Sunspots with Ancient Telescopes

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Antique Telescope Society

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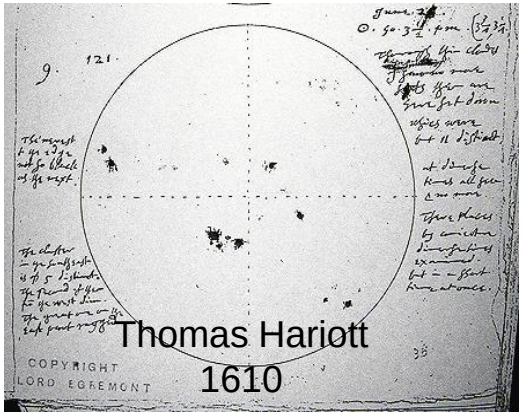
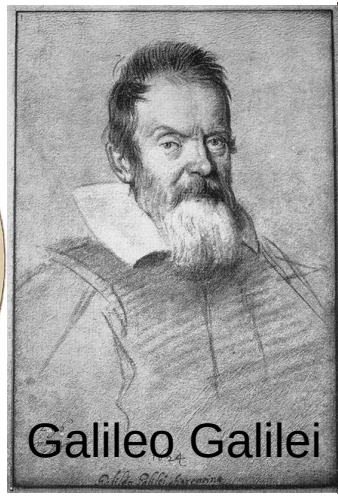
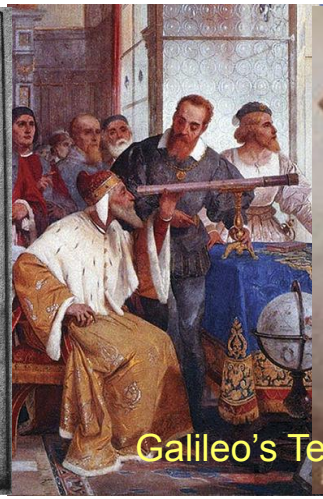
SPD Meeting, Boulder, May 2016

