Digital Photomicrography
with a Zeiss Photomicroscope
Fritz Schulze, Canada

In some idle moments I have played with the idea of converting the 35mm cassette of a Photomicroscope (Phomi for short) to digital. It would not be an insurmountable problem for a qualified and imaginative "mechatronic" to disassemble a digital camera with a large enough sensor and install the various components in a modified film cassette. It would indeed be a challenging project.

Fig. 1

The small Sony Cyber-shot 6.0 shown in Fig. 1 has, of course, too small a sensor. I used it only to show the relative size of a digital camera and its electronics compared to a Phomi film cassette.

For my practical purposes I arrived at a much simpler solution. I have touched this subject in an earlier article about "the Evolution of my Photo microscope". My first step was to exchange the black tube head of my 1960s Phomi for a modern grey one which includes in the slider a prism with a 50/50 split between binocular tube and upper port which carries the camera. This allows me to synchronize the focus between the two and work exclusively through the binocular tube without having to check the camera on top.

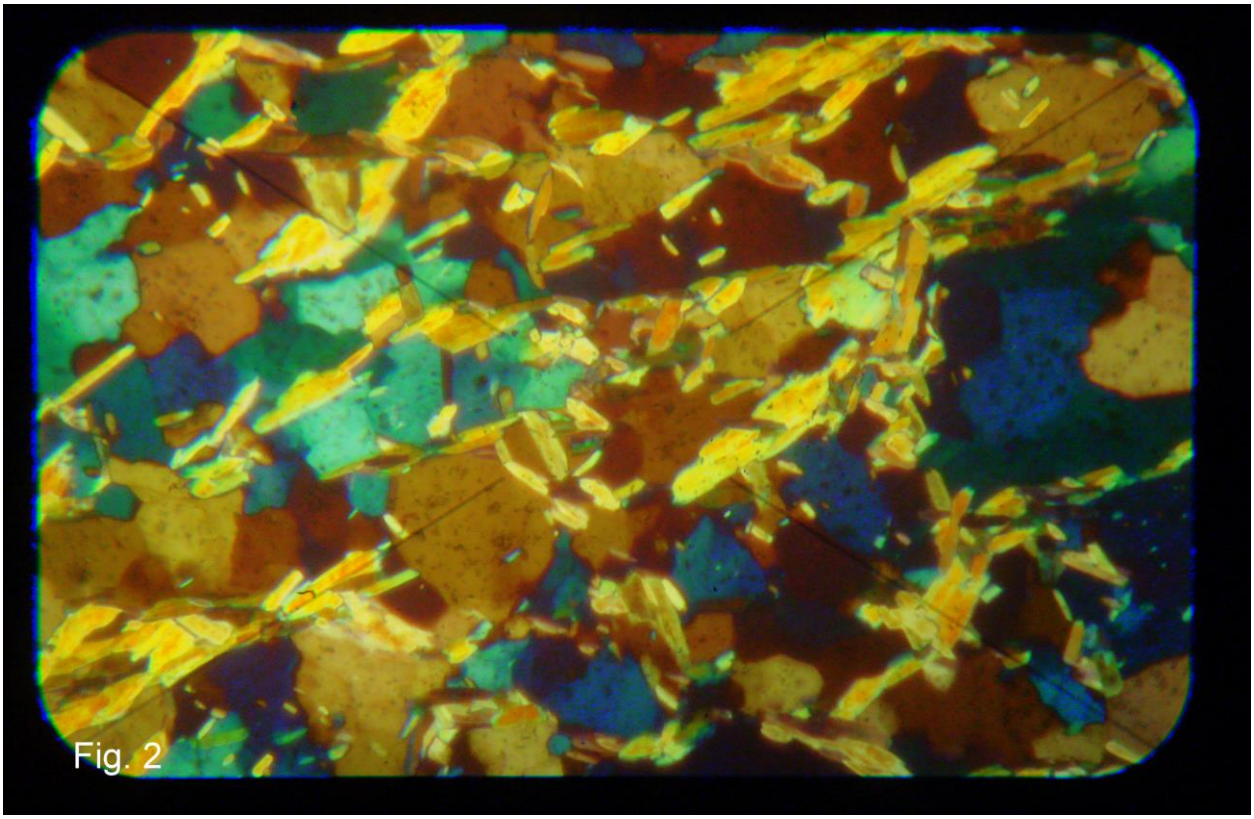


Fig. 2 shows a view through the photographic lightpath of the Phomi with the diagonal crosshairs for exact focusing (Original black tube head, prism slider on the black ring = third position,Planchromat 40/0.65, Optovar 1.25, Kpl W 8x), taken by holding my Cybershot camera over the eyepiece. This selection will not be used in my set-up.

