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MERZ TELESCOPES AT THE UNIVERSITY OBSERVATORY IN CHRISTIANIA, NORWAY

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Abstract: Four telescopes with optics by Merz in Munich were acquired for the University Observatory in Christiania between 1840 and 1882. Two had equatorial mountings by Merz, one by Repsold, and one by Olsen. We describe the acquisition process from correspondence located in archives and libraries. The observing programs are outlined from publications in Norwegian and German, highlighting some results obtained with these instruments.

Keywords: University Observatory; Christiania (Oslo); Norway; telescopes; Merz; Repsold; spectroscopes; visual observations

1 INTRODUCTION

The University Observatory in Christiania (now Oslo, Norway) was inaugurated in 1833 and began its operation with a meridian circle from Reichenbach and Ertel and a Fraunhofer refractor from Utzschneider on an alt-azimuth mounting by Repsold. It was the only astronomical observatory in the country and was founded by Christopher Hansteen (1784–1873; Figure 1), Professor of Applied Mathematics, after years of fundraiseing and other political exercises. Over the following decades several other instruments were added, some in their own domes in the Observatory Gardens. Two were refractors on equatorial mountings from Merz. Two others had optics by Merz and equatorial mountings from Repsold and Olsen, respectively. Recent books by Chinnici (2017) and Kost (2015) address the importance and role of the Merz company and the extent of their delivery of lenses and telescopes throughout the world. Supplementing these reviews is extensive archival material in Norway and Germany that allowed detailed histories to be written of the Merz instruments at the University Observatory in Christiania.

2 A REPSOLD EQUATORIAL WITH MERZ OPTICS, 1842

In 1844 the Observatory's Director, Professor Christopher Hansteen, was joined by an Assistant Astronomer, Carl Fredrik Fearnley (1818–1890; Figure 2), who had just graduated from the University. Two years earlier, an equatorial telescope had been installed in the Observatory tower. It was developed and produced by A. & G. Repsold in Hamburg between 1838 and 1841. It had a mechanical clock drive and 75-cm circles on both axes, divided to 4 arc seconds. The 12-cm f/13 achromatic objective lens had been acquired from Georg Merz in Munich (Kost, 2011), who had become a partner in Joseph Utzschneider's optical institute in 1838. The ambition for the equatorial was to determine celestial coordinates directly by reading the declination and right ascension circles with microscopes on scaled micrometers. The telescope also was equipped with a filar micrometer to obtain relative positions between reference stars and celestial objects.

Figure 1: Part of a drawing of Christopher Hansteen by Siegwald Johannes Dahl, made in 1848 (courtesy: Oslo Museum).

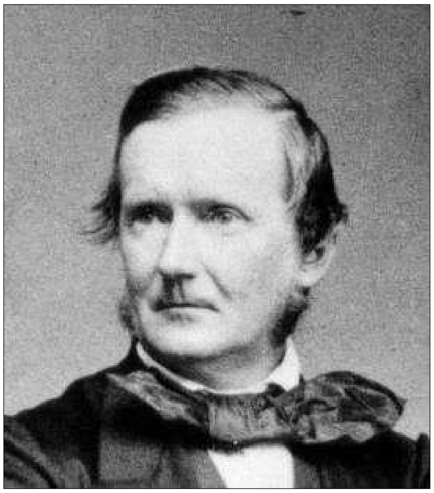

Figure 2: A photograph of Carl Fredrik Fearney (courtesy: Oslo Museum).

For ten years, Hansteen had been saving a fraction of each annual budget. In July 1837, he decided that an equatorial instrument was a wise investment, inspired by the price list from Ertel (1831). Hansteen (1837) asked the Astronomy Professor at Copenhagen University, Heinrich Christian Schumacher (1780–1850), for advice. Their relationship dated back for more than two decades, and Hansteen had visited him repeatedly at his residence and observatory in Altona. Schumacher had been the main advisor a decade earlier when the meridian circle and the first refractor were ordered for the Observatory in Christiania. Schumacher (1837) argued that Ertel's company had developed towards factory production, and that at the time Repsold was the leading astronomical instrument-maker in Germany. He noted that even Struve, who was close to Ertel, had to face the facts and had ordered both the meridian circle and the transit instrument for Pulkova from Repsold.

Schumacher discussed Hansteen's request with Repsold and informed Hansteen that Repsold would prepare a proposal drawing of the instrument so that details could be discussed before the final plan was agreed upon. To lower the costs, Repsold had suggested to Schumacher that the equatorial refractor could use the objective lens of the 6-foot refractor that Hansteen had acquired for the Observatory in 1833.

A week later Hansteen (1838a) wrote to Repsold, confirmed his intentions, and requested a drawing as a reference for further discussions. Repsold (1838a) responded immediately that he agreed to the plan. Hansteen was thrilled and reported the decision to the University. Departements-Tidende, a publication citing news from Government Ministries, reported in April 1838 that "… professor Hansteen has ordered an Equatorial-instrument for the Observatory at the expected cost of 1544 spesidaler." For comparison, this price was five times the annual salary of the Assistant Astronomer.

In July 1838 Hansteen (1838b) informed Repsold that he had wanted to visit Hamburg that summer to discuss the plans, but that because of matters beyond his control he had to postpone the visit to the summer of 1839. This gave Repsold more time for preparations, and he finished a reduced scale model of the mounting as the initial development step (Repsold, 1838b). Details were discussed with several local astronomers and ten days later Repsold (1838c) sent the proposal drawing and a description of the technical solutions, accompanied by suggestions from Schumacher, who had already seen the model and the text. Both Schumacher and Hansteen found the proposal excellent.