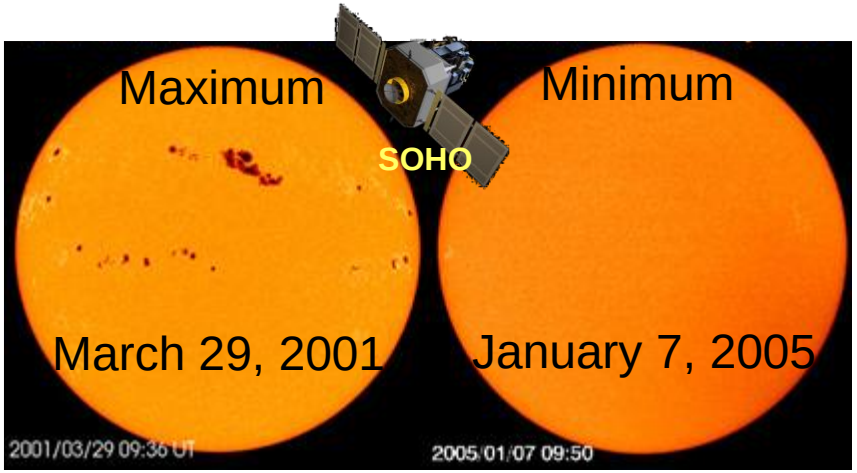
Centuries of Sunspot Observing

We have observed sunspots with telescopes for 400 years

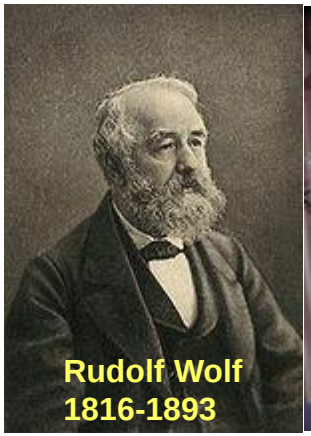








Sunspots observed by Spacecraft

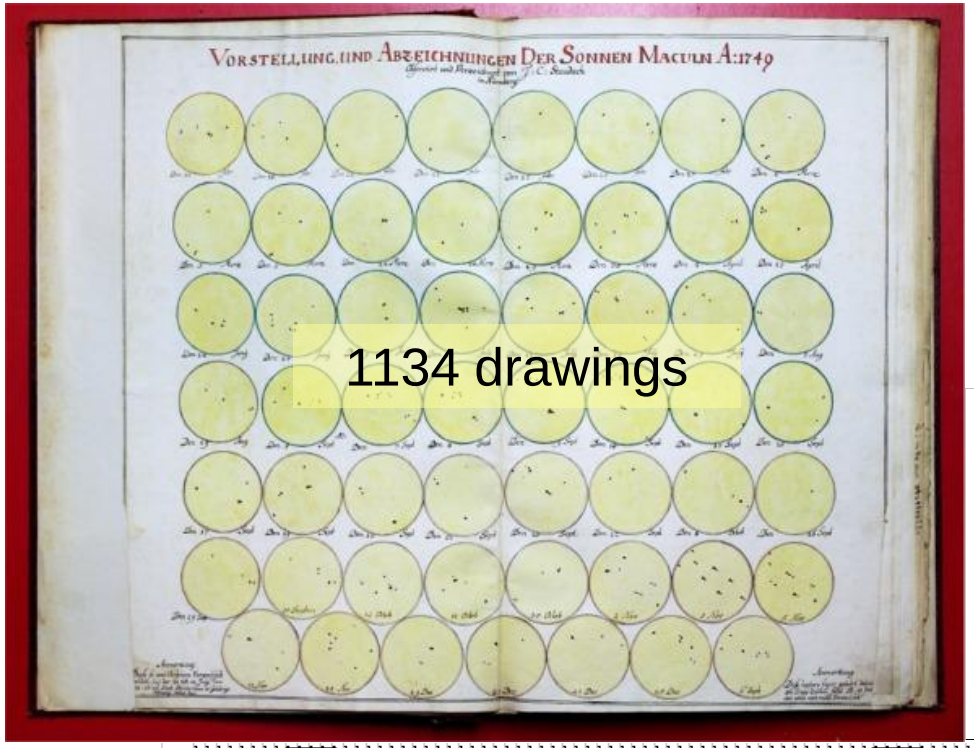


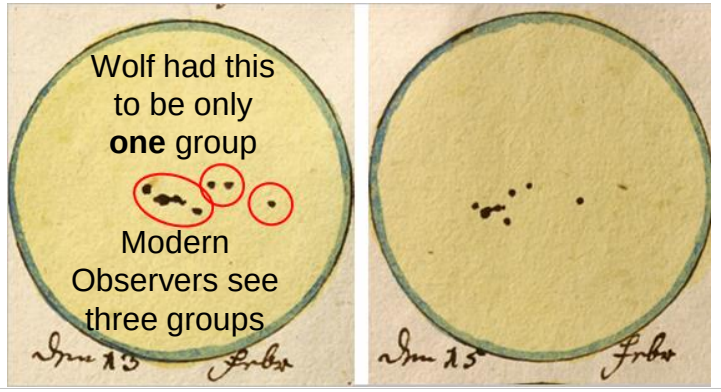
'Compiler' of Sunspot Number

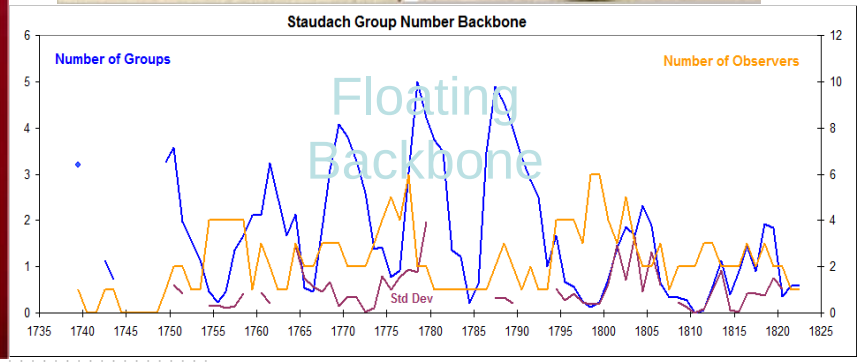
Still used today

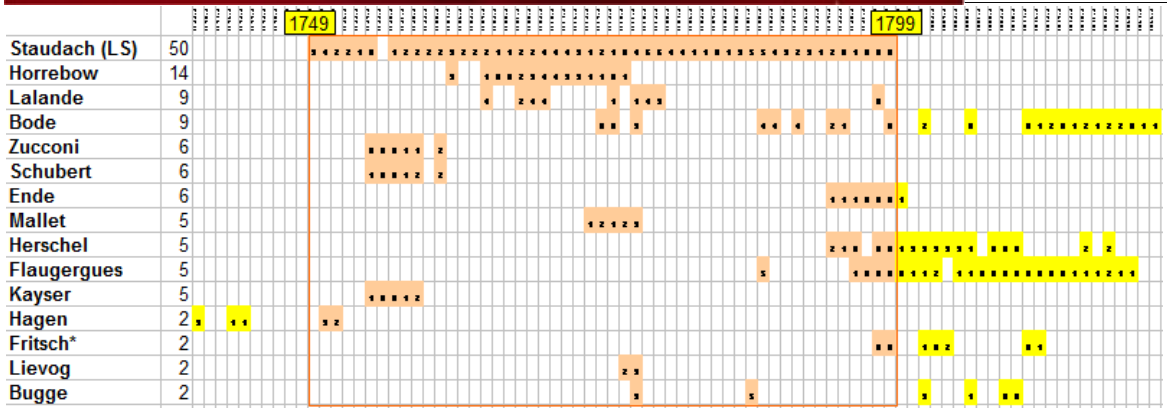
The sunspot number is always determined using small telescopes

J.C. Staudach's Drawings 1749-1799









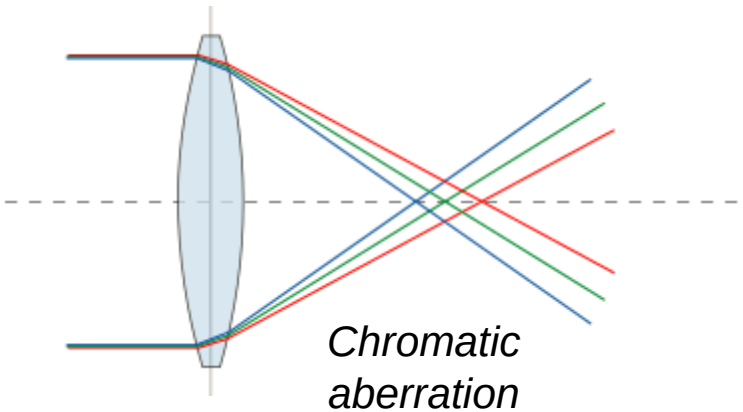
The weak point: the **Staudach Backbone** is 'floating' and is not firmly calibrated to link up with the neighboring [later] Schwabe Backbone

We are Hostages to the Drawings

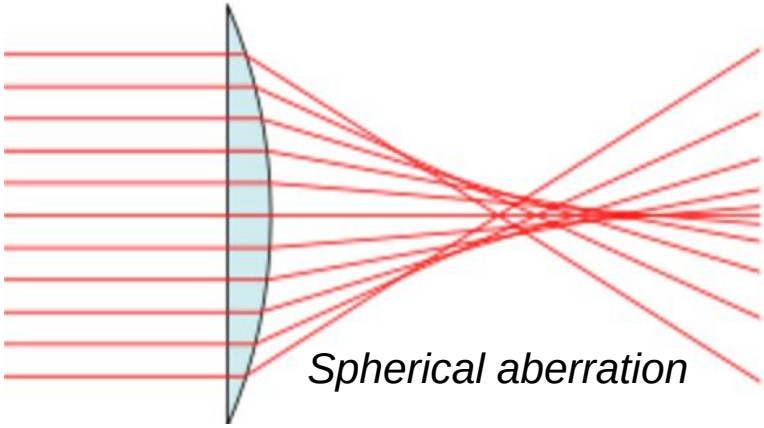
The drawings are today stored in the library of the Astrophysikalisches Institut Potsdam, Germany, and are in very good condition. Arlt (2008) has recently photographed the drawings, one by one. Arlt also draws some inference about the telescope used by Staudach. In the material there is a single mention of a telescope (18 February 1775: “when I turned round with my 3-foot sky tube…”) hence we may assume that the focal length of the telescope was 3 feet. Achromatic telescopes with a focal length of 92 cm were manufactured by John and Peter Dollond from the late 1750s. With such an (expensive) telescope, however, the distinction between umbra and penumbra should have been possible, and the Wilson effect (elongated spots near the limb) should have been visible. Both were not noted and not drawn by Staudach (using projection onto a sheet of paper).