Whoever has a Phomi will have noticed little red stickers with a number both on the tube head and the stand. Mine has the number 0898. This means that the tube head is optically precisely matched to the stand and must not be exchanged, a fact that matters if you buy the Phomi in bits and pieces on e-bay. This applies, of course, to the internal camera optics. I noticed that the image quality of the photo-lightpath with the new tube head is unusable, however, as I have no intention to use the internal optics, it does not matter in my case. Close examination of the new tube head reveals considerable differences in the design. It cannot be used with the built-in 35mm camera **at all**. Whenever I go back to 35mm film I would have to reinstall the original tube head.

In order to establish exact simultaneous focus I needed cross hairs in one eyepiece. My Kpl W 8x eyepieces were both of the focusing type and upon "opening" them I found that they were already prepared for the insertion of a micrometer or crosshairs disc (Fig.3).

Fig.3

I happened to have a suitable disc with a photoframe and crosshairs in my "treasure chest" (Fig. 5). It was, however, a fraction of a millimeter too large in diameter, but I managed to machine the receptacle in the eyepiece to make it fit. In the picture you can see the blank brass where I machined the receptacle. The receiving sleeve with the disc is pushed into the eyepiece barrel from below and the entire unit screwed into the upper part of the eyepiece. Cleaning the disc of any dust particles was a bit tricky, but I managed to do this under a stereomicroscope by means of my "fishing tools" and bulb blower (Fig. 6). Care has to be taken to insert the disc with the engraving toward the eyelens. This was facilitated by the disc having its part number imprinted as it is otherwise difficult to see on which side of the glass the engraving is. Pointing the eyepiece toward the sky I carefully focused my eye on
the double crosshairs and noted setting on the red index as the thickness of the glass displaces the image slightly, the white index being for use without a disc.

Fig. 4

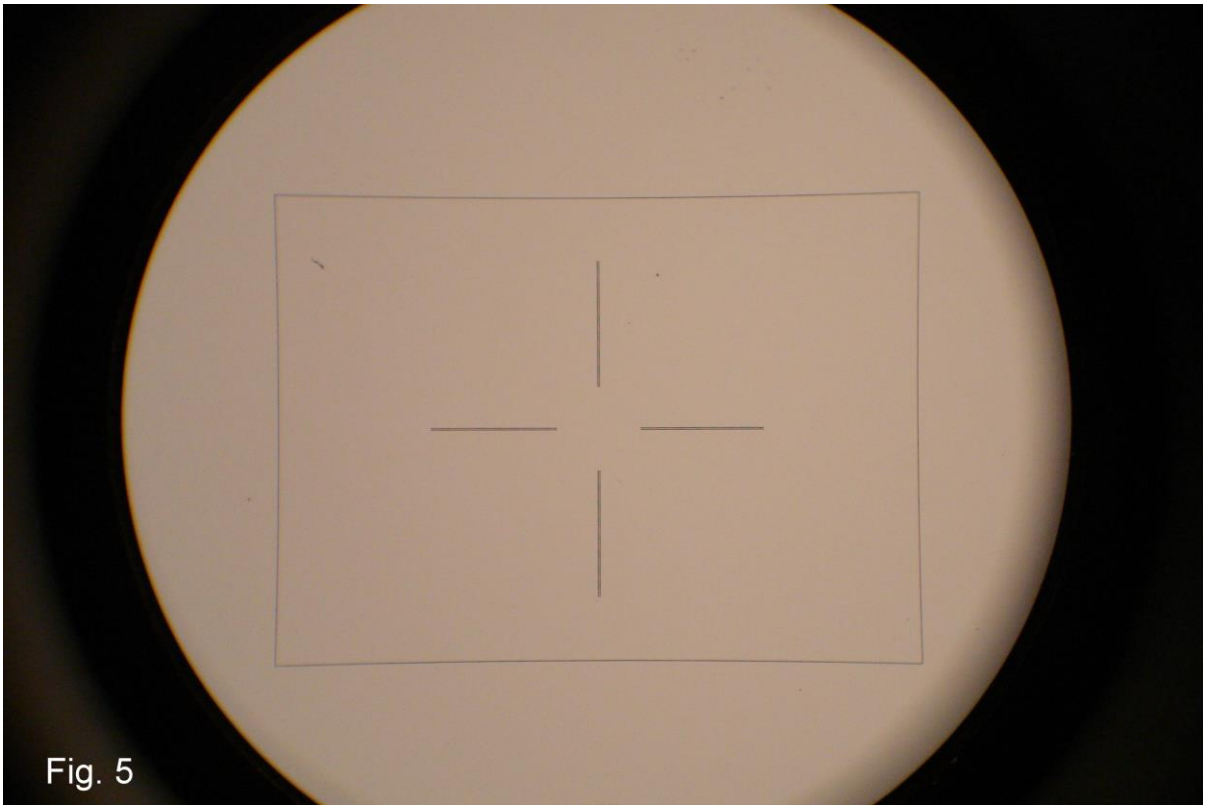


Fig. 5

Fig. 5 shows the view through the eyepiece with the reticle installed.