A novel suggestion was to produce the divided circles on glass rather than the customary brass wheel with a divided silver ring inserted. A test piece was made for Schumacher to evaluate. He found that it was difficult to read the divisions at low levels of artificial lightening, and was concerned that the use of ladders and chairs in the observing room represented a risk to glass circles. But Hansteen liked the idea of glass circles because they would not tarnish, unlike silver, and thus removed the risk of affecting the division markers when cleaned. Also, the scales could be illuminated from behind with appropriate brightness. But he feared the risk of breaking the glass, and eventually decided on customary brass circles.

The telescope tube was proposed to be made of wood, but would then need a system of counterweights to prevent deflections of the ends due to the weight of the objective lens and the filar micrometer. Schumacher suggested that a more rigid solution would be to join two short brass tubes in a central cube, as was customary with meridian telescopes. This was supported by Hansteen (1838c), who also suggested that a new objective lens should be ordered from Munich. He left the choice of lens diameter and focal length to Repsold, who accepted the technical revisions and decided on a focal length of 5 feet, after consultations with Schumacher (Repsold, 1839). Further details were tested on the model in preparation for Hansteen's expected visit.

Hansteen visited A. & G. Repsold in Hamburg as part of his scientific travels to Denmark and Germany during the summer of 1839. They discussed the revised model and construction drawings. With the plan accepted (Figure 3), Hansteen (1839) transferred an amount of 3000 thaler Hamburg Banco in November. The construction work began with the large parts, which were finished by the end of 1839. All the other parts, the test mounting, and adjustments required most of 1840. It also was decided to produce the specially shaped stone pillar in Hamburg to ensure the accurate positioning of the equatorial mount.

The entire consignment reached Christiania by ship in July 1841 (Hansteen, 1841). Hansteen had arranged for exterior scaffolding to be erected so that they could lift the pillar into the tower observing room. A window and part of the wall had been removed to maneuver the piece into position. The wall was re-bricked and the window re-inserted. The rotating roof also needed improvements, but progress was slow due to an exceptionally rainy summer.

Hansteen postponed the installation of the telescope until the summer of 1842. Upon the suggestion of A. & G. Repsold, the assembly work

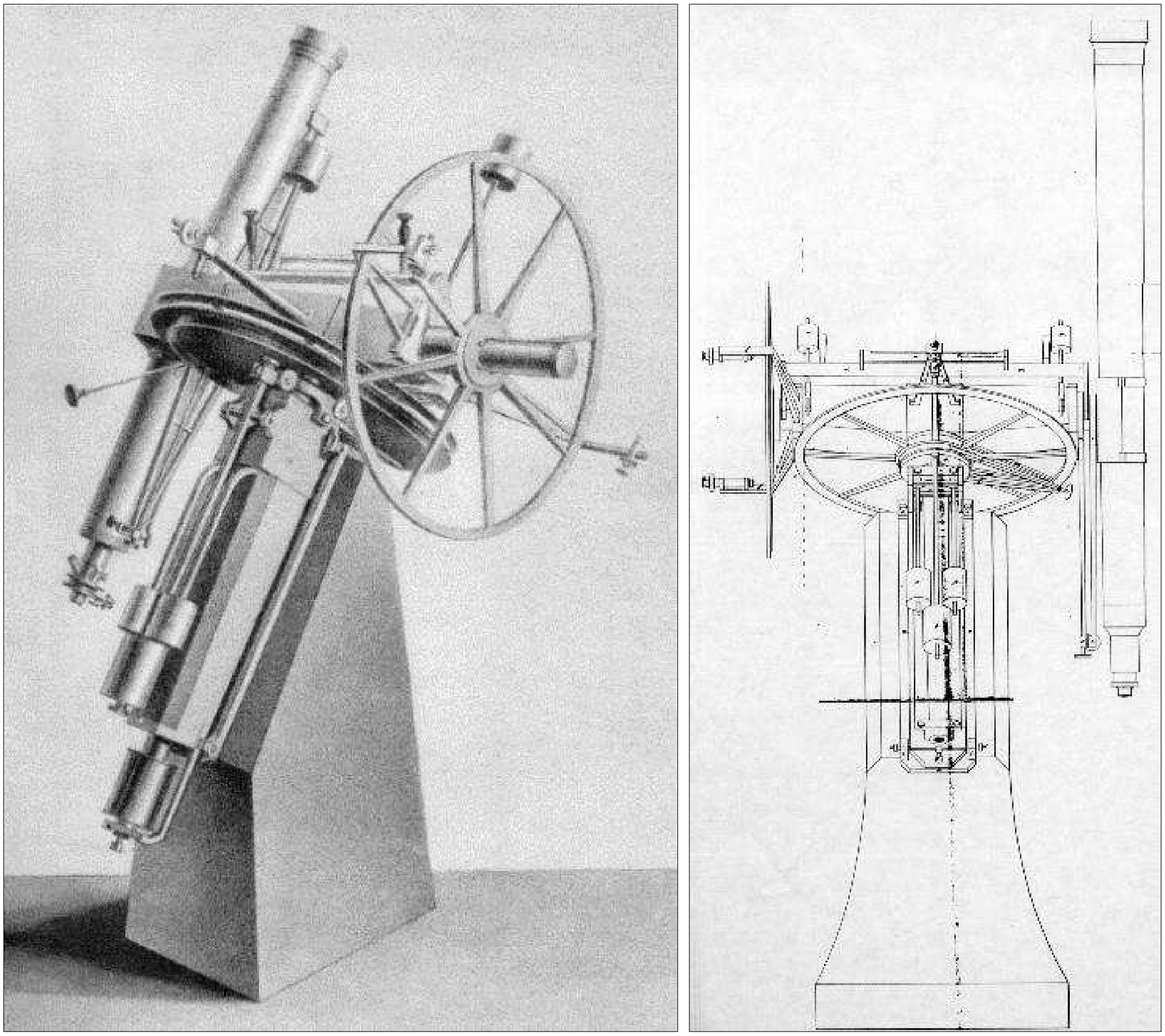

Figure 3: The equatorial refractor (left) and one of Repsold's construction drawings (right) (after Repsold, 1914).

was done by their expert, Mr Flittner. He arrived in Christiania in August 1842 and the entire instrument was ready for testing after two weeks. The polar axis pointed 2 arc minutes to the west and 22 arc minutes above the celestial pole. This was within the range of the adjustment screws and Flittner's work was complete. Hansteen ensured by observation that the two axes were orthogonal to each other and then proceeded to adjust the clock drive so the telescope would track stars. In some positions of the telescope, the drive was too weak and the tracking stopped. Hansteen experimented with heavier loads to run the clock drive, but the problem returned from time to time.

