

ADAPTING DIGITAL POINT-AND-SHOOT CAMERAS TO OLYMPUS MICROSCOPES

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There are some very expensive cameras used on microscopes, but like many hobbyists my budget and interests aim more toward modest point-and-shoot consumer cameras. Many such cameras do not work well with microscopes, some work OK with extra care, and I have collected a few that are very good as well as easy to use. This essay shows examples and comments about the microscope cameras and adapters that I have used in recent years. They are illustrated on Olympus BH2 and BX50 microscopes, which are my personal workhorses, and as you will see I have also emphasized Olympus cameras and adapters. However, these same systems could also work well with other brands of microscopes with proper connectors.



Nikon Coolpix 990, 995, and 4500 models from the "turn of the century" have a 28 mm lens filter thread; the same size as a male thread on a late-model Leitz Periplan 10x eyepiece, after its rubber eye guard is unscrewed (Fig. 1). The eyepiece can then be screwed onto the camera to become an excellent photo relay lens, and it can easily hold the light weight camera when inserted into a microscope eyepiece tube or photo tube. This is a quick, easy, effective, and economical digital microscope camera system.

Figure 1. Nikon Coolpix 990 and Leitz Periplan 10x eyepiece, with its rubber eye guard unscrewed.

The Coolpix 990 and its cousins quickly became popular for microscope imaging. In addition to the lucky match of filter and eyepiece threads, the view screen side rotates to be easy to see from the front of the microscope, and its zoom is internal so the eyepiece does not interfere when attached. Although it sounds low nowadays, 3.34 megapixels is plenty of resolution to capture the tiny image of a microscope view. The Nikon camera optics are very good too.

Figure 2. Nikon Coolpix 995 and Olympus 8x eyepiece adapter on a BH2 trinocular head.

Unfortunately for me, Leitz Periplan eyepieces do not work especially well with Olympus BH2 optics. Olympus eyepieces are needed for proper color focus corrections with Olympus BH2 objectives, so I hot-glued a short 28 mm threaded tube end onto an Olympus WHK 8x eyepiece for attaching to this Nikon CP 995 camera. Here it is inserted into the photo tube of a polarizing BH2 microscope (Fig. 2), giving quite good photomicro images. The view screen side of the camera has been rotated so it is easy to see while using the microscope -- and you need it to focus because this setup is not parfocal with your eye view.





Figure 3. CP990 with a Zarf adapter, also housing a Zeiss 8x eyepiece for the relay lens.

A very nice adapter with a 28 mm thread for these older Nikon Coolpix models is made by Zarf Enterprises especially for the trinocular BH2 head (Fig. 3). It is just a connector, no lens, so an eyepiece relay lens must be used as well (not a film-camera photo relay lens). You need one with a fairly shallow upper body to fit under it. Unfortunately the best one for the purpose -- the Olympus WHK 8x -- is too big to fit well with this adapter. The next best eyepiece relay lens is a Zeiss 8x Kpl, at least in my experience.

The Nikon Coolpix 5000 is a very fine 5 mp camera that can use the Leitz Periplan relay eyepiece via a Nikon UR-E6 adapter. But since I wanted to use an Olympus WHK 8x eyepiece instead of the Leitz, I hot-glued one to the bottom of that adapter, which works well (Fig. 4, left adapter). The

addition of a UR-E5 adapter (right adapter) allows a newer Olympus 30 mm eyepiece to be inserted inside the adapter assembly and also leaves room for the zoom lens to extend. This is good for many stereoscopes.



Figure 4 above. Nikon Coolpix 5000 with connectors. Figure 5 right. Nikon CP5000 mounted on a BH2.



Above right is the Nikon Coolpix 5000 mounted on a BH2 with its 8x eyepiece and adapter, and view screen rotated. Not many controls are easily accessed (the ones on the camera top). In addition, you might want Nikon accessories such as power adapter, wired remote control, and USB computer cable, all available on eBay. I would settle for this fine system except my hobby senses urge me to keep experimenting.

Their special microscope camera systems were (and are) very expensive, but Olympus also developed adapters for some of their consumer point-and-shoot digital cameras. The first adapter was called C3040-ADL, named after the Camedia C-3040 3.34 MP camera (Fig. 6). The same 41 mm filter thread continued on the C-4040 and C-5050 models (4 and 5 megapixels), and those are also excellent microscope cameras. The later models have flip-out LCD view screens, which are very useful high above a microscope head.



Figure 6. Olympus Camedia C-3040 (left) and C-5050 (right) cameras.

The C3040-ADL camera adapter was designed for BH2 160 mm optics, so for the BX infinity optics a version called C3040-ADU was made. Newer Olympus camera models C-5060 and C-7070 (5 and 7 mp) use a larger 48.5 mm lens thread, so for them the C5060-ADU adapter appeared (Fig. 7). These later adapters

have sections that come apart and can be adjusted to make the camera parfocal with the viewing focus. Separate photo relays are not used with the -ADU versions on BX microscopes, but the original -ADL needs a relay eyepiece on the BH2, inserted under the c-mount connector.