The next step was to arrange for a straight vertical tube to be installed in the upper port of the tube head. Again, I rummaged in my "treasure chest" of odds and ends, discarded and obsolete parts, and found enough to manufacture a straight tube. It even has a slot to insert filter holders or an analyser. The microscope being carefully focused on a stage micrometer, I now transferred the eyepiece with its crosshairs to the vertical tube, prism slider position on the red ring, and adjusted its length until the micrometer scale was precisely in focus. To be sure, I checked this with the Leitz Periplan 10x eyepiece, but this time I employed an auxiliary telescope to compensate for any visual deficiency. To do this I first focused the telescope to infinity. The additional magnification of the auxiliary telescope reduces the depth of field to such a degree that the precise focus can easily be discerned.

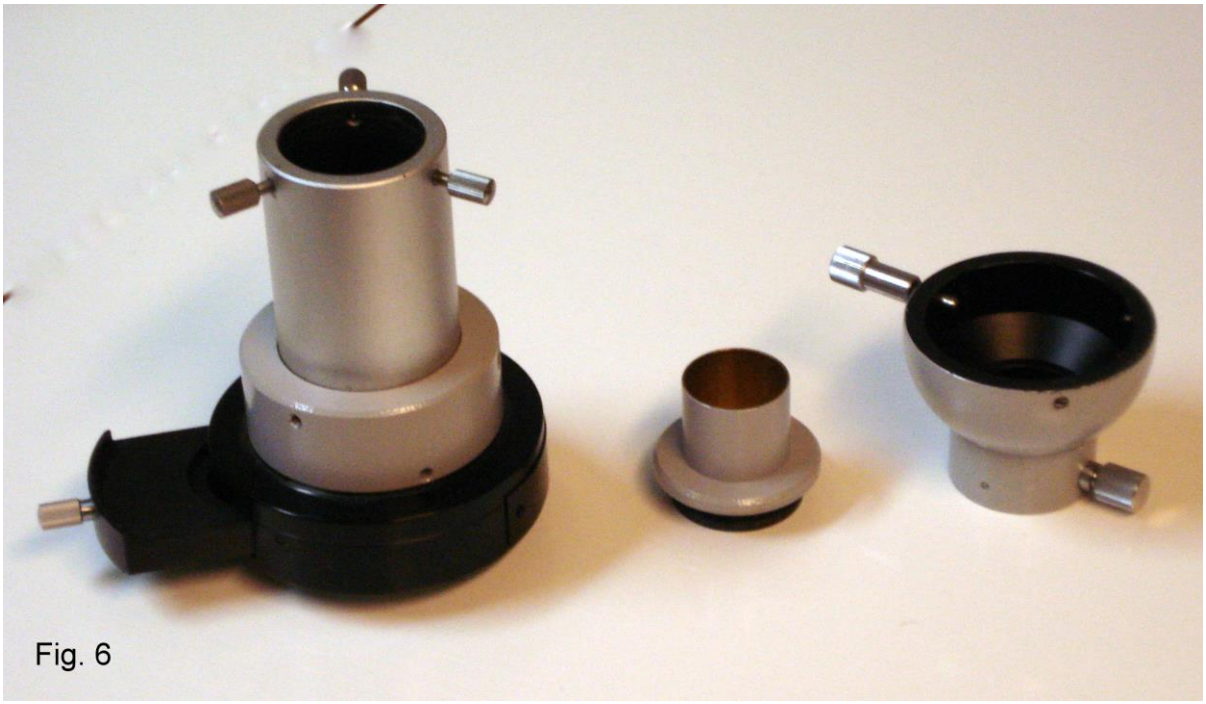


Fig. 6

Fig. 6 shows the vertical tube with the removable top part. This can be exchanged for a C-mount adapter for a video camera (see Fig. 14) and an optional adapter for other accessories (on the right). On the Leitz Periplan eyepiece (Fig. 7) you will notice three small white patches. These are soft spacers to prevent the camera objective from being scratched when the eyepiece is screwed onto the digital camera.

