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Christopher Hansteen and the first observatory at the University of Oslo, 1815-28

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Abstract

A small observatory for astronomical and geodetic purposes was established in 1815, shortly after the University of Oslo came into being. The initial equipment came from the surveying community in Norway, but was rapidly supplemented by both new and second-hand instruments acquired from abroad. Several observing methods were employed to determine the geographical position of the observatory, and the results are re-analysed and compared in this paper. Providing correct local time to society was considered an important task, and this triggered the development of methods of time-determination suitable for an institution with limited resources. The first University of Oslo Observatory also became a site where geodetic techniques suitable for establishing an improved national geodetic net based on triangulation and astrogeodetic observations were developed. These activities led to the establishment of a new observatory at the University in 1833.

Keywords: *Christopher Hansteen, scientific instruments, latitude and longitude, time determination, geodetic surveying*

1 INTRODUCTION

The University of Oslo was created through a royal decree by Frederik VI, King of Denmark and Norway, on 1811 September 2. Decades of perseverance, repeated proposals and a successful fund-raising campaign with significant contributions from private Norwegian citizens (some of whom had received their academic training in Copenhagen) finally permitted undeveloped Norway to plan for a higher education programme. A detailed plan for the new Norwegian University was accepted by the King on 1812 March 24 and teaching began in 1813 June. This was very fortunate timing as Denmark had to turn over Norway to Sweden following the 1814 January 14 peace treaty in Kiel. A separate statement in the treaty obliged the King of Sweden to allow the future development of the University.

Although the plan listed the facilities required for the new University (including a library, museums and collections, laboratories and special lecture theatres, a botanical garden, and an astronomical observatory), only in 1833, nearly two decades later, would funds be allocated for the establishment of a permanent, fully-equipped observatory. In the interim period, Christopher Hansteen, a lecturer of applied mathematics at the new University, established a small observatory, making use of second-hand instruments then available in Norway. This first observatory introduced and established astronomy as an academic discipline at the University and became a development site for time-determination and geodetic operations.

In this paper, we review the work that was done at this first University of Oslo Observatory and re-analyse the observational results and compare them to modern values. We also discuss the current whereabouts of the original instruments, and trace their individual histories through information contained in documents and unpublished correspondence in a number of different European archives.

2 THE OBSERVATORY AND ITS INSTRUMENTS

Christopher Hansteen (1784-1873)[1] had been appointed lecturer of applied mathematics in 1813, and was offered a one-year stipend to study abroad before taking up the post. He returned to Oslo (then Christiania) in 1814 July by sailing an open boat from Denmark to Norway during wartime conditions. Upon arrival, he was required to lecture on introductory astronomy and physics. Employing a Troughton sextant and an Arnold chronometer (No. 132) borrowed from Jens Esmark, Professor of Mineralogy at the University, Hansteen used solar observations to determine the time (and to acquaint himself with astronomical observing techniques), finding to his surprise that the official local time in Oslo was incorrect by 45 minutes. He then suggested that regular observations should be carried out in order to maintain a local time service, and he also stressed the importance of determining the geographical co-ordinates of the new capital of Norway. The University responded positively to these recommendations, and provided funds for a small observatory.

Thus the University of Oslo Observatory was founded in the summer of 1815, and it was located on exposed bedrock on the southern shore of the harbour close to the Akershus fortress (Figure 1). It comprised a 5 m diameter octagonal building with an observation pillar, and housed a small transit telescope, a sextant, and a pendulum clock (Hansteen, 1822a).

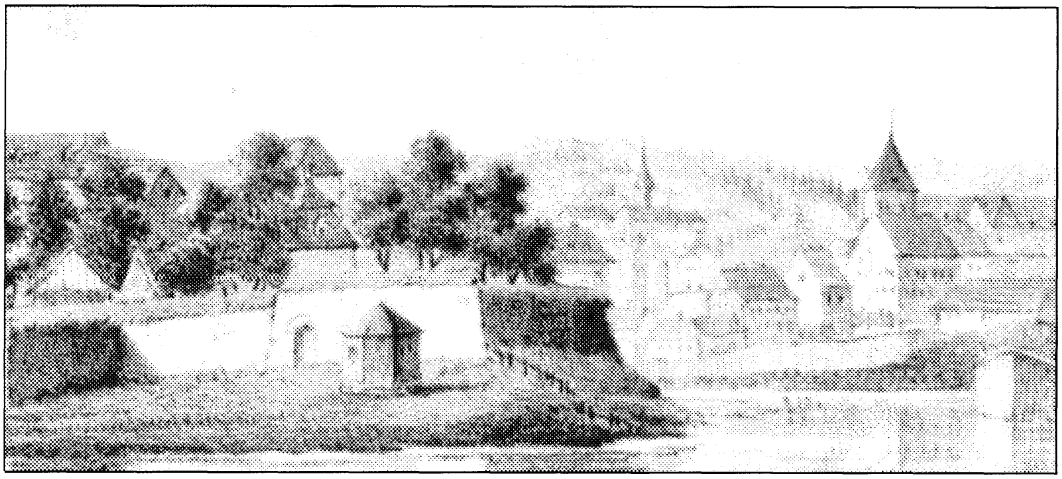

Figure 1. The first University of Oslo Observatory, as depicted in a lithograph by P E Wergmann.