The first observing project included observations of stars across the sky to establish the transformation of coordinates read directly from the circles to the celestial coordinate system. Hansteen (1845) concluded that the small differences were random observational errors and not due to systematical effects of the instrument.

Carl Fredrik Fearnley began his tenure as Assistant Astronomer in 1844. His first task was to determine the Observatory's latitude using the meridian circle and the longitude by observing lunar occultations of stars with the equatorial telescope. When Neptune was discovered in 1846, Fearnley (1847a) began astrometry within a month of the discovery. A year later his observing program was expanded to include the newly discovered asteroids Iris and Flora (Fearnley 1847b; 1848).

Fearnley revealed great talent and skill as an observer and Hansteen decided to offer him further studies and training at foreign observatories. In 1850, the National Assembly granted a stipend that allowed Fearnley to spend two years abroad. The first year was with Professor Friedrich Wilhelm August Argelander (1799–1875) at Bonn Observatory, Germany. Fearnley was introduced to several telescopes and their auxiliary instruments. He made extensive observations of asteroids and comets with a ring micrometer. An occulting ring brings a star to

Figure 4: A ring micrometer (photograph: Bjørn Pettersen).

disappear and reappear twice when it drifts across the field of view when the telescope clock drive is disconnected. A chronometer was used to time the events. If the object was set to cross along a ring diameter, a reference star (before or after) might follow a chord if it had a different declination. Symmetrical timings represent center crossings and allowed computation of the difference in right ascension. The ratio of the chord length to the diameter was used to compute the difference in declination between the object and reference star. While he was abroad Fearnley acquired several ring micrometers that he would bring to Christiania (e.g. see Figure 4).

Figure 5: The Repsold-Merz equatorial refractor (unknown photographer/ courtesy: Norwegian Museum of Science and Technology).

During Fearnley's absence, Hansteen arranged for maintenance of the equatorial instrument. Mr Flittner returned to Christiania during the summer of 1851 to dismantle, oil, and adjust all moving parts. Then Hansteen adjusted the axes and determined the mathematical corrections to obtain celestial coordinates directly from the circles. He obtained a precision good enough to demonstrate that the corrections depended on ambient temperature. Hansteen (1851b) noted that the upper bearing of the polar axis was made of zinc. Since it expands more than brass, the polar angle of the telescope increased slightly with temperature. He restricted his use to that of a differential instrument, and observed lunar occultations and the total solar eclipse of 28 July 1851 (Hansteen, 1852a; 1852b; 1853a). From time determinations of the latter, he concluded that the northern limit of the zone of totality was closer to the Observatory than predicted by theory. The lunar tables required improvement.

Immediately upon his return to Christiania, Fearnley (1853) carried out extensive astrometry of what later turned out to be periodic comet 20D/Westphal, which was discovered by Justus Georg Westphal in Göttingen on 24 July 1852. Fearnley observed it from 20 August to 6 December 1852, using ring and filar micrometers, and the direct reading of the circles (when the comet was near the pole) to obtain celestial coordinates. He noticed a short tail of ½° on 2 September. Later it looked more like a deformed coma with an extension of a few arc minutes. A weak locking screw on the polar axis introduced erratic results for right ascension when he used the circles directly. This problem was not present on the declination axis. Fearnley (1855; 1857; 1858b) thus observed the next four comets with a ring micrometer only. When Donati's Comet (C/1858 L1) developed as a spectacular apparition in September and October 1858, Fearnley (1860) made use of both the ring micrometer and and direct microscope readings of the circles to record its positon, this time with accurate results. Three further comets were observed exclusively with the ring micrometer (Fearnley, 1861b; Mohn, 1864; Geelmuyden, 1871), before Fearnley (1874) again used the circles directly for astrometry of Comet C/1874 H1 (Coggia). Since this comet had a bright coma (magnitude 0–1), in July 1874 he used a Merz universal spectroscope (see below) to do the first spectroscopy of a comet from Norway, noting a continuous spectrum without lines or bands against the bright sky background. All later comets observed with the equatorial telescope (Figure 5) between 1877 and 1919 were observed with ring micrometers (Geelmuyden, 1877; Jelstrup, 1919; Lous, 1902; 1912; Schroeter, 1892). The telescope was dismantled after WWII and parts were used to construct instruments for the Oslo Solar Observatory in the 1950s (Rolf Brahde, pers. comm. 1990).

3 A COMET SEEKER FROM MERZ, 1851

While he was visiting Bonn Observatory, Fearnley received a Christmas letter from Hansteen (1850) asking him to consult with Argelander about a suitable comet seeker for the Observatory in Christiania. In Bonn, Fearnley (1851a) could test two short-focus f/8 Merz refractors: a 95 mm and a 75 mm. The smaller telescope was mounted in a dome and would become the core instrument for the Bonner Durchmusterung between 1852 and 1859. Both were of good optical quality, but spherical aberration was noted at the edge of each field. Including equatorial mountings, they were priced by Merz at 700 and 490 gulden, respectively.

A separate dome was not available in Christiania, so Fearnley decided on the 75-mm refractor, which he argued could easily be carried outside and placed on a platform next to the observatory tower. He even suggested that the costs could be reduced significantly if only the telescope tube assembly was bought from Merz and a local instrument-maker in Christiania was commissioned to construct the mounting. Hansteen (1851a) was skeptical, and argued that the quality of the local mechanical work might not match that of Merz. But he left the decision to Fearnley, and expressed trust in his judgement.

