FRA29 12-ft. Dollond Refracting Telescope, c. 1761-66: Restoration/Adaptations. [Including the design and fabrication by the author of a custom trapeze-type brass mount supported by a 12-ft tall pole-and-rope system, c. 2013.]

Issue:

The Dollond was received as a 2-piece telescope tube complete with its optics. The mount and "tripod" were both missing. However, the presence of original hardware for mounting an eyepiece stabilizer staff strongly suggested that originally the telescope was pole-mounted. This is also consistent with the three mounting bolts with three knurled nuts on the upper member of the 2-piece tapered mahogany telescope tube assembly which revealed no mounting marks. Alternatively, it could have been used in a zenith mount configuration, but as just mentioned the stabilizer compass fitting at the eyepiece suggests strongly that the telescope was designed to be pole mounted.

Approach:

There is little detailed design guidance in the literature for rope-and-pole mounted telescopes. Seventeenth and early 18th century drawings rarely show the details of how the telescope was mounted. Often the telescope is not tethered to the pole and the supporting sling or mount for the telescope is only sketched roughly. The pulley at the top is equally poorly documented, as is the rope strung over the top of the pulley. However some guidance was found from an illustration attributed to P. Chérubin d'Orleans, which shows in some detail the tether slot, counter weights and a two-pulley arrangement at the top of the pole*. Using construction techniques that were readily available to 17th century telescope makers, I ventured forth to design and construct a 12-ft. tall rope-and-pole mount. The design is simple yet sturdy and is a straight forward to make this 12-ft. Dollond telescope again functional in a manner befitting its uniqueness. I have made a plausible construct similar, I hope, to some the original mountings for 12-ft. long refracting telescopes made in the 1760s. The key issues are stability, rotation, tilting, verticality and safety. At first, this last issue might seem unimportant, but depending on the telescope's position there is either a valuable important telescope hanging 11 ft. in the air or there is a 30-lb. brass counterweight hanging 11 feet in the air - either way there is a potential aerial bomb for everything below should construction fail. Secondary issues are ease of use and ascetics. I believe the final result meets all key and secondary issues. I did venture away from Chérubin's design of using a round pole and a collar with a guiding pin keepered in a slot for tethering, instead I used a square beam and a keepered washer on the end of the pivot rod which ran in a flat track the length of the upper 6-ft. section of the pole mount. In addition, I added complete 360 azimuthal viewing while Chérubin was limited to an estimated 15-20 degrees. And, a third departure from Chéribun's design was a single 8-inch diameter pulley at the top of the pole instead of his use of 2 smaller diameter pulleys to span the diameter of his pole. In Version 1 used a small 5/64" diameter brass cable (simplicity and strength) and circular cutouts in the trapeze mount, however, I later discovered that wire cable was not used before about 1830 and that round cutouts for weight reduction without loss of strength came later also. Therefore, in Version 2, I modified the system to utilize a 3/8" diameter manila rope and illustrate how to expand the circular holes into trapezoidal cutouts in the rigid brass trapeze mount if it is later deemed important for period authenticity. The modification to rope dramatically improved the period representation of the restoration of this important telescope. There was no change in functionality and the telescope glides effortlessly up and down the 6-ft. length of the upper section with light assistance. Furthermore, the close coupling of the tether mechanism provides very stable viewing whereas the combined collar and guiding pin stacked on top of the pivot mount of the Cherubin design appears to be a much less stable mounting. My method of tethering in a channel slot is believed to be well within the knowledge/experience base and fabrication capability in the 1760s.

* Source: gallica.bnf.fr./Observatoire de Paris. [Grand oculaire dioptrique monte sur son appui pour y avoir ses mouvements et servir a l'observation des objets du ciel] [Cote: 47A],