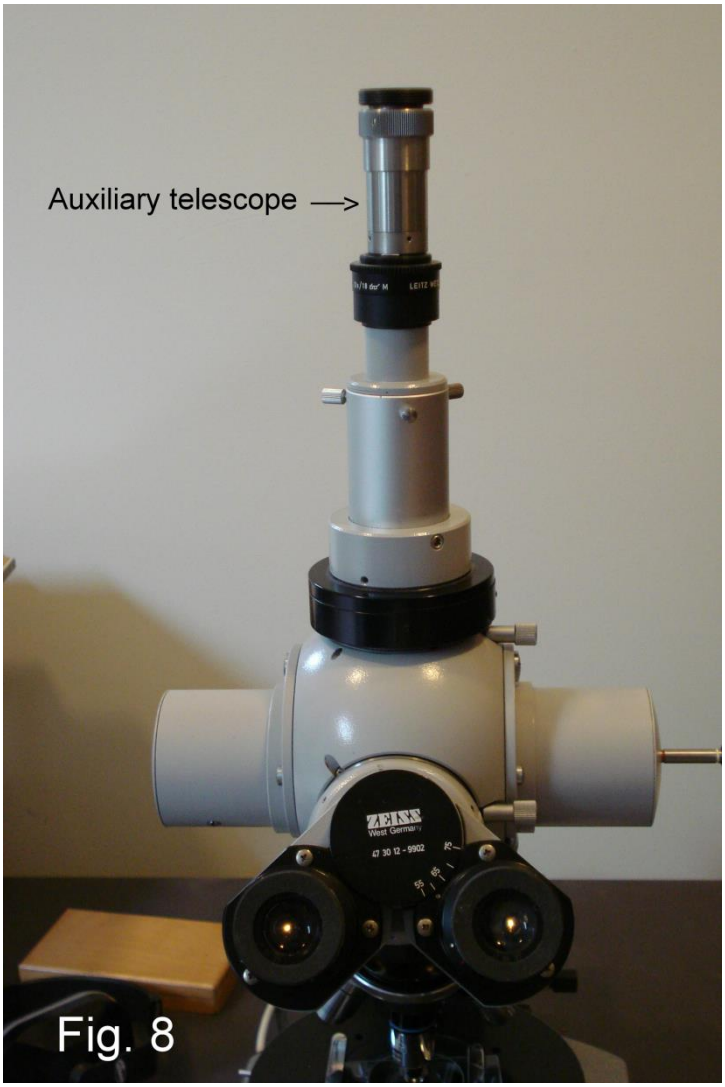


Fig. 8

In Fig. 8 you can see the monocular, straight tube intalled on the tubehead of the Phomi. The auxiliary telescope stands on the Periplan eyepiece ready for the tube length adjustment for precise focus.

Fig. 9

Just for the fun of it, Fig. 9 shows the focus of the light in the exit pupil of the high- eyepoint eyepiece exactly 12mm above the mount. Ideally this point ought to be in the plane of the camera's objective diaphragm. Any considerable deviation causes vignetting, therefore, small and compact objectives are to be preferred. Note that this focal point is **not** an image plane, but represents the rear focal plane of the objective (and the condenser diaphragm. The camera diaphragm takes over the same function).

The next step concerns now the attachment of a suitable digital camera. This could be a problem, as modern digital cameras are small and designed for the ordinary consumers, who, besides, mostly use a smart phone for their picture taking. Lately, big bulky SLR-type digital cameras appeared on the market. These would have to be treated like the old-fashioned 35mm film SLR cameras.

I was fortunate that I was presented with a vintage 2001 Nikon Coolpix 995 digital camera, the second version of this popular camera and demanding at the time a rather high price. Its 3.34 Mega Pixels were the maximum available then but are quite sufficient. This camera is also the only one which has a filter thread M 28x0.75 that makes it possible to attach it to a microscope by means of the Leitz Periplan 8x high eyepoint eyepiece which happens to have the same thread when the rubber eyecup is removed.. Nikon also offer a simple microscope adapter. This feature made this camera immediately popular among microscopists (Fig. 10, with eyepiece attached)..

Fig. 10

Here is my Coolpix camera with the Leitz eyepiece attached and the complete set-up on the Phomi (Fig. 13). One can see a small degree of vignetting which can be eliminated by operating the zoom feature of the camera. The cable visible on the right is from the remote control. The use of a remote control is advisable for reasons of operating comfort and the avoidance of camera shake (Fig. 12). In the same way as the human eye has to focus on infinity when looking into an optical instrument, so has the camera. This necessitates to change the camera setting from autofocus to manual focus and selecting "infinity" (Fig. 11).