The order was placed with G. Merz & Söhne in early May 1851, when Fearnley (1851b) visited Munich Observatory and the instrument workshops of both Ertel and Merz. The comet seeker had a 6° field of view at a magnification of 10X. Another eyepiece gave 15X. Fearnley selected one of them as orthoscopic to address the spherical aberration. The equatorial mounting had 9-cm setting circles and fine motion screws on both axes (Figure 6).

The comet seeker left the Merz workshop in October 1851 (Merz, 1851) and arrived in Christiania on 1 November 1851 (Hansteen, 1851b). That same day the Observatory received a note about Comet C/1851 U1 (Brorsen) in Canes Venatici, which was well placed for a high latitude observatory, but a rainy fall season prevented Hansteen from searching for it and testing the telescope.

A few years later, Fearnley (1858b) monitored the position of Comet C/1857 Q1 (Klinkerfuss) and The Great Comet of 1861, C/1861 J1 (Tebbutt), and he used the comet seeker to estimate the length and shape of the comet tail of the latter comet (Fearnley, 1861b). The comet seeker also was used for an extensive program to monitor Comet C/1858 L1 (Donati) (Fearnley 1860)—which is discussed by Pettersen (2015).

Figure 6: The Merz comet seeker (photograph: Bjørn Pettersen).

When Fearnley took over as Observatory Director in 1861 Henrik Mohn (1835–1916; Figure 7) was appointed Assistant Astronomer. He specialized in comets and was the first astronomer in Norway to attempt astronomical polarimetry, on Donati's Comet (Pettersen, 2015). In August 1862, he used the Merz comet seeker to monitor the shape, direction, and length of the tail of Comet C/1862 N1 (Schmidt) (Mohn 1863).

Figure 7: Henrik Mohn (courtesy: Norwegian Museum of Science and Technology).

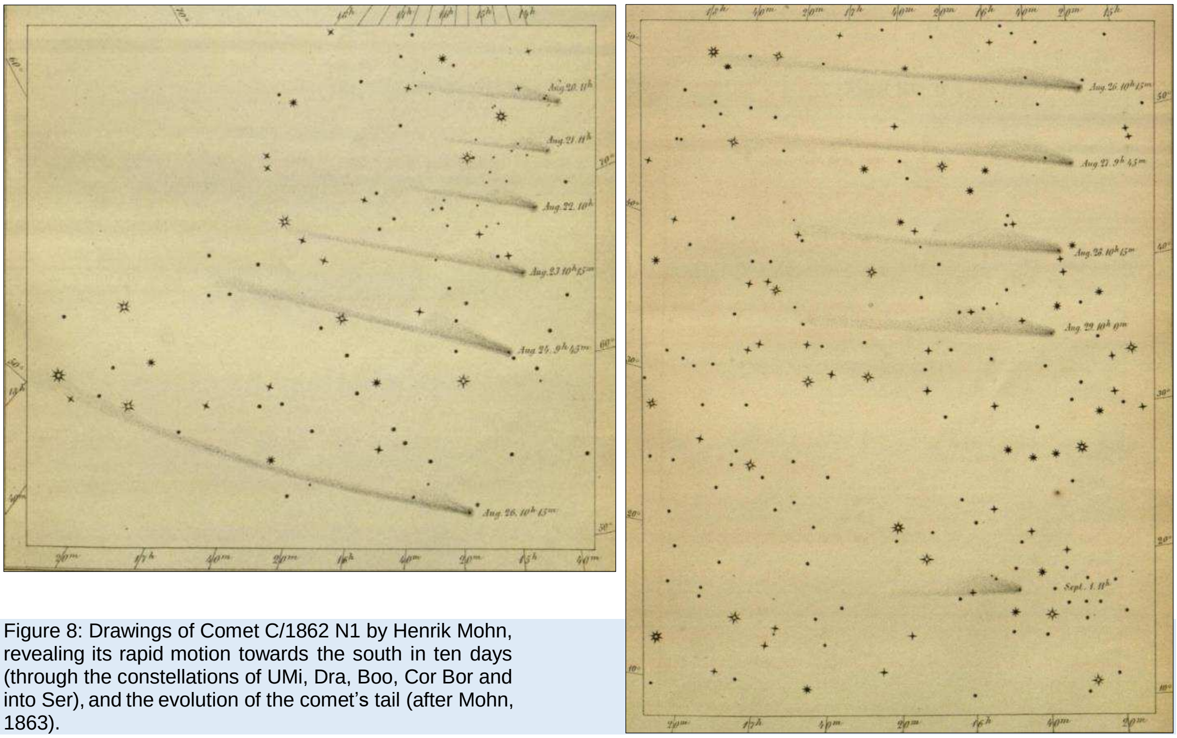

Figure 8: Drawings of Comet C/1862 N1 by Henrik Mohn, revealing its rapid motion towards the south in ten days (through the constellations of UMi, Dra, Boo, Cor Bor and into Ser), and the evolution of the comet's tail (after Mohn, 1863).