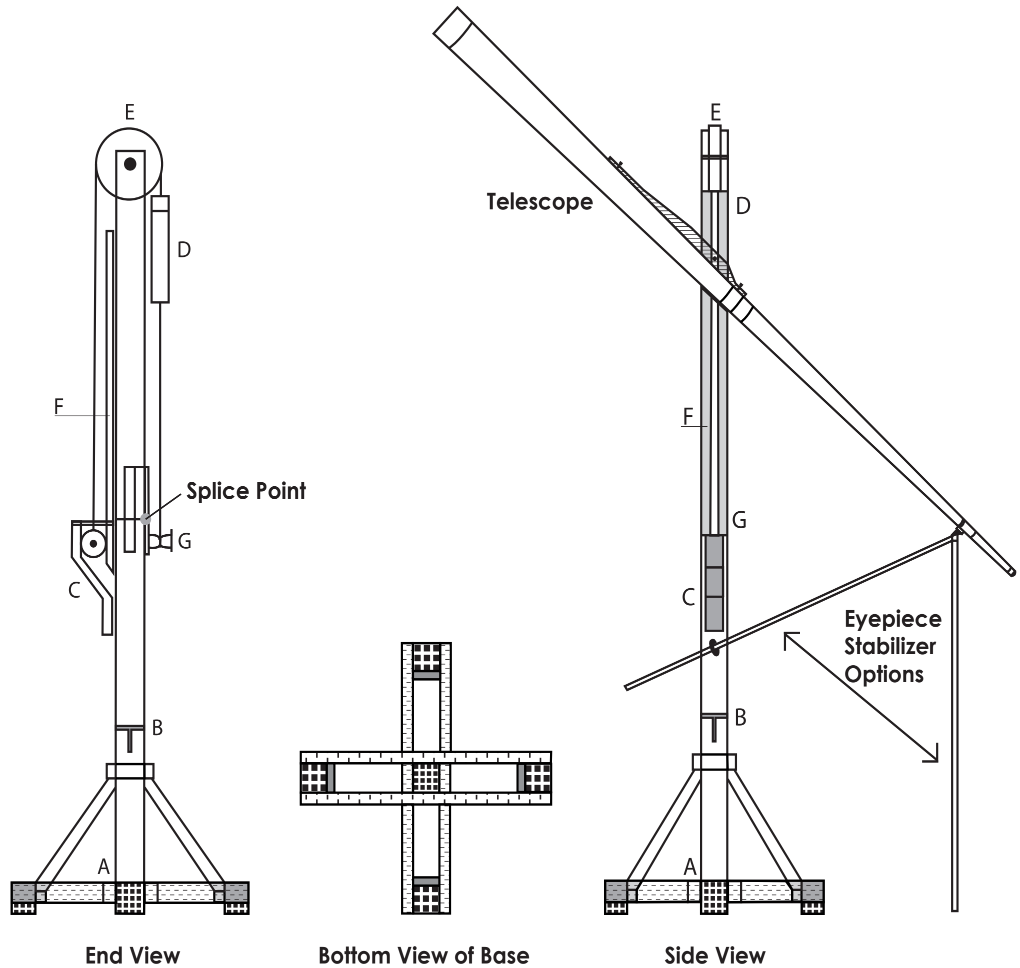
FRA29 Restoration/Adaptations

Rough cut mahogany   Dollond as received   owner

Version 1: Pole-and-cable mounted Dollond

Pole Mount for FRA29

12-foot long 2-piece tapered Mahogany Tube
Refracting Telescope by Dollond



(Scale 1 cm = 1 ft.)

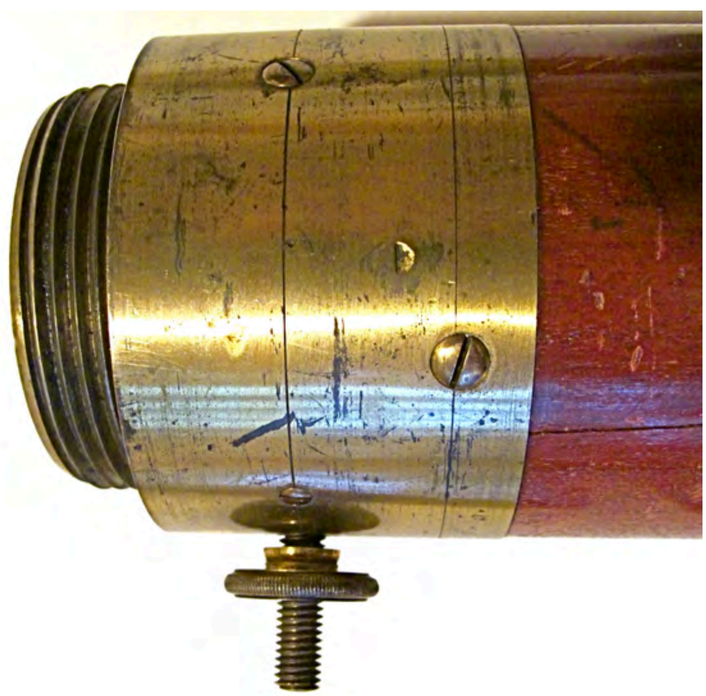
A = 3+ inch thick mahogany base and pole
B = Upper pole rotation point
C = Cradle for telescope and 6-foot high pivot mount
D = Brass counter weight
E = 8-inch diameter mahogany pulley
F = 3/16-inch thick flat brass keeper/slider
G = Tie point for tethered telescope

Design drawing for the pole mount.

Three mounting stud bolts on upper section of 2-piece tapered mahogany optical tube.
There are no marks on the mahogany to suggest the manner in which it was previously mounted.

FRA29 Restoration/Adaptations

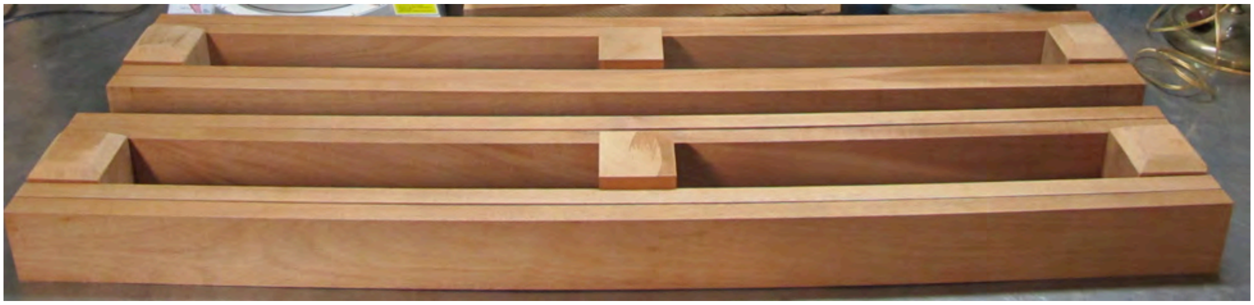
Note: original hardware for attaching a stabilizing staff near the eyepiece of this 12-ft. long telescope is located just forward (to the right) of the rack-and-pinion focus knob pointing down.



