

STACKING MICROSCOPES

For the past decade or so stacking, the digital accumulation of many pictures to increase depth of field, has become prevalent in both macro and microscope photography. More than a few pictures in this year's Nikon Small World contest indicated that they were shot with the technique. Being an avid macro photographer, I've been using it myself for some time, relying on three different softwares depending on the subject and the pictures. For basic images comprising a limited number of shots, Photoshop is enough. For more numerous stacks, I prefer Zerene Stacker. Every now and then, Combine ZP may also be used. This last one is a Freeware, a worthy player in that specialized field.

Stacking pictures is fairly easy for the softwares, but shooting images the right way can present its own set of problems. One of them is proper alignment between subject and camera: when the alignment is deficient the camera may move at a slight angle to the subject. The resulting picture can be stretched to one side. For a time, I used a rig meant to be used with a bellows and macro lenses. I still have it, stashed somewhere deep in a closet, but with the evolution of my equipment and the fact that I love making gadgets I eventually came up with a better solution. Actually, they are *two* solutions, depending on the need of the moment. I call them my "stacking microscopes"...



My old stacking rig



In this image, the camera was moving slightly to the left, which "stretched" the right side.



With proper alignment, the image is sharp from edge to edge.

Both were created out of “junk” microscopes that were purchased at ridiculous prices. Some of it was discussed in a previous article (What to do with a junk microscope: <http://www.microscopy-uk.org.uk/mag/artmar19/ca-junk.pdf#search=%22junk%20microscope%22>). If you go back to it, you will see that even those early versions have evolved somewhat...

Let’s start with the first one. It is meant to replace the focusing rig made of plywood. The base is an old Zeiss microscope bought for spare parts. Most of its column was cut off and on the stub was added an aluminum plate in which was machined a ¼ inch bold hole. This receives an angled plate normally used for panoramic photography. On it is fixed a Stackshot motorized and programmable focusing rail that can move the camera by as little as one micron at a time. Its motion is such that the focusing mechanism of the microscope is now rendered useless. A quick release plate was added to the rail; it has the added advantage of keeping the whole assembly perfectly vertical thanks to two screws that are already part of the mounting collar of the lens I use, the Laowa 25 Super Macro. This lens can give me between 2.5 and 5x by itself. It’s also possible to add extension tubes for more magnification.

The stage came from another junk microscope and was previously used on my stacking rig. A metal plate fixed to the X/Y controls is fitted with a small ball head on which is screwed an alligator clamp; it firmly holds the subject to be photographed. The condenser may be useful to change the appearance of the background, but that usefulness is limited at the magnifications given by the lens. There is no built-in light, but since most subjects will be lit from above, that is also irrelevant. Instead, pair of ¼ inch holes were tapped on both side of the microscope column to receive “magic arms” to hold



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whatever light I chose to mount on it. These days, I often use continuous lights on which can be clipped various filters and light modifiers.



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Two screws on the lens mounting collar neatly fit in the slot of the quick release plate, thus helping to keep everything perfectly vertical.



Worst case scenario should I need more magnification but not quite as much as what is offered by microscope lenses. After removing the quick release plate I can mount my old bellows, which will provide more magnification than a few extension tubes. There are two drawbacks.

First, the vertical alignment must now be verified carefully with a spirit level, otherwise there is that risk of misalignment and the waste of time that can come with distorted pictures. I may have to come up with more refinements in the future...

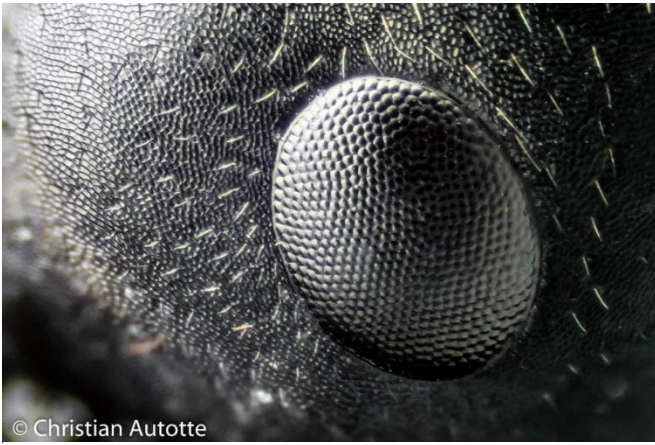
The condenser is no longer aligned and therefore cannot be used, which is not that important for most pictures (or is it? I may have to think about it...). Should I need a white shadowless background, a piece of Plexiglas can be clamped on the angled plate with enough clearance between the stage and Plexiglas to shine some light from below.

Another advantage of this set-up is the possibility of using other lenses with the bellows, so magnification can be adjusted from about 0.5x to over 10x.