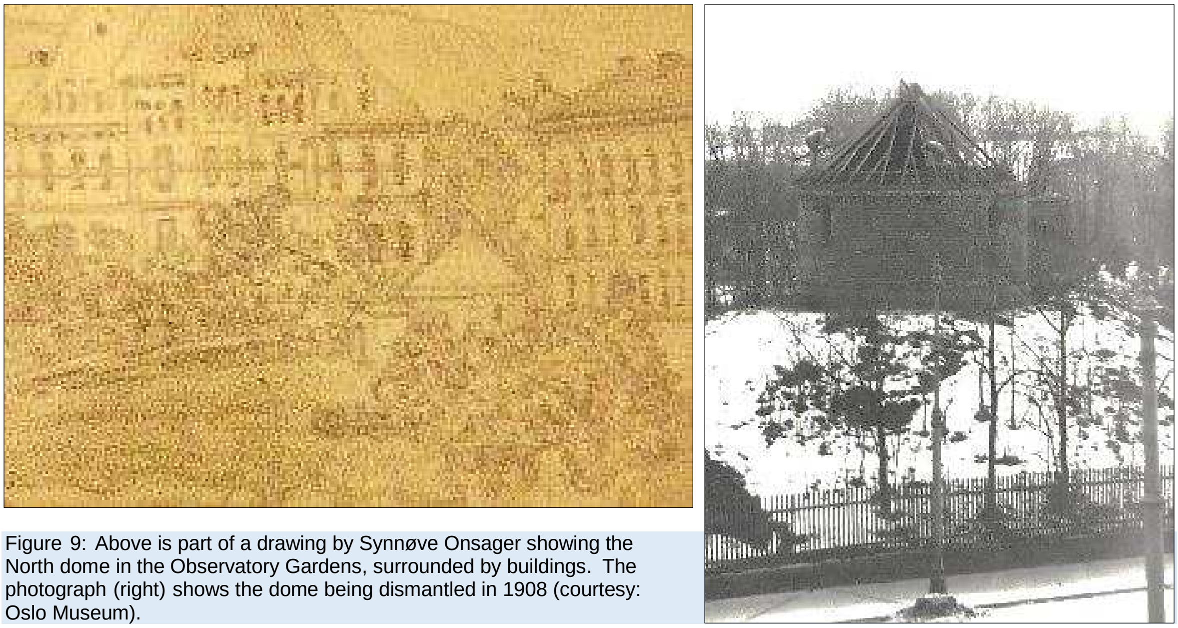

Figure 9: Above is part of a drawing by Synnøve Onsager showing the North dome in the Observatory Gardens, surrounded by buildings. The photograph (right) shows the dome being dismantled in 1908 (courtesy: Oslo Museum).

Mohn found the length grew from 5° to 22° in just five days (Figure 8), and that the curvature of the tail did not follow the great circle through the Sun and the comet. He also mounted the polarimeter on the comet seeker, but did not detect a polarized signal. The orbital plane of C/1862 N1 had an inclination of 172°, so the comet had retrograde motion in a parabolic orbit which brought it close to the Earth (0.1 AU on 4 July 1862). The coma then approached 0.5° in diameter.

On later occasions, the comet seeker would be used to time solar eclipses and lunar occultations, sometimes as student exercises. It is now on display in the Observatory.

4 THE 19 cm MERZ-REFRACTOR, 1857

When Fearnley returned from his studies abroad, Hansteen was ready to invest again. Various options for the best choice of instrument were discussed, to ensure the progress of astronomy at the Observatory and the University. During the summer of 1853, Hansteen ordered a 19-cm refractor with a focal length of 300 cm from G. Merz & Söhne in Munich. It would require its own observatory dome (Figure 9). Merz (1853), after receiving the exact latitude, suggested a dome construction and specified the location of the 2-m high stone pillar inside the observing room.

Two years later the instrument was ready for delivery (Merz, 1855). Architects Wilhelm Hanno and Heinrich Ernst Schirmer prepared drawings and a cost estimate for the building, which Hansteen submitted to the University leadership. Since the National Assembly met only every three years, the application for funds was forwarded directly to the Government. The request was to fund the building costs for the dome from the University budget. King Oscar I, who spent the summer of 1855 in Christiania, ratified the Government's decision in a Royal Decree dated 6 August 1855 (Departements-Tidende, 1855).

When the National Assembly convened two years later, during the fall of 1857, the building had been completed. The Budget Committee criticized the decision process, which had excluded the National Assembly. They expressed concern that the urgency of the matter had not been serious enough to allow deviations from standard procedure. But, in the end the National Assembly ratified the result (Stortingsforhandlingene, 1857).

When the north dome was nearing completion in the spring of 1857, Hansteen wrote to G. Merz & Söhne to request that an instrument maker come to Christiania and mount the instrument that summer. Merz (1857) had to decline because he had scheduled deliveries in both Russia and Spain. Instead, he suggested that a Norwegian instrument-maker be sent to Munich to attend the test mounting of the Madrid telescope before it was shipped, and upon his return to Christiania the 19-cm refractor (see Figure 10) was successfully mounted in the north dome.

The right ascension circle of the equatorial mounting (Figure 11) had a diameter of 24 cm and was divided to 4 time seconds (1 arc minute). The declination circle had a diameter of 38 cm and was divided to 10 arc seconds. There were five eyepieces (with magnifications from 102X to 550X), a filar micrometer (magnification from 100X to 580X), and a ring micrometer.

The first observations conducted with the new Merz refractor were a series of lunar occultations of the Pleiades in November and December 1857 (Fearnley, 1858a). When Comet Donati appeared high in the skies in the Fall of 1858, all of the telescopes at the Observatory were employed and Henrik Mohn used the new Merz telescope for astronomical polarimetry. He concluded that the light from the comet's head was reflected sunlight (Pettersen, 2015).

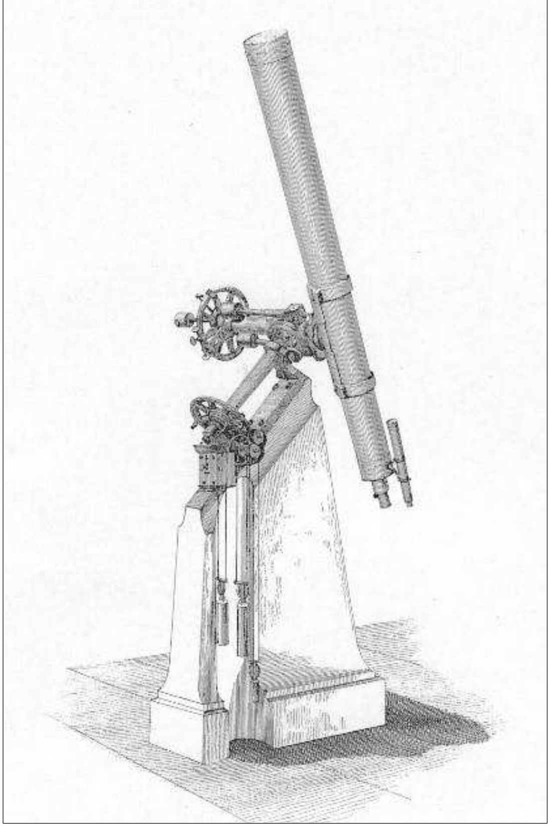

Figure 10: Merz's drawing of the completed 19-cm refractor (courtesy: Deutsches Museum Archives, Munich).