Coupler flange with one of the mounting lug bolts (all with knurled Dollond fastners) on the upper section of the 2-piece tapered mahogany optical tube.

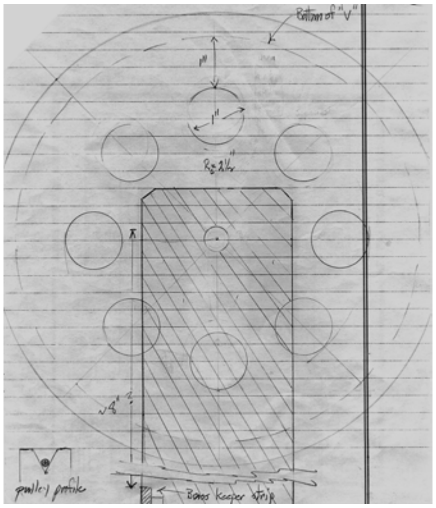
FRA29 Restoration/Adaptations

The two 7-ft x 3" x 3" mahogany beams will be used for the pole mount - a partially fabricated pulley lies on one of the beams. The round mahogany dowel will become the eyepiece stabilizer staff. The bundled mahogany boards below will be used for the stabilizing footers to the pole mount.

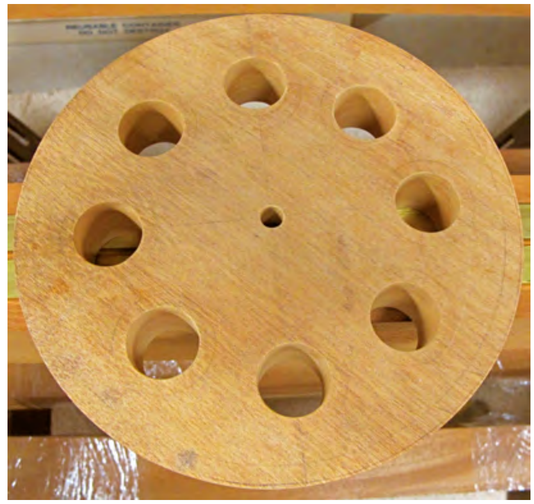


Rough cut mahogany base for pole mount.

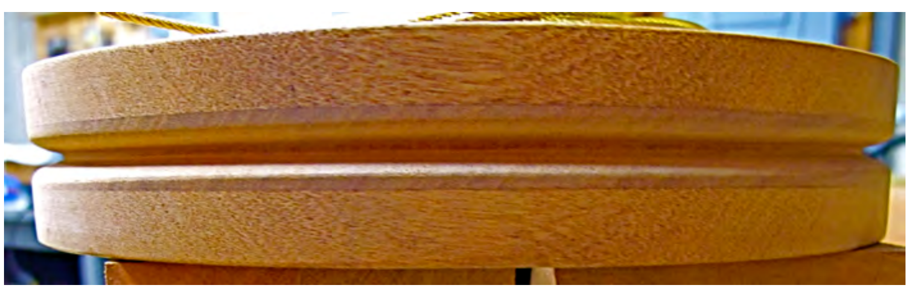
Close up of one of the foot pads (upside down).



