attaches by a strong magnet to the top of it. That arm adds another ten inches and it is easy to add more joints to make a much longer arm.

In the photo you can see I have one Flowerpod holding a homemade collapsible diffuser to take the sting out of the light and a second with an longer flexible arm that is holding the stem of the bud from the weak-but- still-present wind. This combination gives me what I need to carefully stack a photo, as shown here.

I know it is a lot of hassle but this combination works very well and makes it possible to take photos I otherwise would not be able to get. The Flowerpod is the invention of nature photographer Les Saucier. Here is some more information on the device:
<http://www.appalachianjourney.com/flowerpod/page45/page45.html>

Retouching Stacked Photos

Way back when I was first getting into focus stacking, I refused to retouch, ever. If it needed retouching I just ignored that photo and concentrated on those that were OK. Believe it or not, at that time I felt that focus stacking was already such an almighty inconvenience that I was damned if I would add insult to injury by having to fiddle with the finished stacked photo. I was a close-up photographer and this focus stacking was just something I was experimenting with and pretty much a nuisance at that. It was a bit of a learning curve.

Of course the results of focus stacking did grab my attention and ever-so gradually I became addicted and was drawn into the long (and sometimes painful) process of stacking photos. Still, retouching stacked photos was not something that I warmed to easily, much less enjoyed. I did not have the patience and at that time I still felt that if a photo needed retouching then I had done something wrong. This just shows you how little I understood about the mechanics of focus stacking, like: there is no way to avoid retouching most stacked photos. Period.

Well, I am all grown up now and habituated to retouching just as I had to learn to enjoy stacking the photos in the first place. Things change and even I do

too, albeit probably more slowly than average. That being said, let's talk a bit about retouching stacked photos.

Some of the focus-stacking software is amazing at what it can do considering there is no human making real-time on-the-spot decisions when they are needed. I checked out (and purchased!) various focus-stacking programs and finally settled on Zerene Stacker as being IMO the best of the lot. There are many roads that lead to Rome and we can't easily walk them all to the end, so at least for now I am walking with Zerene Stacker.

Since I am a systems programmer I guess I am allowed a professional opinion and I must say that this is a wonderful piece of programming that Zerene Stacker's author Rik Littlefield has put together. It is a brilliant program. And its retouching features are almost ideal and this is what I will be looking at here in this post.

The problem inherent in focus stacking is that, because it is essentially a sampling technique (like CDs, DVDs, etc.), by definition sampling 'samples' parts of the whole and leaves other parts out. Where the samples come together there are always holes or gaps and this naturally produces artifacts that may or may not blend well in the final photo. While most artifacts may be lost to even the vigilant eye there usually (or often) are stubborn artifacts that detract from the finished photograph. And I don't like em'.

The artifacts are not entirely random and can be grouped into general types. Perhaps the most common type of artifact is what is called a "halo," an artifact which manifests when a sharply defined edge of an object (like a leaf) is contrasted by the more distant background bokeh behind it. Along the edge of the leaf a small dark halo appears that catches our attention every time and can spoil the photo.

Another common artifact occurs when one object in the detail overlaps another but is at a distance above or below it. This is really the same halo-problem discussed above but in a different form. Trying to separate one overlapping detail from the other can be too difficult for the program with the result that where the two intersect are some out-of-focus blurs that are not welcome.

Most of the existing stacking programs offer more than one technique for getting results. Helicon Focus and Zerene Stacker both offer two main ways to stack. However, in my experience, only Zerene Stacker's (ZS) two techniques are radically different from one another and only ZS can handle very fine overlapping hair or bristles successfully, albeit by sacrificing a tiny bit of color exactness and by increasing noise somewhat.

Zerene Stacker offers what it calls DMap and PMax stacking algorithms. DMap is more or less what the other stacking software on the market offer and most programs do a decent job. However PMax is to my knowledge not offered by any other software and it really shines at reproducing fine detail, and this is where IMO the other software falls down.

And although the two methods can be seen as alternatives, choosing one method or another, the best thing to do is to run them both and combine them. And there is a particular order in how to combine them. Zerene Stacker has a choice to run both PMax and DMap together. This takes longer, of course, but will produce the best results. The flow is simple:

THE BASIC IDEA

The program first calculates PMax and automatically saves it. It then proceeds to calculate DMap which at one point in the calculations requires you to set a threshold (a slider) that indicates how much fine detail you want to preserve and how much of the entire photo is irrelevant noise. While you may experiment with this slider, I tend to set it from high to very-high, and like the results. Once both of these methods are calculated, base your final photo on the DMap by selecting it (highlight) and then entering the retouching mode. Once it has displayed DMap (right screen) for you to see then select PMax (highlight finished PMax file name) in the left screen as the main photo you will use for retouching 'from'. So you have at this point PMax in the left screen and DMap in the right screen.

Now carefully inspect DMap (right screen) for any problem areas, keeping in mind that any part of DMap that you can preserve unaltered will give you better color and less noise. With that in mind, when you find areas in DMap that are incomplete or show artifacts, using the computer mouse, carefully overwrite just those areas (from PMax onto DMap), trying to keep your cursor small so

as not to copy wider areas than you need. Often these areas are just a tiny 'lighter' area or line where two objects overlap.

If you copy too much you will introduce unneeded and unwanted noise (or even a dark halo) into DMap, so look carefully. And that is the main idea. If you based your finished photo on DMap and copy PMax areas to overwrite DMap, you will have the best result in most cases. In some cases you may have to copy large areas of PMax or almost the whole photo, but you have been given the idea: copy as little as you can but as much as you need. Also, don't forget to use the other individual photo layers instead of PMax, where needed.

Retouching stacked photos is unavoidable and this is where Zerene Stacker really shines but any retouching is time intensive, as in: it often takes much longer to retouch a stacked photo than to set it up and take it in the first place.

I guess one point is that if you are looking for a slam- dunk approach to close-up photography, focus stacking is probably not your cup of tea. As mentioned, it takes time to stack and even more time to retouch, but the result is worth the effort, in most cases.

I don't want to turn this into a retouching tutorial, but only to paint with broad strokes as to what you are getting into when focus stacking requires retouching, which is regularly. Zerene Stacker's retouching features are extraordinary and are getting better all the time. Here is my general workflow.

- (1) Shoot the stack.
- (2) Transfer images to Lightroom.
- (3) Export Tiffs to Zerene Stacker.
- (4) Stack Photos with both PMax and DMap.
- (5) Use DMap as your base photo for retouching (right screen) and select PMax to retouch from in the left screen.
- (6) Having selected DMap (highlighted finished DMAP) enter 'retouching' and then select PMax to retouch from. At this point I am retouching the photo based on DMap as base and PMax to use for overwriting areas of DMap AND any of the individual stacked layers themselves.

What is so useful about Zerene Stacker's retouch feature is that I can (using the mouse) run up and down my stacked photo layers in real-time watching how each layer affects my final image. At any point I can press a key to alternate my finished image with how this particular layer affects that image. I can see what could be added.

If I find an area that I would like to add to my finished image, using the mouse and an adjustable cursor, I just brush over that area and it overwrites my finished image. Using this method, I can touch up areas that are troublesome. And while this can take real time, just as often as not I can overwrite an entire section of the image in a second or so.

(7) Commit the Retouching -- When I have done what I need in retouching, I commit the retouching.

(8) I then save the image to disk and reimport it into Lightroom or whatever I like to view my photos.

That is it for many stacked images. However, in some cases, no matter how finely I retouch, there are areas that remain bothersome. In that case I add an extra step:

(9) Photoshop – I import the final image into Photoshop and using the Clone tool I very carefully touch up the offending areas. I have to alternate between using a hard edge and a softer edge on the Clone tool and perhaps add some Healing brush strokes as well.

(10) I save the finished photo.

Anyway, I hope I have given you some idea as to what is involved in retouching stacked photos. I include four images as an example in this and the next two posts. The four images are:

(1) Image using PMax. Notice all of the blurry or hallowed areas, only some of which are marked by red arrows.

(2) Image using DMap, 1st Pass. Things look a little better with DMap and I am not getting as many halos, but more single artifacts where one part of the plant overlaps another.

(3) Image using DMap, 2nd Pass. Upping the threshold on DMap did not do a lot of good in this particular instance.

(4) Finished Image. Here is the image after retouching using both PMax, Dmap, and the various individual layers of the stack. I did

have to take this image to Photoshop for those last touches, but it looks decent now.

There you have the general idea as to what an average retouching session involves. It takes time and at first glance the stacked image can make you want to just throw it out. I notice that I have to be in the mood to retouch, so I wait for those mood. Otherwise it can drive me crazy.

Is it worth it? We each have to decide that for ourselves. I have spent just as much time retouching standard one-shot photos, so what's new?

To me, all photography is impressionistic, a reflection of the mind of the photographer. Snapshots hold little interest for me. The arduous technique involved in stacking and retouching photos has taught me patience and attention to detail, both of which are things I need to have more of. Focus stacking is not for the faint of heart. Anyway, you have been warned.



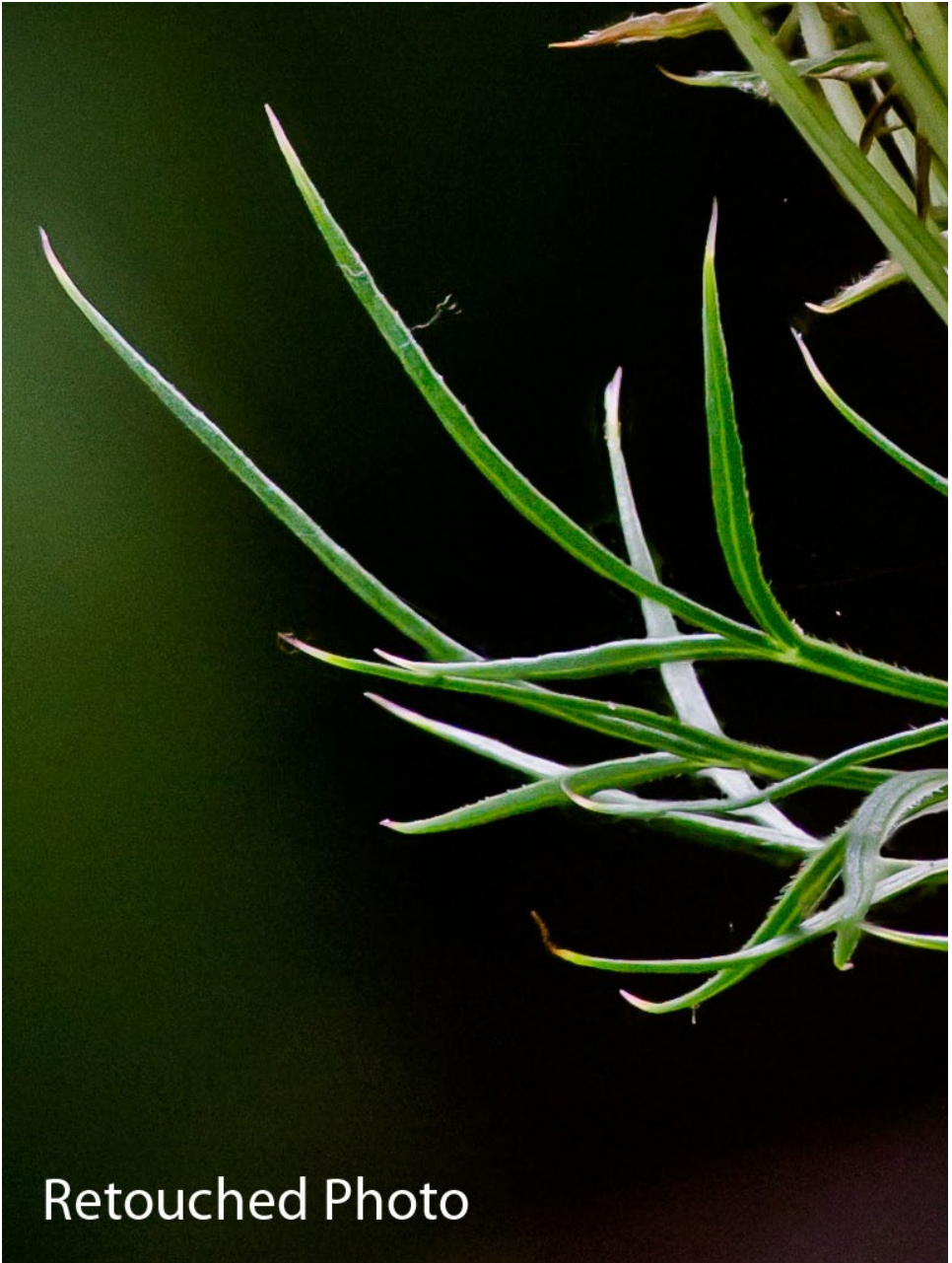
(1) Image using PMax. Notice all of the blurry or hallowed areas, only some of which are marked by red arrows.



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(4) Finished Image. Here is the image after retouching using both PMax, Dmap, and the various individual layers of the stack. I did have to take this image to Photoshop for those last touches, but it looks decent now.



Final Image

There you have the general idea as to what an average retouching session involves. It takes time and at first glance the stacked image can make you want to just throw it out. I notice that I have to be in the mood to retouch, so I wait for those moods. Otherwise it can drive me crazy.

Is it worth it? We each have to decide that for ourselves. I have spent just as much time retouching standard one-shot photos, so what's new? To me, all photography is impressionistic, a reflection of the mind of the photographer. Snapshots hold little interest for me. The arduous technique involved in stacking and retouching

photos has taught me patience and attention to detail, both of which are things I need to have more of. Focus stacking is not for the faint of heart. Anyway, you have been warned.

More Notes on Retouching

When I was just starting out in focus stacking I was not about to have to retouch my stacked photos. It was enough trouble to focus stack in the first place, much less have to go and essentially Photoshop the damned things. It was too much trouble and crossed the line from where I was willing to go. Live and learn.

I no longer feel that way or try to assert my demands on what focus stacking has to be or not be. The simple fact is that focus stacking is a sampling technique much like digital music or movies and sampling anything by definition means something is left out or un-sampled. Most of the time what is ignored or not sampled is not missed and does not cause a problem for the eye when we look. But in many and perhaps most stacked photos you will find unwanted artifacts that result from the sampling process, the most common being what are called “halos” or motion echoes around objects that stand out from their background.

For the longest time I tried very hard to ignore the halos or to pretend they just don't matter, but they do. For one, the halos were pointed out to me until I allowed myself to see them too, but I still did not retouch them. What I told myself (and it was true) is that my every photo is a trial, an experiment, and not a finished piece. I felt I was learning the technique and did not have the time to fix every artifact. I would never get anywhere.

So, after several years of training in the technique of focus stacking I have gotten around (finally) to the stage where I want to produce a finished photo. Not every photo is worth retouching, so I allow myself that. Otherwise, I would be up all night and for no good reason. The really good photos are worth removing the artifacts. My point is that you may want to wait until you are sure you like the technique before you spend the time removing artifacts because retouching is time- consuming, really tedious, and that alone might put some of you off the technique.

What Does Retouching Involve?

I put off learning about retouching stacked photos for as long as I could. I did not like the idea at all and I didn't really try to even learn what it involved. And it is difficult, relatively. For those of you who may be like me, let me tell you what retouching is actually like.

A typical stack may be something like ten to twenty or more photos, each a separate focus layer. These are the layers that are merged together but there are gaps between where the layers overlap and these can cause artifacts – unwanted glitches in the photo. There are other factors I won't go into here.

In retouching software we can select any single layer without the artifact and use it to overwrite the area on the composite photo with the artifact. It reminds me of using “PressType” years ago to overlay type on paper. Many if not most artifacts can be repaired, smoothed, or removed, but not all. Some photos cannot be salvaged, usually when there are objects that are too far in the foreground – too much distance between parts of the subject. And of course if the wind blows (and it does around here) any movement can make an error difficult to impossible to repair. Often you can just delete that layer, restack, and be OK.

The process seems smooth enough until you encounter any object that is round or that extends from the back of the photo toward the front. In other words as long as the subject is approximately two-dimensional (flat), it is not so difficult. However, as soon as something extends

toward the lens we no longer have a flat subject which means each layer has some (and only) part of whatever-it-is that needs retouching and this situation is much harder to cope with.

And then there are places where the increment between layers is too wide; there is no overlap. This is really a case of “operator error” where we needed to use shorter increments. In this case there is little to nothing that you can do to remedy the situation, although in some cases you can blur out the whole background by using a background layer. It gets complicated.

It becomes a case of how much time do you want to devote to this photo and sometimes I ask myself why don't I just take a standard one-focus-spot photo and ignore all of this focus-stacking stuff. This

is about as bad as it gets, however, and otherwise focus stacking is pretty much a fascinating and rewarding technique.



The Nikon 105mm f/4 Macro Lens

This is a very sharp lens and can be found on Ebay now and again at a good price.

Focus Stacking Software

The focus stacking software I have found convenient are Zerene Stacker, Helicon Focus, and Photoshop CS5, and in that order. These all work more or less well.

Photoshop CS5 is a great improvement over CS4 but the program is still not ready for prime time as regards focus stacking and that is an understatement.

Both Zerene Stacker and Helicon Focus work well and both are available in a demo version so I suggest you try them. I suggest getting the 64-bit versions of either program if your computer will handle it and you value your time.

By all means get the 64-bit versions which are \$289 from Zerene Stacker and \$250 from Helicon Focus. I have tried and purchased both of these packages and have done (relatively speaking) a lot of focus stacking. Both companies have fine software.

That being said, my personal preference is very much with Zerene Stacker and I have a couple of reasons. One is that the retouch feature in Zerene Stacker is much better than that in Helicon Focus IMO. And retouch is the name of the game the deeper you go into stacking focus. Why?

The reason is simple. Focus stacking is a sampling technique much like digital music CDs sample from an analog base. By definition all samples are just that, "samples" and that means something is not sampled or left out. In the case of focus stacking what is left out tends to cause unwanted artifacts to appear that detract from and can ruin a stacked photo. So as much as I originally resisted retouching any stacked photo, over time I have accepted that it has to be done. After all, most of us accept quite easily that we have to fiddle with white balance and other factors in post preprocessing. Retouching is the same idea. Therefore a very easy-to-use retouching method as in Zerene Stacker is worth a lot to me. It is really a brilliant solution.

My second reason is that the support and hand-holding from the Zerene Stacker staff is exemplary and I have been in the software business for a long time (second only to Microsoft on the Internet) and run a software company full-time. I am sure the other

companies also have good support. You pretty much have to pay for Adobe support, so I won't go there just now. So take thirty days and check out some software and find out which brand you like.

Summary

There you have a few suggestions on focus stacking. I should add one more comment:

Patience and Exercise

Macro and close-up photography is a slow process, ideal for those of us who need to learn patience. If done well, stacking photos can slow us down until we are forced to experience just the present moment. For many of us who are busy and think too much this is a good thing and a respite, the best medicine I know.

It is also physically the perfect exercise for older folks. What else would possibly induce me to get up, get down, get up again, now get on my knees, now on my side, etc.? You could not pay me to get the exercise I naturally get when motivated by this or that wonderful shot. It is especially good for the abdomen, all the holding of the breath, keeping perfectly still, maintaining a pose, etc. This is all good.



The Nikon 35mm f/1.4

This is not a macro lens, but rather a wide-angle lens but it is so sharp and so fast and can get so very close that remarkable close-up shots are possible with it.

Focus Stacking Notes

Time Consuming

Focus stacking like stitching, some HDR, and macro techniques in general is not for everyone. For example I generally am always in a hurry, so the tedium, patience, and complexities of focus stacking are perfect therapy for me. They slow me down to actual living and I appreciate that. But many just don't want to bother with such a painstaking technique or don't benefit from the patience required.

Space Expensive

Focus stacking is also a real memory hog and if hard- drive storage capacity is a worry, the 15 or 20 twenty- eight MB RAW files needed to create a resulting 150 MB TIFF file is a lot. Multiply that by a day's work and you are talking real storage. Luckily storage has come down in price and gone up in size from my first home computer with its 8K of memory. And then you have to back it all up. You get the idea. Focus stacking carries a price in patience and in equipment.

An Approach

Not everyone likes focus stacking, either the idea or the results, and I am in a perfect position to appreciate why you might want to just skip over this technique. I, however, can't seem to do that. I will spare you most of my usual pitch about how no matter where we look with our eyes, everything is in focus. That's part of the appeal of focus stacking. After some years of practice this technique is so ingrained in me that I am actually uncomfortable if at least a certain amount of the photo is not in focus. I am taking some corrective photo- therapy and practicing at the traditional single-shot photos once again. Focus stacking is a hard habit for me to break.

Impressions

I will also not dwell overly on my observation that all photography is impressionistic since that seems to raise the hackles on any number of photographers. Stacking photos is a real quick lesson that we are sampling what we see and creating an impression. Any of you who do post photo-shoot Photoshop work should know that photos are impressions like any other graphic art form, but I won't

argue it here. It is the human mind that is impressed and it is the photo that presents that impression. Enough said.

Outdoors

I am not much for studio work when it comes to stacking photos. I am an “outdoor” photographer most of the time. I have a studio and I do use it, but mostly when it is too windy or cold to be outside. And I don’t tend to microphotography, to ultra-close-up shots of any kind. I know how to stack lenses but I don’t enjoy that level of magnification. I am all about creating images of complete mini-worlds, micro-landscapes – dioramas... outdoors if possible.

Equipment for Focus Stacking

I give the impression (so I have been told) of being an equipment hound and having money to burn on lenses and what-not. This is actually not true. What I am is an enthusiast and I seem to always find a way to get whatever it is I need at the time. To do this I often have to sell something else, cut back here and there, and you-name-it. Once I get a lens or something in my mind, it is hard for me to shake it. Eventually I find a way to get it. “Inquiring Minds Want to Know” as our

tabloid “The National Enquirer” says.

And I do have a bunch of lenses by this point but most of them were purchased to find out for myself the difference between the bias of other photographer’s rants and the facts about a given lens in my work. I waited years to buy the Zeiss 100m Makro-Planar because I had surmised that it would not float my boat, but I had to judge for myself. It is a great lens for many but not great for me. I have racks of lenses that I had to see for myself if this or that lens would do the trick, whether it had that “magic” or not. Most don’t.

