Cyclops Rises From The Ashes!

Tom Woods

Fig. 1. Cyclops using a microscope. Figure generated by A.I. (Artificial Intelligence)

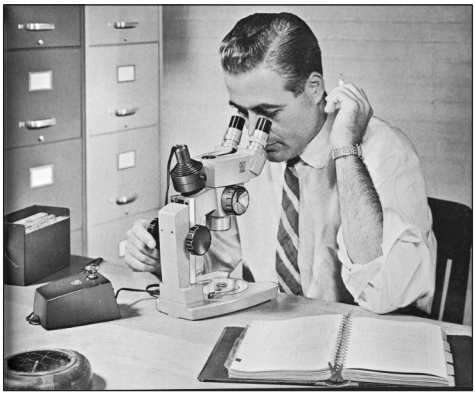

Fig. 2. Cigarette-smoking microscopist with Cycloptic microscope, 1956 Catalog photo

Well, not really (Fig. 1). The Cycloptic microscope, hopefully! The American Optical Company (AO/Spencer) Cycloptic dissecting microscope (Fig. 2), manufactured from 1956 through 1988 (a remarkable 33-year production history), has been extensively described (see, for example, the excellent review by Kreindler [1]). The microscope derives its model name, "Cycloptic," from the appearance of its large apochromatic "Common Main Objective," or CMO (Fig. 3), residing immediately above the stage and below the eyepieces and prism housings.

The Cycloptic microscope was, and still is, a fabulous and user-friendly microscope, with thousands in worldwide use

Fig. 3. Cycloptic microscope tilted to show the apochromatic common main objective

Fig. 4. Inside the head of an older Spencer stereomicroscope with prisms secured with brass brackets

Fig. 5. Photo from 1963 Cycloptic catalog. The bond between the prism and backing plate is claimed to be permanent

in laboratories, industrial settings, schools, and homes. I suspect it is also true that hundreds, if not thousands of these microscopes ignominiously ended their working careers in trash bins, because of the dreaded "loose prisms" problem.

Prior to the introduction of the Cycloptic microscope in the mid-1950's, the American Optical Company and its predecessor, the Spencer Lens Company, manufactured extremely robust dissecting microscopes with prisms locked in place with metal (usually brass) brackets (Fig. 4). Absent a catastrophic fall to the floor or other disaster, the prisms of these earlier microscopes were extremely resistant to any abuse which might interfere with optical alignment. With its introduction in 1956, I suspect as a cost-savings measure, the prisms of the Cycloptic microscopes were simply

Fig. 6. Cycloptic prism housing bolt and wrench

glued to metal backing plates using an adhesive (Fig. 5). Unfortunately, despite catalog marketing claims, the "permanent bonding agent" between the glass prisms and the metal backing plates becomes embrittled and weakened over time, with the result that the prisms may be knocked out of alignment (resulting in a double image), or simply fall off the backing plates if the microscope is bumped or jolted. This results, of course, in a useless microscope relegated to a storage closet or to the trash.

In this paper I describe a relatively simple procedure for repairing and restoring Cycloptic microscopes with "loose prisms." Although the procedures I describe are specific to the Cycloptic microscope, the principles involved are universal and may be adapted for use in restoring other types of microscopes with damaged optical systems.

Procedure: - Disassembly

The left and right hand prism housings of the Cycloptic microscope are held in place with a single, heavy duty bolt (Fig. 6). American Optical (AO) manufactured a special wrench, with two metal protuberances, to engage matching indentations in the bolt head. Absent the special wrench, it is relatively easy to fabricate a working substitute. Once the bolt is removed and the prism housings separated, it is necessary to remove four machine screws securing the backing plates (Fig. 7).

With the prism housing opened, the backing plate and associated prism are removed. Fig. 8 shows an intact prism/backing plate assembly. In the case of a damaged microscope with "loose" prisms, the prism will be found roaming free in the housing.

