Aurorae Borealis Studia Classica

Vol. II

Om Nordlysets Perioder / Sur les périodes de l'aurore boréale (1882)

by Sophus Tromholt

digitized by UiT, with a biographical introduction
and summary of contents by Kira Moss

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- The editor

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SOPHUS TROMHOLT (1851–1896)

Biographical introduction
by Kira Moss

Sophus Peter Tromholt was born on 2 June 1851 in Husum (at that time Danish, now a German town in Schleswig-Holstein). Tromholt started writing about the northern lights already at the age of nineteen, with a series of articles in the Danish newspaper *Dags-Telegraphen*; his first scientific paper on the phenomenon came out in 1873. Having grown up in Husum, Oldenburg, and Randers, Tromholt moved in 1868 to Copenhagen to receive formation as a schoolteacher. After several years of teaching in Denmark, he moved to Bergen in Norway, where he worked as a teacher from 1875 to 1882 at Tank's School. At the same time he wrote several articles on the aurora. From 1882 Tromholt quit teaching to concentrate fully on his interest in the phenomenon. Thanks to funds from among others I.C. Jacobsen in Copenhagen, he was able to manage a polar station in Kautokeino/Guovdageaidnu during the International Polar Year 1882/83. Tromholt's station in Kautokeino made observations corresponding to observations at the official Norwegian station in Bossekop. Tromholt later embarked upon an expedition to Reykjavik (1883/84) to test theories that had been put forward by Finnish physicist Selim Lemström (compare *Aurorae Borealis Studia Classica*, vol. III). In 1887, he left Norway and went to live in Germany. He subsisted as a writer and lecturer in astronomical subjects for about a decade, until he died in Blankenhain in Germany on 17 April 1896, at the age of 44.

Among Tromholt's works on the aurora borealis the following are particularly noteworthy. In a methodological paper in the journal *Archiv for Mathematik og Naturvidenskab* ['Archive for Mathematics and Natural Sciences'] (1882), he discusses the problem of measurement of the height of the aurora. He also drew a star atlas for use during observation of northern lights and published a bilingual paper on the periodicity of the northern lights, *Om Nordlysets Perioder / Sur les périodes de l'aurore boréale* (Copenhagen 1882). In 1885, he published a popular account of his Kautokeino expedition, *Under the Rays of the Aurora Borealis – in the Land of the Lapps and Kvæns* (London 1885; Danish version: *Under Nordlysets Straaler – Skildringer fra Lappernes Land*, Copenhagen 1885). In this book, Tromholt tells about his experiences in Northern Norway, his observations of Sami people and their culture and his considerations about the nature and cause of the northern light. Tromholt is today known for his fine portraits of Sami people, many of which were included in this book. He also published several textbooks on natural science, as well as riddle books.

During his residence in Bergen in the 1870s and 80s, Tromholt collected a large number of contemporary auroral observations through questionnaires. The resulting material furnished him with data for the present work on the periodicity of the northern lights, with the full title *Om Nordlysets Perioder (efter Iagttagelser fra Godthaab i Grønland) / Sur les périodes de l'aurore boréale (d'après des observations faites à Godthaab en Groenland)* ('On the Periods of the Aurora Borealis, on the Basis of Observations Made in Godhaab [Nuuk], Greenland'). The 60-page article was issued as an offprint from the yearbook of the Danish Meteorological Institute for the year 1880 (*Meteorologisk Aarbog for 1880 / Annuaire Météorologique pour l'année 1880*, published 1882).

Bibliography

Moss, Kira & Peter Stauning: "Sophus Peter Tromholt: an outstanding pioneer in auroral research", *History of Geo- and Space Sciences* vol. 3, issue 1 (2012): 53–72. https://doi.org/10.5194/hgss-3-53-2012

Moss, Kira & Peter Stauning: *Sophus Tromholt: "Skæbnen og nordlyset er jo lige uransagelige".* Copenhagen: Forlaget Epsilon, 2012.

Portrait of Sophus Tromholt. Courtesy of Tromsø Geophysical Observatory, UiT

OM NORDLYSETS PERIODER / SUR LES PÉRIODES DE L'AURORE BORÉALE

Summary of Contents
by Kira Moss

The article provides an analysis of observations of northern lights made by Samuel Kleinschmidt in Godthaab (Nuuk) during the years 1865–80. Tromholt's analysis shows the opposite relation between sunspot activity and northern lights in the polar region than the one found in the temperate zone. He concludes that the northern light oval moves north and south during the course of an eleven-year period, a yearly period, and a daily period. The original has no chapter headings; these have been supplied here in [brackets].