Figure 7. Olympus screw-on tube adapters for particular Camedia camera models. Left to right: C3040-ADL; C3040-ADU; C5060-ADU with top removed.

The threaded tube section on the right in Figure 7 fits the C-5060/C-7070 camera thread to allow room for the zoom lens extension, and it also attaches to any of the adapter assemblies to the left. But I assume the optics in the C5060-ADU version are idealized for the camera.

Inside the middle section is a big projection lens, and on the bottom is the threaded opening for the c-mount connectors discussed below. Only one thumb screw on the adapters is actually needed -- they just release the bottom c-mount tube section, so it stays connected while you can slide the camera off and on the microscope easily (or they can help to make a parfocal adjustment).



Figure 8. Olympus BH2 adapters with a Camedia C-4040 camera.

In recent years I have collected quite a few of the accessories and appropriate cameras by Olympus for use in photomicroscopy. The C3040-ADL adapter tube is screwed onto the filter thread of the C-3040 or later cameras of that series (in Fig. 8 it is a C-4040). This adapter has a projection lens that matches BH2 Olympus optics perfectly, so I also expect it will out-perform non-Olympus adapters (I have no proof however).

The U-PMTVC tube is a connector with a c-mount end that attaches to either a BH2 or BX microscope. An Olympus or after-market infrared remote is very useful to control shutter and zoom.



Figure 9. MTV-3 and U-PMTVC c-mount connection tubes for BH2 head flanges.

The camera adapter C3040-ADL requires a C-mount at the microscope head end, which is not standard for BH2/BX trinocular heads. The MTV-3 and U-PMTVC attach to the head's photo tube to provide the necessary male c-mount thread (also used for video or TV cameras). They fit over an eyepiece projection lens – as mentioned above, I use a Zeiss 8x Kpl for my consumer cameras. Both adapters seem to work the same on a BH2, each with a 0.3x reducing relay lens (removable on the MTV-3).



Figure 10. U-CMAD-2 (left) and U-CMAD-3 (right) c-mount connector tubes for BX heads.

Adapters to provide a c-mount attachment for BX microscope heads include the U-CMAD-2 and U-CMAD-3, both commonly with a U-TV1X-2 tube end threaded onto the base. Unlike the BH2 c-mount adapters, these are empty; no projection or relay lens is needed for this infinity-tube-length microscope.

The adapter and bottom tube on the right in figure 10 are Chinese clones of the Olympus parts, but as far as I can see they have about the same quality and function for a lower cost.



Figure 11 (left). Mounted neatly on a BH2 trinocular head, this C-4040 with adapters C3040-ADL and U-PMTVC provide excellent digital images.

The C-4040 camera and its two adapters cost me about \$240 in total, and I was lucky to find them that cheaply on eBay. If you are in a hurry there are usually some listed for higher prices.

Figure 12 (right). On my BX50 microscope, a Camedia C-5050 (5 megapixels) is attached to a C3040-ADU relay adapter and U-CMAD-2 plus U-TV1x tubes.

The C-5050 camera features a flip-up LCD screen for easier viewing to focus, but in fact it is parfocal with the eyepiece view anyway. A small RM-2 infrared remote shutter release is attached with velcro next to the left eyepiece tube, so I don't need to look up from the viewing to snap a photo. The video-out cable is attached to an old laptop nearby to allow quick reviews of images (not a live view, unfortunately).



These later Olympus cameras feel especially solid and well designed. Their semi-professional lenses and built-in functions are a step up from inexpensive consumer versions. Olympus did a good job with the special adapters needed to make them work well on the microscope. The cameras are cheap enough now but the adapters are usually expensive, although once in a while a bargain appears on eBay.

In 2005 the Camedia C-7070 (7.1 mp, Fig. 13, right) camera replaced the C-5060, and it also fits the C5060-ADU adapter. It is the best microscope camera and adapter system that I have tried so far, with a great lens, more than enough resolution, and an articulated view screen that can be turned and tilted downward toward the user. I also thought maybe the C-8080 (8.0 mp, Fig. 13 left) could be adapted with a step-down ring, but it is really too large and heavy, and I can find no microscope adapter for its big lens. I think it was the end of the line for this model series. The C-8080 is a great man-size camera for normal use, however.



Figure 13. Olympus Camedia C-8080 (left) and C-7070 (right).

These cameras had street prices of \$800 to \$1100 when new, but now (early 2013) even when in great condition go for \$90 to \$160 on eBay (the C-7070 is a little scarce). A fault such as a bad flash or cosmetic damage can make the camera much cheaper but still OK for our purposes. I like the C-8080 although it is unsuitable for photo-microscopy, so I will keep it to use as a scenery camera.



Figure 14 (left). The Olympus Camedia C-7070 at work on my BX50P microscope.