So now I have a closet full of lenses, not to mention other equipment. And after all that expense and experimentation, there are only a few lenses that I actually use and cart around. Reams of online posts about favorite lenses have been written. Of course I too have my favorites, chief among them the Cosina- Voigtlander 125mm f/2.5 APO-Lanthar macro lens. I use it all the time and highly recommend it for close-up and macro work, at least outdoors. Its only downside is that it is no longer made and thus is expensive and hard to find.

And while I love that lens, in the process I had to buy at least four other Voigtlander lenses, a couple by Zeiss, a Lester A. Dine, and a small army of Nikon lenses. And I had to test every tube extension, diopter, close-up lens, and tele-converter on the market to make sure I was not missing something. I wasn't. It is remarkable how few lenses I actually need. What is brilliant about the Voigtlander 125 is:

(1) FAST – At f/2.5 few lenses are as fast and over 100mm. For my work a fast lens means light in the viewfinder so that I can see to focus in the early- morning light.

(2) LONG – 125mm means 1:1 image size, which is a definite plus over anything less. The 200mm lenses (aside from not being as sharp) are not as fast and many have short-ish focus throws.

(3) FOCUS THROW – This lens has a very long focus throw which means I can turn and turn the lens barrel and get only a small movement. This is, for me, key.

(4) SOLID – This lens is built like a tank and I put it through a lot of work and travel. (5) SHARP – This lens is very sharp indeed. It is not as sharp as say the Coastal Optics 60mm APO, but all things considered it is sharp enough.

(6) APO – This lens is apochromatic which means it has no chromatic or spherical aberration as most lenses do. It reproduces subtle colors.

(7) MANUAL FOCUS – All my macro work is done with manual focus. I never use auto focus when doing close- up work.

(8) LIGHT-NORMAL – Not sure what the right words are to describe this quality, but the idea is that the lens is not too sensitive to light and not too insensitive, but just stable and normal. It is a perfect workhorse of a lens, day in and day out. No other lens touches it for macro work IMO.

On the down side, the Voigtlander is not electronically linked to my Nikon bodies, so everything has to be done manually, which is fine by me. I prefer all manual settings. Above are the qualities I look for in a macro or close-up lens. Some macro lenses have some of these attributes, but the Voigtlander is the only lens I have that has all of these qualities. It is unfortunate that copies of this lens are rare and expensive, but it is not a flaw in the quality of the lens. I

hope Cosina will re-issue it soon and inexpensively so more macro photographers can appreciate it.



Cosina/Voigtlander 125mm f/2.5 APO-Lanthar

Macro Lenses

There are all kinds of macro lenses out there and they all do some kind of job. Start out with the one you have and see how you like it. You can find good used Nikon 105mm Macro lenses on Ebay for around \$500 or less. They work well.

Light

Photography is really about the light, almost a science of light. Without enough light our lenses (and eyes) strain and with too much light we can do little or nothing. Most macro work that I do is

in less than too-much light. Broad sunlight is blinding and pretty-much unworkable for me. That is why I depend on diffusers and reflectors, but mostly diffusers. On a bright day I need something between the sun and my subject. That is why early mornings and evenings are best. However, I am usually too tired to do much in the evening so as summer comes on I like to get out there earlier and earlier each day to catch the light and the coolness

Light and Shadow

I do a lot of photographing in the woods or in places where shadows and light come together in the same photo frame. Often when under a canopy of leaves there may be a shaft of pure sunlight piercing the shade and striking the plants on the forest floor. This makes for a fine photo but more often than not the shaft of sunlight

is too bright (by contrast) with the softer shadows and it is very difficult (often impossible) to balance the lighting later in post-processing. Somehow the sunlight has been too blown out to really bring back into line.

It is at these times that I use a diffuser and place it in the path of the sunlight and above the subject on the forest floor. And I tend to use not your standard Photoflex translucent diffuser which is too opaque for my tastes (unless you are in full sunshine) but rather my own home-brew diffuser made of some gauzelike fabric that filters the sunlight and tones it down rather than removes it. The effect is more like one that we would get if we used a standard window screen to filter the light.

Luckily these little diffusers easily fold down to something that fits in my kit or even into a pocket. Most commonly I use a 22" circular diffuser, but I also have 12" and 32" diffusers that I sometimes bring along. You would be on point to ask me where do I get the third arm to hold the diffuser when I am focusing a stack with my left hand and clicking the remote trigger with my right.

Well I have done just about everything you might think of when it comes to this issue. I have lodged diffusers in trees, in windows, propped them up with sticks, hung them by hooks and threads – you name it. And I have alternated holding the diffuser by hand with focusing and triggering the remote, which much resembles juggling

three balls. When you are taking fifteen or so shots, hand-holding a diffuser is a pain.

Most often I use a little device called a “Flowerpod” designed by nature photographer Les Saucier, which you can read about here: <http://www.appalachianjourney.com/flowerpod/flowerpod.html> This device weighs about a pound, collapses to less than 12 inches and works like a charm. I let the Flowerpod hold my diffuser and carry it in my little over-the-shoulder kit bag along with two diffusers, one translucent and the other screen-like. Diffused light can turn a throw-away photo into one that is perfect. It is worth the effort. In fact, a general rule I am finding is that good macro and close-up photos take not only time and patience but also the proper equipment to bring off.



Small Kit

I am not one who likes to drag a lot of stuff through the woods and streams. I don't use a backpack for the most part. The largest bag I

can tolerate is a messenger bag with over-the-shoulder straps. More often I use a 10"x10" over-the-shoulder bag about the size of an army mess kit. It is tolerable. Sometimes it is just my tripod, ball-head, and camera.

I often carry an extra battery in the car, other lenses, a light tent, hip boots, mosquito netting, and you- name-it, but I don't haul all of that around. I don't tend to go more than a mile from the car on any one trip, so I am not backpacking or camping overnight. Aside from carrying my carbon-fiber tripod, ball head, and camera with lens attached, what else do I carry in my smallest over-the-shoulder bag? Not a lot, but here is the list:

- (1) Flowerpod tripod and flexible arm.
- (2) Shower cap for the camera in case it rains.
- (3) Two or three diffusers.
- (4) An extra lens... sometimes.

Carrying It All

It would seem that there are many ways to carry your camera, tripod, ball head, and stuff. Many photographers take their camera off the tripod for every shot and carry it in a special bag. I am too lazy for that and don't feel the need to do it. My ball head is attached to my tripod with "Loctite Threadlocker" which makes it very difficult (but not impossible) for the ball head to unscrew from the base of the tripod.

Sidebar: And less I forget it, if you use a tripod with a center column, best use the Threadlocker on the hook hanging from the bottom of the center column because otherwise that is the first part you will lose.

Sidebar: I always use a tethered remote release on my cameras and they are another accessory that is easy to lose. Check the tightness of the connection as often as you think of it or you will be backtracking to find where it fell off. When I carry my camera and tripod I try to have the remote release hanging under the tripod on the top of my shoulder so that I can see it dangling below my right shoulder.

Back to securing the camera to the ball head. I use quick-release knobs (not lever-clamps) and I very firmly tighten the knob to

secure the camera body to the quick release. And of course I use an L-bracket so that I can rotate the camera relatively quickly by 90 degrees.

Once all of this is done, I carry my tripod, camera and ball-head attached, over my shoulder with the camera pointing down, lens cap off and in my pocket. This method has worked well for me for many years with no problems. Knock on wood. I carry my little 10x10 canvas kit bag using a shorter over-the-shoulder strap. Anything gets heavy after a long enough time but this system works well for me. You will find your most comfortable way to carry your gear I am sure. How Long the Shoot?

I don't tend to go on a shoot lasting more than a couple of hours unless I travel to some special place and then I may spend three or four hours. It is not so much that I get physically tired, although that sure happens, as that my photography "eye" wears out and I am no longer seeing (as much) the beauty all around me. When that happens I might as well call it a day as any shots I take without that "eye" will seldom be better than just average.

However, I often will go out for two or even three sessions a day. I like to take some photos, come back and look at them, and perhaps then go back out. Remember that with focus stacking, processing the photo layers can take a lot of time and if you need to retouch then that takes even longer. I find retouching too much of a hassle in the middle of the day and tend to relegate that task to some evening when I am in the mood and have already figured out which photos are good enough to spend the time removing the artifacts.

Software You Will Need

I have made it a point to say that you can get decent results from Zerene Stacker, Helicon Focus, and even from Photoshop (CS5), so I am not going to try promote all stacking software equally. You can find what works for you. What works for me and works best is Zerene Stacker. I use it almost daily and for long periods of time at that. It works beautifully and retouching on Zerene Stacker is miles better than any other software I have seen. Also they have superb support.



Boots on the Ground for Wading

Focus Stacking Detractors

Like many new and unpolished techniques, focus stacking has its detractors. It just rubs some folks the wrong way. And the learning curve with stacking focus produces some very bad examples and that is mostly what we see online. I sure am guilty of posting stacked photos with tons of artifacts so I understand why they may not appeal. This technique is still new to the world. On the other hand, well done stacked photos can be breathtakingly fine.

Focus stacking (like HDR and the various forms of stitching photos) is still in its infancy and bringing up the rear at least with the mainstream audience. Give it a few years and focus stacking will emerge as what it intrinsically is, a brilliant form of impressionistic photography.

Increments

I use the lens barrel to focus incrementally. You can use a focus rail to control your increments between layers and there is even an automated focus rail that can be programmed to exactly measure and move the camera between shots. That is more than I want to fiddle with so I am content just moving the lens a bit manually for each photo. For me one important quality of any lens I use is having a long focus throw. Those lenses with a very short focus throw don't give you enough distance to turn the lens. My favorite macro lens offers almost 720 degrees of focus throw, more than enough for me to tweak a turn of just a little bit.

I turn the lens just a tiny bit, especially if I am on an area of the subject that I want to be especially sharp. I turn the lens and then press to put the mirror up into lock position. Mirror lockup is essential for me in focus stacking. Lock the mirror up and wait for the shock of the mirror slap to die away. Then take the shot.

Doing this ten or twenty times per photo takes coordination and time. It does not help to lock the mirror up, take the photo, and then wait. You need to lock the mirror, wait, and then take the photo. I find that I can turn the lens just enough to build a good stack, increment by increment.

Tripod

Yes, you need a tripod. There are focus stackers who stack photos handheld but they are like the showoffs riding their bikes and

shouting “Look Ma, no hands.” I can’t imagine not using a tripod. I need all the stability I can get. In the studio I use a really heavy Gitzo tripod, one I would never carry in the field. It is solid.

For outdoor use I have a carbon-fiber Gitzo tripod (GT2531) that I like a lot. I prefer the three-sectioned tripod to those who have four sections because they are stronger and more stable. I do close-up and macro work, not in high winds, and not in unstable conditions, so my GT2531 is plenty stable. And I wait after “Mirror up” for any vibration to die away. I also have another carbon-fiber for wet work, like wading in the spring ponds taking photos of the tiny chorus frogs.

Ball Heads

I don’t like (or use) big and heavy ball heads, no matter how fine they are. I personally want everything as lightweight as possible and most ball heads are too heavy. I find that the Markins Q3 ball head (with twist knob) handles smaller cameras (Nikon D200, D300, etc.) and lenses just fine and at 10 oz. weights less than any of the more popular models. I have several

them and like them a lot. You will need a good ball head with (in my opinion) a twist knob. For larger cameras or panoramic heads I use the Really Right Stuff BH-40 with a twist knob.

L-Bracket

L-Brackets allow the camera to be rotated 90-degrees from vertical to horizontal position and back in a few seconds. I consider these are essential for macro work because switching back and forth between vertical and horizontal view happens all the time and putting screwing and unscrewing the camera to the tripod runs the risk of stripping the screw or receptacle, which would be costly to fix. An L-Bracket is an important accessory.

Gotcha!

My days of tracking, stalking, hunting anything, critter or rock, are over and it is not because I am getting older. I no longer have an interest in pursuing anything. This is more-or-less also true for making elaborate trips to Yellowstone or even the nearby bird sanctuary. I have been there, done that, and the whole idea of expectation and looking for something falls flat for me.

Found Beauty

Instead, I am into what we might call “found” beauty, whatever catches my eye that is beautiful. That’s what I like to photograph. Even if it is a rare specimen of a you-name-it and it does not strike me as awesome, I tend to walk on and just leave it be. My rule of thumb is “Every photo I take is something that moves me by its beauty.” Simple. And I will be the first to admit that my photos are what is beautiful to my eye and may appear as ‘everyday’ and boring to someone else.

Not Art

I also recognize and can at times appreciate “arty” photographs, photographing something in nature that also has an “art” look about it, whether by form, texture, and so on. I am not trying for that. To me nature just as I find it is all the art I need or can stand. You can’t improve on nature and looking for human-like art in nature is something that I find boring. A photo of a simple leaf that I find beautiful is the kind of art that pleases me. On this point photographers can agree to differ and will find their differences.



Battery Checker

A battery checker is a great tool to have on hand if you are using AA or whatever batteries. I carry one in the car.

Light Uses

I don't have to point out that lighting is crucial to photography and focus stacking just ups the ante. It can be hard in a semi-cloudy day to get consistent light across a set of ten or twenty photos. As the light changes it affects each layer in the stack.

If you want to really understand lighting get a feel for lighting as done with video, like movie lighting. There is no difference in light between still photography and movies, only budget. A movie set, indoors or out, cannot afford to screw up the lighting, and video and film eat light. Movies have to be well lighted and even a little study of their methods is enough to point out that it is all about the lighting.

Still photography has it a little easier but focus stacking has it less easy than single-shot photos because consistency of light is a factor in processing stacks. It seems we almost always have too much light or too little and we need to be prepared for both ends of the pendulum.

With too little light we can always open the aperture, slow the shutter, and boost the ISO, although we would rather not stray too far from optimum ISO conditions. It is tougher when there is too much light as in full midday sunshine in an open field. Yes we can narrow the aperture, run up the shutter, and zero-out the ISO, but in my work that is not enough. I depend upon diffusers to handle too much light. And that means carrying them around with me somehow.

I can store all kinds of things in my car but I don't do much shooting in my car so sooner or later I have to decide what to carry with me? Should I take a couple of small diffusers or also bring a big one. And how are they to be positioned. Remember I need two hands, one for turning the focus barrel and the other for clicking the remote. And what about wind?

Wind is a real party pooper for focus stacking and even a small breeze will end my hopes and send me scurrying back to trying for single-shots again. Should I bring the light tent to stop the wind? And what size light tent? This means carrying the tent (collapsed of course) through fields and woods, never something I look forward to. What are the answers?

In my case the most-common answer is "Play it by ear!, use your imagination, innovate, etc." At least that is what I tell myself. Wind is the great enemy of focus stacking. Michigan, where I live, was scraped flat millions of years ago by huge glaciers so there is not much to stop the wind around here. Wind is almost a constant and that is a pain if you need and want to get out in the field some each day to photograph.

So what I do is the obvious. If there is no wind I try to focus stack. As I walk around my home my eye is always peeled at the Tibetan Prayer flags hung outside our center. Are they moving or are they still. If they are still, I should get outside. Is there light and what kind? I am a perfect barometer for photo conditions and all of this is aside from: do I feel like it and is my eye capable of seeing beauty on demand? Not always.

The Kinds of Light

DEEP SHADE: In deep shade, like in woods, dells, woodland streams, I keep the ISO as low as possible, open up the aperture, and work mostly with still life.

MOTTLED SHADE: If I am in shade, but with shafts of sunlight, I get out the diffusers, in particular the one

that lets the most light through. I have spent years trying to believe that that little bit of sunlight filtering through on my subject would be offset by all the shade, but at least in my case that does not work. That little bit of sunlight is ‘hot’ and either blows out or makes it very difficult to bring the whole image into balanced light. I just use the diffuser and it works almost every time.

LIGHT SHADE: I like to believe that light shade is still light and I don’t need diffusers but the resulting photos show that the edges of the subjects, even though not lit with direct sunlight, still are too bright and tend to blow out a bit. I just use the coarse diffuser (the least opaque) and things work well. The light that clinks to reflective parts of the subject is too bright for light shade.

HIGH OVERCAST SKY: This is traditionally the best light to photograph in because the whole sky acts as a diffuser. If the wind is down, so much the better. That being said if there is too much light, even in the diffused sky, my resulting photos are almost always better with the coarse diffuser, the one that is like a piece of gauze or window screen. For me, light needs to be toned down.

DIRECT SUN: If it is direct sun I get out either a full light tent (of the correct size) or the traditional translucent diffuser, the ones that really are quite opaque. Many times I will put my own shadow between the sun and the subject and that works well too.

Reflectors

In addition to diffusers, reflectors of one kind and color or another can be very useful to redirect and shine light on the subject. I don’t do this as much as I probably should but I intend to. Mostly I am into diffusers.

Flashlights

I am not above carrying around one of those little LED flashlights. “Fenix” is one of the main brands. I have one that takes a single

rechargeable AA battery and it works well. I was able to purchase a tiny diffuser that snaps over the lens and opens and closes like a cap on a hinge. These can be useful if you need just a little light or want to backlight the bell of a flower or something. The problem with flashlights, like with diffusers, is that you need an extra arm to hold it steady. I use a Flowerpod to do this and that works fine.

Flowerpod

This little device is lightweight, folds up and slips into a small over-the-shoulder bag, and can do all sorts of things. I use it to (as mentioned) hold the flashlight on rare occasions but more commonly to hold one of the diffusers to block direct light so my two hands can focus the lens and operate the remote.

I also use the Flowerpod to hold the stem of a flower or to reach up and grasp a branch firmly so the wind won't affect it. I even have ordered extra segments (line-lock $\frac{1}{4}$ inch) to lengthen the reach of the flexible arm. I have two Flowerpods and they are the ideal assistant for my work.

I also have McClamps, collapsible mini-tripods, Plamps, and other devices that I mostly leave at home given the advent of the Flowerpod. They don't hold anything but their own weight.

Clips

I also carry a few little clips much like the ones you can find in any stationary store for (what else) clipping this or clipping that. I can clip a diffuser to a bush or branch leaving my hands free for other things. Old-fashioned wooden or plastic clothespins are great. There are many uses and these take up almost no space or weight.

Knee Pads

When I got a pair of inexpensive and very light knee pads my wife gave me a look like I had gone soft or something. Actually I am often on stones and forest floors where stems and roots and more stones abound. In the moment of trying to photograph a tough subject my knees land on whatever is there and does it ever hurt sometimes.

For \$9 on Amazon, I got a pair of light, foam-like, waterproof knee pads that I love. They also keep me from getting soaking wet when kneeling on wet grass. Yes they might look dumb but they help and

I hardly notice them on when I am walking, at least until I take them off.

Rain Protection

A rainstorm can come up in a very few minutes and lenses and camera bodies really don't like them. It is best to have something to protect both camera and lens while I get wet. The best and least expensive item is just a plastic shower cap that you can get at any drug store or large food store. It weights next to nothing, wedges in the bag (or holds a lens) and is large enough to fit over both camera body and a reasonable-sized lens while the shower descends.

Water and Food

I don't carry water or food with me. I usually have some water in the car that invariably gets too warm to drink. If I am thirsty that is where I get a drink. I don't want to carry water around because of the weight. I don't go on long shooting trips or if I do my food and drink is in the car. Clothes and Footwear

For swamps I have hip boots and carry them in the car. For cold and wet mornings I have high-ankle-height waterproof leather boots that zip up on the sides. For dryer times I have the lightest-weight running shoes I can find.

In summer I wear shirts. When it is the leastwise windy or cold I wear either a micro-fleece vest or a nylon quilted fest filled with PrimaLoft or some type of microfiber.

In fall and spring I have a light coat and in deep winter I have a fiber-filled big coat. As for hats I wear a navy watch hat or a very light floppy safari-type hat that is ventilated at the top. For gloves I tend to wear knit racing-bicycle gloves and in the coldest parts of winter I have mitten shells over the gloves.

For socks I use Thorlo Light Hiking Socks with a moderate cushion. These are the best socks I have ever found and I have worn them in the mountains of Tibet, Nepal, and elsewhere. They cost about \$14 a pair in quantity but last for ten years of constant wearing. Now you know everything about me. Usually I also carry a smart phone with me for whatever emergency or phone needs that might arrive.

I am not now nor never was an all-day back-packer at least when it comes to photographing. I do not like to carry much equipment and prefer to be light and move freely. I would rather learn to use the lens I'm with than take with me a half dozen lenses. Typically I carry one macro lens on the camera body and a small or smallish wide-angle lens (typically the Nikon 16mm fisheye) in my bag. I make due with less.

Color Spaces

If you are using Zerene Stacker, you are taking a set of TIFF layers into Zerene Stacker and saving the resulting stack to a TIFF. Often the color space profile (sRGB, Adobe RGB, Prophoto RGB) is lost and depending on what viewer you use, the colors may or may not reflect the original. You can check this by looking at the original and looking at the web version carefully.

If the colors don't more or less match, the color profile may have been lost. In that case load the file into Photoshop and convert the profile from whatever it is to sRGB for web viewing. If there is no profile whatsoever you may want to assign one in Photoshop. Both of these can be found under the Edit tab in CS5.



Cosmetics Mirror

An inexpensive plastic double-sided hand mirror is a valuable assistant for reflecting light on a subject. Sand down one side so it is opaque (as shown here) and get very gently light when you need it.

Macro Photography

As Exercise

Macro photography is some of the best exercise possible. Try and get me to go through the gyrations a macro jaunt involves and I wouldn't do it. The getting up and down, on your knees, then on the ground, getting back up, holding still in that awkward position, waiting, getting back down, etc. It would be crazy if I were not moved to it by some little critter here and a leaf formation there. Macro photography is so absorbing I scarcely realize I am literally

exercising most of the time. You couldn't pay me to do it but I find myself happily doing it for the sake of this or that photo. Don't underestimate the health benefits of close-up photography. It is not only the fresh air and being outdoors. I am actually exercising.

Equipment: What Do We Need?

This is a thorny issue and it is only too easy to fall into the belief that the next piece of equipment is going to make all the difference in your photo results. Some folks would rather research equipment to buy than photograph and we all probably do it to a degree. I know I love to browse photography equipment and build dreams about this or that item.