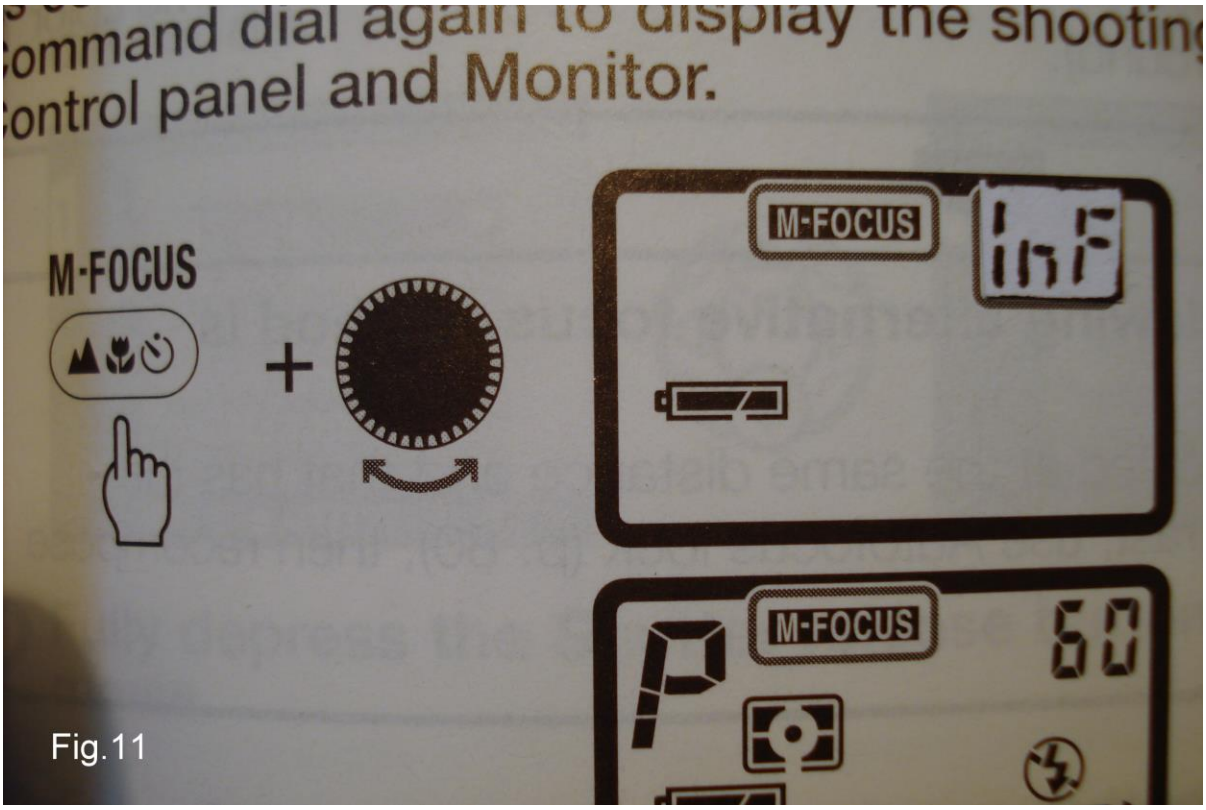


Fig.11

Fig. 12

By the way, the Nikon Coolpix 995 has an additional advantage in so far as the camera monitor can be tilted and positioned in such a way that it can be seen from the microscopists position at

the binocular tube. This is very practical for checking quickly on the picture to be taken and making sure that the camera "clicked" (Fig.13).

Fig. 13

The Coolpix also has a white balance for compensating different colour temperatures. My Phomi has a 12 V 100 W halogen incandescent bulb as a light source. I have used both a compensating filter for incandescent light such as a Tiffen #80C (series 5, which fits on the microscope), a Zeiss daylight filter, and the camera's automatic white balance. But the actual