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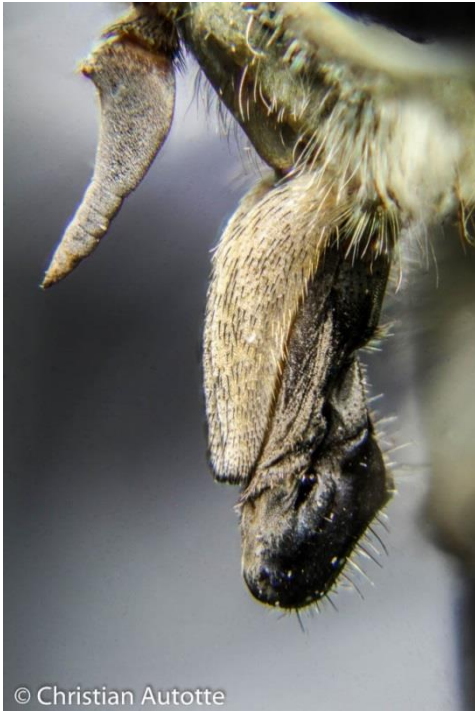
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Carpenter Ant eye, number of images unrecorded



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Bumblebee portrait, stack of 39 images



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Horsefly mouth parts, number of images unrecorded



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Horsefly eye, 150 pictures stacked



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Small June beetle head, 91 pictures stacked



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Tiger Beetle head, 48 pictures stacked



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When the magnification must go beyond 10x I switch to my second stacking microscope. It's a bit more of a "microscope" than my first one. It's built around an old Olympus microscope (probably built by Zeiss, if one is to trust its design), and was greatly modified. First and foremost was the addition of a Stackshot rail made to order; it had to be shorter than the usual rail in order to fit in the restricted space. The rail is bolted where the stage and condenser are normally attached to the base of the microscope arm. On the rail is fixed an aluminum plate machined to receive the stage and condenser, which can now move up and down to focus the subject being photographed. You will recall that Stackshot can move by as little as one micron at a time, which is enough to provide dozens or even hundreds of shots to be stacked. The coarse focus mechanism of the microscope can still be used; I have also added a locking screw so that it can be locked in place; the fine focus is then accomplished with Stackshot.

Because the stage and condenser have been moved by the thickness of the rail, something had to be done to align the optical tube with the condenser. By a lucky coincidence, the adjustment needed was exactly of two inches; a pair of one inch aluminum square tubing brought everything in perfect alignment. As with my previous unit, a set of ¼ inch tapped holes were made in the tubing to allow the mounting of lights for incident lighting. But this unit also has a mirror and a good condenser, so standard microscope lighting can also be used. There is no built-in light, but the mirror serves adequately with the proper external light source.



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A modified microscope, Stackshot, and a computer equipped with Zerene Stacker... Once set-up simply presses "Enter" and go for a pint...

The Stackshot can be controlled through a computer via Zerene Stacker. With it, it's possible to select where the first and last shot should be taken and the number of total shots to complete the stack. An alternative is to choose the beginning and the end, program the distance between each shot, and let the program calculate the number of shots needed. A delay between pictures can even be programmed to give time for electronic flashes to recharge. As soon as a few pictures have been taken, Zerene will start to stack them. All a photographer needs to do is make sure that all is well before leaving for a coffee or a pint, as the case may be...

Of course, one could always do it by adjusting the fine focus manually, if one was patient enough. Problem is, I'm not always patient enough... On top of it, the remote control way of the Stackshot / Zerene combination eliminates the possibility of jarring the equipment when focusing by hand. Stackshot is also more precise in adjusting the distance between shots, which can help the stacking program.



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Forams, stack of 12 pictures.



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Daddy-Long-Legs eye, 100x, stack of 81 pictures.



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Peacock feather, 100x, stack of 111 pictures.



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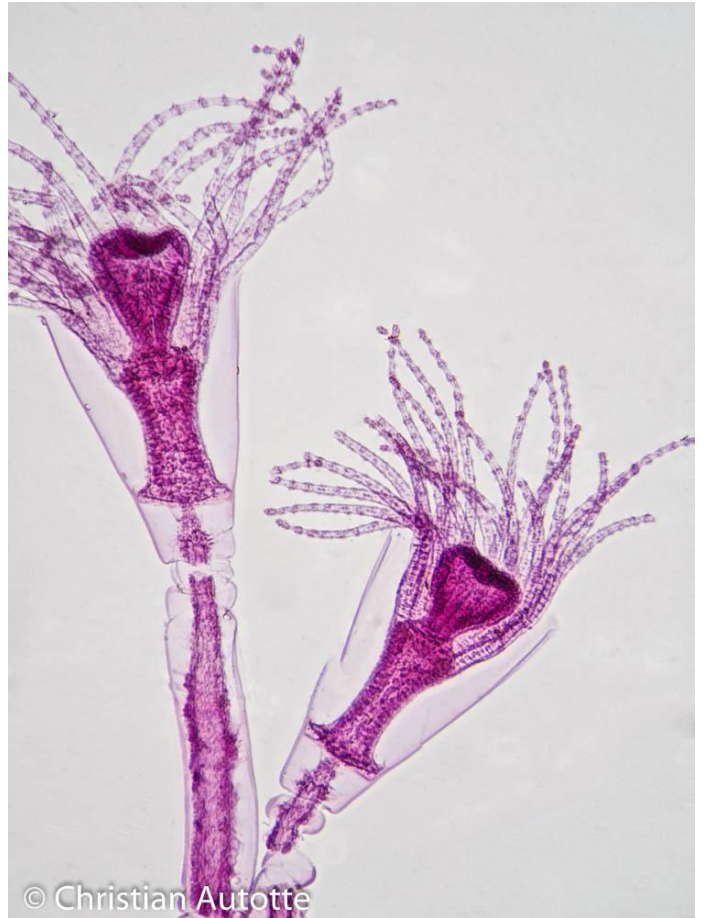


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Obelia, 100x, stack of 27 pictures.



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Obelia, 100x, stack of 19 pictures.

An Obelia slide in my collection was shot with the stacking microscope. After some post-production to correct white balance and remove some defects the pictures come out nice and sharp. Pictures at left are the first ones in the stack.

Comments to the author Christian Autotte welcomed, email:
cautotte.9001 AT videotron DOT ca
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