The articulated C-7070 LCD screen can be tilted for easy viewing from my chair, although the adapter assembly makes it all very tall! However, the same RM-2 remote, power adapter, and video cable from the C-5050 also work with the C-7070, and likewise the camera is parfocal with the eyepiece focus. You need about half of the zoom power with these cameras to put all of the view within the projection circle of the relay adapter. That amount of zoom seems to have little or no effect on the image quality, as far as I can tell.

This setup provides extremely nice images: sharp, bright, high contrast, even focus and lighting across the view, and very convenient to obtain. I like this system very much, which is just as well because I can't afford any more of the gear!

I have gathered a big collection of cameras, adapters, and accessories, yet now I only need the parts in this photo. Eventually I might sell some as kits ready to use on Olympus microscopes.

Otherwise, used point-and-shoot cameras by themselves have little value after 8 or 10 years, even ones costing more than \$1000 when new (and some of mine did -- but of course I bought them used). It is very affordable and most convenient to have one dedicated for microscope use.

Below is a table showing specifications of the microscope cameras I have used.

POINT-AND-SHOOT CAMERAS I HAVE USED WITH MICROSCOPES

CAMERA	YEAR	MPx	CCD	APERTURE	ZOOM equiv.	THREAD	ADAPTER	PRICE new	PRICE 2013
Olympus C-7070	2005	7.1	1/1.8"	F2.8 - F4.8	27-110 mm (4x)	48.5 mm	C-5060 ADU	\$699	\$120-200
Olympus C-5060	2003	5.1	1/1.8"	F2.8 - F4.8	27-110 mm (4x)	48.5 mm	C-5060 ADU	\$699	\$60-100
Olympus C-5050	2002	5.0	1/1.8"	F1.8 - F2.6	35-105 mm (3x)	41 mm	C-3040 ADL/ADU	\$799	\$60-90
Olympus C-4040	2001	4.0	1/1.8"	F1.8 - F2.6	35-105 mm (3x)	41 mm	C-3040 ADL/ADU	\$900	\$30-40
Olympus C-4000	2002	4.0	1/1.8"	F2.8 - F11	32-96 mm (3x)	41 mm	C-3040 ADL/ADU	\$450	\$20-30
Olympus C-3040	2001	3.34	1/1.8"	F1.8 - F2.6	35-105 mm (3x)	41 mm	C-3040 ADL/ADU	\$800	\$20-40
Nikon Coolpix 5000	2002	5.1	2/3"	F2.8 - F4.8	28-85 mm (3x)	37 mm	UR-E6 to Periplan	\$1100	\$60-80
Nikon Coolpix 995	2001	3.34	1/1.8"	F2.6 - F5.1	38-152 mm (4x)	28 mm	Leitz Periplan	\$900	\$30-50
Nikon Coolpix 990	2000	3.34	1/1.8"	F2.5 - F4.0	38-115 mm (3x)	28 mm	Leitz Periplan	\$900	\$30-60

If you are assembling a camera system for a BH2 or BX, the Olympus C-7070 is the best performer, but the next two are also excellent. The C5060-ADU adapter you will need for the top two is very hard to find, but I see a number of C3040-ADU adapters on eBay (some over-priced). Images you can get with the other cameras are all very good in my opinion, but the C-3040, C-4000, and C-4040 models do not have flip-up view screens, and the C-4000 cannot use a remote control. The main differences among images made by such good cameras of various resolutions are their sizes on a computer screen, as when you zoom to a maximum or "actual pixels" view of the image. Zooming in more than that is not useful. You need to use higher power objectives on the microscope to get closer views with digital images.

Good consumer cameras have settings that you won't need for photomicroscopy. In general: turn off the flash and auto-focus (manual focus at infinity); let the camera control the exposure (some will dispute this); use a bright light level; use a blue daylight filter; set the image resolution to a high level, if possible. Take a series of shots at slightly different focus levels. Pick the best ones and be ready to adjust them a bit with software such as Photoshop. It is helpful to have a remote control for the shutter because you can shake the camera when pushing the button. Also use a power adapter, because a long session will eat up batteries.

Consumer cameras have built-in processing of color, noise reduction, and sharpening, so unless you can get a "raw" image file, different models may make slightly different images. There are many layers of glass between the objective and the ccd chip in a point-and-shoot camera, which is why you need good quality lenses. Some folks prefer digital single-lens reflex camera backs with their big ccd chips, no camera lens, and perhaps fewer relays for the image. But they are expensive, many use a moving mirror that can cause vibration, and you might only find a generic adapter lens made for the camera, not for the optics of the particular microscope. That makes my inexpensive "point and shoot" cameras more attractive, and they can provide fine images with the high-quality adapters most appropriate for them.

Also see Alan Wood's excellent website about Olympus photo-micrographic equipment. You are invited to join ("like") my Facebook Page <https://www.facebook.com/Stones2GemsMicroscopes>, where I illustrate many microscopes collected over the years, with examples of rock images obtained with these cameras.

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