For example, I can focus on a lens that catches my eye or that photographers I respect recommend. I will spend hours traversing the Internet to read every review, description, and mention of that lens while at the same time I am inching toward just buying the damn thing. And I usually end up not waiting too long, checking my finances, and figuring if all goes south at least I will have this lens... and then this lens. You get the idea.

While we don't need endless equipment, having the right equipment does count for a lot. Some tiny cameras have a macro feature or you can screw a close-up lens on the front of the camera and get a sense of what macro photography is all about.

I am primarily a nature photographer as opposed to a product photographer so I don't have too much to say about studio work although I have done a fair amount of it. The general approach is similar so what we go over here as regards photographing nature will usually pertain to product photography in the studio, with the caveat that product photography requires mastery of artificial lighting, flash, and so on. My point is that you can start with what you have on hand and work up from there to a more expensive rig.

That being said, let's walk through what the well-dressed macro photographer needs to be aware of when heading for the fields and woods.

DSLR and Medium Format Cameras

Most macro photographers are all digital at this point, although some film buffs hang in there. I gave up film years ago and am still glad about that. I never liked having no feedback from film until it

came back from the drugstore and the sense that you have to pay for learning and failed shots. I very much like digital cameras and being able to shoot as much as I please without watching the money clock.

There is also a whole world beyond DSLRs, the world of medium format and view cameras, both much more expensive than the 35mm format. I will not be discussing these very high-end cameras here. You may find some details on this approach at:

[WWW. Luminous- Landscape.com](http://WWW.Luminous-Landscape.com)

Here we will stick to the Single Lens Reflex (SLR) bodies and lenses which most macro enthusiasts are using today.

For years it has been a question of being a Canon or a Nikon user because those were the two main brands that both professional and amateur photographers used. You were either in one camp or another because the lenses of one brand did not fit on the other and vice versa. Once you have four or five lenses on the shelf it was not easy to switch from Canon to Nikon because you would have to sell everything and buy brand new lenses as well as a new camera body. That continues today.

However more and more companies (like Sony and Panasonic) are entering the fray, so you have more to choose from. The problem of lenses fitting only the brand of the camera you bought still exists for the most part, so be careful when picking a brand to start out with. Just for the record I use Nikon cameras and lenses. I just started out that way and forgive me if I am very happy with that decision. But I will leave you to sort out what works for you.

The Camera Body

DSLR (Digital Single Lens Reflex) refers to the camera body without a lens. Although many companies offer a camera body and some starter lens (usually a not- to-good zoom lens) most of us buy just a new camera body because we already have a bunch of lenses. So what are the features you want to have on that new digital camera body?



Remote Shutter Release

A remote of one kind or another is indispensable for macro and focus-stacking work.

My Focus-Stacking Rules of the Road

In general (not always) my recipe for stacking macro nature shots is as follows. I include the obvious and the not-so-obvious:

(1) First Light – I try to get both the dim early light, the first rays, and then as the sun rises, what I can. I move to shadowy areas as the sun takes over. Sunlight, except in small shafts, is too bright for my taste. I use diffusers. I carry diffusers and the most-used diffuser is my own body between the subject and the sun.

(2) Cold – Cold is good for a couple of things. One it slows critters down a lot and gives me a chance to stack photos. Second, it

causes dew to be present which is great on plants and not always so great on critters.

(3) Go Slow – I move slowly around critters and try not to cast shadows over them unless the shadow is very slow moving. I take my time. I am in no hurry because there is nothing in particular I am looking for.

And now for the pearls of wisdom upon which no price can be put:

(4) Found Photos – I stopped “looking” for photos or critters a long time ago. Expectations of any kind are never the friend of this photographer. I am not a stalker. Instead, I wander through nature until I am struck by the beauty of a shot. That is the one I take and I pass up the low-hanging fruit, even if it is a rare critter... well, maybe just a shot or two of the rare ones. In other words, I wait for something to strike me with its beauty and then I photograph. (5) Breathe – I breathe in that fresh early morning air. I feel the invigorating cold and am refreshed. (5) Light – As mentioned earlier, I delight in that pre- dawn and dawn light. I invite it. I celebrate it. I am out there all alone and the natural world is waking up.

(6) Critters – In my own way I wish that all critters might be happy and not suffer. Most of their lives are very short. As the great Tibetan Lama Chogyam Trungpa once said “Some of us will die very soon, the others just a little later.” I reflect that I too am a “critter.”

(7) Gratefulness – I am grateful for the opportunity to be out in this very fresh morning and I wish that every photographer (and every human) could experience this as well.

(8) Mixing – And last, but not least, I mix my photography with my meditation.

Here are a few of my views on photography:

I started photographing close-up when I was about 16 years old. I was a naturalist from the age six and a serious one at that. By my teens I had learned a great deal about nature and my main focus was herpetology, in particular salamanders. Of course by that time I knew and loved about every critter that could be found in the meadows and woods. I still feel that way. Loving all humans has been a little more difficult.

Anyway, by my teens I was taking nature photos that were (I am told) very good. Then somewhere around then I discovered girls and my interest in nature was put on the back burner for a decade or so.

What follows is more or less where I am now, how I go about photographing these days, not the somewhat long journey of how I got here.

I am not a “gotcha” photographer. My interest in chasing down critters and capturing their photos has passed. I did that and never liked it too well at best, and gradually that kind of photography lost interest for me. It was too much like taking snapshots, just because I could and not always because I wanted to or that the subject was that interesting to me.

Today you could perhaps call me a photographer of the “found,” subjects that I just come across when I take my camera out in the woods or garden. And for something to be “found,” in my eyes it has to appear beautiful to me. Notice, I said, “to me” and not to you. Taking pictures for others as a primary motivation might be good for professional photographers, but I have no intention of making money from photography. I do it for the beauty of it, so beauty is my main motivation.

Years ago if I came across a scene or critter that was remarkable I would photograph it, but looking at these shots later they seemed to be just snapshots of something I didn't really care about. These years I walk on by unless I am struck by the natural beauty of what I am seeing. Only then will I photograph it.

I may be looking at a beautiful flower, but unless I can see the beauty right here and now, unless I am moved by it, I won't photograph it. And I have to relax when I go out photographing. My day-to-day job (yes I still work a fulltime job) is busy enough to distract me from what is really important in life, so just walking outside with a camera in my hand does not equal good photos. I have to unwind.

It takes time for me to relax and open my eyes to what is sublime. There are days I can walk for a long time before seeing anything worth photographing. And at other times everywhere I look is incredibly beautiful. Does this tell me something? Sure does. It tells me that beauty is in the eye of the beholder and that what we see

out there in the wilds is simply a projection of our state of mind on the screen of whatever we are looking at.

More...

We might think that photography is all about technique (how we manipulate our equipment) or about having the best camera bodies, lenses, filters, and tripods – things like that. And it is true that good equipment and proper technique is important and worth having. But using equipment depends on the mind and motivation behind it. In some area of our life most of us know that having the best equipment does not guarantee that we know (or care) how to use it, much less get good results. So while we can talk lenses, techniques, and all of that, this alone will not promise us good photos. What then will?

Good photo technique will never be acquired unless we have the proper motivation, the intense interest and drive to keep at it long enough to build solid technique that will work for us. We can't just fake it or wish it so. The practice or habit forming part of any discipline (like photography) is a great desert that can only be crossed with an intense interest, love, and passion for the subject. You will never get across the habit-forming practice needed to take good photos just because you “want to” or because it would be nice for others if you could do this or that. It will never happen. So what is proper motivation?

Proper motivation differs for each of us. What it takes to inspire us to do enough photography to master some part of it is where we can agree to differ and also where we find our differences. There are many roads to Rome but we have to follow one of them to the end to get there, so it can be important to pick an approach that will work for us and not assume that what works for others will also work for us.

Wanting to take good pictures is IMO not enough of a reason to bring forth the inspiration to actually acquire the necessary technique. Taking good photos has to be more personal than that. It has to fulfill or complete something inside us, to stand between our self today and what we will become - our own future self. We need to do photography as part of learning to know ourselves.

There probably are as many reasons as there are people, but the path to good photography (so that we are satisfied) involves

discovering or satisfying some itch deep within us. Otherwise we just won't keep at it long enough to become satisfied with what we produce, to get good at it. We can't do it just to get more attention from others. That is too weak a motive. We have to do it for ourselves because we have to, and because it completes us. We have to love it. It is not as if there is a choice or another way or road to take. The road is obvious and we don't have to remind ourselves to do it; we can't wait to do it.

Something About Photography

Photography is easy to do and hard to do. It is easy to take snapshots of this and that, but harder to take carefully composed and light-balanced shots. The learning curve is rather long to good photography and few would want to put in the hours necessary to climb that curve. Wanting to take 'nice' photos or a desire to show your friends what great photos we take is not the kind of motivation that will go the distance. It takes a little more than that.

For one, it takes practice, but practice is something few people like to do unless they actually really want to learn something. And technical proficiency by itself is not all there is. We have to have an eye for composition and what is "beautiful," and that is very personal to each of us. If 'WE' like the photos we shoot, that is enough. What others feel about our photos is not important because few people in the world want to see more than a few of our photographs. My family begins to roll their eyes after seeing maybe ten photos. For some reason they don't want to see the hundreds of thousands of photographs I have taken. I can't understand why.
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My point is that usually 'we' are the primary viewers of our own photos. I can't remember a time that one of my kids has come and asked me to show them my nature photos, at least not lately. I can remember many times I have asked them if they would like to see some photos. I have more or less stopped asking. My wife Margaret? Yes, she sometimes likes to see photos because she loves nature, but again: never as many as I would like to show her.

My point is that (at least in my opinion) there is very little chance of anyone becoming skilled at nature photography unless they love nature (a lot) and are inspired to actually get out there and photograph. For example, one year I watched the sun rise every

day it was not raining from around May through October. That means I was out in the fields and meadows in the dark at dawn for half a year, usually soaked to my waist in cold dew, down on my stomach, crawling around, and so on for hours at a time. Who on earth wants to do that? This is what I am talking about. It takes that kind of 'crazy' to get enough experience to actually get better at it.

As for the intention and motivation, for me the mixing of photography with my mind training is a major driving force to go out and take photos. I have written a whole book on mixing my dharma practice with photography. The book is called "Experiences with Mahamudra" and it is a free e-book here:

<http://astrologysoftware.com/books/index.asp?orig=>

If you want to know how I go about photographing nature, I have a one-page free ebook called "Small Worlds: My Key to Photography in One Page." It is here, along with some more technical e-books on photography:

<http://macrostop.com/>

As for equipment, good equipment does help, but it is expensive. You can do a lot with less expensive equipment if you have the will and motivation to practice. Most skilled photographers I know either use Nikon or Canon cameras. I happen to be a Nikon user and am glad of it. I have a bunch of Nikons, including the D1x, D3s, D3x, and D7000.

More important to me than the camera is the lens. I have a lot of close-up and macro lenses and have studied fine lenses to a considerable degree. The lenses I use most are not Nikon. The finest forum and photo site for lenses that I have found is Nikon Gear, where I am also the official mentor of the macro photography forum. You can find that site here: <http://nikongear.com/live/>

There is a little on photography for starters. If you have other questions, I am glad to try and answer them or work up a more technical blog than is this one.



Breathable Hat

A ventilated, foldable, and very light hat is handy when it gets hot.

Macro and Close-Up: The Expanding Universe of Equipment

I get requests and messages about equipment, especially for doing focus-stacking work. You can take close-up photos with almost any camera, probably with the one you already have. All you do have to get in close. Sounds easy, right?

Chances are that what you will get when you first start out are snapshots, quick photos of whatever you are pointing at. The journey from close-up snapshots to real macro and close-up photos is an ever descending spiral into more and better equipment and it will cost you not only money but even more time.

The descent into photography equipment is a steep and slippery slope. Many introductory books point out that you don't need expensive equipment to do good close-up work but I have never met a good photographer, close-up or otherwise, who did not have at least decent equipment and who was not really into discussing just what is the best equipment and why.

So yes, start with the equipment you have, but don't fool yourself that you will not want more and better equipment. I have never seen it happen yet. Perhaps because taste in composition and photos is so personal (as in: we don't go there unless invited), photographers that I have met talk of little else but lenses, camera bodies, and the like. For example:

You may have a camera and want to take close-up or macro photos. Well, do you have a tripod? Most macro photographers use a tripod and would not consider doing otherwise. And how good does that tripod have to be to actually assist you? And on that tripod do you have a ball (or other type) of head to mount your camera on? And can your camera snap on and off (quick-release) the ball head or do you have to manually screw it on and off each time, thus endangering the mounting screw-hole on the base of your camera? And do you have an L-Bracket so that you can quick-change your camera from horizontal to vertical view and back again. And so it goes.

That is how the descent into equipment works, by extension and degrees. It is like that old song "The knee bone is connected to the leg bone, is connected to the angle bone," etc. only here every piece of equipment logically requires an additional or adjacent piece of equipment, and there we go.

Yes, there are a few valiant souls out there who don't use tripods, who don't use L-brackets, who don't use this or that, but they are the few standouts to the rule that there is a minimum amount of photography equipment needed to take good close-up and macro photos. And I am not even talking about lenses; let's not go there... yet.

And the wise advice given over and over but seldom heeded is: If you think that you are going to like close-up photography, get good equipment from the get-go and save yourself not only money but the suffering of using cheap (or no) equipment during your

formative days with the technique, the time when you need all the help you can get.

I should know. For years I never heeded the advice to get a good tripod and a good ball head. I have a whole closet of cheap tripods, mostly aluminum and flimsy, that I can't even sell, and a box of even-worse heads, grips, etc. that I now understand are (and always were) almost impossible to use. And life without a quick-release and an L-bracket? I can't imagine it.

With that in mind, what level of equipment do we need to give ourselves a real opportunity to focus on actually photographing our subjects? Although I am sure many reading this will differ (let's discuss), here is a list of what I feel I would have to have:

Camera

Right now I feel the least expensive camera that does all the things I need is the Nikon D7000. It has relatively good ISO levels, great megapixels, interchangeable lenses, a Depth-of-Field Preview button, and the ability to park the Mirror-Up when taking photos. It also has the ability to fire the camera remotely. Of course I would prefer an FX camera like the D700 which was and is one of the best bargains I have ever seen for doing this kind of work. I actually use the Nikon D3s and (when I am not being lazy because of the increased file size) the D3x.

Tripod

I have to get in line with tradition and exhort you to get a solid (and lightweight if you can) tripod. I know we have to carry the darned things and we want it lightweight and carbon fiber, but carbon fiber and too light (such as the Gitzo 1228) are still too flimsy for the best work. I use heavier tripods as well, but have settled on the carbon-fiber Gitzo GT3631s as a compromise that I can both carry and that will be stable enough. It is solid.

Ball Heads

The same advice goes for buying a Ball Head. Don't buy three or four cheap ones and then finally buy one good one. I only use the Swiss-Arca style quick release style and have had nothing but lots of trouble with the various Manfortto quick-release plates, grips, etc., trouble like: they fail! I have a whole box of them that I can't get rid of.

Just go out and buy a Really Right Stuff BH-40 or equivalent (or equivalent brand) and be done with it. They have good resale value if you decide photography is not your thing. And I suggest the screw- knob quick-release clamp and not the lever-release clamp. I have never had the screw-knob release clamps fail as long as I screw it on tight, and the lever- release looks to me that you could possibly release it by mistake, even by the dreaded 'operator error'. With the screw-knob style it takes time to unscrew it.

I have used the Markin's Q3 ball heads and like them because they are inexpensive, but they do not compare to the RRS BH-40, so I no longer suggest that size head.

L-Brackets

You need to have a quick-release L-bracket so that you can switch between horizontal and vertical camera orientation. No way around it.

Remote: I can't imagine doing stacked photos without a remote of some type. You don't want to be touching the camera when you are shooting a 30-shot image. Adjusting the lens or rack is bad enough.

Lenses

I have published notes on macro lenses and could post them again if needed, but you will need a macro lens that is somewhere between 60mm and 200mm. There is lots posted on these lenses, but feel free to discuss them. The classic Nikon 105mm macro lenses are very usable.

So that, IMO, is the minimum equipment I need to do macro and close-up photography: camera, lens, tripod, ball-head, remote, and L-bracket.

Of course you will want some diffusers, reflectors, flash (I never use them), and what not, but the above is what I need to head out into the woods and meadows. Since I am sure there are other opinions (which is why I wrote this), let's hear them.

Focus Stacking Notes:

Here are a few thoughts to keep in mind if you are serious about getting into stacking focus. I realize that most here already know this, but I offer it for those who are just getting started in focus stacking.

Best Aperture for Focus Stacking?

The best aperture is whatever is the sharpest aperture for the lens you have. You are not looking for depth- of-field here because that is what you will simulate by stacking focus, so don't stack at f/11 or f/16 just because you may get more DOF. Go for the aperture where your lens is the sharpest, which is usually around f/4-5.6 for most lenses. Let the stacking give you the sense of greater depth-of-field.

Focal Length

You can stack with pretty much any lens, but keep in mind that the wider the focal length of the lens, the less you need to turn the focus ring for each layer. And most wider-angle lens do not have a long focus throw so just a tiny movement may be enough. If you are stacking with lenses that are 100mm or longer, a lens with a very long focus throw is a real help.

I routinely stack with lenses from 35mm to 200mm, most of them being macro lenses.

A Good Tripod

There are focus stackers who use no tripod, like as kids we would ride a bike and yell out "Look mom, no hands!" I don't go there and if you want stacks of 6-10 or more layers, it for sure won't work. Get a good tripod and ball head. Use them.

grass cannot but keep the formWith focus stacking, especially in early morning or dim light you need a fast lens, not because you are shooting wide open but because you need enough light in the viewfinder to know where your key points of focus are. A lens of f/2.8 or faster is a real blessing in "magic" light of dawn and dusk.

Focus Increments

There is no set rule here but you want your increments short enough so that the overlap between shots (from the DOF your aperture is set to) is enough to merge well. Some shooters use a focus rail. I just use the focus ring but often move the ring just a tiny bit in each shot. This is something one has to get the hang of.

Focus Throw

A long focus throw while not useful in sports or action photography is very useful when stacking focus. I was surprised at how short the

focus throw is on many fine lenses. If you have a lens you really love for focus stacking and it has a short focus throw, you may have to use a rail. The wonderful Coastal Optics 60mm f/4 APO lens has too short a focus throw for a 60mm macro IMO.

Watch the Light

This is more of a general photographic concern rather than limited to focus stacking. Pay attention to the light in your frame. If you have variable light, like a shaft of sunlight in a shady place, you may want to modify that shaft of light with a diffuser. I have thrown out more stacked photos because I could not nicely tone down hot spots where clipping occurred than for any other reason. Carry some small translucent diffusers with you and figure out some way (and it is difficult) to position them to filter the hot spots while you step through the focus stacking. The same goes for specular highlights (bright reflections). Tone them down in the field and don't count on post-processing to be successful in removing or modifying them well.

Front to Back

Another very common mistake is to not catch the very tip of the front of your subject. You get back home and find a perfectly-stacked photo except that the front- most part is out of focus. It happens a lot. As a rule I back off until the whole thing is out-of-focus and creep up until just before the tip of the top of the front of the subject appears. I stack from there inward.

Extraneous Stuff

Another way to ruin a shot is to have too much room between the very front of your subject and the subject itself, like a blade of grass in the foreground or a stick, etc. If you can include the grass or stick in the composition (and resolve it), fine, but this is perhaps the most common way to produce large and un- fixable artifacts – a bridge too far. I remove or tie back whatever is intruding in my shot. Yes, Photoshop CS5 can remove extraneous objects pretty well, but so can you and perfectly.

Sensor Cleaning

Cleaning your sensor takes on another whole meaning when you focus stack. That spec of dust on a single- shot photo becomes a long line when 15-20 layers are stacked, a line not always easy to

remove if it passes through part of your subject. They are nasty, so be ready to clean your sensor if you are around dust, which means: just get ready.

Touch-up

If you imagine that you won't have to touch-up your stacked photos, think it through. Focus stacking is a sampling technique like digital music, etc. By definition sampling means that something is left out. More often than not what is left out may cause unwanted artifacts in the final stacked photo. Plan to fix those if you want a finished looking photo. Focus stacking requires and teaches patience.

Spirit and Motivation

Physical equipment or gear is not the only requirement for good photography. We also have to be able to "see" and that requires relaxing into it just as it is. This article goes into the spiritual 'equipment' it takes to know Mother Nature.

Looking out your windows at the birds visiting your feeder is a good start but probably not the way to really learn about nature. Watching from a distance may be great for landscapes and sunsets but for any real knowledge you have to actually get your whole body out there and into it – complete immersion. And there are two qualities you will need and they are time and patience, time for anything worthwhile to sink in and patience to be still enough to experience what is there.

For myself, since I am mostly old now, when I first go outside I like to find a nice spot (often in my own backyard), and just plop down and sit for a spell. And it does take time, time for me to unwind and become more aware, and time for the critters that went silent on my arrival to resume their business as usual.

In recent years I stopped mowing my back yard and just let it grow. I seldom walked on my mowed yard anyway or at least not often. My front yard stays mowed (the city demands it) but my backyard has become a home for countless insects, not to mention toads and even the occasional rabbit or two. And I also have a large area in that yard where I have let the milkweed take over and that patch alone is an incredible place for many insects, butterflies, moths, and spiders. They are having a big party out there.

After ten minutes or so (this is where the patience comes in) I tend to calm down and begin to “see” the life around me. Of course it is up and moving again but often I just don’t see what was there all the time until I relax. I usually have my camera with me but things would be the same without it. Before long everything is going on again, often on the same plant or even the same leaf. All I have to do is observe.

And if I am looking for some critter in particular to photograph (I’m on a ‘hunt’), that seldom works because I hurry right by everything else that is right there, that is happening now and usually don’t find what I was looking for anyway. For me it is much better to use the “found” approach to photography, just taking lots of time and seeing what happens to be there right now rather than what I wish were there. I also find it good to keep in mind what the long-term benefits of nature watching are:

Watching nature gives me a second opinion on just how life works compared to what organized society offers. Society sends many mixed messages, trains of thought going in opposite directions, and enough blurring of the truth to breed confusion. Nature is 20-20 all the time but it may take a while for us to get used to it. Of course, nature can be “beautiful” in itself but the real beauty of nature is in what it brings out in me, in the reaction I have to what I see. For example, it is very difficult to look carefully at nature and not be moved at things like

- (1) the preciousness of life,
- (2) the impermanence of it all,
- (3) the instant karma of cause and effect,
- (4) and the endlessness of it all. Compassion naturally arises in this situation.