Fig. 7. Prism housing showing unopened backing plate secured with 4 screws

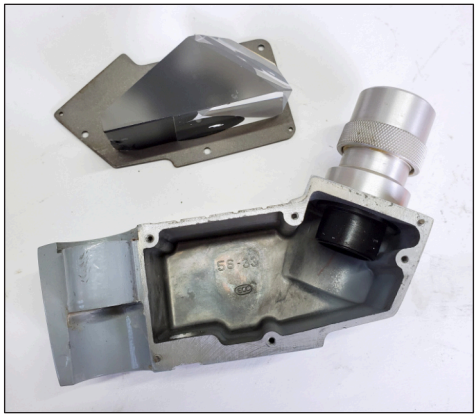

Fig. 8. Prism housing opened to show prism glued to backing plate

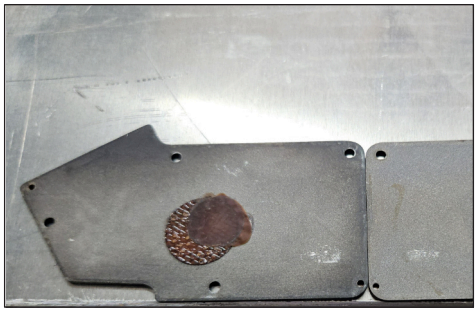

Fig. 9. Backing plates with residual adhesive attached

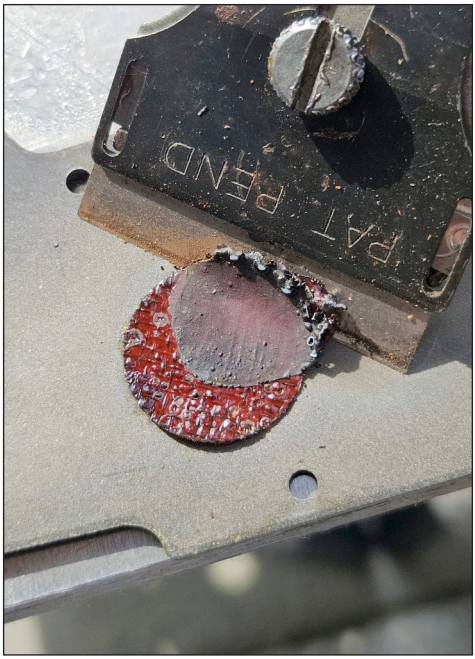

Fig. 10. Removal of old adhesive from backing plate with razor blade scraper

Remediation

Old adhesive must be removed from both the glass prisms and the backing plates (Fig. 9). I have found that a propane torch or hot air gun makes removal of the adhesive rapid and easy. Residual adhesive is easily cleaned up with a razor blade scraper (Fig. 10, 11). A final touch-up with a wire wheel removes any remaining traces of adhesive from the backing plate (Fig. 12.). Prior to regluing of the prisms and backing plates, it is advisable to clean mating surfaces with a solvent such as xylene (xylol).

One of the eyepiece tubes (usually the right-hand tube) must be disassembled and removed from its prism housing, to allow for precise optical alignment during reassembly at a later stage of the process. The left-hand eyepiece tube is left assembled and untouched. Each eyepiece tube consists of two parts (Fig. 13), lower and upper (inside and outside the prism housing), which are firmly set

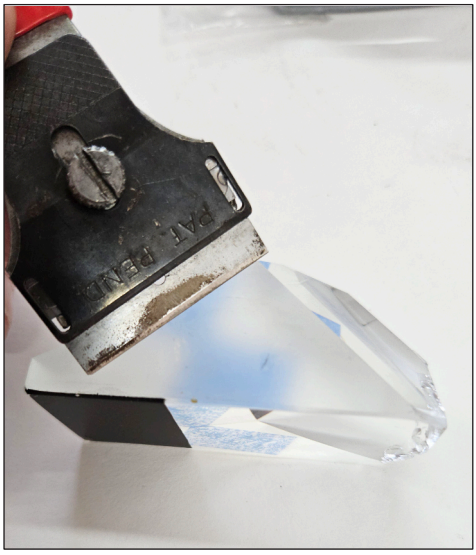

Fig. 11. Removal of trace adhesive from prism

Fig. 12. Removal of trace adhesive with a wire wheel

in place with low melting point solder. To disassemble the eyepiece tube and remove the solder, I use a heat gun (Fig. 14). Once the solder is melted (this becomes obvious as the melted solder will seep from the tube base), the eyepiece tube can be easily disassembled. All traces of solder are removed using a combination of heat and a brass bristle brush. A final cleanup is accomplished with a solvent such as xylene.

The original prisms can usually be reused if not too badly damaged. Any glass chips found in the housings should be removed with compressed air or a cleaning rag. With the prisms removed, this is a good time to clean the two lens assemblies, upper and lower, in each prism housing. One lens assembly is located within the lower half of the eyepiece tube (this is called the "amplifier lens"), and the second assembly is located at the bottom of the head and is called the "binocular body doublet."

Reassembly

I use home-made wooden right-angle jigs, left-hand and right-hand, to ensure the re-glued prisms are in proper alignment with the backing plates (Figs. 15, 16). I fabricated these jigs after dismantling a non-damaged Cycloptic microscope and studying the alignment of the prisms to the backing plates. I am happy to share information on the construction of these jigs with anyone interested; please contact me at the email address shown at the end of this article. I use an industrial strength adhesive called E6000, and can make precise applications using a 5 ml Luer Lock syringe with a blunt needle tip (Figs. 17, 18). A small amount of adhesive is all that is required. The assemblies are allowed to set up overnight.

With the prisms glued firmly in place on their respective backing plates, it is time to reassemble the microscope and make a final alignment of the optical system.