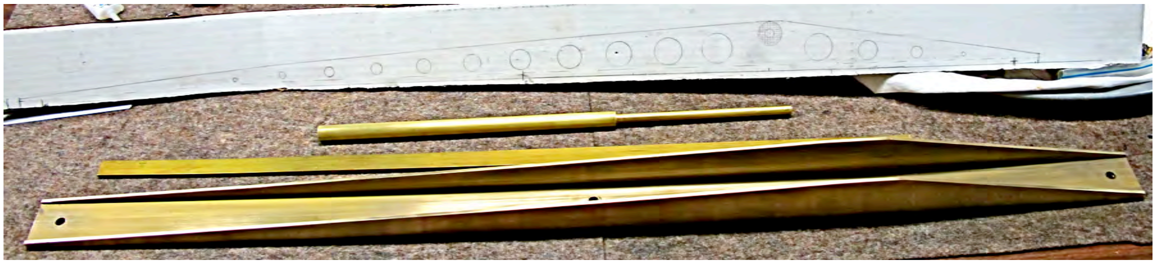
Rough design of pulley



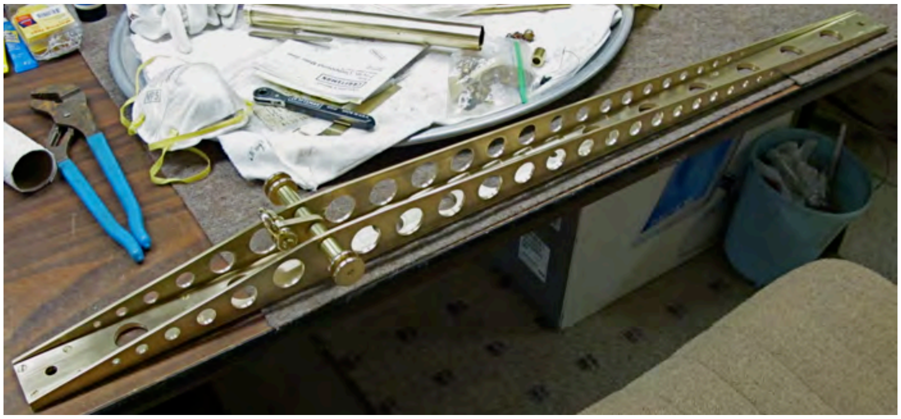
Rough cut pulley



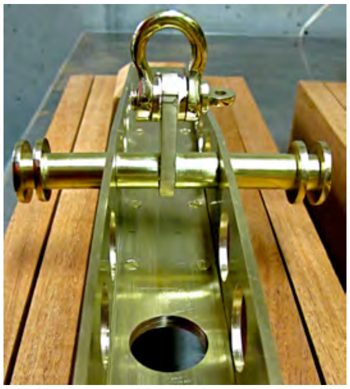
Pulley made from three (3) 12" x 12" x 3/4" squares boards that were glued and then shaped roughly with a band saw and smoothed using a router and a home-made jig keyed to the center hole; The eight 1 1/8" holes were bored on 45-degree radial lines used a Forstner drill bit in an antique drill press. Bottom photo shows the pulley milled out (grooved) for a 5/64-inch diameter brass cable (Version 1 design).



Channel brass "sling" for mounting the 12-foot telescope will use the three existing bolts and knurled fasteners on the upper tube of the telescope. Brass rod and heavy walled tube will become part of the support/securing mechanism connected to a counter-balance cable. The white board pattern of decreasing diameter circles (in the background) will become decorative holes drilled in the vertical sides of the channel - more important, they reduce the weight of the sling mount without much loss of strength. Note: The design can be changed later to transform the circular cutouts into trapezoidal cutouts - see last page of this section.



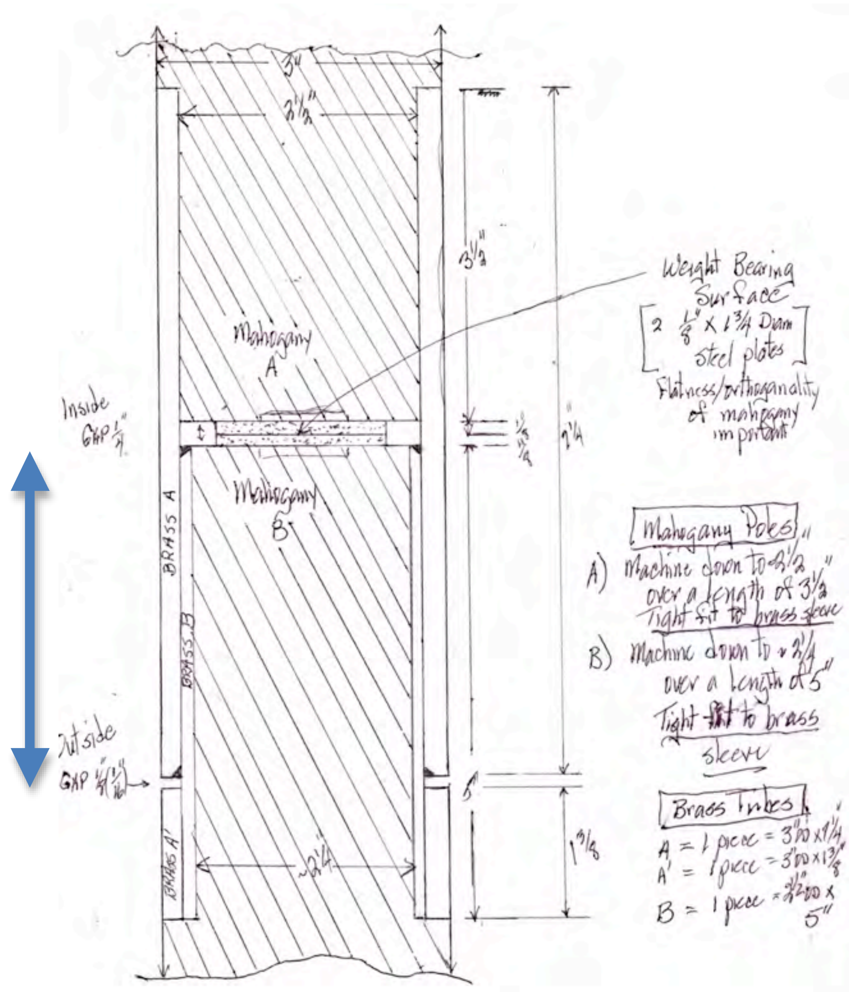
The brass clevis is located at the center of the rod in the tethered pivot mount mechanism. The rod supports the telescope while in the terrestrial viewing mode and the "washer set" closest in the photo tethers the telescope to the pole for celestial viewing as it is raised and lowered in the brass track. That is, the brass washer is keepered or trapped and slides captive within the track.



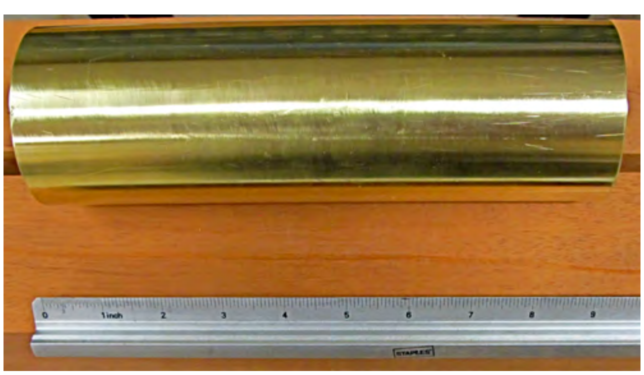
Detail of the brass clevis for attaching the 5/64-inch brass cable or a 3/8-inch braided manila rope to the trapeze mount; a 30-lb.counter-balance weight is connected at the other end and hangs on the backside of the pole.