If what I see does not invoke a reaction, does not bring forth some compassion from within me, then I

usually need a stronger dose. Right now many of us only get what I am talking about here when someone close to us dies and puts us into a special frame of mind for a short time. I am suggesting that we develop that frame of mind a little at a time rather than only through the shock of a loss or tragedy. Trust me, it works, and it is good to be able to get into this frame of mind on a regular basis, to

learn to “die daily” as the Christian saints point out. Nature is the perfect teacher and even the Tibetan Buddhists point out that natural appearances, Mother Nature, displays all of the dharma, all of the time. They call it the “Lama of Appearances.”

Nature’s Nature

I was fortunate to be introduced to the world of nature at an early age thanks to the kindness of a woman named Peggy Dodge, a graphic artist and a friend of the family. My mother and Mrs. Dodge would meet with a small group of local artists at the Dodge farm which was located in a rural area that included a small pond, meadows, and fields. Mom would take me along. Peggy Dodge also had a true love of nature and all its creatures, a love which she was kind enough to share with me when I visited. I was six years old.

From that age until I was about sixteen I studied nature with an intense passion pretty much all of the time. School was mostly lost on me for I was way too busy thinking and planning what I would do each afternoon out in nature when school was over for the day. I had my own mini-nature museum in my room where I kept all kinds of animals, insects, snakes, and you-name-it, including rattlesnakes, copperheads, skunks, spiders, boa constrictors, and anything I could manage to keep alive. I had insect collections, rock collections, leaf collections, fossil collections, shell collections, and so on. It would be true to say that any real education I got (at least what actually sank in) came from what I learned from observing nature. And it never occurred to me that everyone else was not getting this same education! I would like to pass on some of my enthusiasm for the world of nature.

Let me begin by pointing out that I realized quite early- on that there are real differences between natural law and human-made laws. Human laws are made by people and they can be bent, twisted, and even broken at times, and usually are. This is of course what lawyers do so well. Yet nature’s laws cannot be broken. If we break them, they break us. No one defies the law of gravity with impunity. What goes up, comes down. What is born, eventually dies. We all mentally know this, at least in principle.

Because I grew up with my eyes glued on natural law, that was the law that I came to revere as the truth – the bottom line for me.

Society's laws were far less consistent and frequently just plain confusing. But it is only in recent years that I have realized what a great teacher nature was for me back then and how lucky it is that I put my trust in what I saw in nature rather than only in the various rules and laws society wanted me to learn, which often seemed to contradict one another, and still do.

There is something wonderful about consistency, especially when one is young and trying to get a handle on life and, if nothing else, mother nature is consistent. Her laws are always the same and there is no way of getting around them -- no exceptions. What you see is what you get. There are no behind-the-scenes or backroom deals being made. Nature demonstrates perfect equanimity. Everyone and everything is treated equally. This fact alone avoids the confusion that society's laws can instill in us. In nature, a rose actually is a rose, is a rose...

And nature keeps no secrets. She openly shares the facts of life and death with anyone who cares to observe. Unlike society, where death, dying, sickness, and all of the suffering-side of life is for the most part either sanitized or swept under the carpet, nature never blinks. It is all right there for us to see, if we will just take a peek. I am not saying here that what nature shows us is always a pretty sight, but with nature you never have to figure out what is real and what is not. It is obvious. For a little kid (or even an adult!) this can be an extreme act of kindness. What society does not care to discuss with us, nature is only too ready to reveal. And nature has other messages for us as well, which I will mention in the next blog.

Permanent Impermanence

I can't say for those of you reading this but in my experience too much of the time the sheer business of life causes me to forget many of the more important things. I am ashamed to say that it takes some really sobering event (like the death of someone close) for me to snap me out of my busybody trance and take even a day or so of time to really consider life itself. And while I never expect or welcome such events, I do very much appreciate the time out at those special moments, time to consider the bigger picture, and the ability to remember deeply once again what is really important.

Nature on the other hand is a constant reminder of how impermanent this life we are all living is. I can never forget the time

I was traveling through India and was saying goodbye to a great Tibetan meditation teacher, who said to me: "Tomorrow, or next life, Michael, whichever comes first." His words woke me up a bit and the message was much like the one that nature is consistently offering us: awareness of our own impermanence. None of us are about to live forever and I might keep that in mind once in a while. Nature points out impermanence to us all the time. It is hard for me to take a walk along a country road in the early morning dew and see the thousands of earthworms and slugs trying to cross the tarmac before the fierce summer sun rises and fries them to a crisp. These creatures made a bad decision to cross the road just at that time and though sometimes I try to pick them up and carry them to the grass on the roadside, it is almost impossible to save them all. I just can't do it. And some of them are crawling in the direction of travel of the road itself, so they will never make it! This is just one instance of the kind of impermanence nature demonstrates. It is all around us. We won't look. It is too painful, but why can't we look?

And, as mentioned earlier, nature never blinks. We blink. Nature shows us precisely how cause and effect works, what the Asians call 'karma', action and the results of that action. And the equanimity of it all! No one breaks the law of gravity, neither person nor creature. All are treated to the same result if we break that law. Nature brooks no lawyers.

And as we get closer to nature, as we take time to actually look, we see that every form of life, every sentient being, is not unlike ourselves. Every creature out there wants to be happy (to just live) and no creature that I have ever seen wants to willingly suffer unless it's the human being. We each seek happiness and we try real hard to avoid suffering. Every sentient being feels the same way. We have that kinship with all sentient beings.

Nature reminds us that life is in fact impermanent and that all life is indeed precious, and that those who have life don't want to lose it. And in nature it is easy to see that our every act has consequences, real results that we would be well advised to keep in mind. And all of the above is ongoing, in fact seemingly endless. Nature is not about to change and the only actual change we can expect will be our own attitude, how 'we' receive or take what is given, how we accept what is already there. Nature is the perfect teacher when it comes to attitude adjustment. She proves that we

might well adjust our attitude to her laws and, how if we do not, we will pay a very dear price. And I have forgotten perhaps the most important message that nature teaches us, and that is about love and compassion. It does exist in nature and I will point out where in the next section.

The Root of Compassion

In what I have written so far there is seemingly no compassion in Mother Nature. She is merciless, inexorably precise about what she exacts from us, and when. There are no sentimental tears shed by Mother Nature. She is indeed a harsh mistress. But she does have one soft spot and it is important for each of us to discover and remember what that is and where to find it.

If we look for compassion and kindness in nature it is seemingly nowhere to be found unless we could agree that her laws themselves are kind in the long run. She treats all beings equally. Is equity itself a kindness? Yet she does have a compassionate side.

It would seem that love and compassion are only to be found in the relationship between a mother and her children. True love and real compassion (and a willingness to do anything for another being) is pretty much limited to the way a mother feels about her child and what she is willing to do for that child. And you see this all through nature, not just with human moms. The love of a mother for her child is the one bright spot in what otherwise may appear as the torrent of nature's nature.

It would seem from observation that most natural creatures live in perpetual terror of being killed and eaten while at the same time hunting, killing, and eating something else themselves. I know this is not 100% true but, in general, nature is not a peaceful place at all, and most sentient beings do not live in serenity. My point is that perhaps the only place in nature that we find true love and compassion is in the relationship of a mother to her offspring. This is a rule that is remarkably constant throughout all natural realms – the love of mother and child. Can you even imagine if it were not there? How could life go on? It would not. So much depends on this fact.

And it is interesting to me that all of the religions of the world appear to be working very hard to have us treat each other as a mother naturally treats her child, to get us to go beyond just family

love (the love family members share) and extend that same love to others, to those outside of our immediate family. The Buddhists would have us extend that love to all sentient beings, and not just to humans. Christians say “Do unto others, as you would have them do unto you” and the Buddhists would agree with that, but they would add: and you make the first move! Reach out with love and kindness.

In nature compassion is always local, limited to that very special relationship between a mother and her children. Fathers share in that too, of course, but it is with mother and child that true love and compassion seem to be most pure and present. In this way Nature is a great teacher. She does not obscure or perfume the way things are. Truth is revealed for what it is in nature – straight up. In nature we can see impermanence clearly, not obscured or sanitized as it is most of the time in society. It is clear through examining nature that life is indeed precious, and is not something guaranteed to go on forever.

And it is clear that our choices, our every action, bring consequences. And the situation that nature presents is not only the way things are right now but the way things will continue to be on into the future. The way things are is the way things have always been and will always be. It is up to each of us to respond to these very clear facts, something that in most societies we never have a chance to do. Instead, most of us tend to ignore all of this and willingly prefer to remain ignorant, to ignore the obvious.

The only light in this otherwise fierce darkness is, as I pointed out, the very real love, care, and compassion that a mother has for her child. Thank heaven for that! Mother love has been a beacon of light for all of us virtually forever. There is nothing else like it on earth. We all celebrate Mother’s Day but Father’s Day kind of just slips by. It is not the same. I like to joke at my house that all the kids responds to Mother’s Day and that it gets a whole 24-hours but the celebration for Father’s Day is lasts only a few minutes.

The Buddhists have patiently tried to tell us for centuries that every person we meet, even every sentient being has been our mother in some past lifetime and that every last sentient being has also been our child. Perhaps this is an attempt to make clear to us that we should treat each other with the same kindness, endless love, and compassion a mother will show her child. This may be the bridge

we as a human race have been forever unable to cross, the key not only to Mother Nature but to our own nature, the two being the same anyway!

The question is how can we do this? How can we learn to treat each other with the kindness that our own mother has shown us?

Well, the Christian, Buddhist, and other religions have been trying for thousands of years to show us how, to point out the way, and they all seem to agree that it involves treating ALL sentient beings as a mother treats a child, with that same endless care, kindness, and compassion, a universal remedy that is much easier to say than to act out in real life. And it would seem that this will not happen until the kind of compassion arises in each us for all sentient life that we find in how a mother loves her child. And last, it seems that many of us don't get really serious about all this unless something upsetting happens to us.

There is another way. Exposing ourselves to the truth of nature a little at a time can help to make that possible by gradually softening our obscurations and giving us opportunities to feel compassion for all beings, not just our friends. Our greatest teachers (saints, priests, lamas, etc.) have shown us what this might look like, but not enough of us have been able to have that realization.

May that kind of compassion awaken in all of us and may we share that kind of realization with one another. May we extend this to all sentient beings who, like us, only seek to be happy and not to suffer.



The DSLR Mirror

Looking directly at the mirror of a Nikon D3x, the same mirror which you want to have up before you take a macro shot, using the Mirror Up command. It makes the dust fly around in there when it flaps.



Battery Compartment

Side view of the Nikon D3x, showing the battery compartment and one side of the L-Bracket.

The Spiritual Side of Macro

Taking good photos is not something I ever learned from books. There is always a stark gap between conceptual learning or training and direct experience. Books and teachers can but point at it, point out how to do it, more often how they did it, and not necessarily what would work for me. This is a perennial problem, the difference between book learning and actual experience. Experience involves taking the plunge into direct experience where we are out there on our own and have only our self to please. Imagine that? We can read about how others do it and, inspired by their account, attempt to ride the coattails of their experience out into the field and find out for ourselves, but this too often soon leaves us high and dry, forced to find our own way once again. As Yeats wrote: "The grass cannot but keep the form, Where the mountain hare has lain." We can never properly conceptualize direct experience. Words pale next to experience and words only exist to point the way to experience. We can describe how to do something, point out how to approach it, but can't just give the direct experience to another. We each must have the experience for ourselves. That is the whole idea of learning and teaching: to point out the way to the experience itself.

I only gradually became aware of how to present my photographs to others. For years and years I photographed and not only did not show them to anyone else but hardly looked at them myself because I was not interested in the final results or photos, but more in the process of photography. What do I mean by 'process'?

The process for me was being out in nature, usually in the early morning, often at or just before dawn. It was about the crisp morning air, the cold wet dew on the grass, the bit of mist in the meadow -- things like that, and seeing all this through the lens of a camera. This poem I wrote captures something of that:

From A Dream

I have gone to paint the sunrise in the sky,
To feel the cool of night warm into day,
The flowers from the ground call up to me,
The self I think I am is hard to see.

There was part of me that got lost out there in the misty dawn, a part of me that was too much with me the rest of the day, a part I needed a rest from. Let's just call it the busyness of my day-to-day

distractions, my job or concerns about money, etc. Or we could say that there were things that weighed on my mind too heavily and needed to be set aside even if for only an hour or so at sunup.

Photography was not simply escape; it was a way or door to the future, a rabbit hole that I leaped through, a door in the back of the cabinet that I could not wait to find whenever I could manage it. Through photography I helped to close a door to the past and spin a window on the future that eventually became a door I stepped through. I grew from it. I found myself through photography. It was visceral and not an option.

Our passions, the things that we love, need not always be a diversion or distraction. Sometimes they are the way through the present to our future and not just an escape from reality.

Photography is just such an experience for me. I am relating this not to discourage anyone from

photographing but to point out that perhaps the single most important quality we need is proper motivation, the right intention. If we want to learn photography just because we have a will to learn photography, good luck! Of course we can do it, but it will take a long time and may be pretty boring as well.

If we want to learn photography just to show others our photos, that is even more difficult, perhaps almost impossible. Another way to say this is: our interest in others had better be as strong as our interest in ourselves if we hope to get good results. The only way I know into photography is as a way to satisfy or complete something in myself that is lacking. Again: photography can be a doorway to the future, not a sidebar or pastime.

Photography is not something I 'should' do or have set out for myself to do but rather it is something I can't wait to do. Given the opportunity, this is what I find myself doing for fun, just because I want to. And there is this more subtle and difficult-to-explain point:

For me photography was never only about cameras, nature, photos, or techniques. Above all it is about "seeing," about a way of seeing in the world that for me is liberating. I very much mixed my mediation practice with photography and at the time hardly was aware that this was even taking place. I wrote a whole book about this experience so I will not belabor it here. But I will try to sum it up.

Meditation or training the mind is about concentrating, of course, but more important it is about relaxing or resting. And it is not about resting willfully; it is about just letting the mind naturally rest, allowing the mind (and body) to rest – allowing that to happen. And in that resting there can be a pristine clarity, a seeing directly not of any ‘thing’ but seeing itself seeing – seeing ‘seeing’. And that is liberating. Well, in a word I found that ‘seeing’ or rest while looking through a lens and still do. This is why the process of seeing is more important to me than the resulting photos, but the photos seem to be getting better too.



Sensor Magnifier

An LED magnifier that fits over the open whole on your camera when you remove the lens allows you to see in an instant every last piece of dust in there. The best peace-of-mind money I ever spent.

Is Ultimate Sharpness Apochromatic?

Chromatic aberration is something photographers must live with, the idea of color fringing due to the fact that different colors focus at different distances from a lens. If two wavelengths of light (usually red and blue) are brought to focus in the same plane, the lens is called achromatic. If three or more wavelengths of light are brought to focus in the same plane (at the same distance), the lens is termed apochromatic, as in APO lenses. The idea is we would like to have all the colors focus on the same plane, like on our sensor.

“APO” is a term rather loosely used by lens manufacturers. Not all lenses labeled “APO” are really properly corrected, so just having the term “APO” on a lens does not guarantee any particular degree of correction. However, there are certain lenses that photographers seem to agree do deserve to be called apochromatic, macros such as the Coastal Optics 60mm f/4 APO, the Leica 100mm Elmarit-R f/2.8 APO, and the Cosina/Voigtlander 125mm f/2.5 APO-Lanthar. And there are others.

I don't have the technical expertise of some of our members here, but I do have a pretty good eye for images. In recent years I have been searching for the Holy Grail of Sharpness in lenses, a true Odyssey, for sure, and probably a bit of a fool's errand, as some have pointed out.

In brief, my journey lead me through the best of Nikon's macro lenses, on into lenses like the Voigtlander 125mm (and the others pointed out above), and finally into the extremely sharp industrial Nikons, such as Macro Nikon Multiphots, the Nikkor CRT, the Repro macro, the Printing Nikkors, and others.

Although the industrial Nikkors were indeed very, very sharp, their resulting photos still left something to be desired. It would seem that sharpness alone is not enough, and that part of what I was calling sharpness really turned on how color was handled. In other words, color treatment very much affects what I was calling 'sharpness,' which brings me to the apochromatic lenses.

When all was said and done, I seem to end up using the three APO lenses mentioned above, the Voigtlander, the Leica, and the Coastal Optics. I have many other fine lenses, such as the Zeiss 20

50mm and 100mm Makro-Planars, but (to my eyes) their more “contrasty” look (for lack of a better word) detracted from their use in my work. Yes, they are very sharp, but part of sharpness (so I argue here) is color, and the Zeiss lenses are not true APO lenses. And that apparently (to my eye) makes a difference.

Then, when I did a lot of work with the various industrial Nikkors, which indeed are as sharp or sharper than the above mentioned lenses, the results left something to be desired. So, ‘sharp’ by itself is not all that sharp, so to speak. In fact, in the end my idea of sharpness turns on color. I was surprised.

Perhaps the industrial Nikkors lack the modern coatings or something, so I have to be careful what photo environments I use them with. Where subtleness of color is not key, they work fine, but where refined color is paramount, I had best use other lenses. Hopefully some of you reading this will have the proper explanation for what I am only able to see as a difference.

All of this was pre-Nikon 800E. With the advent of 36 megapixel images, all of this becomes (for me anyway) much clearer. What was something I guessed at with the Nikon D3s and D3x, becomes more obvious with the D800E. It is clear from the D800E photos that uncorrected non-APO sharpness lacks something that APO-corrected lenses appear to have, as in: what I am looking for, call it sharpness or whatever.

My question and reason for writing this is to seek other opinions on this and explanations for what I am seeing.

Am I crazy to think that ultimately sharpness, depends on color, like: perhaps resolving the color fringing with APO lenses?

Are the ultra-sharp industrial Nikkors missing something, like APO corrections, and if so what?

Do the higher resolution (megapixels) of cameras like the D800E make all of this more obvious?

What does that tell us we want in a lens for fine color work?

I apologize in advance if I misunderstand any of the technicalities involved here, so set me straight please. 21

Entrance Pupil Problems with Stacking

Since I started using the Nikon D800E, I have had some minor but annoying problems with stacking the resulting images. It has nothing to do with the D800E, because the problem happens in the stacking program, not in the camera. And the problem is....

The two main modes of stacking, PMax and DMap, no longer line up perfectly exactly. There are some very slight differences between the two modes to the effect that when I try to retouch using one on the other, there are slight differences that make the retouching not worth it in some cases.

The good news is that DMap by itself (with the D800E) is almost perfect in this higher resolution. I have asked around and no one can explain why it should suddenly be so much better.

Meanwhile, the problem of the two modes not working so well together I took up with Rik Littlefield, the author of Zerene Stacker. Littlefield is incredible in that he is unerringly interested in every facet of not just his program, but all stacking and related topics. He studied the problem and suggested the problem is the following.

In the stacks I have been doing, I place the camera and lens on a focus rail and move the whole ensemble incrementally forward for stacking, as opposed to fixing the camera/lens on a tripod and turning the lens helicoid. This Littlefield pointed out can make a difference.

He said that the entrance pupil for the lens determines how stacking programs can handle the images. The ideal situation is if the entrance pupil in the lens stays fixed, and the camera incrementally moves on its own. He pointed out that there is no chance of this when we move both camera and lens together as a unit on a focus rail, but that instead by turning the helicoid to stack, with some lenses the results will be better. In particular lenses such as the Nikon 35mm f/1.4G, which has back-focus this will work. "IF" lenses, since they are internal focus lenses will cause problems when I stacking by moving the camera and lens as a unit.

Best of all would be to use a bellows, fixing the front standard (with the lens) and moving the camera on the back standard while the

lens stays stationary. In this way, we are sure the entrance pupil does not move at all.

The problem I have with this solution is that with a lens like my old favorite CV-125mm APO, it is not useful to mount that lens on a bellows and move the camera from behind, because the lens was built for its particular dimensions and is drastically altered when used with a bellows. It is what it is, and that is why it is a great lens. Start messing with it, and it gets ordinary fast.

However, an enlarger lens like the APO EI-Nikkor 105mm works perfectly as a bellows lens, since it was originally designed as an enlarger lens, so I tried that.

Sure enough, the resulting PMax and DMap images matched perfectly and there are no more problems with stacking this way. Now, I can't stack everything on a bellows, because I will continue to use all of the various lenses I love, but I do understand that I have a solution at hand with the bellows, should I need it.

As to why the greater resolution of the D800E brought this problem to my attention in the first place, I have no idea other than perhaps the finer detail brings it out. Any ideas?

Liquid Focus

“Liquid Focus” is what I like to call stacking focus using the widest aperture of a sharp lens. I can just paint in focus with the razor-thin slices of the wide-open lens, or sometimes I imagine it is like dipping the subject in liquid focus, right up to whatever line I don’t want to cross. And I can choose a sharp line of demarcation or (by narrowing the aperture) a little more depth-of-field. It is also a little like the new 3-D Printing processes, where machines increment layers of substance to create complete three-dimensional objects.

In my early years stacking focus, I was always pushing the narrow end of the aperture, pushing for as much depth of field as I could get. Of course that was death on bokeh, brought on a struggle with diffraction, and was mostly an exercise in futility, when I could just as well been painting in focus exactly where I wanted it.

Then I spent a long time focus stacking by setting the aperture to the sharpest focus, usually somewhere around $f/5.6$. That showed better results than pushing the f-stop up to $f/8$ and $f/11$, where diffraction begins to set in, plus I lose much of my nice blurry bokeh. Still, neither of these is as flexible as wide-aperture stacking. And it is not a tribute to my native intelligence that it took me so long to discover the virtues of stacking wide-open, or perhaps a stop or two down.

Of course these two approaches are not mutually exclusive. You can use both and even single-shot photos become more appealing to me since I have received my Nikon D800E. I have to do a bunch of tests just shooting one layer as soon as I can tear myself away from my delight in stacking layers with this new camera.