The initial astronomical observations were made with Esmark's sextant and with a 35 mm diameter transit instrument that was made by Johan Ahl[2] of Copenhagen (Blankenburgh, 1973:4, Schalen *et al.*, 968:25). Due to its inferior performance, Hansteen replaced the latter instrument in 1815 August with an f/12 Sisson's transit instrument of identical aperture (Figure 2), finding this optically and mechanically excellent for its size (Hansteen, 1816). Esmark had

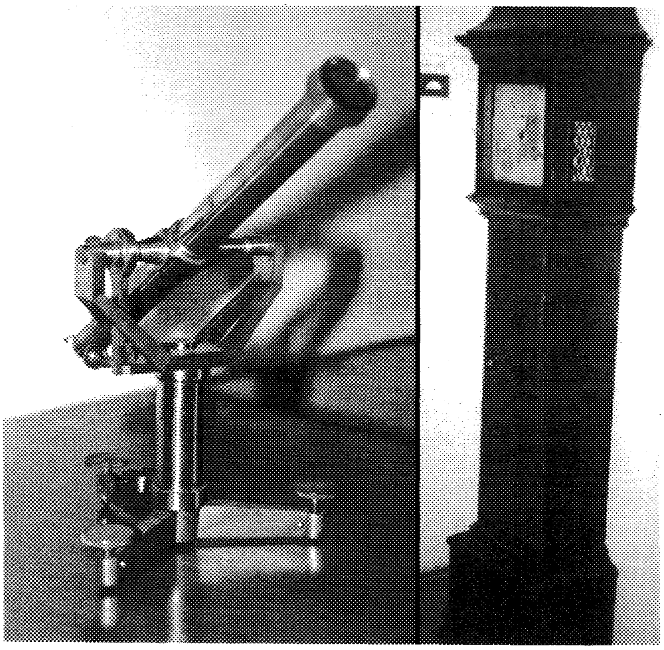

Figure 2. The transit instrument by Jonathan Sisson (left) and a pendulum clock by Abraham Pihl were initial core instruments at the Observatory.

acquired this instrument at an auction in London earlier in the year, and he sold it to the University upon returning to Oslo (see Esmark, 1815). After visits to observatories in neighbouring countries, Hansteen (1817a) concluded that by comparison his own small transit instrument had larger magnification, showed sharper images with less chromatic aberration, and mechanically performed much better than the others he had examined.

Meanwhile, a pendulum clock made by the Reverend Abraham Pihl (1756-1821), a Norwegian multi-talented innovator and scientist, was used to record time. Esmark had acquired it from the Pihl estate and lent it to the Observatory during its first three years of operation. This clock was replaced in 1818 by a pendulum clock by Jahnson of Copenhagen, which was loaned by the Geographical Survey of Norway.[3]

3 THE POSITION OF THE OBSERVATORY

3.1 Latitude

Geographical latitude was determined by repeatedly observing circum-meridian altitudes of the Sun (i.e. near the meridian) with a sextant furnished with an artificial horizon. Typically, a dozen measurements were made within a 15-minute interval. Time was determined by observing the meridian transit of the Sun or a bright star with the transit instrument, or with the sextant by applying the method of corresponding (i.e. equal) altitudes on either side of the meridian. The results of the two timing methods would usually not differ by more than 4-5 seconds.

The initial observations with the sextant did not achieve the expected accuracy. Hansteen (1822a) therefore selected a test area and compared relative angle determinations made with the sextant and with a geographical circle made by Johan Ahl.[4] His detailed investigations led to the conclusion that the scale of the divided circle on the sextant was in error, and it was then sent to Troughton in England to be re-divided. When the instrument returned in the summer of 1818, Hansteen started his latitude observations from scratch. Later that year someone broke into the Observatory, and some instruments were stolen and others were damage. The University then sent Hansteen to England to arrange the repair of the damaged instruments, and they also provided him with funds to purchase a good sextant from Edward Troughton (see Figure 3).