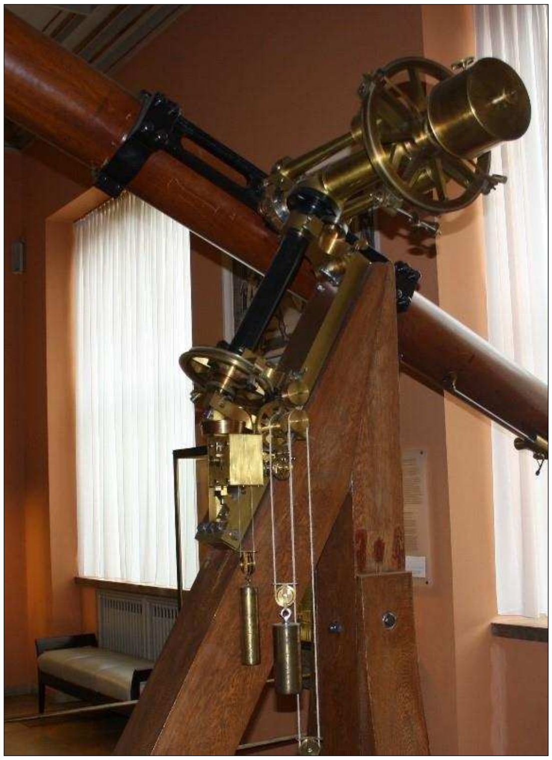

Figure 11: The Merz mounting and clock drive for the 19-cm refractor in Christiania, now on display in the Deutsches Museum in Munich with the 22-cm Merz refractor from Berlin Observatory that was used by Galle to discover Neptune (photograph: Bjørn Pettersen).

A year later Hansteen returned the objective lens to Munich. The glass was not tight inside the brass mounting, which appeared to be slightly out of shape. Merz (1859) suspected that the lens mounting had suffered a blow, but when the objective was dismantled the thin spacers between the crown glass and the flint glass were found to be in incorrect locations. Merz commented that the lens components appeared to have been mounted by untrained hands. After he had repaired, remounted and adjusted the objective it was returned to Christiania. Fearnley (1861) then made another set of observations of lunar occultations of Pleiades stars, and he observed a transit of Mercury (Fearnley, 1868). The positions of numerous comets (and some asteroids) were then determined with the ring micrometer (Mohn, 1864; Schroeter, 1892; 1894; 1895; 1896b).

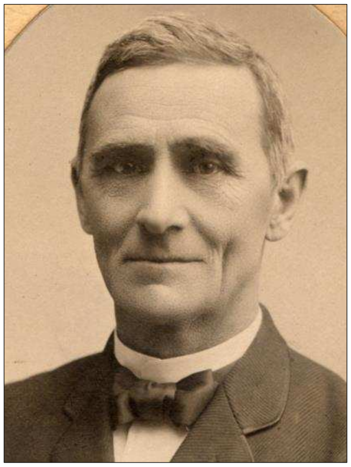
Figure 12: Hans Geelmuyden (Photo: Ludvig Forbech/MUV).

4.1 The Visual Parallax of a Nearby Star

In 1869, the Observatory in Christiania joined the Astronomische Gesellschaft sky mapping project. Two years earlier, Hans Geelmuyden (1844–1920; Figure 12) had succeeded Mohn as Assistant Astronomer. For 12 years, Fearnley and Geelmuyden used the meridian circle to determine the coordinates of 3,949 stars in a zone between declinations 65° and 70°. A serendipitous discovery during the project was a star with a large proper motion: 2.94 arc seconds per year, at position angle 274.5° (Fearnley, 1878). Geelmuyden suspected that it was also nearby and attempted to determine the parallax of AOe 11677 (= BD 66°717 = Gliese 424) by repeated visual determinations (V = 9.3 mag) of its coordinates relative to a slightly fainter comparison star nearby (7 arc seconds north and 90 time seconds west). He hoped to detect small systematic changes in the course of a year that would allow him to calculate the parallax. Geelmuyden (1879) used a filar micrometer on the Merz refractor from 4 September 1878 to 14 October 1879. He made 222 observations in right ascension and 206 observations in declination on 26 nights. When he solved for the parallax and the proper motion in the same solution, the errors were large. If he kept the proper motion at a constant value, the parallax was 0.27 ± 0.08 arc seconds in right ascension and 0.24 ± 0.04 arc seconds in declination.

The image quality of the telescope appears to have been a returning issue. In 1871, Fearnley asked if improvements were possible. Sigmund Merz (1871b), who had taken over the company four years earlier, replied that new lens components would be expensive, but he offered to cover 25% of the cost if an inspection of the objective lens suggested that the crown glass or flint glass component had to be replaced.

In 1880, Fearnley attended a geodesy conference in Munich. He visited the Merz Company, and may have brought the 19-cm objective lens to have it inspected. Sigmund Merz suggested that a new objective lens should replace the existing one. He offered one with the same diameter, but a focal length 12 cm longer, at favourable exchange conditions, as described in a footnote by Fearnley (1885). It was shipped to Norway on 29 September 1882.

