GP 6: Tools and Technologies of physics research

Zeit: Dienstag 14:00–16:30 Raum: HS 9

Hauptvortrag GP 6.1 Di 14:00 HS 9

Tools of Physics as Technological Systems: Building Big Telescopes before 1825 — •Richard Kremer — Department of History, Dartmouth College, Hanover, New Hampshire, USA

The classic histories of the telescope credit Fraunhofer with inventing the parallactic mount (the "Fraunhofer" or "German" mount) when in 1824-25 he built the large refractor for Dorpat. Solving a host of mechanical problems, Fraunhofer's design drew wide acclaim and would be widely copied by makers of large refractors for the remainder of century. The success of the German mount provides a central theme in most narratives of telescope history.

In this talk I will reconsider this episode in telescope history by looking not at post-1825 telescope mounts but at pre-1825 attempts to mount telescopes equatorially. Technology historian Thomas Hughes proposed a set of concepts for analysing what he called technological systems. By applying those tools to the history of large eighteenth-century telescopes, I want to look for "reverse salients" or bottlenecks in the system (optics, mounts, operating procedures) that Fraunhofer was trying to remove. Hooke, Sisson, Ramsden, George Adams, Short, Nairne and Troughton had all devised equatorial mounts; Herschel's large reflectors employed alt-azimuthal mounts. How did these eighteenth-century makers and their customers understand the reverse salients in their technological systems? How did Fraunhofer understand those reverse salients? And how did technological systems, astronomical practices and trade secrets circulate across boundaries of nation states, scientific disciplines, and craftsmen's shops? END

GP 6.2 Di 14:45 HS 9

Fraunhofer's colored solar spectra and his prism spectrometer — •Jürgen Teichmann — Deutsches Museum, München, Museumsinsel 1

Around 1813/1814 (published 1817) Joseph Fraunhofer discovered several hundred dark lines in the solar spectrum. A new found letter from 1823 proves, that at this date he tried to color his black and white figure printed 1817 from an copper etching, which he had made by his own hands. Three such hand colored spectra remained till today, two of them in the Deutsches Museum, Munich, one in the Goethe-Museum, Weimar.

Also the prism spectrometer which he used and some of his first diffraction gratings exist in the Deutsches Museum. To what extent all these objects originate directly from Fraunhofer? Which importance had they for his research, for the discussion in his scientific environment and as objects of a self standing parallel world, of which the signs and its experimental character stayed to be exotic for most scientists before their explanation as absorption lines in 1859 (and also stayed to be strange for a big amount of scientists decades after this year)?

GP 6.3 Di 15:15 HS 9

Pushing wide-field microscopy to the limit around 1900 — •Timo Mappes — Deutsches Optisches Museum (D.O.M.), Carl-Zeiss-Platz 12, 07743 Jena, Germany — Friedrich-Schiller-Universität Jena, 07737 Jena, Germany

Experimenting with the parameters of Abbe's resolution limit formula, scientific studies on enhancing the numerical aperture (N.A.), and reducing the wavelength were performed. As such, objectives with N.A. of up to 1.6 were introduced in 1889 and successfully applied by leading diatomists. However, these objectives were eventually limited in use by the delicate mounting of their front lens, and the toxic and aggressive nature of the required immersion liquid. Still, these systems were re-introduced for conoscopy several decades later.

In 1902 wide-field microscopy at easily accessible short wavelengths was carried out, namely with sparks of Cd (275 nm) and Mg (280 nm). The entire optical train had to be manufactured out of fused silica or rock crystal. The systems were optically corrected for 275 nm only and consequently called "Monochromat". Being in the middle ultra violet the numerical aperture had to be re-defined to enable the use of Abbe's resolution limit formula, and "relative Apertur" (r.A.) was introduced for calculation. While the increase in resolution was outstanding, the images had to be caught on film to make them visible. Thus, the entire procedure was very time-consuming and not fitting for applications in biological or medical research. However, fluorescence was discovered with this setup, while initially being identified as a disturbing side-effect.

GP 6.4 Di 15:45 HS 9

Saussure's hair hygrometer: the art of measuring atmospheric humidity — •Fischer Stéphane — Musée d'histoire des sciences de Genève

Among the many instruments invented or perfected by the Swiss naturalist Horace-Bénédict de Saussure (1740-1799) the hair hygrometer is undoubtedly the instrument that has had the greatest commercial success with more than 150 copies sold.

Saussure first made many experiments in laboratory. He is one of the first to highlight the phenomenon of relative humidity (percentage of humidity compared to the saturating value). The results of his experiments are published in 1783 in his *Essai sur l*hygrométrie*, considered as a reference work in the field.

To validate its work and so that its results can be reproduced by its peers, Saussure sells its hygrometer throughout Europe accompanied by an explanatory note on its operation.

Thereafter, Saussure uses his hygrometer to perform many measurements in the field. During his ascent to Mont Blanc in 1787, he observed that the total humidity decreases with altitude. Measuring the moisture content of the atmosphere was one of Saussure's main activities. As such, it can be considered a pioneer of modern meteorology.

On the basis of these considerations, the Musée d*histoire des sciences de Genève, which conserves the instrument*s collection of Saussure, including several hair hygrometers, plans to reproduce some hygrometric experiments carried out by the Genevan naturalist at the end of the 18th century.

15 min. coffee break