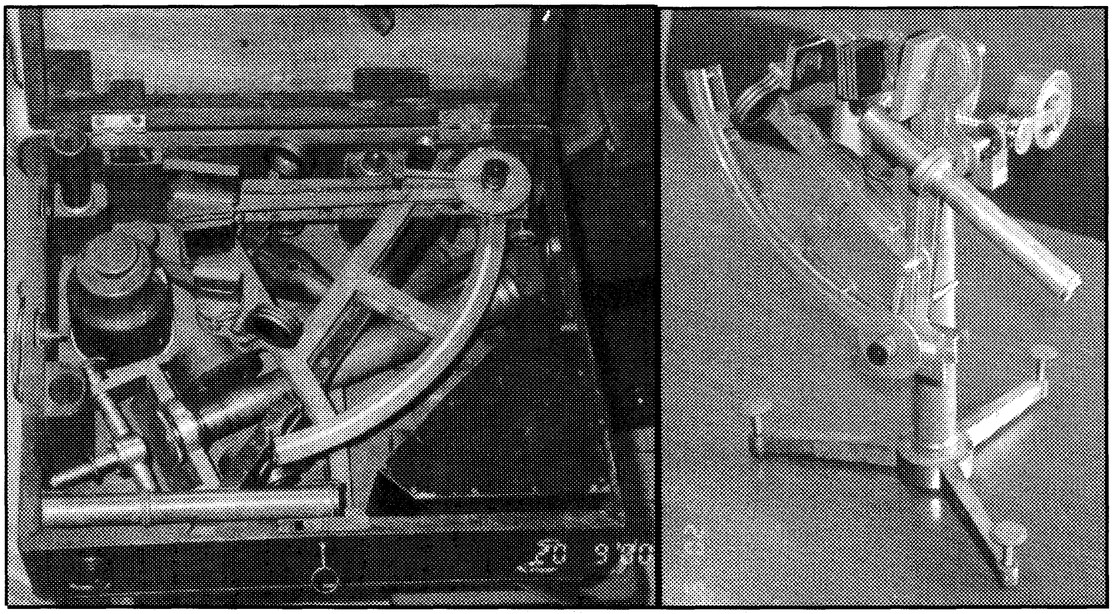

Figure 3. The sextant by Edward Troughton (No. 1385), acquired in 1819.

From three years of solar observations[5] made by Hansteen (1822a, 1823a) with the new sextant, we derive a value of $\varphi = 59° 54' 07''.2 \pm 3''.9$ for the latitude of the Observatory. During the autumn of 1821 Hansteen repeatedly observed α UMi, obtaining $\varphi = 59° 54' 03''.7 \pm 2''.4$. Sidereal time was determined before and after the α UMi observations by observing the altitude of α Lyr.

In 1817, Hansteen (1817b) had requested the advice and assistance of his colleague at Copenhagen University, Professor Heinrich Christian Schumacher, in acquiring an astronomical theodolite. Schumacher (1817) visited instrument makers in Munich that summer and reported to Hansteen that Reichenbach had agreed to finish the instrument by the summer of 1818. The delivery was delayed several times, and at the end of 1821 Schumacher (1821) was so embarrassed that he decided to sell Hansteen the best universal instrument at his own observatory in Altona (Figure 4). It had been made by Reichenbach some years earlier, and was used by Schumacher in 1815 to determine the latitude of Copenhagen (Repsold, 1918). The two vertical circles had diameters of 27 cm and the horizontal circle was 36 cm, while the refracting telescope had an objective lens with a diameter of 46 mm, a broken optical axis, and a focal length of 50 cm. Hansteen had used this instrument during a visit to Schumacher's observatory in 1820 so he knew he was being offered a high–quality instrument, and his reply to Schumacher immediately reveals this:

> Your very nobleminded offer ... caused me great joy; in my current situation I really need your instrument far more than I need a theodolite ... If you can really bear to separate yourself from this beautiful instrument, then send it as soon as the first ships arrive from Christiania ... but I can easily conceive that you find yourself in the same position as a father of a delicate and well behaved daughter who's hand in marriage is proposed by a totally unknown man; the father fears that the delicate flower will wither by the coarse touch of rough hands, and his heart bleeds as he gives his consent. I totally respect this feeling and know I would have had it, perhaps to a degree that would require me to say no!... In my short paper you will find that I have treated my sextant delicately and I believe also sensibly, although I had never had my hands on a sextant before returning to Christiania. Of course there is a large distance from a sextant to a universal instrument by Reichenbach, but one should consider only the philosophy expressed. And I promise that if I were to succeed in obtaining the utmost performance the instrument has to offer, this will happen with no harm or rough treatment to the instrument. (Hansteen 1822b):

They agreed on a price of 1550 fl., and the instrument arrived in Oslo on the schooner *Fortuna* in 1822 May (Schumacher 1822). A series of daytime observations of α UMi made at the Observatory with this instrument in the course of the year produced a latitude of $\varphi = 59° 54' 08''.4 \pm 1''.6$.

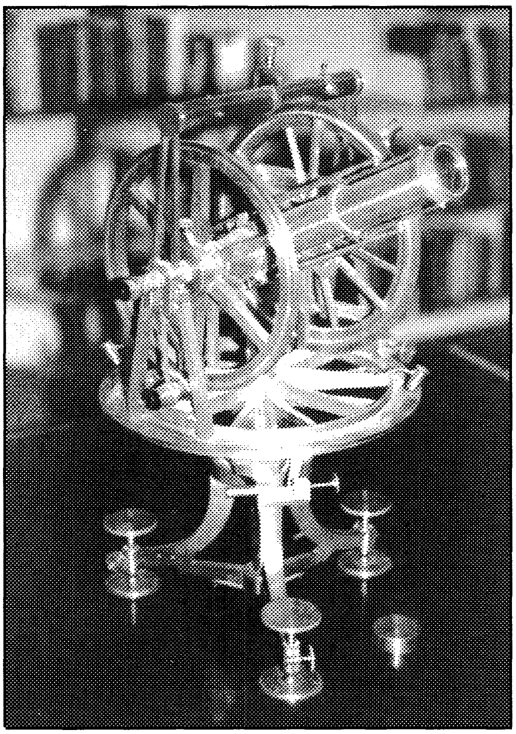

Figure 4. The universal instrument by Georg F Reichenbach.