And you can stack with variable apertures, if you are very careful with your histograms. Having several layers in focus, successively deeper in the shot also works (I tried it), but I don’t use it a lot. I am considering doing so, but all of this takes so long. With the huge file size from the D800E, it can take me an hour just to stack one photo, so I have had to relax and learn even more patience, which is good therapy for me. I am too much in a hurry anyway.

And for years I have been more than a little envious of the quality I can see in medium-format cameras and digital backs, so even if the

D800E does not quite reach the MF heights, it comes close enough IMO to move the bar closer to that hallowed format. The results are good enough to keep me busy and off the streets for a while.

Here is a photo (and a crop) with the Nikon D800E, CV-125, and Zerene Stacker. It is not supposed to be a finished photo, but just an idea of a swatch of focus across the subject. If you know early-morning foliage with fine dew, you can understand the coloring here.

On the next post is the crop. I will take some like this, with no stacking, as soon as the weather permits and there is no wind.





Single-Shot Live-Subject Macros - The Nikon D800E

Not sure why I am sharing this: It is not because these are acceptable results, but rather to discuss the challenges that the new D800E offers when it comes to manual focus. I was at an event for a few days, but not one I imagined I would be using macro lenses, so I only brought one, the Voigtlander 125mm f/2.5 APO-Lanthar, just as an afterthought. I also brought the Nikon 800E, although I was there to shoot with the Nikon D4 and the Nikkor 24-70mm and the 70-200mm. Anyway...

In the early morning one day I had time for some macro shots using the D800E and the CV-125, so I took some single shot photos. It was just a little windy, so stacking on a rail would have been fruitless.

The results were anything but encouraging, not because there is anything wrong with the D800E that I can see, but because of my own lack of technique. There was not quite enough light for very high apertures, so the DOF was shallow and it shows. It was hard to get enough of the subject in focus to feel comfortable.

While most of the problems I ran into would be solved if I stacked focus (on a static subject), since I could create my own facsimile of DOF, taking one-off shots proved to me how critical the focus is with this new camera. It was frustrating to say the least. And, it is hard to see in the tiny LCD whether you really have the focus or not.

I should have brought the Micro-Nikkor 105mm f/2.8 VR lens. That would have helped. Trying to focus moving subjects with the CV-125 in only medium light was painful. However, I can say this:

The camera is great and even from these relatively unfocussed shots I can see that if I do my homework, that very high-quality shots are possible in the future. But this camera will separate the men from the boys (so to speak), and there is a real learning curve here for single-shot focus on live subjects. Ouch!

After this experience, I am not so quick to recommend this camera for everyone. It is going to be very painful for those without the

patience to focus this baby. Again, a VR auto-focus lens would help, and I have not tried to figure out whether my copy of the D800E has the right/left focus problems. Not sure how to do that. What is an easy test for that?

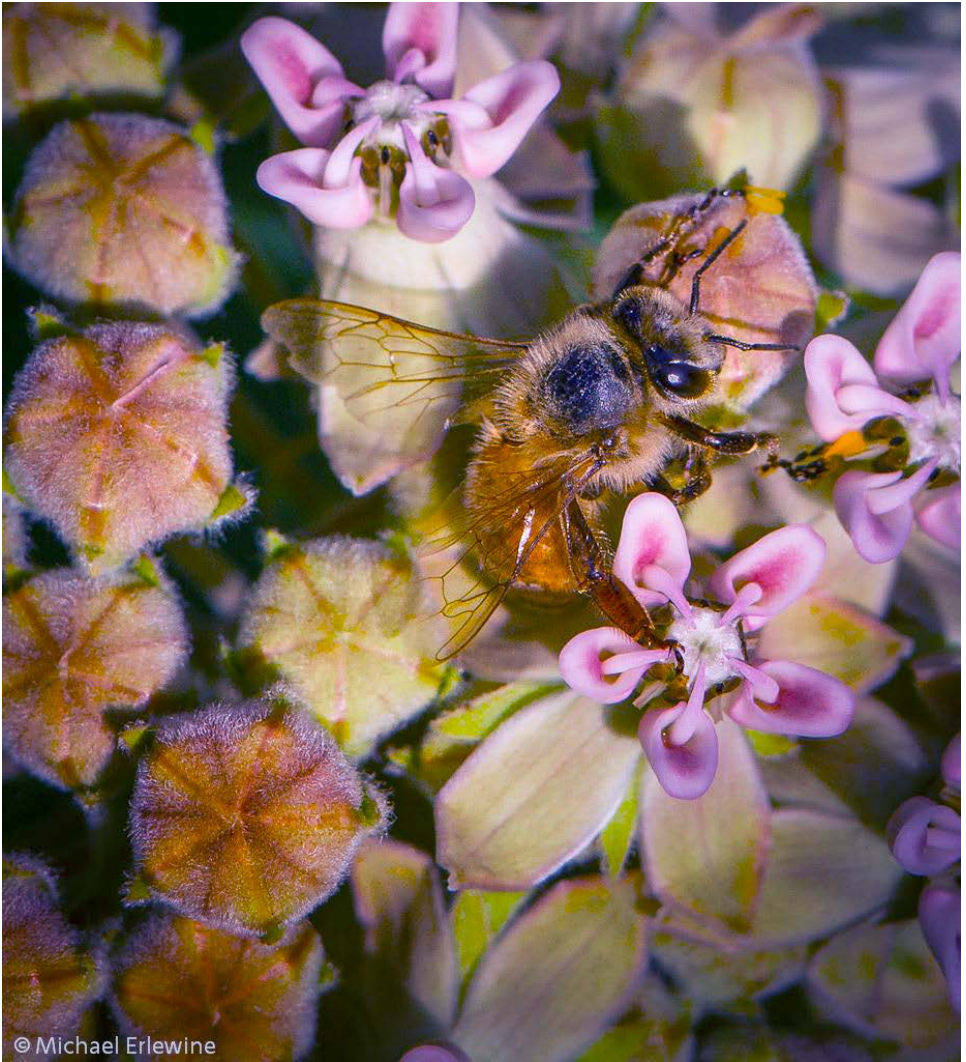
So my takeaway is embarrassment at my own technique, and the sense that I need a lot of light for one-offs, higher apertures, and that an autofocus lens would help a lot. I would want a tripod, even for these shots and, at least for now, I have to be ready for a workout. I felt clumsy with the D800E. This camera is demanding when it comes to focus. And as wonderful as this camera is, it appears to me at the moment that for this kind of work, it is a specialty camera, not a general camera, at least in my opinion.

Of course, I am still a little daunted by the experience, and I can only blame myself for the results. However, I am peaked to try it again soon.

All shots with the Nikon D800E, CV-125, and an aperture perhaps at $f/5.6$ or lower, not enough DOF for what was needed.



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Focus Stacking in a Box

The Nikon D800E is proving to be a real game changer for me and I will tell you why. Since, for some reason, it seems I can push aperture beyond $f/11$ with some lenses and the result has a pretty good depth-of-field. Of course, bokeh becomes a problem as in: there isn't much, but the allure of a one-shot photo with no artifacts and decent DOF field is tempting.

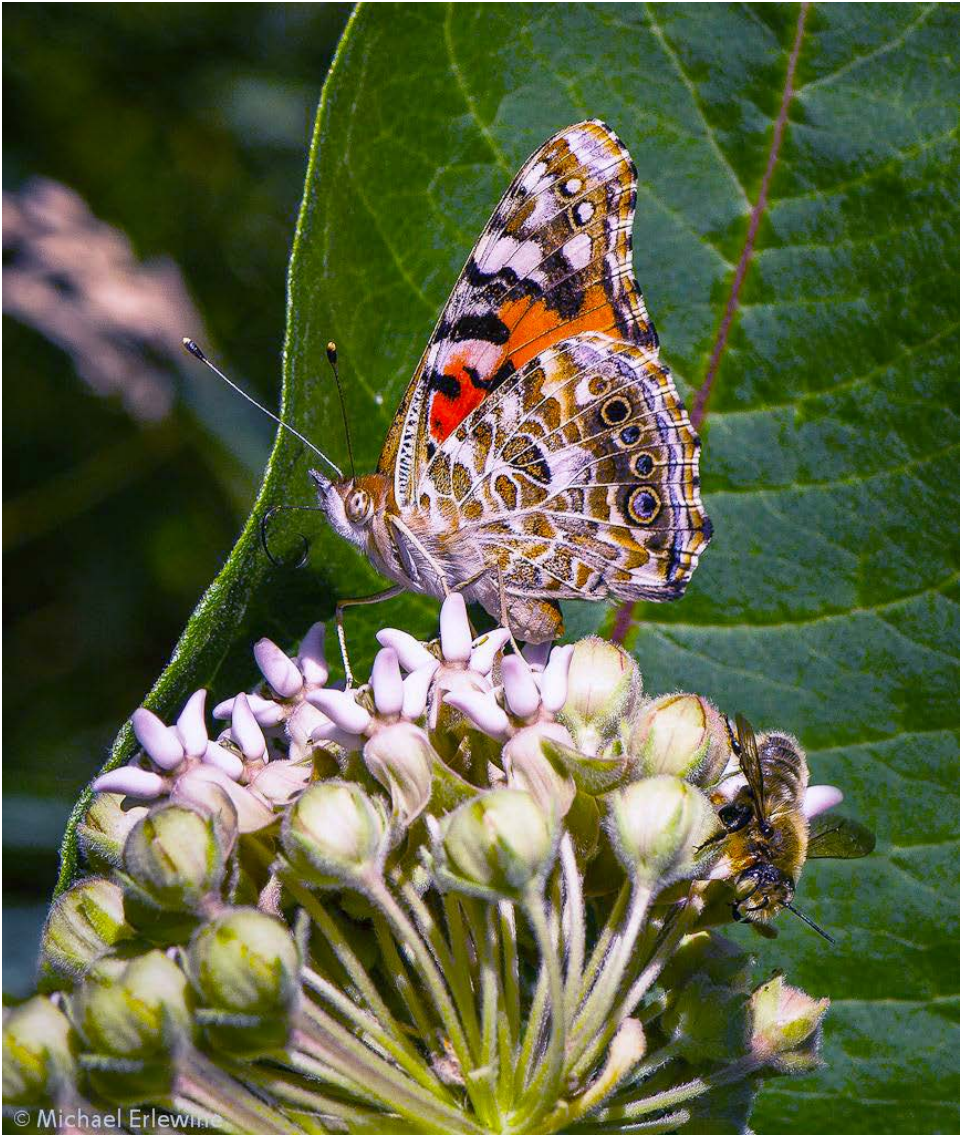
And, of course, with live subjects there is no contest. Live critters can seldom be focus-stacked, except on rare occasions or very early on a cold-ish morning.

I find myself asking the question, what is it that I want? Am I so addicted to stacking that the process itself is a big part of the appeal (which it is) or am I just after photos. The answer is both.

Aside from the process, it is true that the effects of focus stacking on the finished photo itself is part of the charm of that technique.

The process of photography for me is very healing, but that process is not limited just to focus stacking. Any repetitive technique is something I can respond to. Putting the process aside for the moment, as for the resulting photo, I don't care what process is used as long as the finished photo captures what I am after, usually with some emotional character.

This shot taken with the Nikon D800E, $f/13$, 500th, ISO 400 is a two-layer stack, but I have dozens of good single shots which tells me that the single-shot D800E photo will replace some part (perhaps a good part) of my photos. There is no reason to stack if I can get what I want with a single shot. I include a couple of single shot photos below.



Nikon D800E, Micro Nikkor 105mm f/2.5, f/13, ISO200, 500th

Summary: D800E for Close-Up/Macro Work

So Far, So Good, with some Caveats

I have written some of this elsewhere, but will incorporate it here for those who missed it and want a summary. The Nikon D800E is IMO a game changer for close-up and macro nature photography. Whether used to stack photos on a rail or taking single-shot photos of live critters, the camera excels. I know there are autofocus (and probably other) problems floating out there, but I assume they will be resolved by a firmware upgrade or camera replacement. I have not run into them, but neither have I tested for the autofocus problems. This is not to say the camera does not present new challenges. It does.

D800E: Studio and Focus Stacking

I have extensively tested the D800E in the studio (or outside when winds are calm), mostly on a focus rail, and the camera is outstanding for this kind of still-life work - stacking. All is good and this has been well documented (at least by me). The camera is sharp beyond any others I have ever used. Period.

Even with limited single-shot experimenting, it seems to me that the D800E will curtail some amount of my focus-stacking work by replacing stacking with single-shot photos, especially in the field. Where before I could not stack because of the ever-present wind in the flatlands of Michigan, now I am encouraged to try single-shot outdoor photos, either with an increased shutter speed or waiting for a momentary lull in the wind.

This will almost certainly increase my still life work in the field. Until the D800E came along, I mainly waited for a period of calm regarding wind, and did my stacking during the calm. Those periods of calm are rare here. Now I will see what single-shots can do.

However, I stack in the studio regularly, at least in the winter. I am encouraged to approximate focus stacking with either a single-shot carefully set up or a short stack of perhaps one to three layers. I continue to be amazed at the amount of detail a single shot of a still life will give me with the D800E. All I have to do is pay attention to ISO, aperture, and the other factors that I would normally.

I can (without regrets) say that I will be taking more one-shot still-life photos in the field and be sacrificing very little, especially since my focus stacking technique has been moving more and more toward have a limited area in focus and letting the rest go to bokeh or whatever.

Not sure I would do one-shots in the studio when I have the opportunity to stack, but I am starting to believe I just might. There is something nice about have no artifacts in a photo. In fact, this camera brings new life for me in taking single-shot nature photos, which for me is saying something. I will no doubt be doing more walking around.

One-Shot Nature Photography

As mentioned, I have done considerable field testing of the Nikon D800E for single-shot autofocus live-action shots. I am very pleased with the camera, but like everything else there is no free lunch. Well, perhaps with the D800E there is a little free lunch.

I have not been able to use manual focus APO lenses like the CV-125 or the Coastal Optics 60mm APO in the field for single-shot photos due to difficulty with manually focusing on fast-moving critters. Single-shot manual focus, in general, is very difficult with this camera. I have been resigned to using what autofocus macro lenses I have, like the Micro-Nikkors 105mm f/2.8 VR and the Micro-Nikkor 200mm f/4, and find so far that the 105mm VR is the most flexible. It is a solid lens. The 200mm, while sharp, adds too much darkness to the viewfinder for my comfort. I have yet to try some of the wider autofocus Micro-Nikkors, but they are on my list. So what have I learned from the single-shot work?

Single-Shot: ISO

The D800E is less tolerant than I hoped when it comes to ISO. I find that the ISO needs to be as low as I can get it, largely due to the need to crop tightly, thus making noise more visible. In fact, because of cropping, noise is a large factor. Even ISO 400 is too high for comfort, and ISO 200 also produces noise when you crop it small enough, obviously. I am trying to hold to ISO 200, unless forced upward, but that is asking a lot.

My guess is that we will generally see more noise in this kind of nature photo than in the past or that some noisy areas will be cloned solid in Photoshop, which is worth it in some cases.

Single-Shot: DOF

As for Depth-of-Field, we are not stacking here, so the old rule of push the aperture as narrow as possible holds sway. Yes, there seems to be some additional leeway toward higher apertures with the D800E, but for most work f/11 is about as high as I want to push it. I tried higher apertures and for fine still life work (with the finest lenses) I can perhaps get away with it. For most work, f/11 does a pretty decent job of putting things in focus. I am somewhat impressed with f/11 for single shot detail.

Single-Shot: LIGHT

Since I am shooting at f/11 when I can, that means I need light and more light. I am shooting a lot in full sun and that means that harsh highlights and light-related considerations are now a problem. Still they seem (so far) easier to deal with than the additional noise from too little light. What this tells me is that, as usual, good technique and some luck will be important. Like all new equipment, in time we will master what we can. Right now, it is still new.

Single-Shot: SHUTTER SPEED

Obviously this varies, but the shutter speed greatly affects the freezing of motion with fast-moving critters, and too low a shutter speed adds unwelcome movement and noise. I push the shutter speed as high as I dare, which means I am in full sunlight more often than I wish. In the past I have avoided full sunlight with a passion, but here (at least for now) I have no choice.

Focusing with the Nikon D800E

I will leave aside the autofocus problem that is being discussed elsewhere, since I have not tested my camera for that. I can say:

Focus Stacking: No problem, since it is manual and incremental. Works perfectly.

Autofocus: So far seems to work well with the Micro-Nikkor 105mm VR. All is well.

Manual: This camera is a royal PITA to manually focus. Think of it this way: the same great detail the camera delivers in output requires the same degree of technique going in, i.e. focusing. It is a bear to focus manually because you can't see well enough in the LCD screen. Perhaps live view would help and in the studio, tethered to a laptop would probably be wonderful. However, in the field, in standard conditions, trying for pinpoint focus is going to require a learning curve on all our parts. Although totally understandable, manual focusing for a single shot is my least favorite feature of the Nikon D800E, even though I expected it.

Unexpected

And there is another effect I am experiencing with the Nikon D800E that is harder to put my finger on. It has to do with 'process'. I am so used to the very tedious process of focus stacking that I almost feel guilty just taking one photo and moving on. I am all about process for working with the camera meditatively, getting my mind right. With a single shot, I have hardly begun letting the mind rest.

I know that I will adapt to whatever adjusted process is required, so I am not really worried. It does give me more pause to consider composition, color, and perhaps most important the whole idea of photos as impressionistic. With so much tedious technique perhaps removed or at least limited, I seem to be increasingly interested in photography impressions, so watch out. I might be changing... again.

My guess is the D800E will be in short supply because of its qualities, unless Nikon decides to cut it some more slack on the production line.

I have posted many photos using the D800E in recent weeks. See the Macro Forum for examples.

Photo: The photo shown here is a single-shot photo taken with the D800E and the Micro-Nikkor 105mm f/2.8 VR lens, with ISO 400, f/11, and 1/25th of a second, taken in some wind. It is not an inspired photo, but just an obligatory sample to show how the D800E can take a reasonable one-shot photo with some depth of field. Yes, If there were not wind, I could focus stack this more

perfectly, but one thing the D800E is starting to do is make we want to concentrate more on composition and mood. That's not all bad.



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Wide-Aperture Stacking

In early January of 2012 I saw a post by “Akira” of a Chrysanthemum taken with the CRT Nikkor 55mm f/1.2. It was not a stacked photo, but it was a close-up and I liked the combination of sharpness and softness it presented. It started me to think differently about photo stacking and marks the beginning of a breakthrough in my work.

Perhaps I had been looking at the wrong end of the lens aperture all this time. For years I had tried to push aperture to the high numbers and narrow openings because that way I could get more DOF and detail. And I did this with stacking as well. Everyone knows that large, wide-open, apertures give us a very thin DOF, and I never wanted that. And I had steadfastly avoided even looking at a whole range of powerful Nikon lenses that were made for extreme close-up work. And many of them were very, very sharp, even wide open. What possible value could they be for my work? But then I began to see how they could be used.

What if I used these exotic sharp lenses wide open (or nearly so) and then stacked that very narrow depth of field to amass as much of the subject as I wanted in focus and just let the rest of the photo go to bokeh and blur? I experimented with what few lenses I had that were good for close-up work, and that were also both fast and sharp. I liked what I saw.

And then I got a copy of one of the exotic Nikkors, the CRT Nikkor 55mm f/1.2 lens. These babies are expensive! And I began to stack. And sure enough, stacking selective areas in the subject, combined with the broad sense of blur or bokeh, made for very interesting photos. After all these years I had found a technique that actually satisfied me. I felt like one of those gold miners who pan for gold for many years but never get a strike, and then hit pay dirt.

I had at last found something that I actually liked. As it turns out I don't see anyone else using this particular technique, at least to any extent.

I began to look for other exotic Nikkors, and they are exotic for several reasons. Most of them were not made with an F-mount, but rather for special equipment. They have off-size threads or no

threads at all. Some of them are designed for a single magnification range only, like 1:1. Anything outside of that range is not usable. Forget about going to infinity. Most lack some of the sophisticated coatings we find in newer lenses, and so on. One expert claims they are mostly museum pieces. Not anymore!

These exotic lenses are fast and very sharp. And they are expensive and rare. Perhaps they are expensive because they are rare and mostly purchased to display in museums or whatever. I can't say. I don't see many folks using them to make photos with that I have come across. Of course Bjørn Rørslett knows about these lenses and has written about them, or at least most of them. Another huge resource has been Klaus D. Schmitt (kds315), who has collected and archived the exotic macro lenses for years. Schmitt has helped me find these exotic Nikkors, shown me how to use them, and even built special mounts and helicoids for my work. Schmitt knows these lenses.

Impressionism and Surrealism

So what is it that I think I am doing? I am using very fast lenses that are sharp wide open to stack focus. Although these lenses have a razor-thin DOF, I am stacking that thin DOF to create a very sharp image of whatever size I want and allowing the rest of the photo to be well out-of-focus. I find the contrast of the very sharp stacked portions against the more dreamy bokeh of the background to scratch some itch I have always had inside of me, call it the realist meets the impressionist.

The sharply focused areas of the photo are featured against the broad pastel-like dreaminess of the background and I guess the subtext message the photo sends is something like:

“This crystal-clear reality we live in and believe exists is but an island of awareness suspended in a larger dream we are having, a dream painted in broad strokes and colors which has no past and no future, a product of our own mindstream.” Sorry, I had to do that.

I know this is somewhat abstract, but that is the kind of impressionism/surrealism I am trying (perhaps not yet successfully) to project.



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Macro Photography: The Process vs. The Results

This is something of a mini-essay, so please be warned and feel free to ignore what follows.

I have tried to discuss this concept in earlier postings on NikonGear.com but probably did not present it correctly, the difference (in photography) between process and results... and their relationship. In other words, I want to contrast here the 'process' of doing photography with the end result, the final photographs we tend to post.

Of course they are related and (for argument's sake) I am taking the side of the process rather than that of the end resulting photos to make a point. For the most part (and this is not meant in a derogatory way) this site is oriented more toward the final photos and not so much on the process of how we got there. I understand why this is so but am curious just the same as to what is lost in not sharing more of the process of taking photography.