With the new objective lens, Geelmuyden (1885a; 1885b) made another set of observations of AOe 11677 from 2 October 1883 to 17 November 1884. Over 30 nights he recorded 287 observations in right ascension and 283 observations in declination. The new parallax result for right ascension was about twice the value of the original one. The declination result compared nicely at 0.23 ± 0.04 arc seconds. Geelmuyden was never able to identify the cause(s) of the systematic errors.

The Hipparcos Satellite determined the proper motion of this nearby star (HIP 55360) as 2.9525 arc seconds at position angle 273.6°, and a parallax of 0.110 ± 0.001 arc seconds.

4.2 The Opposition of Asteroid Eros in 1900

Among the long succession of astrometry of comets and asteroids over the years, a special effort was made with the Merz refractor during the Eros opposition in 1900. The asteroid was observed on 49 nights from 14 October 1900 to 18 April 1901 with a filar micrometer. This was part of an international project with 58 observatories participating, to improve the solar parallax value by determining the diurnal parallax of 433 Eros. Professor Hans Geelmuyden (1902a; 1902b) and Assistant Astronomer Jens Fredrik Schroeter (1857–1927; Figure 13) made 787 observations in right ascension and 1064 in declination. The final analysis of the international dataset was made by Hinks (1910): the photographic data yielded a solar parallax of 8.807 ± 0.003 arc seconds, while the visual data, including the Christiania observations, yielded 8.806 ± 0.004 arc seconds.

4.3 The Afterlife

As the city expanded and buildings gradually surrounded the Observatory, the observing conditions also deteriorated. The Merz refractor was used for timing lunar occultations of stars (e.g. Schroeter, 1896a) and planets (Geelmuyden, 1898; 1900b), sometimes during lunar eclipses in order to include faint stars. Timings of solar eclipses were made six times until 1907, when there was also a transit of Mercury, and short reports were published in *Astronomische Nachrichten* (Geelmuyden, 1891b; 1899; 1900a; 1903; 1905; 1908).

In 1908 the Merz telescope was dismantled and the north dome was demolished in order to provide room for the new University Library. In 1920, when Jens Fredrik Schroeter became Observatory Director, he sent the Merz telescope and mounting to Munich to assess the costs of modernizing it. His plan was to mount it in the Observatory tower and dismantle the smaller Repsold refractor. The conclusion of G. & S. Merz G.m.b.H. was that the refractor might continue its service, but the mounting was considered mostly of historical interest. Modernization of the mechanics was not recommended; it would be less costly to acquire a new mounting. The refractor was returned to Christiania, but the mounting remained in store at the Merz workshops. It was later transferred to the Deutsches Museum, where it is used as a mounting on a Fraunhofer type wooden pillar for the Berlin 22-cm Merz which Galle used to discover Neptune (Fuchs, 1955). It is still on display (Figure 11).

5 MERZ SPECTROSCOPES, 1872

In October 1871 Fearnley ordered a spectroscope from Merz (1871a), who regretted a delayed delivery because many other observatories had also ordered them. The universal stellar spectroscope (Figure 14) was ready for delivery in May 1872. Merz (1872) explained that a delaying factor had been difficulties in obtaining prisms of good quality. The instrument arrived in Christiania during the summer of 1872 and the Observatory accounting book shows that Fearnley paid 240 gulden on 31 August 1872.

Another spectroscope was also received from Merz (Figure 15), but we have not found any correspondence that reveals the date of that acquisition. Merz continued to produce spectroscopes for several decades (Kost, 2015: 270).

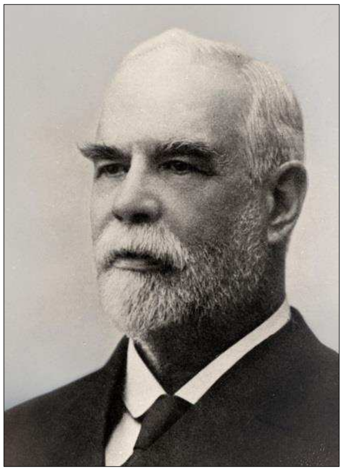

Figure 13: Jens Fredrik Schroeter (photograph: MUV).

Fearnley used the spectroscopes on the 12-cm Repsold-Merz equatorial refractor to observe the structure and dynamics of solar prominences. He adjusted the spectroscope to show the Hα-line (6563 Å) in the center of the field of view. The entrance slit was oriented perpendicular to the solar limb, and by moving the telescope, he could scan for prominences above the limb. By inserting a red filter to exclude background light from other parts of the spectrum, he opened the entrance slit to see the entire prominence. Fearnley published very little of these results, but a few drawings remain from what appears to have been a 3-year observing program. He observed both quiescent and eruptive prominences. His drawings were very detailed (e.g. see Figure 16), and he must have spent time patiently waiting for moments of good seeing to obtain such high-resolution results.

On one occasion, he noticed both a red and a yellow image of a prominence in the field of view (Figure 17). In the spectrum, he located a yellow emission line next to the Na D-lines. Today

Figure 14: A Merz universal stellar spectroscope (photograph: Bjørn Pettersen).

Figure 15: A Merz universal stellar spectroscope (photograph: Bjørn Pettersen).

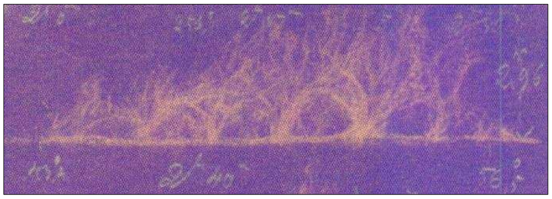

Figure 16: A group of quiescent prominences observed by C.F. Fearnley (photograph: Bjørn Pettersen).