An average telescope used by an amateur at the time probably suffered from fairly strong spherical aberration. Because of a couple of mirrored solar-eclipse drawings, Arlt (2008) suggests that Staudach was using a Keplerian refractor with a non-achromatic objective and that he most likely missed all the tiny A and B spot groups (according to the Waldmeier (1938) classification). Such groups make up 30-50% of all groups seen today. To convert a group count without A and B groups to a full count of groups of all classes, one must thus multiply by 1.65. Taking into account that Staudach’s telescope likely suffered from both spherical and chromatic aberration, the actual factor is likely to be somewhat larger. But we don’t know how much larger, and **that is the problem**

Aberrations of Singlet Lenses



Chromatic aberration



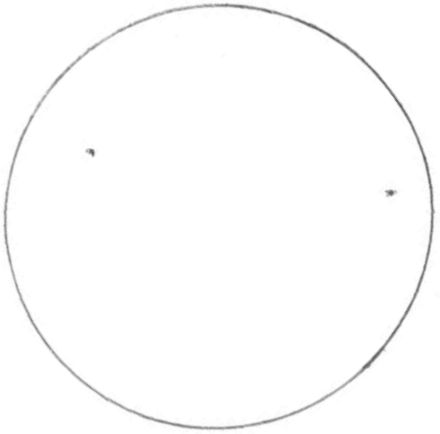
Spherical aberration

Paper telescopes from the early to mid-1700s

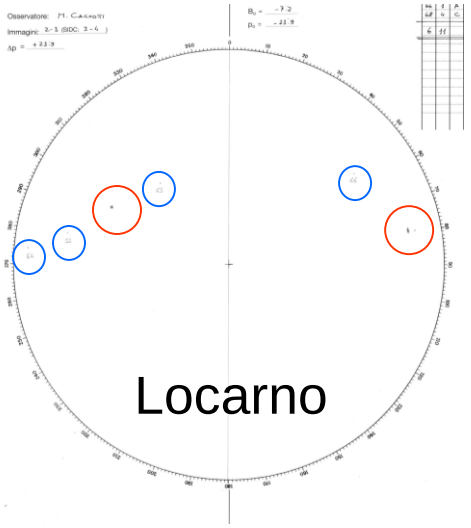
The Project

- Find telescopes (from the 18th century if possible, or build replicas) with similar characteristics as Staudach's
- Find people willing to observe, i.e. make drawings of what they see (high precision of positions not needed)
- Make systematic observations over some time (many months) perhaps at least one drawing per week, better daily
- If we can find several people, they can share the load (and also make it possible to assess the 'error bar')
- Scan the drawings and communicate them to me (leif@leif.org). Website: http://www.leif.org/research
- I'll process the drawings and produce a scientific paper with the observers as co-authors publishing the result
- Benefits: Exposure of ATS (Antique Telescope Society) and providing an important calibration point for the Sunspot Series (real science)
- First observation 14 January, 2016.
- Continuing… (120 days with 160 drawings, so far – Jun 1st, 2016). One observer reported having 'withdrawal symptoms' after a week of overcast prevented observations !