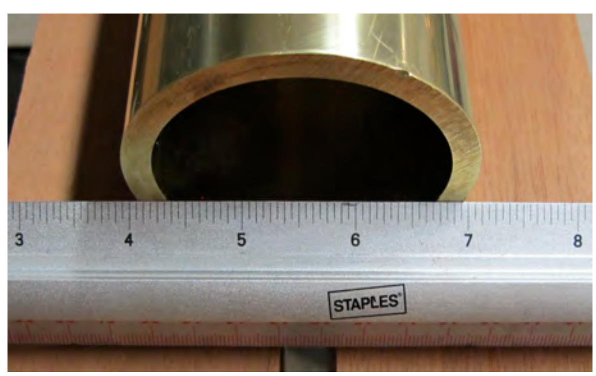
FRA29 Restoration/Adaptations

(Rotation coupler was designed for 360-degree azimuthally pointing and maximized co-axial rotation accuracy)



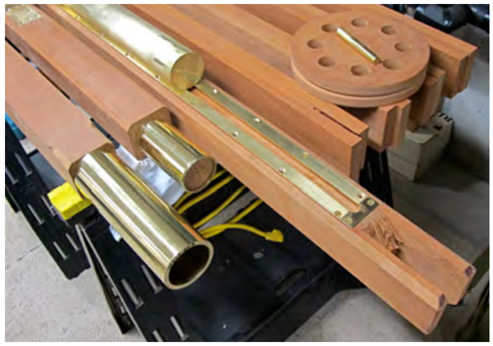
Blue arrow indicated the distance (3 1/2 inches; not to scale) over which the two rotatable cylinders walls are in contact to provide precise axial rotation of the two-piece pole. Any rotational angular error over this distance is magnified by ~ 31 times at the top end of the pole.



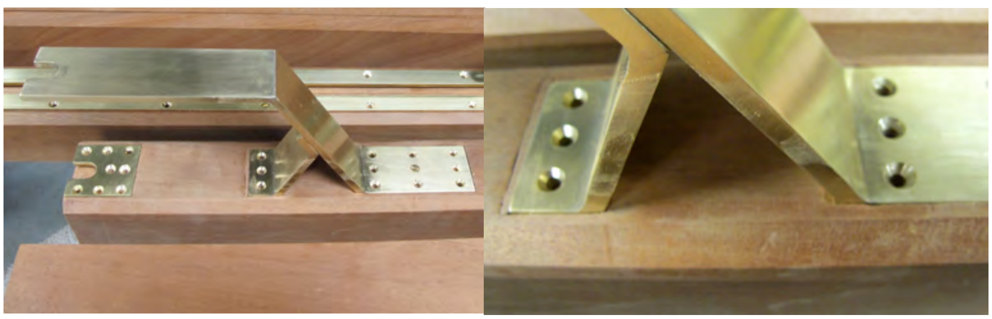


Outer (brass A) sleeve is 9 1/4" long x 3" OD x 0.25" wall thickness forms one component of the rotational couple.

FRA29 Restoration/Adaptations



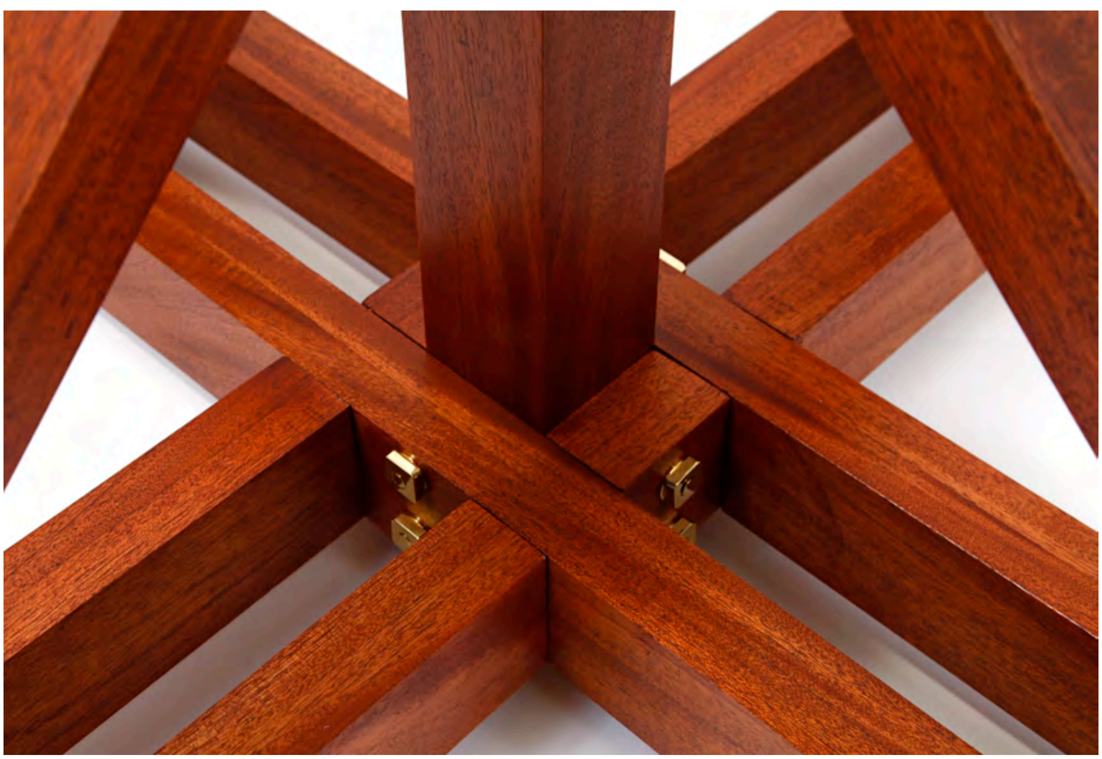
First two mahogany posts (lower left) show the rotation coupler that will provide the concentric rotation of the upper pole section. These brass cylinders are precisely size for the small one to slide inside the larger one to form the rotation coupler. The next post shows the lower end of the counter balance (30 lb.) lying on top of the recessed brass keeper track (3/16" x 3/4") that tethers the telescope to the pole. Note that the pulley slot is only rough-cut with material that will be removed in the bottom of the slot. Pulley and brass axle rod are shown lying (upper right) on the footer boards that will brace of the center pole.