This is a question each of us have to answer for ourselves: do we mostly photograph because we want to produce 'great' photos or is the process of photographing itself something we depend on and look forward to. For most of us, it is probably some of both.

And this may be especially true for beginners, those trying to learn to get the results that they admire in other's work. Beginners know little to nothing about the actual process that produced the results they seek because, by definition, they have not learned the process. They only have seen the results and like them.

The beginning photographer often tries to produce the final result without proper knowledge of the process required. This process is either consciously kept secret or is (more likely) simply an oversight on the part of the skilled photographers who are in the habit of only presenting their results and not their process. In other words, the photos we admire from our favorite photographers did not spring full-blown like Athena from the head of Zeus but are the result of a long (and often satisfying) technical journey we each must take. Why is sharing that journey important?

Beginners naturally try to skip the learning curve and just jump right to imitating the results they admire and that result is seldom satisfactory and too often tends to be brittle, constipated, and forced. It lacks the spaciousness and relaxation that comes from long practice and exploration – stretching out.

Part of the problem is that by focusing mainly on the result and generally ignoring (being ignorant of) the process, the best result is not achieved. On the other hand, not being overly concerned about the result but concentrating on (and learning to enjoy) the process is actually a quicker path to good results. This is true because learning and doing the process properly over time is what produces the best results.

Too much concern with the desired result (the 'great' photo) is counter-productive in that it obscures or tries to short-cut the process it takes to reach the result. And that process, as mentioned, is what actually produces the result, a Catch-22 if I ever saw one. You get the idea.

Communicating more about the process of learning a technique may actually produce better results more quickly than just posting the results. And I wonder how aware any of us are of the process it took to get from the beginning to where we are now for any technique. And some of us value the process more than the result. In other words, many of us like to do photography irrespective of our results. I am one of those people. But I also find that by thoroughly enjoying the process my resulting photos actually get better too.

I came to this concept by learning to focus stack. I get lots of questions about how to best go about stacking focus. And of course I try to share the technique. But any technique is literally the essence of our long experience and by definition is very compact or condensed. The boiled-down technique (written out) does not speak to the hundreds of thousands of photos that were taken or the many years of taking them. The current photo results, the technique I could tell someone in a few words, do not explain that it was this very long process that incremented the resulting technique.

The long learning process that actually produces any technique can perhaps be communicated in a few words. But how do we share the process? If I had not learned to love and look forward to the process, to years of focus stacking, I would never have had the endurance to take the journey that produces whatever results I can now manage.

In other words, it was because I did not care about the final result (and a good thing too!) as much as I cared for the process of being out there photographing that I have managed to learn anything worthwhile. At least for me it has taken years of process to get any results worth seeing.

My point is that it might be worthwhile sharing more about the process we go through in our photography as well as the resulting photos. Any thoughts or comments?

Focus Stacking: How I Got Started

I have been focus stacking for many years now. It has been a long, slow learning curve, one during which I have always been trying to scratch an itch inside me, searching for some kind of photographic expression that satisfies me and completes whatever I feel is missing in my vision of photography. I am sure many who are reading this have something similar going on.

My interest in stacking focus arose, like it has for most who use this technique, from attempts to achieve greater depth-of-field (DOF), usually by pushing apertures narrower and narrower, while at the same time trying to avoid the effects of diffraction. This is, of course, very difficult to do and IMO often a lesson in futility.

For a long time I switched back and forth between trying to get greater DOF through a single shot and trying to achieve DOF through focus stacking. Both are maddening in how close they come and still how far away from perfect they are. There is no free lunch. I went back and forth like this for years. I would attempt to focus stack, like the results, but be frustrated by the artifacts and imperfections. So I would switch back to traditional one-shot photography only to have the same experience.

Of course the moment I began to post stacked photos, I was labeled as that “focus stacker,” often considered a pejorative term. In reality I was just a photographer experimenting with a new

technique. At this point I am pretty much in the focus-stacking camp, although using it sparingly rather than too much.

And I have paid my dues, doing many hundreds of thousands of photos on the way to learning how to stack focus. And the same goes for different lenses. I have tried all of the well-known macro lenses, some for considerable lengths of time. I used the legendary Micro-Nikkor 70-180mm Zoom for a couple of years, and of course some of the Micro-Nikkor 105mm lenses, and so on. I have over fifty lenses and most of them are macro or close-up lenses, but not all are Nikon.

In fact, my favorite all-around lens is the Cosina/Voigtlander 125mm f/2.5 APO-Lanthar, and I have written glowingly about it for years. It is still IMO the finest macro lens on the planet and I have

learned to use it well. As most of you know, once we learn to use any one lens well, we can pretty much pick up any other lens and know how to get the most out of it in short order. Many readers here could probably write the book or at least a chapter in “Zen and the Art of Using Lenses.”

Focus stacking, like many techniques, is meant to be used sparingly. Of course in the beginning I tended to over-stack photos, putting everything in the frame in sharp focus. This gets old fast and I began to learn that a little stacking is better than a lot. The thing about focus stacking that sets it apart from traditional photography is that with traditional photography there is only one main point of focus and one plane that it occurs in.

With focus stacking we open up the possibilities where the eye is drawn to by having much more in focus, so we have a choice where to look. It is our choice, not the photographers. When we stack focus we offer the viewer something closer to how our vision works in real life. In real life, even though the peripheral part of our vision is blurred, everywhere we look things are in focus. Focus stacking allows us to look where we want to, not where the photographer or lens dictates. This may seem like a subtle difference but I feel it is a main part of the charm of stacked photos.

WHAT LENSES?

I probably have scores of macro and close-up lenses by this time. I tend to wander through them, using first this one for a while, then another, and so on. Of course certain lenses are used more often and become my favorites because they best do something I need done. I mentioned that the Voigtlander 125mm APO is my very favorite because, of all the lenses I own, it can do more of everything I need than the others. I have put together a free e-book on macro lenses called “Close-up and Macro Photography: A Primer, Book Two: Macro & Close-up Lenses” and it can be found here:

<http://macrostop.com/>

In the history of macro photography, perhaps the most popular lenses are in the range of 90-105mm in length because these lenses generally give a little more room between your subjects and

the lens. This is especially true with live critters and the 200mm Micro-Nikkor is popular for that reason. It provides that extra bit of room.

And while true macro photography is 1:1 magnification or higher, I tend to be more interested in magnifications a little less than that, say in the range of 1:2. I really am mostly a close-up photographer with a little macro work thrown in. I lose interest as the magnification climbs above 1:1 and start to resemble what we might get from a microscope. I need more context around the subject to tell my story.

This means that I like macro lenses that are wider, in the range of short telephotos like 60mm. The 50mm Zeiss f/2.8 Makro-Planar lens is one of my favorites as is the new Micro-Nikkor 60mm f/2.8G lens. I also like and use the Coastal Optics f/4 60mm APO lens, and so on. Again, the book mentioned above has notes on some 42 lenses.

I am less of a “gotcha” photographer than I used to be, less into stalking critters or even hiking with equipment overland here and there. Of course I am getting older, so that is a factor, but not the only one. I also am doing more and more stacking on a focus rail and the number of layers I use keeps going up. Where I used to get away with a dozen layers, I often shoot over 100 these days. This makes working in the field more difficult, especially because here in Michigan where I live (it is very flat) we have wind too much of the time. Stacking 100 layers with no chance of wind is rare.

This means I do more and more studio work and less field work although I do spend time outdoors collecting samples of things to photograph back in the studio. Actually, on the days when the wind is calm I like to photograph in the field. When the wind is up, studio work is much more productive as I can control a greater number of factors. So let me review my history with focus stacking just a bit.

My initial attempts at close-up and macro photography found me pushing the macro lenses I had to higher (narrower) apertures in an attempt to achieve greater depth of field (DOF), but this was usually an exercise in frustration. The combination of less light at narrow apertures and the onset of diffraction was disappointing. And

always having the background in too much focus made for bad bokeh and blah photos.

So I stumbled on the idea of focus stacking, I don't know where. It could have been from John Shaw or another one of the well-known close-up photographers. I can't remember. At first focus stacking seemed a whole lot of trouble, like rubbing your tummy and patting your head at the same time. And my results were terrible. It surprises me that I did not just give up and walk away. I did in fact quit it a couple of times.

Somehow I persevered, although my first stacked images were not encouraging. I guess somewhere in my mind I knew stacking had some rewards for me. I thought it might help to scratch that itch I had always felt for photography. I am a nature photographer probably because I am a naturalist. I know a lot more about nature than photography. Having been raised by a mother who was a fine artist, I was early on imbued with a sense of color and composition. That has never been a problem for me. I have a good eye for the beautiful. Instead, the problem for me it has always been trying to get what I see in my head onto a digital image.

Aside from technical issues, there were a multitude of other issues that had to be sorted out relating to photography. What was I trying to achieve? Did I want my nature photos to be fit for a field guide? Was it realism I was after or some impression I wanted to capture? Was I hunting for specific nature subjects or was I a "found" photographer, photographing whatever I came across? Did nature need me to add art to a photo or was I looking for the art in nature. All this had to be sorted out and that took a lot of time.

In the end I found that I was not a stalker of bugs and critters. I resented being invasive into their worlds, even if the photo was good. Although I am a realist, a simply realistic portrait of a scene is not satisfying to me, not that one exists. In fact, IMO all photography is impressionistic, the photographer's impression of nature and life. I am repelled by attempts to improve nature with human art. You can't salt the salt, and nature is perfect just as it is.

I am definitely looking for the art or perfection that is already in nature. And I am admittedly an impressionist, someone that

combines realism with the broad strokes and colors of impressionism. In other words, I believe each of us eventually finds our own style. For me it has taken a long time, but I am getting there. Now, back to stacking focus.

For me learning to stack focus has taken years. In the beginning I was turned off by the classical microphotography stacks of some insect's compound eye. It is not that I did not appreciate it, but after the tenth and 100th example, I was no longer moved. And that was the most popular kind of focus stacking at the time I discovered the technique. I had no interest in being cooped up in a studio when I could be out walking at dawn on a summer morning. No way.

So I became an advocate of what I called short stacks, usually less than ten and seldom more than fifteen layers to a stack. And I made it work, although looking back it is a hard row to hoe. And I did not like using focus rails and dragging that extra weight around in the field, so I sought out macro lenses with long focus throws. In short I made all the possible mistakes I could. I am a slow learner.

I did all I could to avoid paying the real bucks it takes to have a solid tripod. And the same with a high-quality ball head, although the experts I read all advised me otherwise. I am stubborn and hate to spend money I don't need to. In that case I needed to and it took me a long time to find it out.

There is no substitute for a solid tripod. There is no substitute for a good ball head. There is no real substitute for a focus rail for fine work, etc. I made all the mistakes I could. The good news is that I eventually learned. It just took me longer than most.

Influences

As for influences, they are several, none greater than nature herself. I have been a serious student of nature since I was six years old and a dedicated herpetologist through my teens. As for photography, I seriously learned to photograph when I was 16 years old when my father (a fine amateur photographer) loaned me his Kodak Retina 2a, a tripod, and a light meter and sent me on a six-week bus tour of the U.S., Canada, and Mexico with kids my own age. He carefully showed me how to use the equipment, never expecting I would follow his instructions. But I did, and meticulously.

When I returned from the trip, to my father's astonishment I delivered a whole slew of more than excellent slides, some of which still stand up to my best work today. Of course, I had no idea I had done well until my father told me, and I could not see my results until I returned and they were developed.

Anyway, my father was my first tutor. Much later in time I found the book "Close-ups in Nature" by John Shaw a fine guide. From there I kind of moved onto the web and into digital cameras. Once on the web I looked for interesting camera sites and came across Ken Rockwell. I tried to swallow his blogs hook, line, and sinker until I discovered that although some of his technical remarks were a good resource, his advice on equipment was way off the mark. In particular, his all-out recommendation to buy the Nikon 18-200mm Zoom (which even I could tell was a lousy lens) ended my trust in Rockwell. I looked elsewhere.

When it comes to lenses, two names stand out in my experience, those of Thom Hogan and Bjørn Rørslett. Hogan was very helpful, but Rørslett's analysis of lenses was indispensable for my learning curve. I came to depend on his recommendations and comments. Still do.

As for aesthetics, I have no major influences. I was raised by an artist mother and am thoroughly acquainted with both western and eastern art. From the beginning I have had my own inner vision of what is beautiful, based on my inner and outer experiences with nature. Nature has been my passion and my own inner vision my guide. Of course, I have loved many macro photos that I have seen, but I found no single photographer I wanted to emulate. However, there is one photographer that inspires me, not so much to imitate him, but just with the work he has done, and that is Fred Nirque. In Fred I find a brother on the path and his detailed panoramas are some of the most inspiring photos I have ever seen. I have zero nature photos on my walls, but one of Fred Nirque's photos, "Growling Swallet," might be an exception.

Nirque did inspire me to obtain some good panorama equipment, but I found that I am mostly a close-up photographer and don't really even do that much macro work. I find 1:2 magnification about my speed. I like mini-dioramas, tiny landscapes, those perfect world

that still exist in this sometimes worn-out world. If I get too close, as in macro, I lose some of the context I need to tell a story, the setting in which the jewel that is my subject is set. I like it a little wider.

Well, there you have some of my history. All my stacked work until recently are just experiments, ones that I am not particularly happy with at that. I have never found what I was looking for until now, but I feel that perhaps I am close. And that brings me to the present.

Considerations for Selection a Close-up/Macro Lens

What follows necessarily is somewhat of an exercise in futility as the variables in assessing fine lenses for close work are many and their permutations seemingly infinite. Still we can't own them all and in the end must make some attempt to compare lenses, one to another, in order to decide what lens might be most useful to us for a particular kind of work. There are several types of information presented here and the various specifications for each lens, a photo of the lens.

The specifications and lens photo I am sure you will find useful because they are seldom gathered in one place and this should save you searching for this information. By reviewing this material I see that almost all of the lenses included here are sharp and are worthy of taking very fine photos if we know their limitations. I am certain that if you pick through the data you will come up with opinions of your own that will elevate one lens relative to another, and so on.

To repeat, after doing all of this, I found that most of the lenses listed here are plenty sharp enough to own and use. For me that is my own take away from this material.

I also include a quick shot of the lens itself and any comments I have about the lens. By all means take my comments with a grain of salt. They are impression from my use of the lens and since in day-to-day use I have my favorites, many of these lenses got only cursory use. Still, some of my observations may be helpful. At least that is my hope. I will say just a few words about what in my opinion makes a good lens for close-up, macro work, and also for focus stacking.

How to Pick a Lens

There are a number of key factors that figure into what makes a good close-up or macro lens. Not all lenses have all the desired factors and some of it depends on the particular kind of photography you want to do. No lens (or very few anyway) seem to have everything. Some lenses will have better sharpness, some better color, and so on. As you read about the factors and qualities of various lenses, you will want to keep your eye on the qualities that are most important to your work.

As mentioned earlier, my first attempts at macro photography were sometime around 1956 when armed with a Kodak Retina 2a and a close-up lens I began to take some macro shots. They were not too successful but I was only fourteen years old. In recent years I have spent a lot of time doing close-up and macro nature photography. In my search for the right lenses I have tried a good number of them. Here is what I value most in a lens for near focus:

Sharpness

Of course I want it sharp but the more I work the less I am concerned about 'absolute' sharpness. There are a lot of very fine sharp lenses available in the Nikon mount or that can be converted to that mount. Most of the lens mentioned in this article are sharp or "sharp enough" for good macro work. Sharpness is not the only consideration. A lens can be very sharp but difficult to use for other reasons, like it is too sensitive to light or the widest aperture does not make give enough light in the viewfinder, etc.

Fast Lens

I value a fast lens (one with very small f-stop numbers like f/1.4, f/2.8, etc.) not because I shoot wide open but because I need to have maximum light in my viewfinder for focusing well. Since I often am photographing around dawn or when the light is still fairly dim (but nice) I need to see what I am doing. The bright light of full sun is not what I am looking for.

Also I do a lot of focus stacking and I need to see what to focus on at each step. I don't entirely agree with those who say that to focus stack you need to just get to the front of the subject and then automatically click on through and not focus on anything in particular but just make sure to have regular intervals.

Of course I understand what they are pointing at but in my experience this is not enough. For example round, spherical objects in the frame do not stack well. Your increments have to be much finer (shorter) than otherwise if your subject is round. In fact in many subjects there are key points that you don't want to just auto-increment past but very carefully be sure to get them in extreme focus. In other words: if I am blindly incrementing along with a stack and reach a key point I do finer increments before, at, and after that point to make sure that that area is in prime focus.

There often are several such points in the series and I need to be able to see to focus in the viewfinder to do that and I want a fast lens for visibility. For example, someone commented recently about the Nikon 70-180 Zoom Macro. I spent a couple of years intensely using that lens but gradually abandoned it because its widest aperture is f/4.5. This morning I got that lens out in case I had made a misjudgment or might see it differently today. It was about 8:30 AM here and the sun had not really gotten strong.

Looking through the 70-180mm it was very dim indeed and not at all bright enough for my work. On a bright day the lens would be fine but I don't shoot in bright sunlight and even tend to avoid bare sunlight, concentrating more in shadows or light haze. The 70-180mm Zoom Macro is a wonderful lens, but not for me for the reasons mentioned.

Focus Throw

Something not often mentioned is the focus throw of a lens, how many degrees does the barrel have to rotate to go from close-up to infinity. I was surprised at some of the fine macro lenses that have a short focus throw. For macro work and especially for focus stacking I need a longish focus throw or else put the camera on a focusing rail. I prefer the long focus throw on a lens to carrying a rail around.

I was shocked to find that the very expensive Coastal Optics 60mm APO macro lens has a focus throw of only 210 degrees. For example the CV-125 APO has a focus throw of 630 degrees and the Leica 100mm Elmarit has one of 710 degrees. However, the old Micro-Nikkor 60mm f/2.8 D macro has a throw of only 120 degrees and that is not desirable.

The wider the angle macro lens (50mm, 60mm, etc.) the more important it is to have a long focus throw. Macro work is just the opposite of sports photography where you want a short focus throw. In macro, and most of all in focus stacking, a long focus throw is a big advantage. You need it or use a focusing rail.

Reproduction Ratio

Another feature to keep in mind is the reproduction

ratio. How large is the image in the frame? Most macro aficionados prefer a lens that goes to 1:1. "1:1" means that the image in the sensor and the subject image are the same size. Not too many good macro lenses get to 1:1. In fact there are whole businesses that help you get from smaller ratios (like 1:2) to 1:1 image size.

There are not all that many lenses that will give you the 1:1 ratio and my view of putting close-up diopters on the front of my lenses or extension tubes on the rear of my lenses (or both) is not flattering. I have all the key diopters, tubes, etc., but I use them only as a very last resort. Actually I hardly ever use them at all. I know that many photographers love them but I feel a lens just as it is sold is a perfectly balanced thing and anything added to it (front or behind) can only lead to a degraded image. This is a fact.

Luckily for a lot of my work I don't always need to have a 1:1 reproduction ratio. I shoot a lot of close-up work, what I call mini landscapes or dioramas and can use lenses that are not ultra-close.

APO (Apochromatic)

Not absolutely required (except by me), but very helpful are lenses that are APO enabled. Apochromatic lenses are corrected for chromatic and spherical aberration more than the common achromat lenses. There are not many good ones, the most well-known in the Nikon format being the Cosina/Voigtlander 125mm APO-Lanthar, , the Leica 100mm APO Elmarit, and the Coastal Optics 60mm APO. Recently added are two new APO lenses from Zeiss, the 55mm Otus f/1.4 and the 135mm F/2. These are the best lenses I have ever used. I prefer APO lenses in my work most of the time. IMO the differences in coloring can be dramatic.

Minimum Focus Distance

Most lenses used for macro work have a very short minimum focus distance, in fact many can appear too short if working with live critters, like 50-60mm lenses.

If you are shooting insects or live-whatever, some lenses require you to be so close to the subject that the end of the lens actually blocks the light or the close proximity of the lens scares

off whatever you are photographing. The 60mm range of macro lenses are in this category. And while the 100mm to 105mm macro lenses are very popular, many photographers would rather work with lenses in the 200mm range because it gives them just enough extra distance to not disturb their subjects. If you are really into photographing critters then a lens in the 200mm range may be what you are looking for.

One odd technique I like is to use a telephoto like the Nikon 300m F/4 ED-IF lens which has a minimum focus distance of something like 4.9 feet on the Nikon D3x and crop out a photo. I can photograph a frog out in the middle of the pond, crop it out, and still have enough pixels for a fine photo. This only works with a sensor with a high megapixel count, like 36MP.

Summary

Those are some of my main considerations when choosing a macro lens. I don't care how heavy or bulky a lens is. Carting these things around is second nature to me now. It is easy to see that if we insist on having all of the above points in a single lens we quickly are down to almost none. In fact the one lens I have that is sharp, fast, has a long focus throw, goes to 1:1, and has APO is the Voigtlander 125mm f/2.5 APO-Lanthar. No other lens has all of these features without adding diopters or settling for a short focus throw, etc. It is no wonder that this lens is in great demand. The Nikon 105mm VR macro is pretty good as well... in terms of having many of the features.

My Key to Taking Good Photos

The poet Gerard Manley Hopkins came up with a concept that struck me as true. He even made up his own word to describe it, “inscape.” Inscape was to Hopkins an insight or path into the eternal or beautiful, literally the way or sign of the beautiful in the world around us. Let me explain.

I look forward to my trips out into the fields and woods. They offer me a chance to get my head together, to relax from the day-to-day grind of running a business, and generally to relax a bit. This is not to say that just going outside and walking in nature means that I am instantly relaxed. That usually takes time.

It is the same with taking photos. In the first ten minutes of a photo shoot I often don't see all that much to photograph. This too takes time, time for me to slow down, open up, and ‘see’, and let the natural beauty all around me in. It could be that I am still filled with all the workaday-world thoughts, the things I have to do, problems, and what-have-you. It takes time for my mind to relax and let go of its constant chatter. This day-to-day endless worry and thinking affects my photography. And here is where the word ‘inscape’ comes in.

As I get out there and wander through the fields or wherever, I gradually start to slow down and begin to see things that are beautiful, scenes that I might actually want to photograph. Slowly my view of the natural world around me starts to open up again, and I begin to experience things differently. I begin to ‘see’. It takes time and usually does not happen all at once.