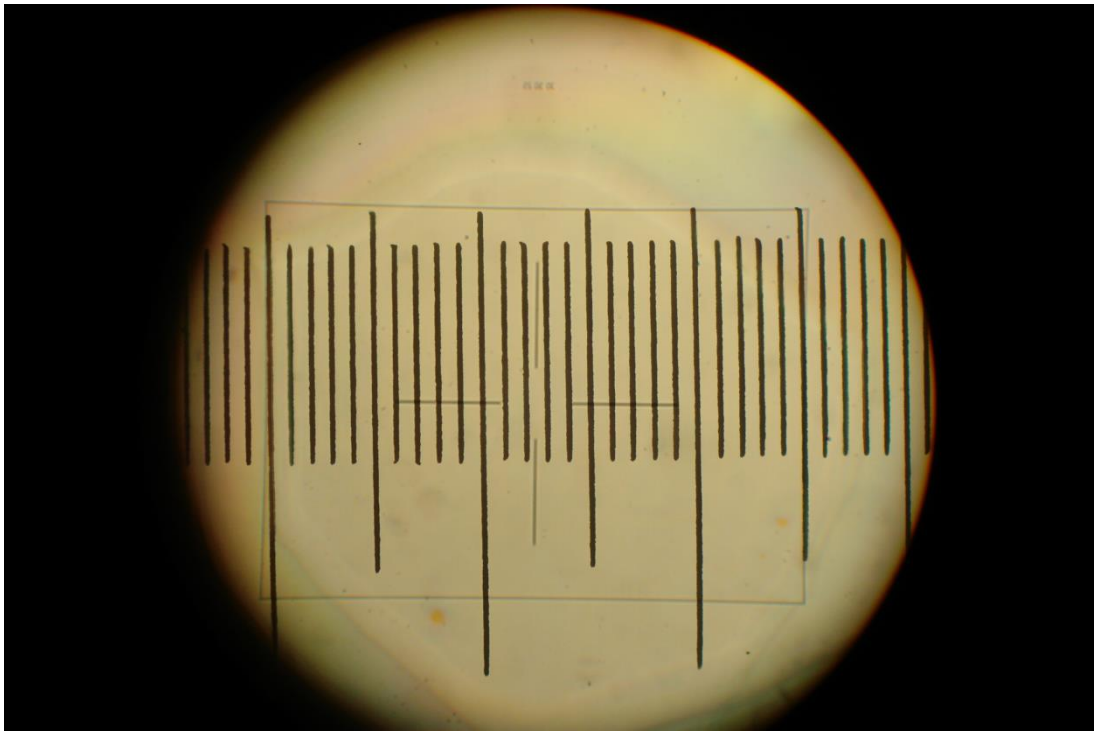
photography and its implications are not the subject of this article, and as I am more a tinkerer than a microscopist, I actually have little experience in practical photomicrography.

Finally my C-mount adapter (Fig. 14) and a colour video camera (Fig.15) attached to the Phomi. This would be a fine set-up for demonstrations (my monitor and U-matic videorecorder have hardly been used!), but moving pictures can, of course, also be taken with the movie-mode of the digital camera. The C-mount adapter brings the sensor of the video camera into the intermediate image plane 10mm below standard tube rim.