Fig. 13. Two part eyepiece tube after removal of solder and cleanup

Fig. 14. Using a heat gun to melt the eyepiece tube solder

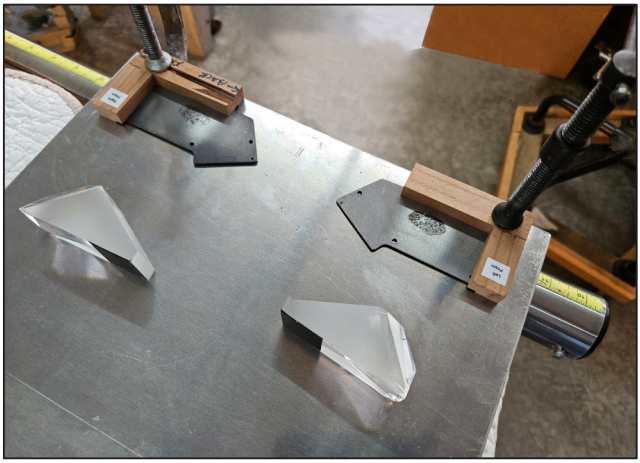

Fig. 15. Jigs prisms and backing plates used for precise alignment during glue up

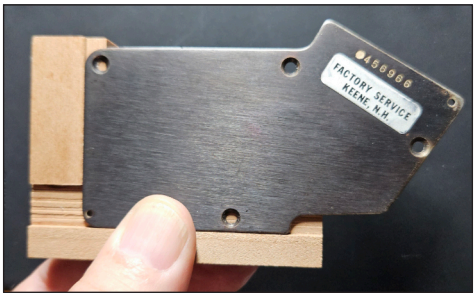

Fig. 16. Close up of jig and backing plate

Fig. 17. Adhesive and applicator syringe

Using the same E6000 adhesive and the applicator syringe, I position the bottom half of the eyepiece tube in the prism housing. The bottom half of the eyepiece tube fits loosely in the housing, creating a "well" with plenty of room to apply E6000 adhesive. The "well" is filled to nearly overflowing with adhesive, and finally the top half of the eyepiece tube is screwed on, finger tight only, to complete the eyepiece tube assembly. Any adhesive squeeze-out is easily cleaned up with acetone. Since it takes several hours for the adhesive to set up, there is ample time to complete the assembly of the microscope and make the final optical adjustment.

The final stages of assembly involve attaching the backing plates with their adhered prisms to the prism housings, and reassembling the housings on the microscope using the securing bolt.

Alignment

After installing a pair of standard microscope eyepieces (typically 10X), the microscope can be tested for optical alignment. Invariably, there will be some misalignment (hopefully slight!), but this can be corrected as follows. The standard eyepieces are removed, and a special eyepiece with a cross-hair reticle installed in the left-hand eyepiece tube (the tube which has not been disassembled). A special alignment microscope slide with a cross-hair is placed on the stage (if this is not available, any microscope slide will do with a "dot" inked in the middle of the slide). The microscope is then focused, aligning

the cross-hairs of both the eyepiece reticle and microscope slide. The slide is taped in place on the stage to prevent further movement. The cross-hair reticle eyepiece is removed from the LH eyepiece tube and placed in the RH tube. Since the adhesive in the RH eyepiece tube has not yet had time to "set up," it is possible to move the entire tube by applying firm pressure with the fingers. The tube is moved slightly but gently, up-down or left-right, in order to again bring the cross-hair reticle of the eyepiece in alignment with the cross hair engraved on the slide. Once this has been accomplished, the standard eyepieces are reinstalled, and the resulting image should be bright, clear, and aligned. Once the adhesive has set up (allow 24 hours), the optical alignment should be permanent.

Conclusion

Many damaged Cycloptic microscopes with "loose prisms" have been that way for years, having been put aside into storage, yet somehow lucky enough to have avoided being tossed into the trash. During transport and storage, the loose prisms rattle around inside and can suffer damage, usually to the prism edges. Damage is usually slight, as the prisms are one-piece and quite robust. Even slightly damaged prisms can be reused with hardly any degradation of the image during restoration.

The procedures described involve using solvents such as xylene (xylol) and acetone. These organic and volatile solvents should be handled with care and used only with good ventilation, as the vapors can be toxic. Disassembly of the eyepiece tubes involves using high heat, either from a propane torch or a heat gun. Wear good quality gloves to protect the hands and fingers. Of course, it is always advisable to wear eye protection during any of the procedures involving solvents and/or heat.

This paper has discussed remediation of the most common problem affecting the older Cycloptic microscopes, the so-called "loose prisms" problem, but there are of course other afflictions to which the Cycloptic microscopes (and other microscopes!) are susceptible. These include older lubricants which seem to turn to glue with age, often causing broken focusing knobs or difficulty in changing magnification levels. Anyone wishing tips on how to address these problems should feel free to contact me at the email address below.

It is my hope that this article may help others restore their Cycloptic microscopes to good use.

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Reference

1. Kreindler, R. J. 2013. The Cycloptic. AO (American Optical) CMO Stereomicroscope. Micscape, April 2013, 37 pp. https://tinyurl.com/zsd22vpb

Fig. 18. Applying adhesive to prisms and backing plates