Detail of recessed mounting bracket which holds the telescope in its lowest resting point (~ 5'10" off the ground). Brass is 1/4" x 2" 360 alloy, which does not bend well so the angles shown were all cut and welded. All of the brass shaping and finishing were done in the author/collector's shop by the author, except for the end cuts on the 2 1/2" diameter brass counter balance and the angle cuts on the "cradle" which were later welded (brazed) for me commercially.

Project status photo as of April 28, 2013.

FRA29 Restoration/Adaptations

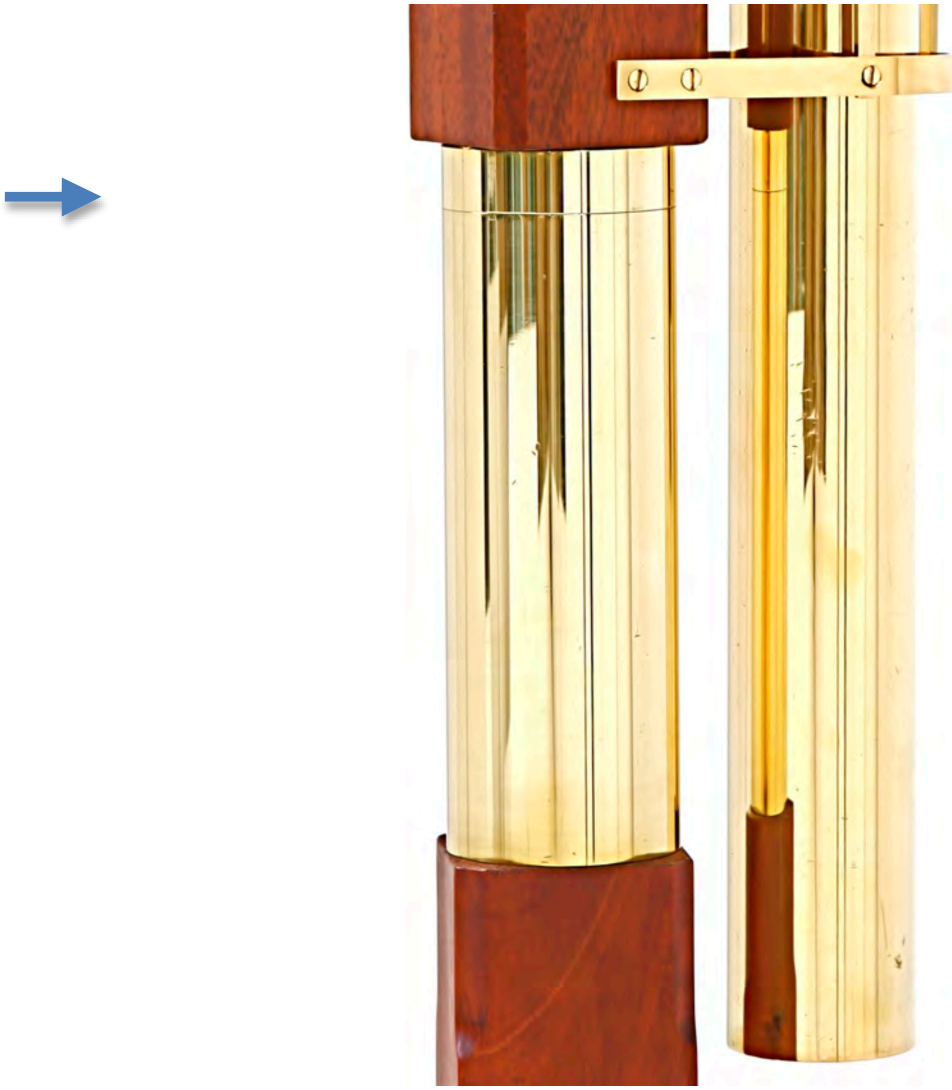


Base completed. Design provides the required strength and stability for the 12-foot pole-mounted 30-lb. telescope with its 30-lb. counter weight. The aged mahogany purchased in northern Pennsylvania once finished does indeed provide a beautiful base for the telescope. Note custom brass hardware.