3.2 Longitude

Longitude was determined by two different methods. The first involved timing of astronomical events from simultaneous observations at two sites. A measured difference in local sidereal time corresponded to the longitude difference between the observatories. Further connections to other observatories would eventually give the longitude relative to a reference meridian. Two centuries ago several such reference sites were used (e.g. Ferro, Greenwich, and Paris). The astronomical events observed were eclipses of the Sun, Moon, and the satellites of Jupiter, and lunar occultations of stars.

At the University of Oslo, The Physical Cabinet contributed a small Gregorian reflector (Figure 5) for these observations. It is a rare signed piece and one of very few remaining from the hands of Jesper Bidstrup, a Danish instrument-maker who spent several years in England in the 1790s. The brass tube is 102 cm long and 13 cm in diameter, and the mirror has a diameter of 12 cm. The University had acquired this telescope from the estate of Thomas Bugge, Professor of Astronomy in Copenhagen, when he died in 1815.

Figure 5. The Gregorian reflector by Jesper Bidstrup, *c.* 1790.

In 1826 Hansteen (1826) requested Schumacher's assistance to order a small Fraunhofer refractor with micrometer. Fraunhofer died that summer, but Schumacher knew that Dr Wolff of Hamburg had a 65-mm Fraunhofer telescope of 100 cm focal length for sale, which he agreed to sell for 212 fl. (190 fl. for the telescope and 22 fl. for the ring micrometer). A year later, after Hansteen (1827b) had received funding for his Siberian expedition, he collected the instrument while visiting Schumacher and brought it (Figure 6) back to Oslo, where he used it to observe lunar occultations (Hansteen 1827c, 1827d, 1827f, 1828b). The following year he took it on a two-year geomagnetic expedition to Siberia.

From Hansteen's observations of lunar occultations of stars between 1816 and 1827 we derive a longitude of $\lambda = 42^{m}\ 59^{s}.3 \pm 2^{s}.6$ east Greenwich, while the partial solar eclipses of 1818 and 1820 give $\lambda = 42^{m}\ 59\ ^{s}.9 \pm 3\ ^{s}.7$ east Greenwich. It is much more difficult to time partial solar eclipses than lunar occultations, where the star disappears abruptly behind the Moon's limb.

The other method of longitude determination involved transport of local time with a portable chronometer. In practice this required one or more chronometers that would run properly and precisely over several days. Local time was determined successively over several days by astronomical observations at the University of Oslo Observatory, in order to determine the clock drift. During the journey to a neighbouring observatory the chronometers were kept running, and upon arrival they were compared to local time derived from astronomical observations at the second site. This yielded the longitude difference directly, but the only control of clock behaviour would be a continued measuring of its drift. Obviously, a number of error sources could affect the result. Travelling on land was slow due to variable road conditions and the chronometers were frequently exposed to external forces. Travelling at sea took between 3 and 5 days from Oslo to Copenhagen. The temperature and humidity during the journey might differ from the observatory conditions and would affect the result by an unknown amount, as would the ship's movement.

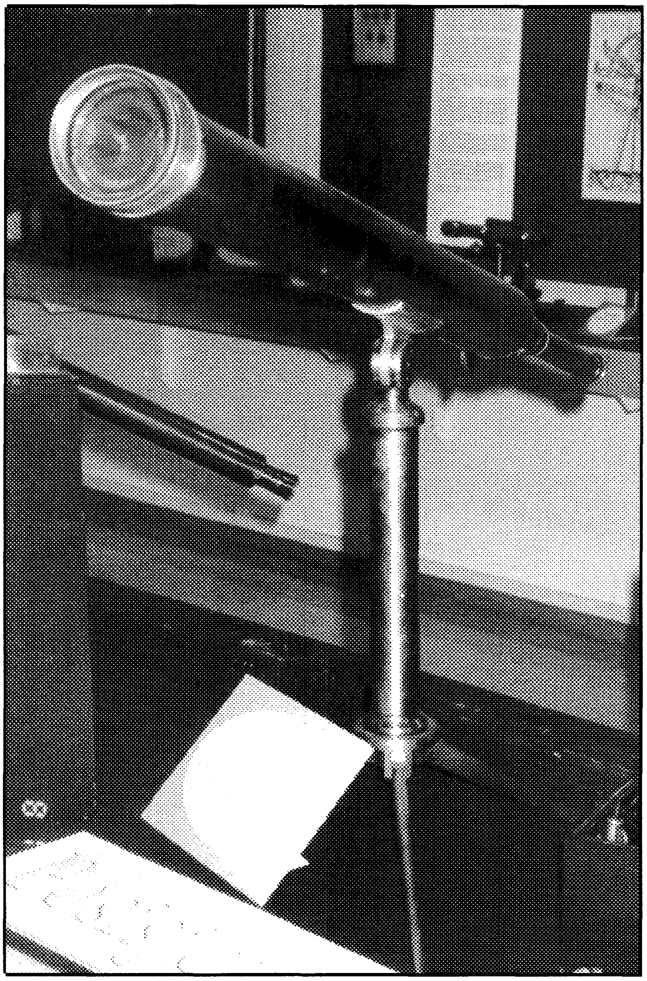

Figure 6. The small achromatic refractor by Joseph Fraunhofer, acquired in 1827.