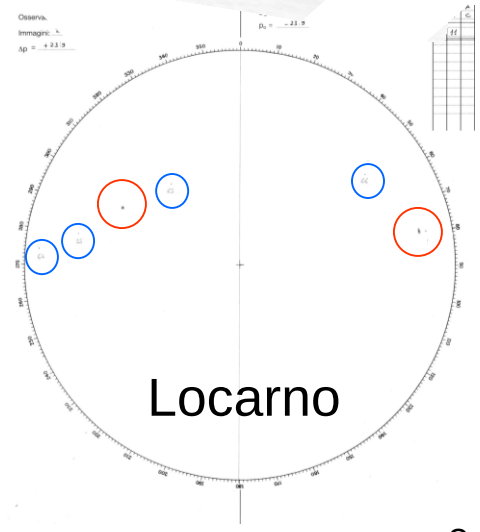
John W. Briggs, Magdalena, NM



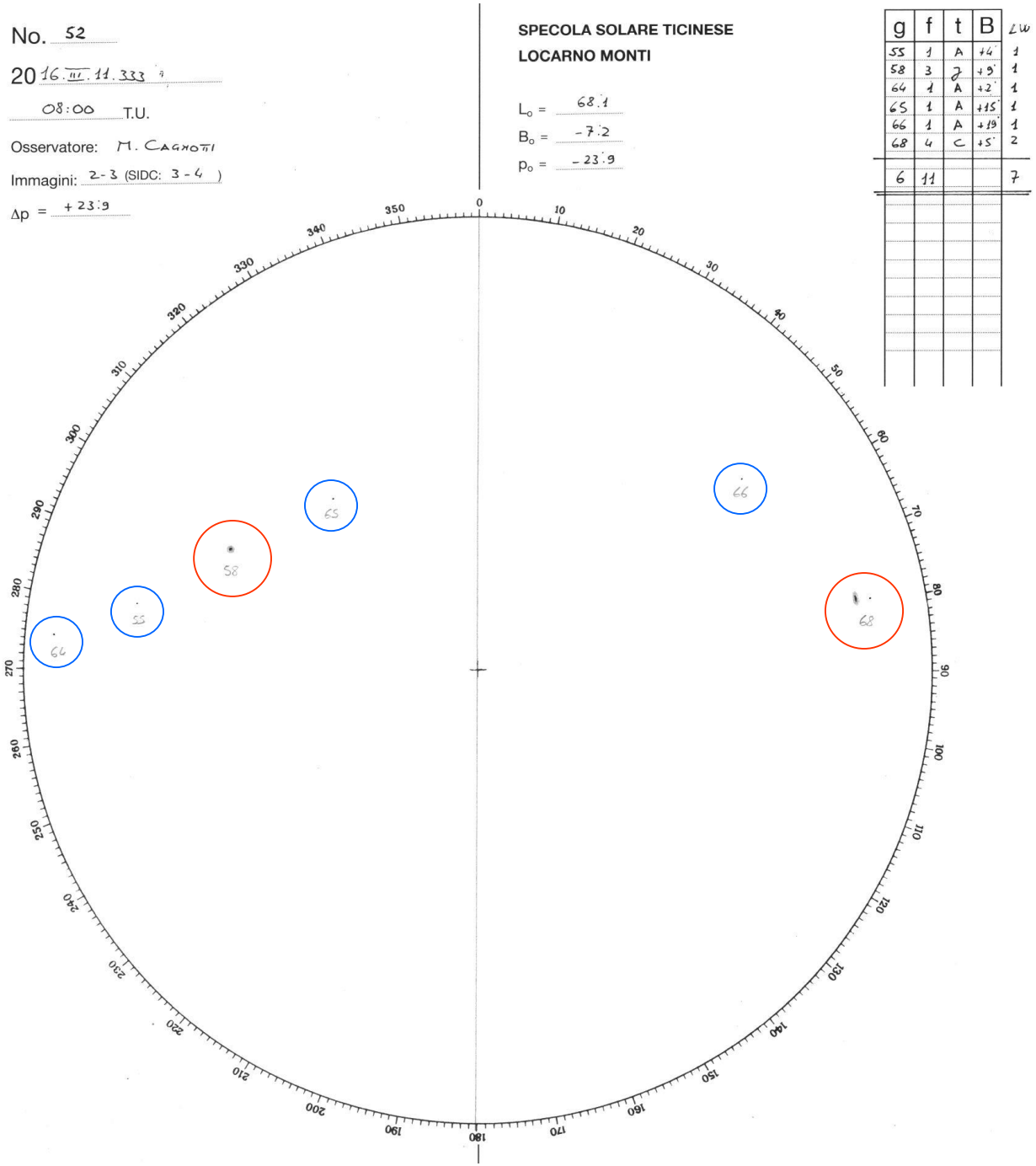
2016-03-11

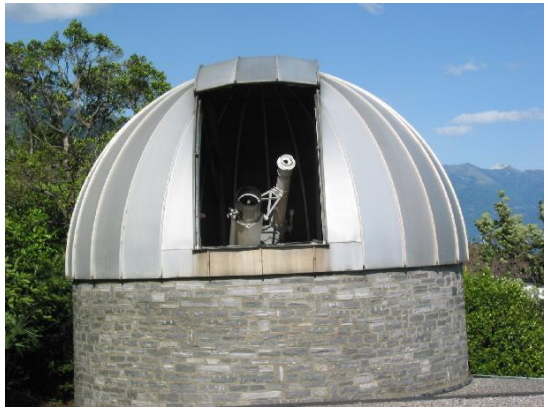


Ken Spencer, Sea Cliff, NY