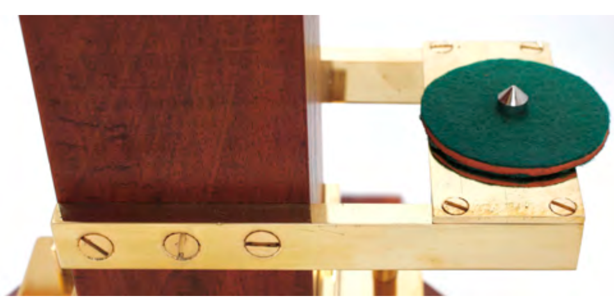
FRA29 Restoration/Adaptations

The design is based on compression stability: the four vertical stabilizer boards (at 45°) are first keepered and then compressed between the adjustable compression plates at the top. At the bottom four brass 90° angle plates (out of view) are bolted to the four mahogany feet (the bolt heads are visible pointing outward at each 'foot'). The compression plate bolts provide the stability independent of any future wood shrinkage and/or bolt-hole wear.

Four independent compression plates not only provide the stability, but also allow for the precise setting of the pole verticality. (See blue arrow) Tightening down on one side and loosening the other side tilts the pole in the direction of the plate that was loosened.



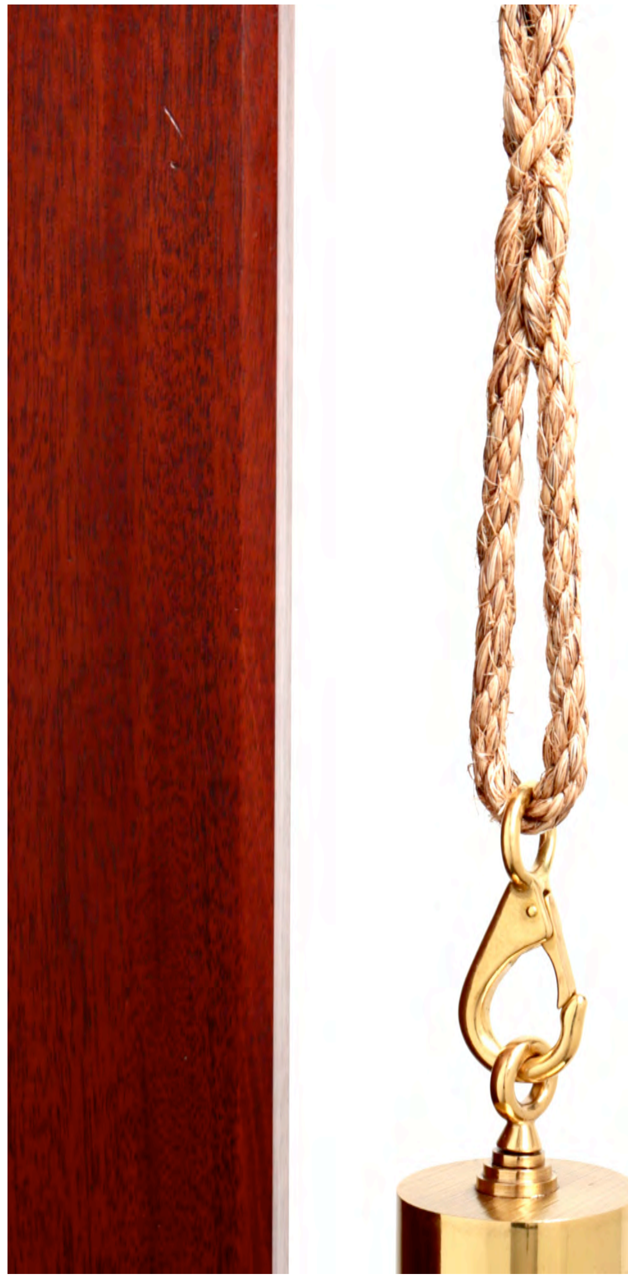
See blue arrow: fine line near top of larger cylinder reveals the point of 360-degree rotation. Brass counter weight on the right. The bottom bracket of the counter weight cage is just visible at top of photo.



Resting pad for 30-lb brass counter-weight when it is disconnected from the telescope.

FRA29 Restoration/Adaptations

Version 1: Brass cable



Version 2: Manila rope
Brass counter-weight cage not shown.

Several key design and construction details: The recessed tether channel, the cradle for holding the telescope in its loading and lowest level within the channel, the recessed heavy gauge brass angle (with its heavy duty square-head nuts) for joining the two 6-ft. sections of the pole, and the counterbalance brass cage (backside), as well as the mahogany keeper block mounted on the outer part of the cradle for securing the retrieval cable (shown) or rope to the counterbalance weight.

Version 1: Photo of "cradle" where the telescope is held in its lowest position - at the bottom of the tether channel. The retrieval cable (shown) or rope (not shown) is keepered in its taunt position, and is used to retrieve the 30-lb. counter-weight from its resting position on the backside of the pole (shown in a previous photo).

FRA29 Restoration/Adaptations

Version 1: Brass cable

Version 2: Manila Rope
Pulley milled to accept 3/8-inch rope.

At the top, 12 feet in the air, the 8-inch diameter pulley provides either cable or rope support for the telescope as it travels up and down the pole in its tethered track shown here.

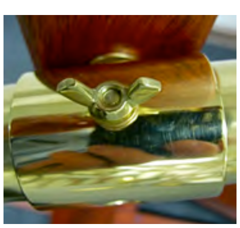
FRA29 Restoration/Adaptations

Telescope configured for both terrestrial and celestial viewing; the staff stabilizer is on the ground.
Project completed; functionality returned with beauty, style, stability, and functionality.