This little pattern of leaves over here or the way the light comes through the forest canopy grabs me just a little bit and the chatter of my mind pauses and begins to slow down. As I walk along, some little thing or scene appears beautiful to me; I am touched by it, however lightly at first. I gradually get distracted from my daily distractions and begin to center.

These little moments are ‘inscapes’, ways out of my mundane world and into the beauty of nature or, more accurately, back into the state of my own mind or being. As I take my time, I am able to see the beauty in things once again, and what I am seeing suddenly seems worth photographing. Like most of us, I photograph what

catches my interest, what I find beautiful or worthy in the world around me.

These inscapes are signals that catch my attention, and they flag me down on my busy way forward to nowhere-in-particular. These moments and signs are how I stop going nowhere and manage to almost miraculously arrive somewhere once again, perhaps only at my own peace of mind. This is one of the functions of the beautiful, to catch us in the turmoil of life, flag us down, and induce us to pull over and take a moment of rest - some time out. These moments of inscape are different on different days and different for different people. They represent the clues or signs that catch our attention and show us the way into the beauty of the natural world, actually the beauty of our own mind. Another way of saying this might be: what is beauty actually? What happens when we see something beautiful?

Beauty is not simply somewhere out there in nature waiting to be found, but always here within us, locked within us, we who are seeing this nature. Only we can see the beautiful. Beauty breaks down the rush of the everyday world and opens our heart a wee bit, making us vulnerable once again, more open to experience and input.

Through the natural beauty outside we go inside and experience the inner beauty of things, which is none other than our own inner beauty. That is what beauty is for, to be touched on, seen, so that we find once again the beauty within our own hearts that we may have lost through the distractions of our daily life. We forgot. We look outside in nature to see in here, to see into our own heart once again.

We can be sensitive to beauty in our photography. I would hate to tell you how many photographs I have of this or that butterfly or critter that are perfectly good photographs, but are empty of magic or meaning. They are well lit, well composed, and have everything that makes a good photograph except that 'magic' that keys or excites me. Instead, they are 'pictures' of a butterfly, but they have not captured any essence of anything. They might as well be in a field guide – snapshots in time with no meaning.

The reason for this (so I tell myself) is because they just happened to be there, photographic opportunities. I saw them and I took a photograph, but at the time they did not instill or strike any

particular beauty in me. This, to me, is “gotcha” photography, taking a photo because I can, not because I saw beauty in it or was moved to do so. There was no inscape moment, no moment of vision – snapshots only.

I find that it really worth paying attention to what strikes me as beautiful or meaningful and photograph that, rather than just photographing the Grand Canyon because it is there or I am there. A lasting photograph, in my opinion, requires more of me than that, by definition. It has to mean something to me and for that to happen I need to actually be moved or inspired. Photographs that have special meaning for me usually have some form of inscape into a special moment that inspires me to capture the scene in a photo.

We can wander for miles looking for something to photograph, chasing down this or that butterfly or animal... searching. Or, we can slow down and let nature herself show us the signs, the inscapes through which we can relax and begin to ‘see’ photographically once again. We can listen to our own intuition. This process of inscape, of insight into the sublime in nature (the sublime within us) I find to be the key to good photographs and to creating photographs that are real keepers, at least in my mind. If we don’t touch our own inner self in our work, we touch no one at all, but when we are touched by a moment, I find that others also feel this. Touch one, touch all.

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Close-Up and Macro Photography

My interest in nature started when I was six-years old, just being outside, taking it in, and recording what I saw in my mind. In 1956, when I was fourteen, my parents sent me on a trip around the country in an old school bus filled with kids my own age. We camped all the way, cooked our own food, hung out, and saw some of the world. Before I left on the trip, my dad loaned me one of his cameras, a Kodak Retina IIa, and taught me how to use it.

For some reason on the trip I took to photographing, and even spent all my spending money on more film. When I got back and had my slides developed, dad was shocked at how good many of my photos were. He was a very good amateur photographer. That was the first time my dad was ever pleased with something I had done so I went on from there. I have never been interested in doing photography professionally because I make my living doing other things. Photography for me has always been just a fun way to learn about nature.

More and more people have cameras these days, if only on their iPhones, so there seems to be a growing interest in close-up nature photography. This booklet is not so much a tutorial on photography (or nature), as it is about some basic information that should be interesting to many of you wanting to get into close-up nature photography.

I will mostly cover the gear that you might need and something about some of the techniques involved in close-up photography. Close-up and macro photography are similar. Macro photography is just a little closer yet, when the image on the sensor is the same size as the subject you are photographing, what is called a 1:1 reproduction ratio. In these articles I will probably use "close-up" instead of repeating both names endlessly.

I will try to roughly organize this material, but you might be wise to browse through the various sections and see what interests you. I may put things down as they occur to me. Finally, I have a number free e-books (some listed below) that may be more on the entry level, so I list the link to those here.

The Art of Focus Stacking (books one and two)

Nature in the Backyard (for kids)

Close-up and Macro Photography (techniques)

Lenses for Close-up and Macro Photography

Just scroll down and see what looks good.

<http://spiritgrooves.net/e-Books.aspx#Photography>

The Expense of Gear

[Note: A lot of this is repeat, but contains some different (and more updated information, so I include it. You may want to ignore it.)

Good gear is expensive. If you can't afford it, use what you can afford. That is what I did for years, but here I am going to tell you about the best gear I have found for my work, which is pretty much also the most expensive. I know you can find less-expensive versions, just as I once did, and many of you no-doubt will. One rule that probably all experienced photographers would agree on is don't pay twice for what you need, which is unfortunately something I did year after year.

In the beginning I would opt out of good gear to save money, figuring I could get by with lousy gear. The problem was, bad gear doesn't work well, so I got hit two-fold. I ended up buying the good gear anyway, sooner or later, and I still have a closet full of lousy gear I can't sell, plus (and here is the painful part) all that time I had to use bad gear that really made learning close-up photography much more difficult.

I might have given up photography altogether based on bad gear, but happily I did not. About the only rationale I can remember for buying cheap is that maybe I would not get 'that' into photography, and so why not buy low. Bad gear is one way to insure you might not get into photography. Good gear also has good-to-reasonable resale value, while bad gear does not, and stays in your closet forever. You should see my closet.

The moral of the story is: do your homework. If you can't afford the good stuff, at least carefully research the lesser stuff so that you get something that works for you rather than you for it. I can't tell you which gear these days is bad because I no longer buy it. As mentioned above, I have a whole closet full of lousy gear if you are interested.



Really Right

Stuff TVS-33 (series three) Tripod

Tripods

Tripods are key for close-up and macro work, specially if we stack focus. Hand-held close-up (much less macro) photography work is difficult at best. There are those who do it, but few successfully. There are even some wild photographers who stack focus handheld, but they remind me of the little kid on the bike shouting out "Look Ma, no hands!"

Most close work is manually focused and done on a tripod, so having a good tripod is important. If you are in a studio, a good, strong, heavy tripod does not have to be too expensive, but for field work we want a tripod that is sturdy and light, a contradiction in terms. Translation: expensive.

I have gathered a small flock of tripods over the years. The tripod I like the best is one of the Series-3 tripods from Really Right Stuff, with 3-section legs. It is comparatively light, solid, and works well. Three-section legs are stronger than four-section legs, plain and simple. The only reason for four-section legs is compactness. I also have bunch of Gitzo carbon-fiber tripods and one Gitzo mono-pod. They work well, but are difficult to clean (which is true of most

tripods) and just not as "nice" as the RRS. My advice to you is to not cheap-out on your tripod. It will affect your work and your spirit.

[Below: Nikon D810 33MP DSLR]



Cameras

Cameras are whatever you have or can afford. I use Nikon pretty exclusively, and I have had Nikons ever since they started creating DSLRs, and before. My first Nikon DSLR was the D1x, and I have had most of them ever since. Right now I am using a Nikon D810, a D800E (which I am selling) and a Nikon D7100. Personally, I prefer full-frame sensors with a high mega-pixel count. I mostly use my D810, and before that it was a Nikon D800E. The D810 is, IMO, the best camera I have ever had, and that includes my medium-format Mamiya RZ67 with a digital back.

I don't know Canon or other brands, so I can offer advice. If you can afford it, the new Nikon D810 is pretty much perfect, and the revamped LiveView is as good as any EVF that I have seen. It is a dream come true and not THAT expensive. Here are some features that you want (or I have to have) in a camera:

Camera Features You Need

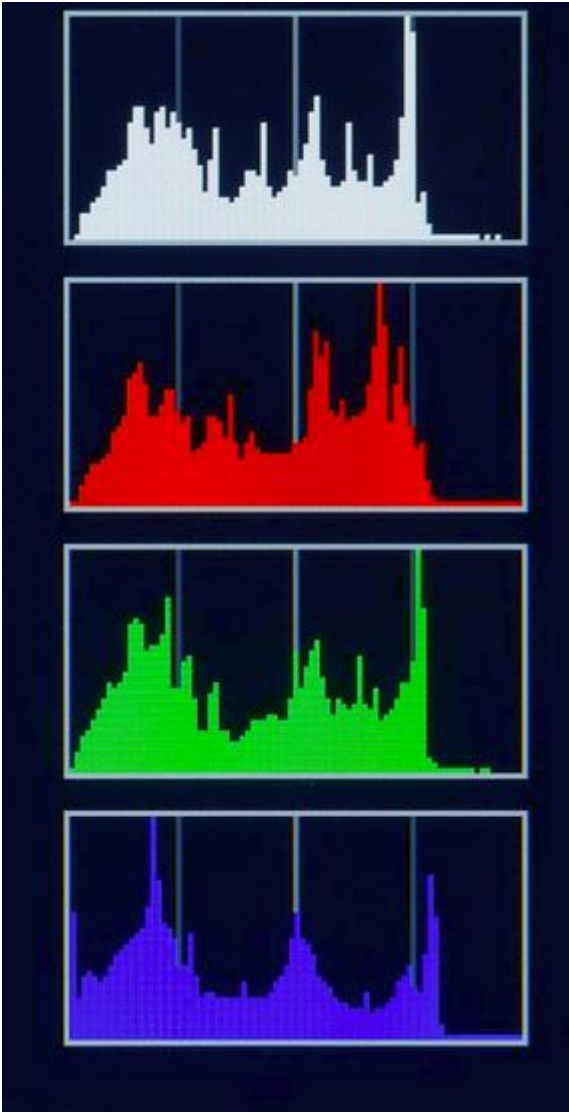
Viewfinders

If your camera has an optical viewfinder (OVF), then try for one that shows 100%. Electronic viewfinders (EVF) are getting better and better, and have the advantage of increasing magnification until you can see to focus. The new Nikon D810 has a LiveView that works like an EVF and is perfect for my work.



Sensors

I have owned a number of DX sensors, less that FF (full-frame). I don't like them and suggest that a full-frame sensor is the way to go, and with a high mega-pixel count at that. The 36MP Nikon D800, D800E, and D810 are perfect. The 36MP Sony A7r has serious shutter vibration issues. I bought one, but sent it back.

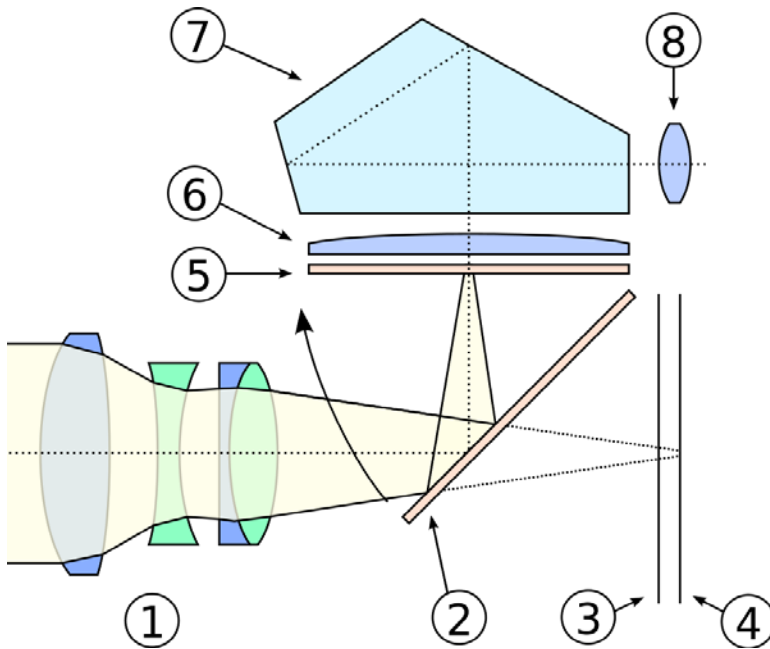


[Above: Nikon Histogram]

Histograms

Since most macro work requires manual focusing and many of the really good lenses don't sync with your camera, it is essential to purchase a camera with a built-in histogram. You want what is called the "RGB Parade," which basically is a color graph for red, green, blue, and perhaps an overall histogram. Read more about histograms here:

<http://www.bythom.com/histogram.htm>



With mirror lock-up the mirror (2) flips up towards (5) well before the shutter (3) opens. As a result light no longer reaches the eyepiece (8).

Mirror Lock-Up

I would not buy a camera without the ability to lock-up the mirror and thus remove the excess vibrations when the mirror snaps up out of the way of the lens viewfinder. It means I have to click the shutter, the mirror goes up, wait for the vibrations to die out, and click it again, but it makes a real difference. Stacking focus means: everything has to be motionless. Some cameras (like the Nikon D810) have what is called an Electronic First Curtain, which allows for vibrationless shooting. Highly recommended, but not always available.



Remote Release Trigger

Absolutely essential. You can't touch the release button on the camera without affecting the shot, however slightly. Make sure your camera can take a remote release, either tethered (cord) or untethered (infrared). Don't leave home without it.

Depth-of-Field Preview

Not available on all cameras, but I would not buy one without it. Otherwise you have no idea of how much depth of field you have. The best Nikon and Canon cameras have this.

Lens Focus-Throw

A lens with a focus throw equal or close to 360-degrees is preferred. With focus stacking you want to take many photos incrementally. If the focus throw (turn of the focus ring) is too short, it is difficult to micro-inch forward. My favorite lens has a 720-degree focus throw (two turns of the focus ring) and that is a real pleasure to use. For action-sports it would be a liability – take too long. For macro it is perfection.



Tripod Heads

Another important piece of equipment is the tripod head, which sits on your tripod and holds the camera. Again, I can only tell you what I have migrated to over the years. There are two basic kinds.



Quick Release Clamps

Before I get started, let me make it clear how important (for my works) a quick-release clamp is, and the only kind I have found reliable is the Swiss-Arca-Style quick-release clamps. I have a whole box of old Manfrotto quick-release clamps that have at times failed, meaning the camera suddenly fell off the head. That is a no-go for me, so, as mentioned, want a box of Manfrotto quick-release clamps?

Another factor involves how the quick-release clamp is secured to the tripod head? More and more companies have what they call a "compact lever-release clamp," a little level that is pushed open until the clamp pops open. I never use these and am very careful to only purchase quick-release clamps with the old-fashioned knob which is tightened by hand. I like to hand-tighten my quick-release clamps, and tight at that. That way if the camera falls off, it is my own fault and not some lever that has decided to pop open. By hand tightening I have never yet had one fail.

All of my equipment, still and video photography, is based on Swiss-Arca-Style quick release clamps and plates, so it can be put

on or taken of in seconds. Without some kind of quick-release clamp you are endangering your 1/4-20 screw socket on the base of your camera by endlessly putting it on and taking it off.



Ball Heads

The most common is the Ball Head, based on a ball that swivels around and is locked in place by a knob. A lousy ball head is nothing to write home about and very much affects my work. I should know because I tried them and regretted it.

There are small, medium, and large ball heads. Over time I found that only the fairly large ball heads are worth having. The little ones don't stand up to having weight on them. I have three or so Markins Q3 heads, a small head that actually is OK for small cameras like some of the new mirrorless. I no longer use them for anything, but they are light and relatively inexpensive.

What I do use is the large BH-55 Pro ball-head from Really Right Stuff, the one with the knob, not the quick-release. I also have the smaller BH-40 (knob variety), but actually don't use it anymore.

The problem with ball heads, in general, is that after you tighten them, they tend to sag. True, they don't sag much and sometimes it is almost imperceptible, but sag they do. I have to try to place the head again and again, compensating for the inevitable sag until I get it right. This is not helpful. Therefore I use a geared head as described in the next section.

I only use ball heads for fast-moving critter work, or for anything with a moving target. Since most of my work is still work, in general, I don't use ball heads at all. Instead I used a geared head as described below.



[Swiss-Arca Cube C1 geared-head]

Geared Heads

For all my focus-stacking work and everything that does not involved a moving target I exclusively use a geared tripod head, specifically the Swiss-Arca Cube C1, with a knob quick-release

rather than a lever-style release. They are expensive, but worth the money.

I can't say enough about using a geared head. It took me a short time to get used to it, but once learned, I never went back to a ball head. No reason whatsoever to do so.

With the Swiss-Arca Cube, I can exactly place the head where I want it. There is no sag and no repeated positioning. Set it once and there you have it. Need to tweak it? Just rotate the head a tiny bit and there you are. As mentioned, once you get used to this head, why would I ever use anything else, unless I am tracking a moving target? I wouldn't.



Video Fluid Heads

This article is not about video, so I will spare you all of the advice about them. In a word, I tend to use Miller video heads and Sachtler video tripods. Perhaps I will write an article on video equipment, but this is not that.



L-Plates and L-Brackets

I use L-Plates from RRS, although I have also used them from Kirk Enterprises. My L-Plates are Swiss-Arca compatible and allow me to switch the camera on the tripod head from horizontal to vertical (and back) in seconds. I can't imagine using a camera without one. I do most of my shooting in vertical position because I like that view.



[Nikon SD-400 with diffuser.]

Flash

I have all kinds of flash equipment, mostly Nikon, plus various frames and extenders. I don't like flash for close-up photography (I tried it for a couple of years) and now never use it, so I am not going to recommend it to you. Also, I am not up on the latest flash gear and probably never will be. I understand the value of flash and appreciate its use for close-ups in some cases, but am unmoved to actually make use of even what I have. Sometimes I use the smallest Nikon flash, the SB-400, with a soft diffuser.



Close-Up Lenses

Now comes the hard part, lenses, which really are the key to this whole close-up/macro project. You need good lenses. The rest of the equipment you might be able to squeak through with mid-range stuff, but with lenses, you should have at least one good lens, at least one you believe is good. It is good for the soul of your photography.

Lenses can be (and mostly are) expensive, at least the really good ones. If you have no real money to spend on lenses just get one of these. They will get you started:



Nikon 105mm f/2.8 VR Micro



Micro-Nikkor 60mm f/2.8 Macro Lens ("D" or "E" series)

Both of the above lenses are adequate for close/up and macro work, the 105mm being better for macro (1:1 images), while the 60mm is great for close-up work. I don't use them much anymore, but I have. The 105mm VR is great for fast-moving subjects like bees where auto-focus is pretty much necessary.

If you have money to spend, do yourself a favor and get a really great lens. Your pocket book may regret it, but you never will. They are that good and spur you on in your progress because they are so awesome to use.

If you are a "convenience" photographer, meaning you don't want to be involved with tedious procedures in setting up and taking close-up shots, you will be happier with one of the two Nikon lenses mentioned above. Both of the above lenses have auto-focus, but most good macro and close-up lenses do not and manual focus is

used by almost everyone in this area of photography that I have met. Almost all of my close-up/macro lenses don't even have auto-focus, so there is no choice. I never use auto-focus except, as mentioned, when chasing critters around, which I seldom enjoy anymore.

In my approach to lenses for macro and close-up work sharpness has been important. I want the lens to be as sharp as possible. Originally I went to the great lens testers and studied what they had to say. As it turns out "Sharpness" is not an exact term. It is somewhat loosely defined and seems to be made up of a combination of resolution and acutance (edge-contrast). I got into that for a while, but found that some lenses, like the legendary Zeiss 100mm (and 50mm) Makro-Planar lenses, while pretty "sharp," were what I told myself somehow too "contrasty" for me. I liked more of a matte finish, whatever we could agree that is.

When I tried to talk about it with owners of the Zeiss Makro-Planars, they did not appreciate what I had to say about their lenses, even though I myself owned them too. But I had to trust my own eyes, so I persisted in my search for "sharp" lenses. To make a long story short, what I found out (and all on my own) was that apparently what I was seeing or picking up on was a lack of lens correction in the Zeiss Makro-Planars. These are not highly-corrected lenses in terms of aberration, and so forth.

In time I discovered that apochromatic (APO) lenses, another loosely defined term, were perceived (by me) as sharper. In other words, they were the kind of sharpness I had always been searching for. Apparently, these finer corrections (APO) removed some of the chromatic aberration (purple fringe) and other distortion just enough so that my experience of photos shot with them was satisfied as far as sharpness goes. Take aware that purple fringe, etc. and the color perceptively improved IMO.

Now I was onto something and began to hunt down and test APO lenses. Unfortunately the time and effort to correct a lens to APO levels is expensive, like: very expensive. Nevertheless, I sold off what I needed to, saved my pennies, and began finding and purchasing apochromatic lenses. And the important part is that, at last, I was very satisfied as far as color and sharpness were concerned. As they say, "who woulda' thunk it?"

And so, in recommending lenses to you, I am afraid I can only seriously recommend one of the APO lenses, but I also know that you may be unwilling or unable to take that leap, which is why I point out the two easy-to-afford macro/close-up lenses listed above. They work, just not as well. And later in this book I will detail a number of lenses that can be used for close-up or macro work, most of which are not APO lenses, but are of course quite workable for anyone but me. I no longer use them. The ones I do use are très expensive. I wish they weren't. Here are my top three, most-used, lenses.



Zeiss 135mm f/2 APO Sonnar Lens

This is not even a close-up or macro lens, but rather a telephoto, but it is so highly-correct (so great) that I use it all the time and crop out the part of the photo I am after. Of course, with the Nikon D810 as a camera I am working with 36MP, so I have a lot to crop from. This is an exquisite lens that costs \$2,122.00, but of course is worth it. I just sold some of the dozens of close-up lenses I never use and bought this one. It is perfect, but is not the easiest to use.