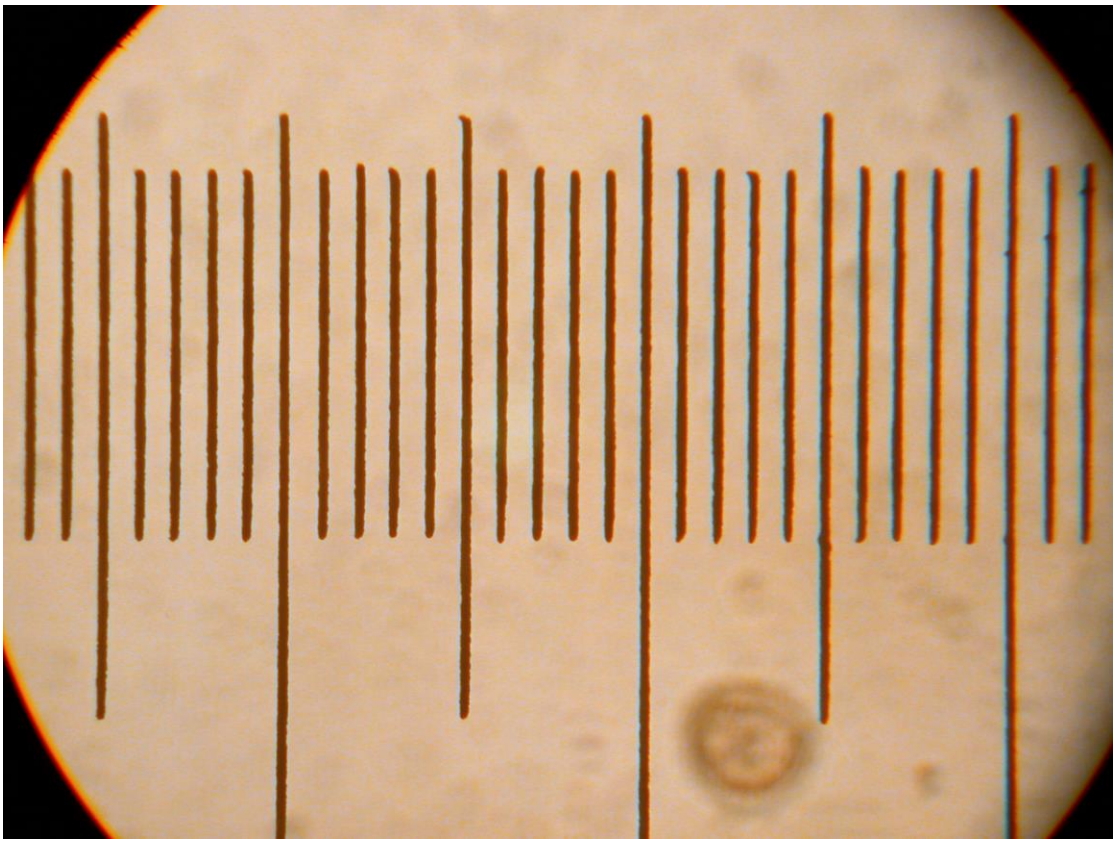

Fig. 14

Fig. 15

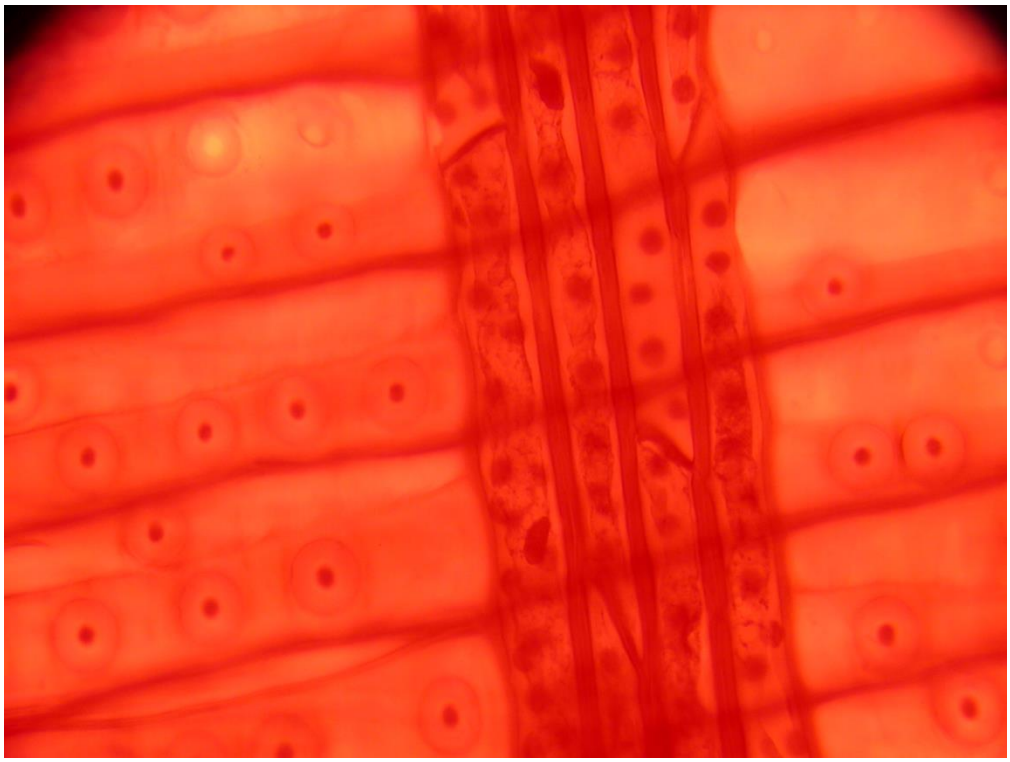
Lastly, I present a number of test pictures taken with the equipment described.