The circular cutouts in the brass trapeze mount can be modified to provide a cascading trapezoid design (shown above) if in the future it is deemed more period appropriate.

FRA29 configured for viewing with the eyepiece staff stabilizer attached to the center pole mount rather than standing firmly on the ground as shown on the facing page. An offset mounting block was used to provide clearance for the staff stabilizer, as the telescope is rotated 360° about its base. This block also extends the mounting point for the staff stabilizer as low as possible and hence provides greater viewing stability.

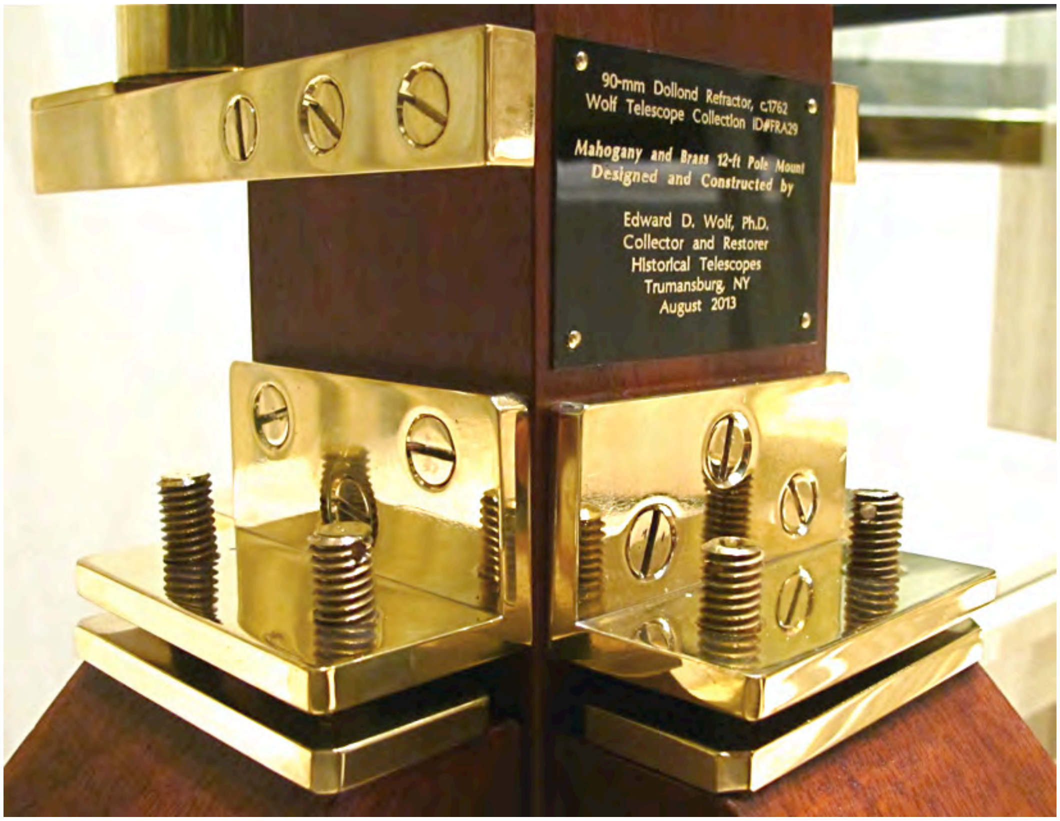
Extended view of the staff stabilizer



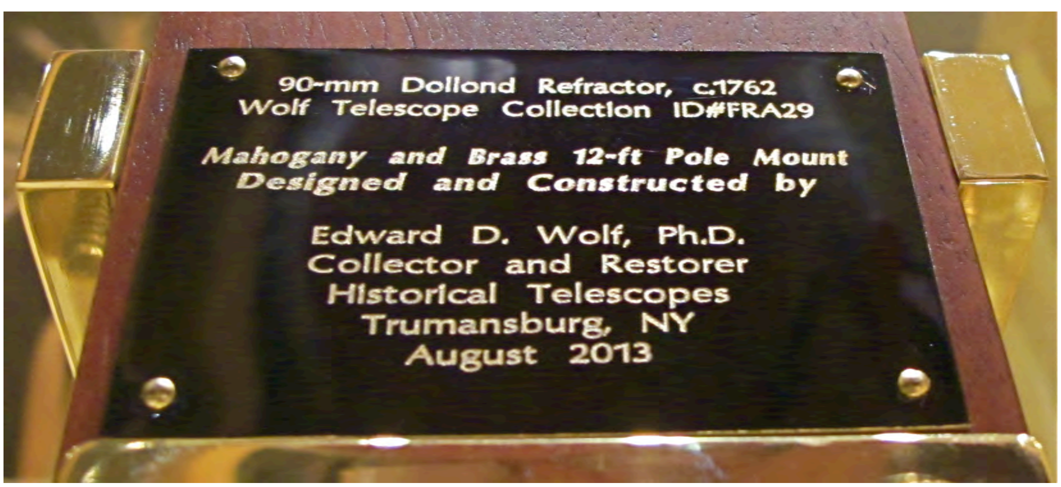
Attachment at pole

Staff extender with tightener

Attachment at eyepiece



Compression plates for strength, stability and adjusting verticality. Just above the plates is the bracket for holding the 30-lb. counter-weight, which is just visible in the extreme upper left of the photo.



Maker's Plaque