

Re: How to distinguish 160 vs 170 mm eyepieces?

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 - *Date:* Wed, 21 Jan 2009 16:01:14 +0000 (UTC)
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shiraz14 <shiraz14@xxxxxxxxxxxxxxxx> writes:

Firstly, thank you for your valuable input. Also, as a correction to any possible misconceptions to my last post, NA was stated to be a dimensionless constant as it was interpreted in the context of a particular lens used to image a specific specimen under a stated technique. Note however that NA is actually a variable (think those of us who are relatively familiar in microscopy would know this ... this is just for the clarification of any potential misinterpretation of the information presented in the last post) ... factors influencing NA include the optical technique used, mountant applied, objective, condenser & eyepiece iris diaphragms (if any), etc.

Yes, it's a measurement of the angle of the actual light cone that forms the image. The condenser iris is provided to explicitly adjust the NA of the illuminating light, and it's generally adjusted to make that equal to or slightly smaller than the NA that the objective was designed for.

As for the clarifications, here they go:

"rear focal plane" (not "real focal plane") = 3D conjugate image plane as observed by the viewer during simple conoscopy.

I presume you obtained the information for the image plane being in the eyepiece barrel from the Molecular Expressions website

That's a useful reference, but I also own a few microscopes and telescopes, and I've done a small amount of optical experimentation on my own.

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Molecular Expressions serves as a useful resource for microscopy, the information provided there serves only as a preliminary guide to microscopy fundamentals ... in reality, an infinite number of image & focal planes exist (which may be sited at any point along the optic train) – raising and lowering (including synthesis and elimination) of focal (& image) planes may be achieved through the insertion of apochromatic auxiliary lenses, etc, and any potential gain/loss in magnification be compensated through the coupled use of a corresponding reducing lens–pair system. For my purpose, I'd need to have the rear focal plane lying directly below the prism assembly but within the trinocular head, if this is not possible (due to space constraints), then at least within an intermediate module sited between the head and the IL axis.

Hold on just a minute. Although it is *possible* to create an optical system that has many conjugate image planes, each such image plane requires a well–corrected lens system to focus the image, plus there needs to be a field lens or some equivalent that does not provide much focusing power but which redirects the light diverging away from the optical axis after one image plane back to parallel or converging so it can be refocused at the next image plane (otherwise the illuminated field will be small).

Thus, it takes quite a bit of extra optics to provide each "extra" conjugate image plane beyond the one normally formed in the eyepiece. The extra optics would cost money plus reduce brightness and contrast, while providing no benefit for most microscopy, so microscopes generally do not include them. Unless you modify the optics, there is just one place where a real image of the subject is formed, and that's at the field stop inside the eyepiece barrel.

Microscopes are often designed to take accessories like polarizers, darkfield equipment and so on, but most of these want to be inserted where the imaging light is parallel, *not* where it is focused to an image. The light between illuminator and condenser is approximately parallel, and the imaging light between the objective and tube lens in an infinity–corrected microscope is exactly parallel, so that provides the places to add these accessories. But no extra image plane is provided. Unless your microscope is unusual, this will be true of it as well.

The trinocular head is likely designed to have parallel light enter the bottom end, go through a tube lens, and then be focused on the field stop in the eyepieces, with a specific light path length through the prisms and mechanics. Any change to this design will require mechanical changes to the position of the eyepieces and other elements, and it may also mess up optical corrections of those elements.

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If you really need an extra conjugate image plane, you're probably best to create one inside a module that is mechanically inserted between the body tube of the microscope and the trinocular head, assuming the tube lens is included in the trinoc head. The incoming and outgoing image light is parallel, so you need a pair of well-corrected lens systems of an appropriate focal length which are corrected for operation at infinite conjugate ratio. You'll also need to trace some rays from points near the edge of the image and add field lenses or aperture stops as needed, to avoid losing brightness or losing contrast from stray light. (I'm not an optical designer; you should talk to someone who knows what they're doing for the details). This should be able to be done without modifying the existing microscope parts.

Dave

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