It has a great focus-throw, but a not-so-great minimum close-focus distance of 2.62' (.80m), which is a ways back. Nevertheless, I use it and I use it all the time and am delighted with the results.

Lens: Zeiss 135mm f/2 APO Sonnar T* ZF.2

Focal Length: 135mm

Widest Aperture: f/2

Narrowest Aperture: 22

Aperture Blades: 9

Filter Size: 77mm

Hood: Included

Close Focus Distance: 2.62 feet (.80 m) Reproduction Ratio: 1:4
Focus Throw: ~ 270°
Weight: 2.02 lb (920 g)

Pros: Best APO, Razor-Sharp
Cons: None. Perhaps a little heavy.



Zeiss 55mm f/1.4 Otus Distigon APO Lens

This is another lens that is not a close-up or macro lens, and it is even more expensive at \$3,990.00, but absolutely worth every penny. This lens has a minimum-focus distance of 19.7" (.50m) and a healthy focus-throw. I can get away with adding the Nikon PK-11A 8mm extension tube to it, which shortens the near-focus distance, but at a sacrifice of image quality wide-open. I have to stop the lens down to about f/4 to keep the sharpness, but that is not too bad for bokeh.

So there you have the two best lenses I have ever found, neither ideal for my work, but both idea for my perception of "sharpness."

Lens: Zeiss 55mm f/1.4 APO Otus Distagon T*

Focal Length: 55mm

Widest Aperture: f/1.4

Narrowest Aperture: 16

Aperture Blades: 9

Filter Size: 77mm

Hood: Included

Close Focus Distance: 19.7 inches (.50m) Reproduction Ratio: 1:7

Focus Throw: 270°

Weight: 2.14 lb (970 g)

Pros: Best APO, Razor-Sharp

Cons: None. Perhaps a little heavy.



Cosina/Voigtlander 125mm f/2 APO-Lanthar Lens

I carry a plastic shower cap for my camera and lens, in case it rains, some narrow-nosed plastic clips, and the various Allen wrenches to adjust my various camera equipment. That's about it. All of this is carried over my head and shoulder in a 10x10" canvas bag.

Direct Sun

Direct sun is very difficult to photograph in. Once the sun is up high in the sky, head for the shade or get out the diffusers because your photos will just not work out easily. Some part of your subject will catch or reflect the light and blow out that area leaving you with a photo that is both too dark and too light – one or the other. The hot spots will be hard to manage. Neutral-density filters (variable or otherwise) can help to tame the light.

High-Haze Sky

Slightly overcast (hazy) skies are probably the best for photographing you can get. Grab your camera and head outside. With no direct sun, the whole sky is your diffuser. You can't beat it because there are no hot spots. I am not talking here about really cloudy days, but just bright hazy skies.

Sun and Shade

Shadows mottled with sun rays make for difficult photography, like a forest canopy with rays of sunlight. It can be very attractive, but those rays of sun blow out easily and conflict with all that shade. I carry a very fine diffuser at these times to filter the sun a bit and bring it down to being less stark.

Flash

I tried it (and a lot) and didn't like what it did to the photos and the subjects. I know it is the way to go for certain kinds of definition, but I don't need it at the expense of the alien-flash look. If you must use flash, use a tiny flash like the Nikon SB-400 and on top of that use a snap-on diffuser and even then rotate the flash upward and not straight at the subject. This can work. Natural light is better than any flash device. So I avoid flash if at all possible and if not possible, I soften it by using a diffuser.



UV Filters

I use clear or UV filters to protect my lenses. I know I am a chicken, and they must degrade the quality of the lenses, however minutely.



Lens Hoods

Most lenses come with a hood and you need them to keep extraneous light out, so by all means use them and if you have a lens without one, track down the appropriate lens hood and buy it. They are there for a purpose.



Extra Batteries

I am a little obsessive about having extra batteries for my camera or whatever. I try to carry an extra one in the car but seldom on my person when I photograph. I seldom shoot more than several hundred photos at one shooting so the new Lithium batteries are enough for one outing.



Close-up Adaptors

These are little lenses that screw on the front of macro lenses to give them even more close-up magnification. I have them but don't use them. They may give you added magnification but for the most part they mess with your good glass. If you do get them, get only diopters which have two elements (not one). There are scads of

inexpensive one-element diopters on the market and they are not worth anything but making your good lenses look crappy. I have all the good diopters and never use them. Almost never. Occasionally I fool myself into experimenting just to remind myself why I don't use them.

Polarizing Filter

Useful for darkening skies, reflections on water or leaves, etc. I have them but seldom if ever use them because I am doing close-up and macro, so not sky, shiny tree leaves, open water, etc.



Memory Cards

I like to have lots of these and big ones. I mostly use Lexar and SanDisk, although I have some Delkin (because they were inexpensive). All work well. My little Nikon D7100 has two 64GB SD cards in it at all times. That's a lot of photos.



Extension Tubes

I have scads of them but seldom use them. They are used to give you greater magnification for a given lens but they always suck light out of your shot anytime you use them and I seldom feel it is worth it. In other words, if you have a $f/2.8$ lens and add an extension tube between the lens and the camera body, you will get greater magnification but lose one or more f-stops. Tubes degrade the image, at least with large apertures (wide open). Suddenly you have an $f/2.8$ lens that now is a $f/3.5$ lens or whatever f-stop. I seldom use them and am not happy with the results when I do.



Teleconverters

You can get a teleconverter lens that is placed between your lens and the camera body that will give you 1x or even 2x magnification. If you put a 2x teleconverter on a 200mm lens, you instantly have a 400mm lens. However, you lose light, meaning suddenly your widest aperture for that lens jumps from f/2.8 to f/3.5 or higher. I have these, but every time I use them I swear I will never use them again. It is very, very difficult to improve on a lens just as it is, which is why the lens was made just that way in the first place – optimum. Put anything on the front or back of it and you are (IMO) just taking a good or great lens and turning it into an average (or worse) a poor lens. I seldom ever, ever use one and don't suggest them. Of course, they are not for macro work but for distance photography. If I was shooting birds I would probably have to use them.



Neutral Density Filters

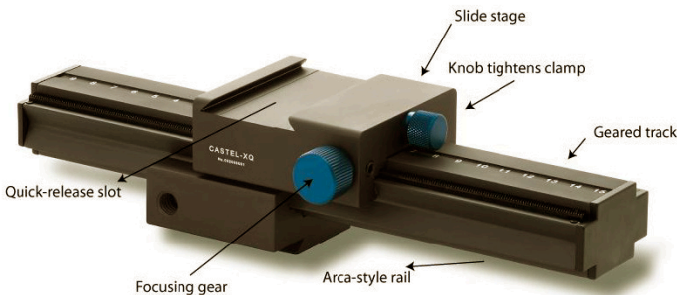
These are used for a variety of reasons like adding blur or being able to use a wider aperture and still lessen diffraction. I don't use them except for video work, where I use a variable neutral-density filter.



Gray Card

Can be useful for setting white balance on site but I seldom bring one along. Instead I do this in Adobe Lightroom. However, for very exact color work in the studio a Gretag Macthett "ColorChecker Passport" system is what I use. In the field I seldom bring one along. I sometimes do.

Novoflex Castel-Q



Focusing Rail

Many macro photographers prefer to stack photos working with a focusing rail rather than turn the focus ring on the lens. Using the

focus ring produces better stacked shots than the same thing taken on a rail, so use that. Either way can produce good stacked photos. Using a focusing rail, you mount your camera on the rail, the rail on your tripod, and by turning little geared wheels incrementally move your camera closer or farther from your subject, taking photos as you move along.



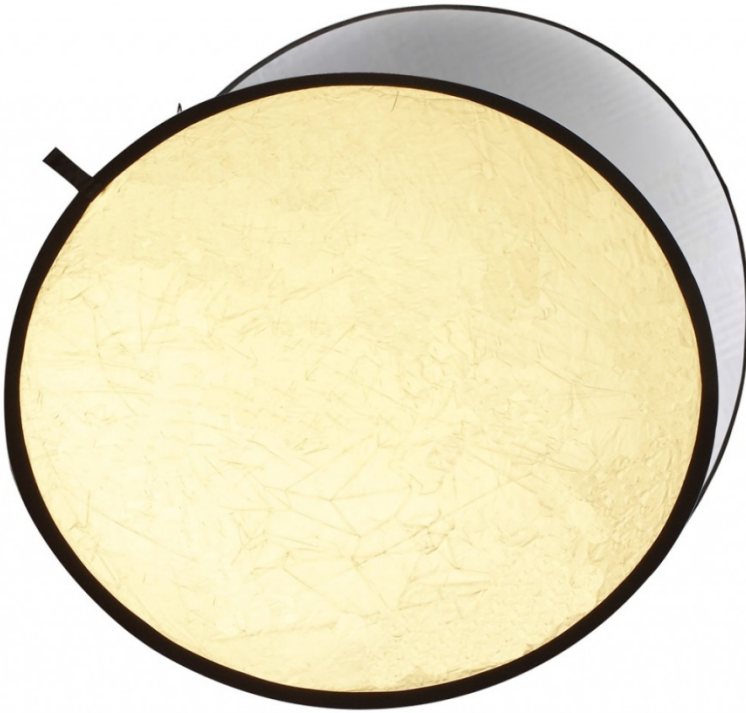
Bellows

Lenses can be mounted on a bellows which is then mounted on a focusing rail for very close macro work, usually in the studio. Special bellows lenses are often (and usually) used. They are similar to the old lenses used in enlargers back in the days of film. I am not going into this here, but some of you may want to learn about them. Bellows are used mostly for ultra-close macro work. A macro lens mounted on a bellows, with the front (lens) end locked and moving that back standard (camera) is a superior way of stacking photos, superior to using the focus ring or a focus rail.



Diffusers

A simple light diffuser can be very useful. Most on the market are too opaque for my taste, so I buy a cheap one, tear out the center, and sew in something that lets more light through. I go to walmart and pick some gauzy white fabric. All I want to do is cut back the strong sunlight a bit. not block all of it.



Reflectors

In addition to diffusers, there are reflectors that reflect light onto your subject. Diffusers allow light to pass through them and you hold them in between the subject and the light source. Reflectors are held off at some angle to reflect light on the subject. I have tons of them but I mostly use them for video studio work. They can be helpful outdoors in taking macro shots where you are in the shade and trying to get more light on whatever you are photographing.

Still Other Thoughts:

Stacking Live Critters

Live critters do sometimes hold still long enough for stacking. Spiders, bees in the early morning, you would be surprised. Ants? Not likely. Butterflies yes and definitely dragonflies. Try for it. You will be surprised what even a two-shot stack will produce in terms of greater focus depth.

Dust Bunnies

Particles of dust, sticky pollen, and whatnot somewhere worm their way inside your camera and cling to your sensor. The results are little persistent spots on each and every photo you take. This is particularly bad when focus stacking because as you focus closer in that little dust-bunny spot becomes a long line on the finished stacked photo or a bunch of lines which can be hard to remove. You must keep your sensor clean for focus stacking.



[BriteVue

Quasar Sensor Loupe]

Sensor Cleaning

This is the ugliest part of digital camera work but you have to do it. There are different levels of cleaning the sensor. On my Nikon cameras I have to lock the mirror up, take off the lens, and look inside. Behind where the mirror was (before it was locked up) is the sensor actually covered by a Lithium Niobate filter which is pretty tough and does not scratch easily. Still, doing anything with the sensor requires care and can be nerve wracking.

For beginners (and occasionally for any of us) cleaning the sensor is not only difficult but often fraught with worry about damaging the camera's sensor. It is no fun at all. The single most-important tool

for cleaning the sensor is some way to know if you have it clean. The traditional way is to go outside, point the camera/lens at the sky and take a photo. Then get the photo off the card, put it in Photoshop (or somewhere), expand the photo, and minutely inspect it for dust, what are called “dust bunnies.” This is a horrible method and can take a very long time, going outside and in, etc. It is easy to spend an hour doing this if you fail to remove the dust you can’t see in any way except as describe above.

The best money I EVER SPENT was to buy a BriteVue Quasar Sensor Loupe which costs a whopping \$88. You can get them from VisibleDust. This is a 7x round magnifier that fits over your open lens hole (when the lens is off) and is lit by six bright LED lights. By looking through it

you can easily see every speck of dust on the sensor. No more taking photos endlessly. If you value peace of mind and don’t want to be ritually humiliated by the previously- mentioned process, just buy one. I know it is expensive, but you won’t regret it. That said, here in general is what has to be done to clean a sensor. Please refer to your camera manual for exact details.

The first step is to place the LED sensor loupe on the camera and look inside. What is there? Is it a piece of hair, tiny dust bunnies, or a gooey piece of pollen? With the LED loupe you can see it all.

The next step is to take a special hand blower and blow air on the sensor to remove any dust particles that can be removed. Be sure to hold the camera with the lens-hole pointing to the ground so the dust stirred up by the blower will float down and out of the camera. Then look again at the sensor.

After blowing a few times, if there is still something there then try a special sensor brush (I use the one by VisibleDust, called the Artic Butterfly). These battery- operated brushes whirl around and become charged so they pick up dust. Very carefully brush the sensor WITHOUT going beyond the sensor and touching the sides, which can have grease. If you pick up the grease and wipe it on the sensor you are in for real problems. Using the loupe, see if this did the trick.

And the last and most scary resort is to use a special fluid and a special swab to actually clean the sensor manually. Again, I use swabs and fluid by Visible Dust made for my Nikon cameras. This

may have to be done repeatedly and it is very tricky. Too little fluid and you don't get it all, too much and it leaves a residue. No fun at all folks.

If all of the above do not work, you will have to send the camera to the manufacturer. The above is a very general description of the process and is not definitive. You must refer to your camera manual for precise instructions. I cannot be responsible for errors you might make in attempts to clean your sensor. Use the procedures listed above at your own risk. Before doing anything please read this excellent article on sensor cleaning by expert photographer Thom Hogan:

<http://www.bythom.com/cleaning.htm>

Shower Cap

Buy one of those inexpensive plastic shower caps with an elastic band in them for rain protection for your camera. They take up almost no space and are totally useful if your camera and lenses get caught in a rainstorm. Just put them over the camera and lens while you get wet. You do not want to get your camera and lenses soaked. Period.

Camera Vests

I have them but don't use them. If I need that many pockets I am taking too much stuff with me. Walking around with a zillion pockets full of stuff is something I have done plenty of in third-world countries where if you don't carry everything, it gets stolen. Pocket-loaded vests are no fun and I really like to travel ultra-light.

Photo Software

We could write a book about photography software and many people have. All I am going to do here is briefly tell you what I use. There are many simple programs for processing digital photos and Adobe Elements is one that will do quite a lot and is inexpensive. However, most photographers use Adobe Photoshop and/or Adobe Lightroom.

I use Adobe Lightroom 5.6 and it is far easier to use than Photoshop plus it also allows me to catalog and keep track of all my photos. Compared to Lightroom, Photoshop is a lot more expensive and difficult to learn, so I suggest you get Lightroom. However, and I am sure Adobe planned it this way, there are some tasks that you can't do in Lightroom and for which you need Photoshop or at least Adobe Elements. If you are on a budget, just get Lightroom and Elements. That will do you. And: you will love Adobe Lightroom. It is intuitive and adjusting photos in various ways is easy. That being said I use Lightroom and Photoshop.

I also use Color Efex Pro 4 from Nik Software, which was picked up by Google. It contains a number of great ways to color-correct and otherwise enhance your finished photos.

Tripod Cleaning

I have several tripods but I primarily use one for dry work and one for wet work (ponds, swamps, etc.). The wet tripod has to be taken apart and carefully cleaned and dried every so often, and at the end of the season, which is a real pain.

Manual Photography

I don't do close-up or macro on any other setting other than "Manual." It takes only a short time to adjust to doing everything manually and after that adjustment I would never go back. I use "Program Mode" for parties and anywhere I need quick, auto-focus results. Otherwise, I use only manual. I set my own aperture and shutter speed and get better results, the results I want. Turn the dial to manual and leave it there. Manual Mode requires setting aperture and shutter speed (and ISO), taking a photo, looking at the histogram, and either keeping that photo or deleting it, adjusting the settings further, and taking another photo. This is the way to go.

ISO

ISO dictates how your camera behaves in low light – how grainy things look. I keep my ISO as low as possible even though I have cameras that can handle very-low light levels like the Nikon D3s. If possible I have my ISO setting at 100 or 200 ISO. This means I have to sometimes use long shutter speeds but if I am doing still life, so who cares. If I am shooting moving critters, I adjust the ISO upward as needed. The Nikon D810 has a low ISO setting of 64,

which is really great. Some cameras offer lower settings yet, but they are fudged, not real.

Be Ready To:

Get Wet

Be ready to get wet and not worry about it. Especially if you are out in the dew and fields early in the morning, you are going to get really wet or you are not doing your job. Sometimes I wear hip boots in the field to stay dry. Most macro work requires being on your knees or lower, so just accept it. I routinely get soaked out there in the dew. I wear knee braces made from a foam-like substance with Velcro straps. Works great for my knees on rocky soil.

Get Dirty

Be ready to get dirty. It is nearly impossible to assume all the positions a macro photographer has to take on and not get anything on you. You are going to get dirty. So what? My family is used to seeing me walking around with dirt residue on my knees from kneeling here and there.

Get Exercise

Macro photography is some of the best exercise possible because you are kneeling down, getting up, kneeling down, dozens or hundreds of times and it is all great exercise for your midsection especially. Best way to lose weight I know and still have fun. As I come across great subjects I am willing to get down again and again and hardly notice it, something an exercise program could not get you to do.

Get Cold

Be ready to get cold. Even summer mornings can be cold. Spring and fall mornings in the field can be very chilly. If the sun is out I start out cold and gradually warm up. The warmth of the rising sun is most welcome.

Waterproof Boots

I need them and the Canadians make the best kind. Up in Canada they are serious about zipper ankle boots and they make them warm and waterproof.

Hip Boots

I use hip boots for streams, ponds, and swamps and also sometimes for wet grass in the early morning meadows. I can kneel in them and still not get wet. They are kind of cumbersome but sometimes it is just too cold to get soaked.

Running Shoes

In warm weather I use a pair of the lightest and most-breathable running shoes I can find and sometimes just let them get soaked. They dry quickly.

Pants

I find the ExOfficio superlight pants can get soaking wet and be almost dry twenty minutes later. I get wet a lot in the summer.

Clothes

Wear old comfortable clothes, just slightly less than what you need because you warm up. Include a floppy hat to protect the ears if in full sun. And footwear to season, but light, and waterproof. I usually wear a light synthetic down vest that I can take off if necessary.



Hats

In winter I use the old wool Navy Watch hats so that I can get my eye to the viewfinder. In summer I either use a baseball cap which I wear backward when photographing or a big (ventilated) loose floppy hat that protects my ears from too much sun. Best of all I wear those synthetic beanies, which have no visor. Patagonia sells them.

Mosquito Netting - As the season grows longer and I still want to get into the deeper danker woods, I carry mosquito netting that goes under my hat and covers my face and neck. Any sports store has them for almost nothing.



Travel Light

Pack the car with stuff, but outside the car, travel very light: a camera, tripod head, tripod, lens and maybe one extra lens and on too-bright days a small collapsible diffuser. That's it. I don't carry food, water, etc. Sometimes a cell phone if I am going to some strange place. I seldom get more than half a mile from the car. I have my water in the car.

The Secret of Focus Stacking is practice, practice, practice. There is no silver bullet. It looks easy, but is harder than you think. The only thing that worked for me was a lot of practice. Get good equipment if you can, get out in the fields and enjoy. When you see something that touches you, photograph it. If it does not touch you, don't bother.

About Michael Erlewine

Award-winning archivist of Popular Culture Michael Erlewine is a well-known entrepreneur, the founder and creator of many large web sites including the All-Music Guide (allmusic.com), All-Movie Guide (allmovie.com), All-Game Guide (allgame.com), Matrix Software (AstrologySoftware.com), AstrologyLand.com, MacroStop, ACTastrology.com, StarTypes.com, ClassicPosters.com, MichaelErlewine.com, and others. Erlewine was very active in the folk scene in the late 1950s and 1960s, especially in the Ann Arbor area which included traveling with Bob Dylan (hitchhiking) in 1961. Later, as leader of the influential Prime Movers Blues Band (Iggy Pop was the drummer), Erlewine played a wide variety of venues including the Fillmore Auditorium in San Francisco (during the "Summer of Love" in 1967) where his band opened for "Cream" during their first U.S. tour.

Erlewine was instrumental in the landmark Ann Arbor Blues Festivals of 1969 and 1970 as well as the Ann Arbor Blues & Jazz Festivals in 1972 and 1973 where he did audio and video interviews of almost all performers. This led to his becoming interested in archiving popular culture and founding the All-Music Guide (AMG) which today is the largest music review site on the planet. He did the same for film, video games, and rock and roll posters. Next to Microsoft Matrix Astrological Software (founded by Erlewine) is the oldest software company on the Internet.

Erlewine still owns and runs the company today, which is located in Big Rapids, Michigan. Michael Erlewine is also very active in Tibetan Buddhism and Macro Photography.

"I generally use the Nikon DD810 camera, with the Zeiss Otus 55mm f/1.4 APO lens, the Zeiss 135mm f/2 APO lens, and the Voigtlander 125mm 2.5 APO- Lanthar, and a Really Right Stuff Series-3 tripod with 3-segment legs, and a Swiss-Arca Cube C1 geared head. As for camera settings, I tend to shoot around f/6 (for stacks) at whatever shutter speed will bring down the ISO to 64 - 200 or so." -- Michael Erlewine

Questions and comments can be addressed to Michael@Erlewine.net and there are other free books and PDF downloads at: <http://www.MacroStop.com>.

For kids there is “Nature in the Backyard” at the site MacroStop.com.

You are free to distribute this to anyone who might enjoy it. No fee may be charged.

Other books by Michael Erlewine here:

<http://spiritgrooves.net/#&panel1-1>

Finally, some 24 video tutorials here:

<https://www.youtube.com/playlist?list=PL5xDr8mWUwrzi4bxY978O1DQykUvj-S2l>