In 1816 August, Hansteen travelled to Stockholm taking the Arnold chronometer with him. He determined the longitude difference between Stockholm and Oslo to be $\Delta\lambda = 29^m\ 16^s.1$ (Hansteen 1822:177). Using modern calibration numbers to eliminate all errors except those connected to the original observation, the derived longitude of the Observatory in Oslo is $\lambda = 42^m\ 57^s.9$ east Greenwich.

In 1817 August and 1822 July Hansteen (1822:156, 1823b:78) took the chronometer to Copenhagen by sailing ship and found longitude differences of $\Delta\lambda = 7^m\ 18^s.6$ and $\Delta\lambda = 7^m\ 17^s.9$, respectively. A repeated effort by steamship in 1827 (Hansteen 1828b: 472) with three different chronometers (Figure 7) and measurements made in both directions of the journey gave a mean of $\Delta\lambda = 7^m\ 21^s.8$. If we combine these results by giving equal weight to each chronometer per journey, the derived longitude of the Oslo Observatory is $\lambda = 42^m\ 57^s.9 \pm 1^s.6$ east Greenwich.

Hansteen's results compare well with modern values. Using his surveying results and old maps of Oslo I have been able to locate the site of his Observatory. My own GPS observation at this location on 2001 December 3 yielded a geodetic latitude of $\varphi = 59°\ 54'\ 11''$ N and a longitude of $\lambda = 10°\ 44'\ 28''$ E. A corresponding observation at the old Observatory meridian in Stockholm on 2001 October 17 implies a longitude difference of $\Delta\lambda = 7°\ 18'\ 49'' = 29^m\ 15^s.3$, which can be compared to Hansteen's value of $\Delta\lambda = 29^m\ 16^s.1$. After appropriately correcting for the deflection of the vertical, I derived a geographical position of $\varphi = 59°\ 54'\ 8''.5$ N and $\lambda = 10°\ 44'\ 46'' = 42^m\ 59^s.0$ east of Greenwich from the GPS observation at the University of Oslo Observatory site. Referring to Table 1, the modern position is closest to the latitude determined with Reichenbach's universal instrument and the longitude determined from lunar occultations. The other techniques contributed results that deviate from the modern value by factors of 1-2 of their respective standard deviations.

Table 1. Geographic coordinate determinations

Latitude

Sextant	Sextant (α UMi)	Reichenbach	GPS
59° 54′ 07″.2	59° 54′ 03″.7	59° 54′ 08″.4	59° 54′ 08″.5

Longitude

Occultations	Eclipses	Stockholm	Copenhagen	GPS
$42^m\ 59^s.3$	$42^m\ 56^s.9$	$42^m\ 57^s.9$	$42^m\ 57^s.9$	$42^m\ 59^s.0$

4 DETERMINATION OF TIME

The pendulum clocks and chronometers available in early nineteenth century Norway were partly of local origin and partly imported from nearby European countries. The quality varied dramatically, and local time throughout the country was often grossly in error. Accurate local time was determined astronomically only at the University of Oslo Observatory and in Bergen. When Hansteen (1855:9) compared time as determined from sextant observations of the Sun in 1815 with public clocks in the capital (e.g. those in church towers), the deviation was as large as 45 minutes. He responded by regularly providing time corrections determined from astronomical observations so that all clocks in Oslo would be consistent and show correct time. He also offered chronometer corrections to ships' captains to ensure accurate starting and ending points for their navigation. This activity was a forerunner to a more general time service, which was initiated at the University's second observatory in 1833 when a time ball was introduced.

