

DRAFT, 07/02/11

RESTORING A LARGE ANTIQUE REFRACTOR by Claire M. Stencil

Nineteenth century observatories and their telescopes are fading away, but some thrive. In the middle of Observatory Park in south Denver, nestled between the tennis courts, soccer field, and children's playground, sits the University of Denver's historic Chamberlin Observatory. Completed in 1894, the observatory is designated a Denver City Landmark and is listed on the National Register of Historic Places. For more than a century, it has offered generations of students and starry-eyed visitors the chance to peer at the wonders of the heavens through its 20-inch aperture, f/15 refractor, with optics by Alvan Clark and Sons, and mechanicals by George N. Saegmuller. The observatory still hosts University of Denver classes and open house nights for the public.



The observatory building itself was most recently renovated in 1997 and again during 2008, by the University of Denver with the support of an Historic Colorado Trust Fund grant. However, more than a hundred years of continuous use have taken a toll on the telescope. The last time any recorded major maintenance had been done on the telescope was in 1917 by then-Director Herbert Howe, installing a Relativity Camera in preparation for the 1918 solar Eclipse. Recent problems with the aging telescope indicated to current Director Robert Stencil that it was time for a tune-up.

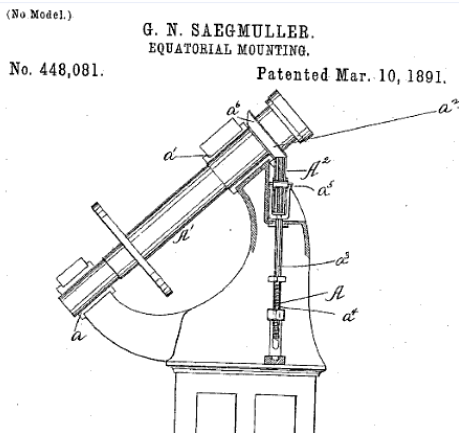
As one might guess, cleaning and repairing a 26-foot long telescope that rises up to 26 feet off the floor is not a one-person job. Stencil called on Fred Orthlieb, a recently retired professor of Mechanical Engineering at Swarthmore College and an Antique Telescope Society enthusiast, who had previously visited Chamberlin to review the condition of this antique refractor.

“Because the telescope has been showing signs of wear and because we are fortunate to have ATS experts like Fred Orthlieb and Chris Ray [who had previously helped remove, clean and reinstall the telescope lenses] available to restore this fine instrument, I seized the opportunity to get this done, in the hopes the telescope can be sustained for decades to come,” said Stencel.

Orthlieb and Stencel, along with Aaron Reid and Doug Spencer, began the project on May 16th, 2011. After erecting scaffolding and safekeeping the precious optics, the difficult first step of getting the Polar Axle vertical-support six-roller stack assembly (patented by Saegmuller in 1891) out of its niche in the mount was completed without incident. This six-roller stack assembly is a unique design element in telescopes designed by Saegmuller, in place of the ball bearings or friction surfaces used by most telescopes. The crew was disappointed to find, however, that two bronze collars that were supposed to keep the disks together had failed, causing two of the larger discs to wobble. This wobbling interfered with the workings of the telescope by causing variation on the clock drive rate. The worn out bronze collars were replaced with thicker, stronger steel collars.



Fred Orthlieb works on part of Chamberlin Observatory’s Saegmuller telescope. Photo by R.Stencel.



Saegmuller's patented equatorial mounting used a unique way to support the polar axis – instead of just bearings, he added a roller assembly that contacts a conical bearing. Because the roller wheels are multiple, they can slide relative to each other and accommodate the polar axle rotation. In our case, years of neglect had allowed the axle of the wheels to become worn and cause wobbling, affecting the clock drive motion.



Doug Spencer stands on scaffolding surrounding the Saegmuller telescope at Chamberlin Observatory.

The majority of the issues addressed during the process were misalignments or wear, both of which were expected due to the age of the telescope. Some of the pieces that were misaligned included the RA tracking worm pinion with its large mating worm wheel, and the paired universal joints in the driveshaft connecting the clock drive with the tracking wormbox. Additionally, the clock drive output miter gear shaft journal showed signs of excessive wear due to insufficient or incorrect lubrication. The crew also discovered a large accumulation of grease in a slot at the middle of the upper shell of the lower bearing, as well as inadequate lubrication at the bottom of the shell, indicating the bearing had been functioning without proper lubrication for years.

One surprise the crew came across during the repair process was a hand-painted marking on the underside of the upper polar axle-bearing cap, which read “Carderock Maryland.” For more than 100 years, the Carderock area has been home to a U.S. Navy center for research and development, test and evaluation, engineering, and Fleet support organization for the Navy's ships, submarines, military watercraft and unmanned vehicles.

Said Orthlieb, “Because Saegmuller designed and probably built, in the sense of providing contract drawings, supervision and funds to whoever actually produced the parts, at least two and possibly three telescope mounts for the nearby Naval Observatory in DC, it's likely that whoever produced that bearing cap took the opportunity to give themselves a future boost as makers of the Chamberlin mount. As it turned out, it was a long time before anyone else saw their ad.”

Other work on the telescope included modifying the coaxial cable conduit at the centerline of the Polar Axle, including its mechanical and electrical connections. Additionally, work was done on the original mechanical clock drive, which included lubrication and mechanical maintenance of the existing motorized tracking drive.

The project was completed on Flag Day, June 14. For Stencel, Orthlieb, Reid and Spencer, being the first people to see inside the telescope since the days of Howe and Saegmuller as far back as 1917 was a look back into history.

“It was very interesting to see which parts had worked well and which had failed over the past century, and to devise improved replacements for the failed bits that would survive and be more effective in the future.” Said Orthlieb. “Having the opportunity to second-guess very talented engineering designers, and to improve on their work without doing violence to their concepts, is always a lot of fun.”

Now the reinvigorated Saegmuller telescope sits inside the dome of Chamberlin Observatory in Denver’s Observatory Park, ready to provide a look at the stars for another century to come.

Available appendices:

Repair chronology, optics, Sept. 2010

Repair chronology, mechanical, May 2011

Author byline.

Additional available types of images:

Chris Ray examines the Chamberlin Observatory Clark lenses during restoration in September 2010. Second image shows the Crown lens drying on rack after washing.



The vertical support six-roller stack assembly, patented in 1891 by Saegmuller, is reinstalled into the telescope.
Photos by R.Stencel.