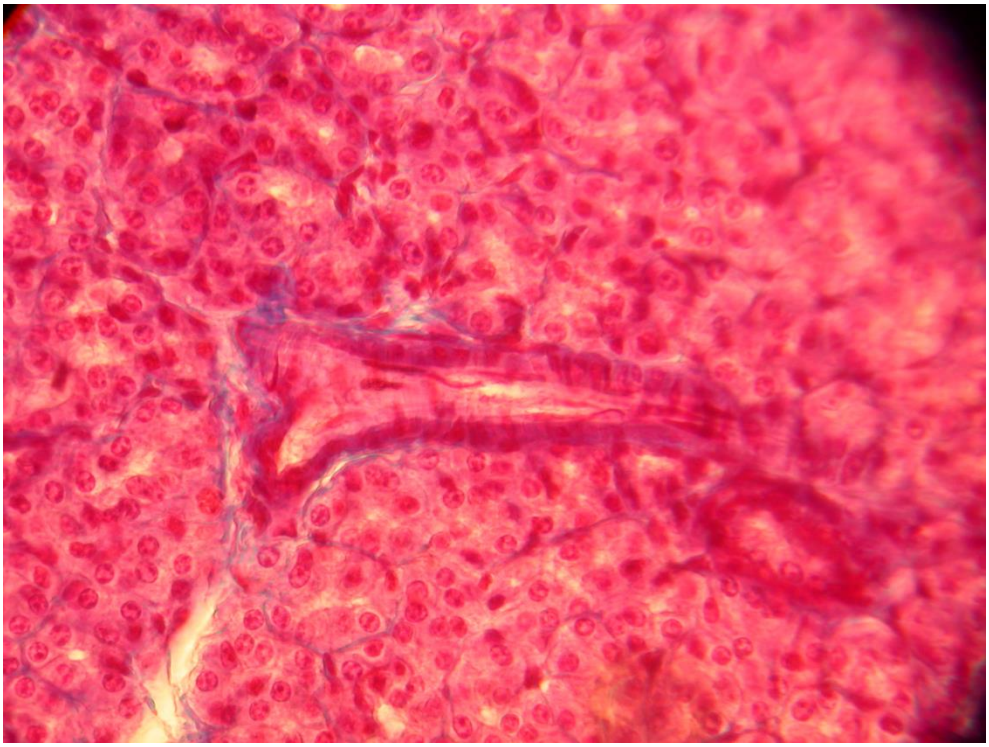
Micrometer seen through the eyepiece (frame width 0.25mm)



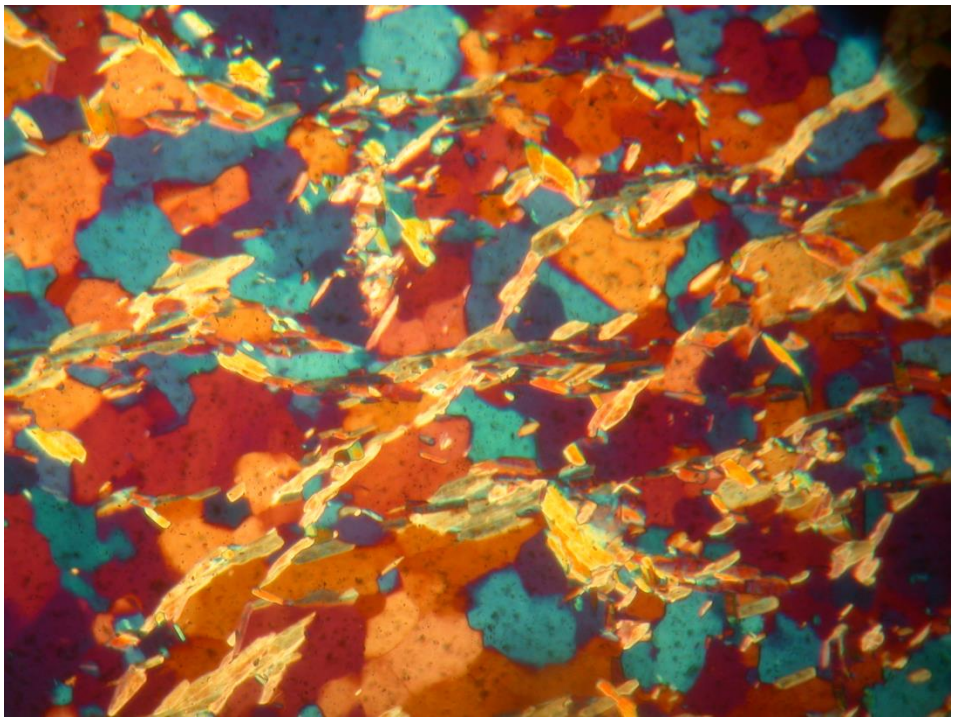
Taken by Coolpix with white balance (spot is dirt on field stop) Zeiss Planachromat 40/0.65, chromatic aberration on right probably due to some decentration in the light path. I have not figured out the cause.



Label on specimen said: Vascular System, Tracheids, Ceder (Plan 40x)



Histological Section (?) (Plan 40x)



Quartzit, crossed polarizers, red I, Plan 40x

Unidentified_diatom, phase-contrast, green filter, Achr. 40x Ph

Fritz Schulze
Vineland, ON, Canada
glenelly AT sympatico DOT ca

Published in the April 2018 issue of *Micscape* magazine

www.micscape.org