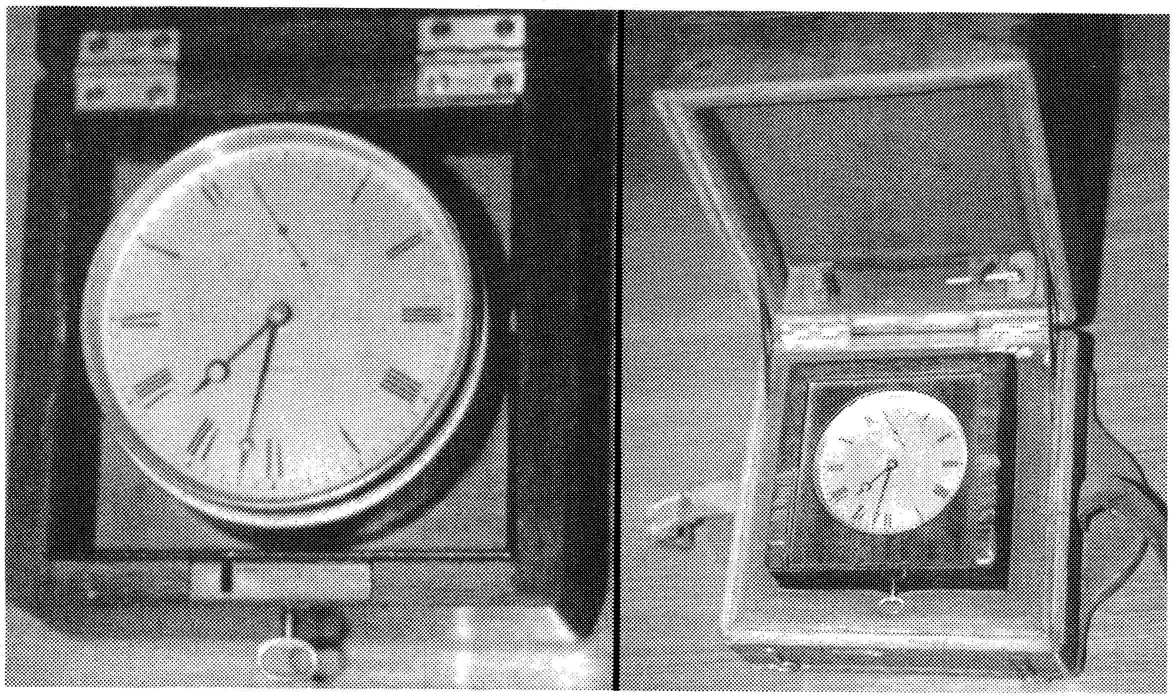

Figure 7. The Kessels No. 1259 chronometer that was used on the expedition between Oslo and Copenhagen in 1827.

Hansteen initially used the transit instrument for time determination, and these observations are discussed in his 1816 letter to Schumacher and in an unfinished text book on spherical astronomy that he was working on in about 1824. Accurate alignment of the transit instrument with the local meridian was essential, and over the years Hansteen was able to improve this by observing successive upper and lower culminations of circumpolar stars. In 1816 January his observations of β and γ UMi indicated that the transit instrument pointed 57″ and 63″ east of the meridian, respectively. Further adjustments led to an extended observing series of upper and lower culminations of α UMi in 1816 December, whereby the alignment was improved to 3″ west. Daytime transit observations of bright stars with known right ascension would provide the time directly. The alignment of the transit telescope was monitored by utilizing a meridian marker.

Due to the limitations of a meridian transit, Hansteen soon began investigating methods to determine time from non-meridian observations. He extensively employed the method of corresponding (i.e. equal) zenith distances of the Sun to determine the time with a sextant. In principle, this involves recording the time when an astronomical object of known declination reaches a given value of zenith distance and comparing it to the computed hour angle for the observing site. When more than one observation is made, the combined derivation of the average hour angle becomes non-trivial because the zenith distance does not change linearly with time. Hansteen (1827d, 1827e) developed a method of time determination which involved using a sextant to observe a series of zenith distances, separated by a fixed change (e.g. 10′) between each recording of the time. The relationship between the hour angle and zenith distance was expressed as a Taylor series, and the appropriate formulae were derived. This method was used to complement and validate time determinations derived from transit instrument observations at the Observatory, and it also proved to be efficient and practical during field expeditions.

When Hansteen received the Reichenbach universal instrument in 1822 he realized that a new approach to time determination could be implemented. Due to lack of space at the University Observatory he removed the transit instrument and installed the universal instrument. He would no longer benefit from the distant meridian marker, which was only visible in daylight. Hansteen (1824a, 1824d) thus began employing the pole star α UMi as a reference since it always appears near the meridian. The telescope would be pointed at α UMi and locked at its azimuth while a new zenith distance would allow timing the transit of another bright star through the same vertical plane. The difference in celestial coordinates and the measured time interval yielded the hour angle at the transit of the latter star. This observation would only take a few minutes and effectively eliminated error sources related to the mechanical properties of the instrument when repeated for several programme stars. The method was equally useful during the day and at night. Hansteen (1828c) derived the basic equations from spherical trigonometry and developed mathematical approximation formulae that simplified the practical computations relative to the exact case. He also discussed the effects of instrument imperfections on the accuracy of the final results and devised the observing strategy necessary to correct for them. Hansteen's paper (ibid.) prompted Bohnenberger (1828) to consider alternative derivations and compare the accuracy obtained by each approach.

5 GEODETIC OPERATIONS

On 1816 May 15 the King of Sweden and Norway ordered that a joint plan for the national surveying of the two countries should be drawn up. At about this time Hansteen detected contradictory results in the triangulation work of the Geographical Survey of Norway (which was then under military command), and on 1817 May 20 he was appointed Co-director of the Survey with the specific responsibility of analysing and evaluating the precision of all previous and future geodetic observations conducted in Norway. He soon began to influence the joint surveying plan, insisting that astronomical positioning and geodetic triangulation were employed in all future work. This also included determinations of the azimuth angle of selected triangle sides for the purpose of accurate orientation of a geodetic net. At this time Hansteen (1816) was investigating the cause of his own contradictory results for the position of the University of Oslo Observatory, and he was unable to suggest an accurate position. Instead he had to accept that the prime meridian for Norway would continue to be referred to the flagpole of Kongsvinger fortress[6] rather than to the University's Observatory. Finally, his experience during the chronometer expedition that summer to determine the longitude difference between Oslo and Stockholm encouraged him to propose that astronomical observations should be introduced as a control of the planned connection of the geodetic networks of the two countries.