Locarno 2016-03-11



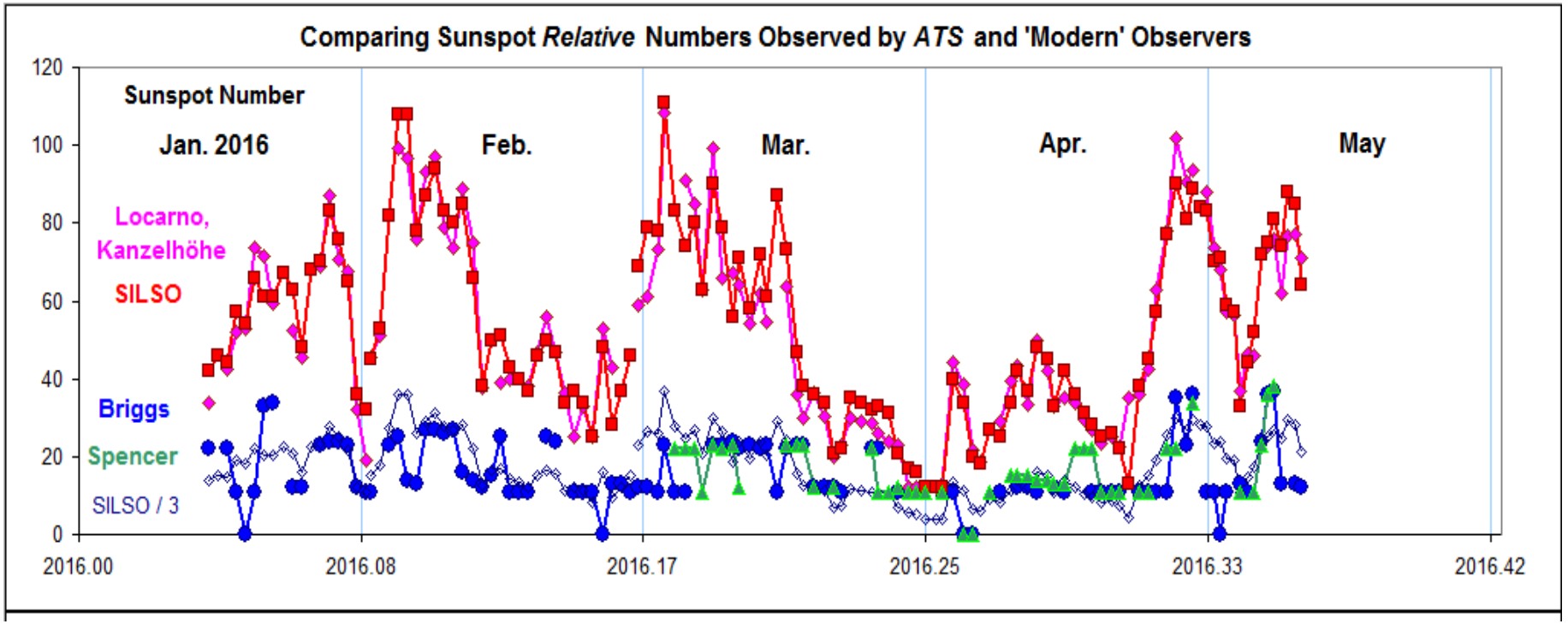


Briggs, Spencer, and (importantly) Staudach simply could not see the tiny groups (in blue circles) with their inferior telescopes