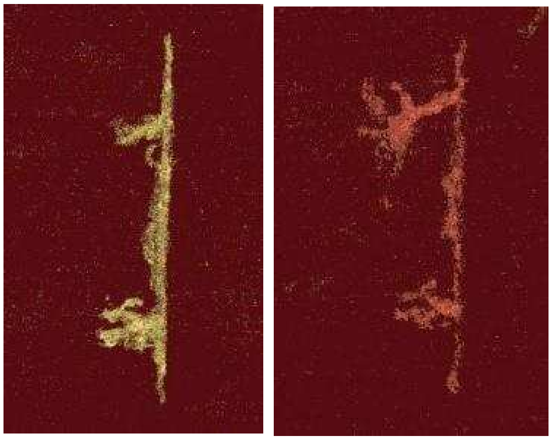

Figure 17: Drawing by C F. Fearnley of a prominence, in He D_3 (5876 Å) (left), and in Hα (6563 Å) (right) (photograph: Bjørn Pettersen).

it is labeled He D_3 (5876 Å), but at the time its chemical origin was not determined. Norman Lockyer had postulated in 1868 that a hitherto unknown element existed on the Sun. He called it helium. It would take almost three decades before the element was detected on Earth (see Nath, 2013).

Figure 18: The 13-cm Merz refractor on an equatorial mounting by C.H.G. Olsen (photograph: Bjørn Pettersen).

6 THE 13 cm MERZ REFRACTOR, 1882

Fearnley attended the General Assembly of the European Geodetic Arc Project (the forerunner to the International Association of Geodesy, or IAG) in Munich, Germany, on 13–20 September 1880. As the leader of the National Geodetic Arc Commission, he was the official delegate for Norway. During his stay in Munich, he visited the workshops of Sigmund Merz in Blumenstrasse 31 and ordered a tube assembly with an objective lens of 13.2-cm diameter and focal length of 195 cm. It had six eyepieces and a filter for solar observations. Two years later a letter from Merz (1882a) informed Fearnley that the telescope had been shipped to Christiania. The Merz account book (1882b) records a payment from Fearnley of 1236 mark on 24 November 1882.

Fearnley also ordered an equatorial mounting with clock drive from the Christiania instrument-maker Christian Holberg Gran Olsen in. The completed instrument (Figure 18) won a silver medal at the Christiania Exhibition in 1883, where it was on display in an observatory dome in the Exhibition Grounds in the Royal Gardens (Pettersen, 2004). A small entrance fee allowed the public to view the Sun during the daytime and the Moon and planets in the evening. It was a popular arrangement with an extra income for Mr Olsen. The telescope remained in its dome for more than a year before it was moved to its new residence in the east dome in the Observatory Gardens in November 1884. There it continued to serve the public once or twice a week, but this time at no cost. On clear evenings, the Observatory Custodian would show the Moon and planets, and lecture on astronomy to the visitors. This arrangement continued until 1934.

In addition to being the Peoples Telescope, it was also used for the occasional observation of lunar occultations (Fearnley, 1885; 1888), solar eclipses (Geelmuyden, 1891b; 1900; 1905; Schroeter, 1921) and transits of Mercury (Geelmuyden, 1891a; 1908). It is now in storage.

7 SUMMARY AND CONCLUDING REMARKS

The optics of four telescopes at the University Observatory in Christiania were delivered by Merz in Munich between 1840 and 1882. Two telescopes, the comet seeker and the 19 cm, were complete instruments with equatorial mountings. The other two instruments had mountings from Repsold and Olsen, respectively. A map (Figure 19) shows the locations of the three permanently mounted telescopes, in the Observatory tower, the east dome and the north dome. Today, office and apartment buildings occupy the sites of the latter two. Only the main building of the Observatory remains.

These telescopes were extensively used for classical astrometry of comets, asteroids and planets, in addition to time determinations of eclipses, occultations and transits of Mercury. Participation in international projects contributed to an improved value for the Astronomical Unit and the detection of a star with a large proper motion. It was shown to be nearby—albeit with numerical results suffering from systematic effects. The Merz telescopes were exclusively used for visual observations. Astrophysical observations were carried out in the 1870s, i.e. observations of solar prominences and of the morphology, spectroscopy and polarimetry of bright comets. For these investigations, the Merz universal stellar spectroscope was a key instrument.

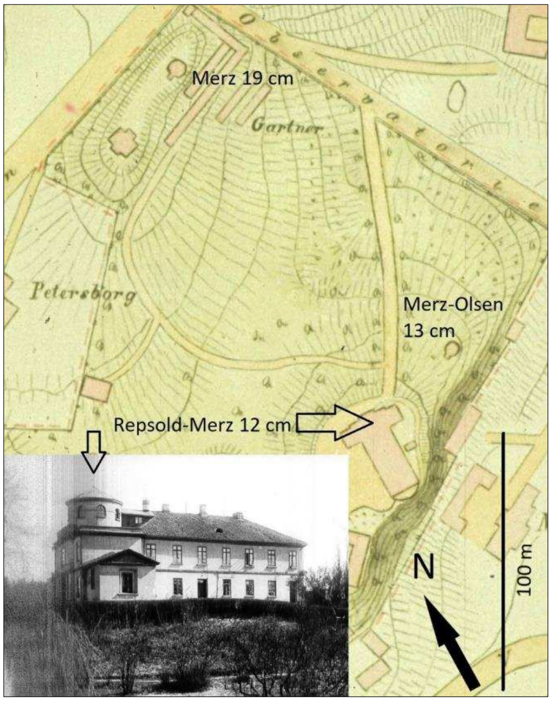

Figure 14: A map showing the Observatory's main building and telescope pavilions (photograph: Bjørn Pettersen).

Attempts to obtain funds for photographic equipment and even to relocate the Observatory outside of the city were never successful. The University Observatory was abandoned in 1934 when the astronomers moved to a new University campus that is now home to the Institute of Theoretical Astrophysics.

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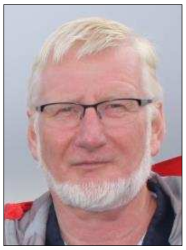

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