The King approved the joint surveying plan on 1817 December 2 and the following summer Hansteen initiated a triangulation project to connect the geodetic nets of Norway and Sweden. With no theodolites available, the measurements had to be made with a geographical circle divided to 1 arc minute and made by Johan Ahl in 1779. The triangulation work was carried out by Svend Stenersen Collin, an army officer first assigned to the Survey in 1810, and took the best part of two summers. In 1818 it extended from Kongsvinger to the University of Oslo Observatory, and in 1819 from Oslo to the Norwegian-Swedish border near Halden. No separate length measurements of triangle sides were made. Rather, the scale of the geodetic net was based on average values for two triangle sides as determined from previous baseline measurements on frozen lakes during the winters of 1780-1782. The azimuth angle of the starting side from Kongsvinger flagpole was not very accurate either, so the derived length of the final triangle side near the border deviated significantly (175 m) from its accurate value determined locally, yielding a relative error of 1:65. Hansteen realized that new instruments were needed, and this triangulation effort was the final one in Norway with a geographic circle.

In 1817 Hansteen had ordered a 20 cm diameter astronomical theodolite with a 35 mm objective lens from Reichenbach, but delivery was delayed until 1823 (Figure 8). This instrument, which is currently on display in the museum section of the Norwegian Mapping Authority, was paid for by the University, and Hansteen (1824e) was eager to demonstrate its performance in an attempt to release government funds for similar acquisitions by the Geographical Survey of Norway. In a demonstration surveying project he determined the position of the University Observatory relative to permanent buildings in Oslo and surrounding hills (Hansteen 1824c). He established a scale by measuring a baseline of 760 m on the frozen Oslofjord directly south of the Observatory,[7] and from its end points he measured directions to church towers and hilltop cairns (Hansteen 1824b).

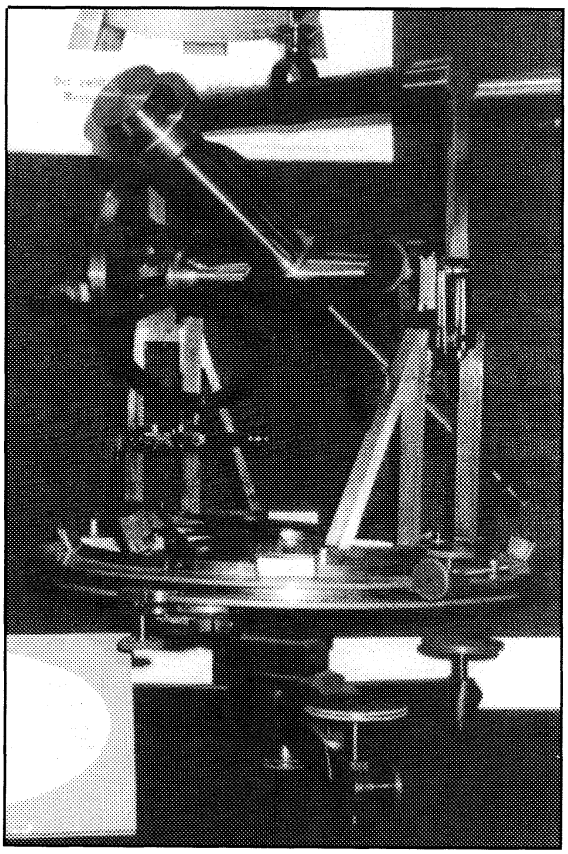

Figure 8. The astronomical theodolite by Reichenbach, 1823.

The results impressed the Government and that summer Hansteen (1824e) received permission to order two new theodolites from Ertel. They were divided to 10 arc seconds and an experienced observer could estimate to one arc second with an eyepiece and vernier. Hansteen wrote a detailed observing manual for the surveyors of the Geographical Survey of

Norway, and he arranged for Theodor Broch, an Army officer with the Survey, to measure a longitudinal arc of triangles between Femunden and Bygdin in 1826 and 1827 in order to investigate the precision obtained in a first order geodetic net. Suitable mountaintops above the forest line were selected as observing stations to ensure uninterrupted line of sight. Cairns separated by several tens of kilometres were put up to serve as observing signals. The distance between two particular mountaintops had been determined by a series of expanding triangles, starting from a baseline measured on the frozen Lake Femunden in 1782. This rather imprecise value was used to establish the scale of the test net. The orientation of the net was determined by an existing somewhat inaccurate 1782 astronomical observation of the azimuth angle of the direction between two selected mountaintops. This effort represents the first triangular arc determined by theodolite in Norway. A mercury barometer was tested as a height determination device during this pilot project, and was standard procedure for several decades to follow.

6 CONCLUDING REMARKS

The first University of Oslo Observatory existed from 1815 to 1828, and served as a training facility for Hansteen and his assistants in astronomy and geodesy. Through it, Hansteen learnt the value of possessing first-class scientific instruments, and the endless labour and frequent loss of results which could occur if forced to work with low-quality equipment; as a result, he always strove to obtain the best instruments available at the time. The Observatory also became a development site for techniques of time determination and geodetic surveying, thus directly affecting time-keeping in the capital and surveying and mapping of the young nation. Eventually the geographical position of the Observatory was better determined than that of the nation's official prime meridian.