Walter Stephani

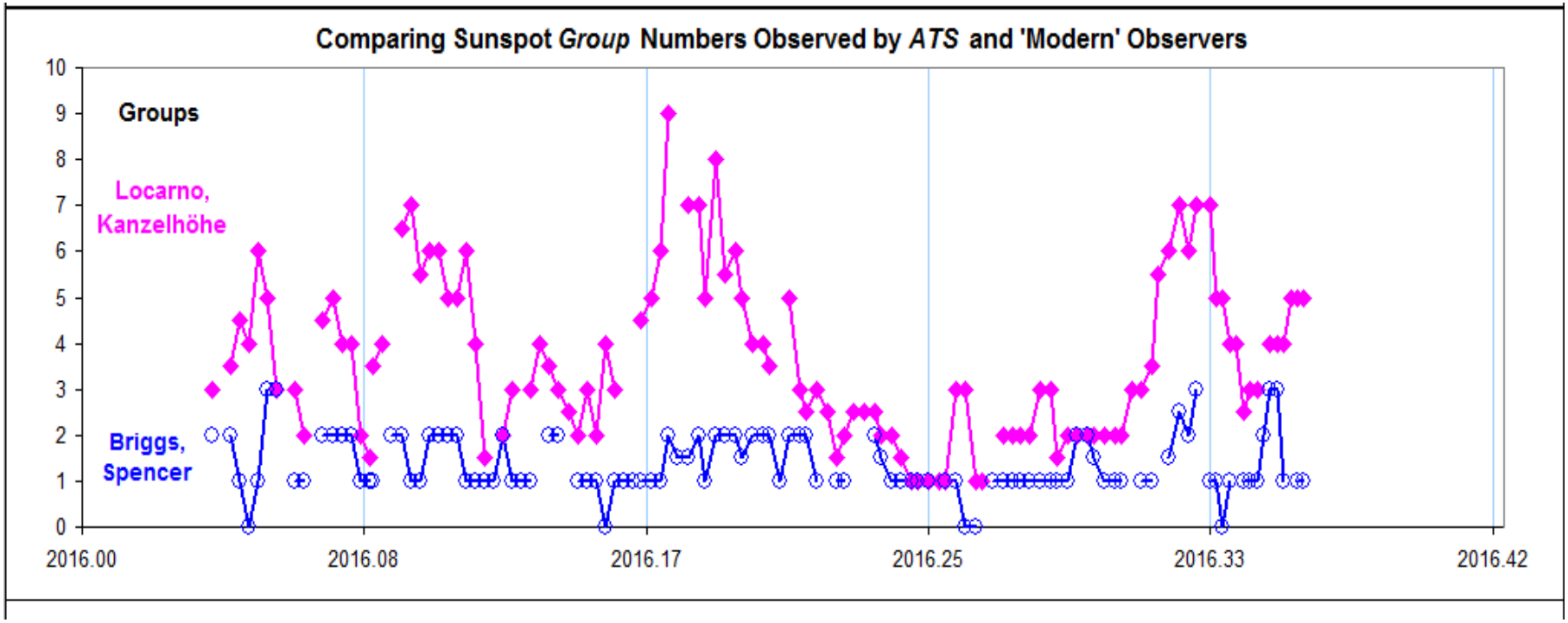
Need photo of telescope in action

Results so Far for Sunspot Numbers



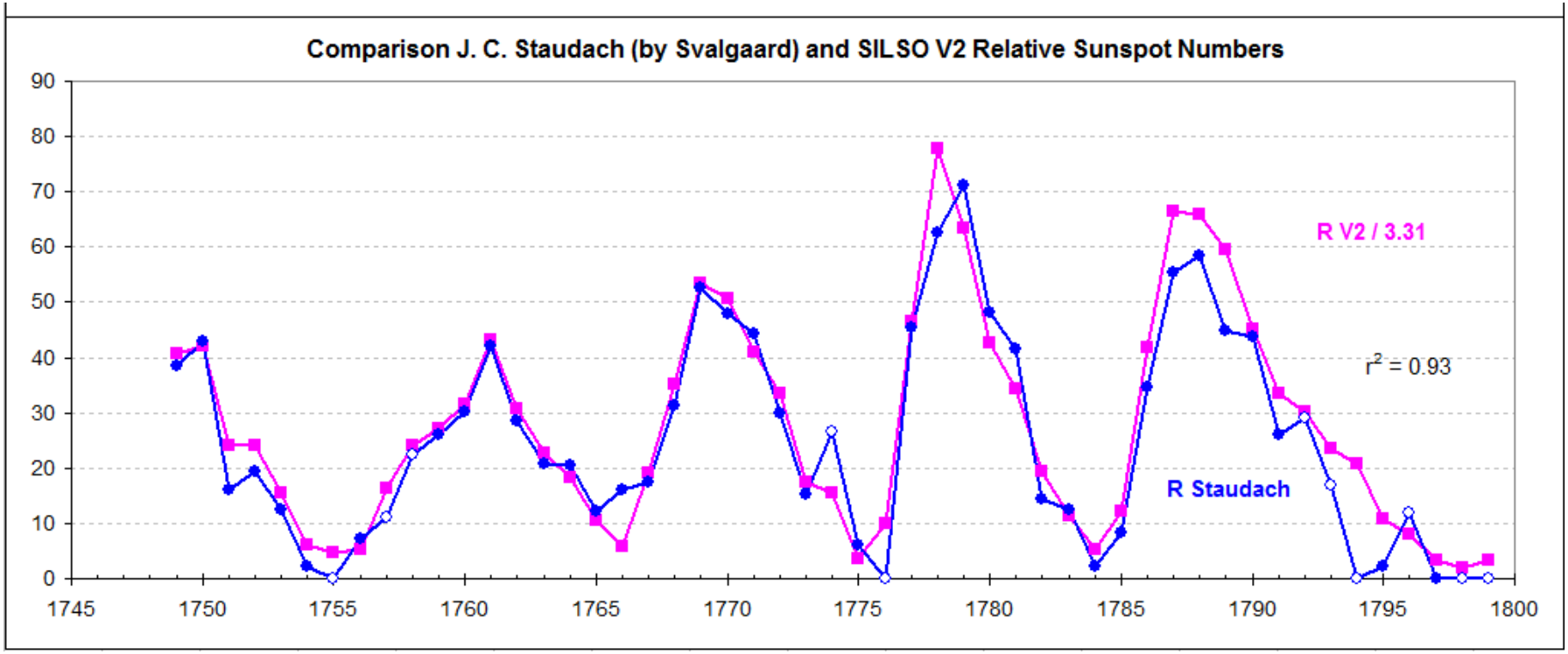
On Average the Modern Observers see sunspot numbers about 3 times larger than our intrepid observers. This is about what we have found by trying to normalize the old data to modern values, so validating the recent revision of the official Sunspot Number

And for Group Numbers



Average Number of Groups (modern) = 3.74
Average Number of Groups (ATS) = 1.39
Ratio = 2.7

Comparing Sunspot Numbers by Staudach and Modern SILSO V2



The reduction factor seems to be ~3.3

Conclusions

- Observations with telescopes suffering from the same spherical and chromatic aberrations as we think Staudach's 'sky tube' did, validate the factor of about three that we previously found was needed to normalize the 18th century amateur observations to the modern scale