In 1828 Hansteen departed on a geomagnetic expedition to Russian Siberia, and when he returned in 1830 the University provided funding for a new, larger, and even better-equipped Observatory. Construction started that summer and Hansteen moved in three years later. Eventually the location of this new facility would become known with even greater precision than its earlier counterpart, and only then was the position of the nation's prime meridian transferred to the University's Observatory.

7 NOTES

1. Christopher Hansteen had studied at the University of Copenhagen and won a gold medal for a treatise on geomagnetism. He expanded this work and published it in a book titled *Untersuchungen über den Magnetismus der Erde (Investigations of Terrestrial Magnetism)* in 1819. This immediately gained him an international reputation. Three years later he was able to announce in *Astronomische Nachrichten* that the King of Sweden and Norway had agreed to fund an expedition to Siberia to investigate the reality and whereabouts of a second magnetic pole on the Northern Hemisphere (Hansteen, 1822a). This two-year expedition occurred in 1828-1830. Terrestrial magnetism remained Hansteen's primary interest and research topic throughout his career. Hansteen was promoted to Professor in 1816, and by this time was already the editor of the official Almanac of Norway (1815-1862). In 1817 he took up the (part-time) position as Co-Director of the Geographical Survey of Norway, a post which he held till 1872. He was appointed to the National Commission for Weights and Measures in 1818, and served on this body for 55 years. In 1823 he began publishing the *Magazin for Naturvidenskaberne* (*Journal of Natural Sciences*) with two other professors, thus creating a forum for science news and original papers. The following year he was a co-founder of a scientific society in Christiania, which served as a precursor to the Academy of Sciences. Hansteen taught mathematics, mechanics, geodesy, and astronomy to the cadets of the Norwegian Military Academy between 1826 and 1849, and he authored several textbooks in these fields. He also founded the University's second Observatory, in 1833, and remained its Director until 1861.
2. This transit instrument, which was manufactured in 1783, has a focal length of 95 cm and is equipped with a levelling tube and a small vertical half-circle. It is on display in the museum section of the Norwegian Mapping Authority.
3. The involvement of the Geographical Survey of Norway, then a military unit, was secured by the personal interest of its Director, Major Benoni Aubert. On 1813 December 17 he

had submitted a proposal to Copenhagen for funds to establish a small observatory at Akershus fortress in Oslo, the office location of his institution. The proposal stated that the Geographical Survey of Norway already possessed suitable instruments, but that they were stored and unused due to lack of proper housing. Aubert argued that an observatory was needed for the astronomical determination of the position of the capital and for the continual training of young officers in preparation of their geodetic field surveying in the summer months each year. The proposal was never considered because Norway was separated from Denmark in the peace negotiations in Kiel one month later. Christopher Hansteen revitalized the proposal in early 1815 as a University of Oslo project, and was supported with instruments and the site by Aubert. Two years later, Hansteen was appointed a Co-Director of the Geographical Survey of Norway, in charge of astronomical and geodetic surveying. He trained and supervised young officers who carried out the observations in the field.

4. This circle, which was made in 1779, has a diameter of 46 cm, and its two telescopes have objective lenses with diameters of 18 mm and focal lengths of 56 cm. It is on display in the museum section of the Norwegian Mapping Authority.
5. Most of the observations were made in the garden outside Hansteen's residence, about 1½ km north of the University Observatory. At first the observations were carried out at the Observatory, but Hansteen found it time-consuming to walk back and forth on observing nights, especially since what promised to be a clear night was often interrupted by a rapid change of weather and the effort was wasted. Moreover, the Observatory was accessed via a locked gate in the Akershus fortress wall (see Figure 1) and Hansteen had to request the key from the guard house at the main gate of the fortress, but in winter often he found his own gate impossible to open because it was blocked by solid ice (Hansteen 1855:10). After a few years of frustration he began observing in his own garden. Local surveying (Hansteen 1823a, 1824c, Hansteen and Fearnley 1849:7) revealed this site to be 49″.6 north of the Observatory and 4″.7 west of it. The observations at the two sites may thus be combined for a corresponding estimate of the latitude of the Observatory.
6. This flagpole was chosen for the location of the prime meridian of Norway in 1773 when the Danish-Norwegian army began surveying and mapping the areas along the Norwegian-Swedish border.
7. In fact, the field work was carried by an army officer, Captain Nils Arntzen Ramm (permanently assigned to the Geographical Survey of Norway from 1818 to 1832), assisted by three young lieutenants from the Norwegian Corps of Engineers, using four equally long rods of pine with flat iron ends. Hansteen (1824b) calibrated the rods (total length = 20.0073 m) using a metre standard by Fortin in Paris. Thirty-eight rotations of the four rods imply a baseline length of 760.277 m. Two full measurement operations produced a difference of 2 mm.

8 REFERENCES

The following abbreviations are used:

SB = Staatsbibliothek zu Berlin

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