[Preface] (p. I)

Preface, signed N. Hoffmeyer, January 1882. The director of the Danish Meteorological Institute, Niels Hoffmeyer accentuates Tromholt's strange results, which he considers to be particularly promising in view of the establishment of a system of observers in Northern Europe led by Tromholt.

[Introduction] (pp. III–IV)

Sophus Tromholt's own introduction, signed August 1882. He describes the great accuracy by which Kleinschmidt has observed the northern lights and expresses gratitude to Hoffmeyer as well as Professor T.N. Thiele.

[On the periods of the northern light] (pp. V–VII)

Tromholt begins with the surprising result that the northern light in the polar belt does not follow the same periodicity as in the temperate zone, but shows a contrary periodicity. The data set of Kleinschmidt runs from September 1865 to May 1879. Tromholt has also used results from September 1879 to April 1880, but only occasionally. **Tab. 1** shows the monthly number of northern lights during the fifteen years in question. The table shows no accordance between the northern lights in Godthaab and sunspots or northern lights in the temperate zones.

[Northern lights and clouds] (pp. VII–XVII)

Tromholt goes through the factors with direct influence on the visibility of the northern light and concentrate on the clouds. In general, one can say that the number of observed northern lights is inversely proportional with the quantity of clouds. Hereafter follows the calculation of a registered average of the quantity of clouds in the single years (**Tab. 2**) and a mean for the year 1877/78 (**Tab. 3**), calculated for each month. Tromholt notes that Weyprecht argues that months with a large quantity of clouds have a large number of northern lights and that it therefore is possible to assume a connection between the clouds and the northern lights. However, Tromholt finds the opposite result for the Godthaab observations. In **Tab. 4, 5 and 6**, Tromholt gives the monthly quantity of clouds and the monthly number of northern lights. **Tab. 7, 8 and 9** shows the same, but calculated on a daily basis. **Tab. 10** shows the yearly number of northern lights, the yearly quantity of clouds, the number of northern lights calculated on the basis of the quantity of clouds, and the relative figures for sunspots as calculated by Professor Rudolf Wolff. This table shows that in years with many sunspots there are fewer northern lights in Godthaab, than at the sunspot minimum. Tromholt proceeds to analyse material from the ”Collectanea Meteorologica sub auspiciis Societatis scientiarum Danicae edita, Fasc. IV”, and finds in **Tab. 11 and 12** the same result, just a little more uncertain. Tromholt has examined Hermann Fritz’s observations from polar areas, but the yearly number of northern lights is so doubtful that it cannot be used. After this, Tromholt goes through a number of observations from Upernivik [Upernavik], Iviktut [Ivittuut], Jacobshavn [Ilulissat] and Sukkertoppen [Maniitsoq]. Especially the data from Jacobshavn confirms, in **Tab. 13**, the results from Godthaab as well as, in **Tab. 14**, the data from Iviktut. Furthermore, in **Tab. 15 and 16** Tromholt presents observations from Stykkisholm in Iceland, which yield the same pattern of results as the ones from Godthaab.

[Northern lights in the morning and at night with regard to the periods] (pp. XVII–XXVII)

After this follows a discussion of the relation between the morning northern lights and the evening northern lights in **Tab. 17 and 18**. By dividing morning and evening northern lights, Tromholt believes to be able to demonstrate an 11-year period. **Tab. 19** shows the morning northern lights, **Tab. 20** the evening northern lights. Both tables follow the 11-year period, with some deviation for the morning figures. Tromholt thereafter discusses the yearly period, by mainly looking at the evening northern lights. The result is seen in **Tab. 21–28**. The result is that the northern light in the polar areas shows a yearly maximum at winter solstice and no trace of a maximum at equinox, in contrast to the temperate zone. Tromholt does not find that there exists single days with a distinct number of northern lights.

[Description of Kleinschmidt's method of registration] (pp. XXVIII–XXXI)

Tromholt describes in detail the method used by Kleinschmidt to register the types and phases of the northern light. He also discusses a remark by Kleinschmidt, about the northern light showing itself most often on the southern sky, especially between South and South-Southeast. **Tab. 29** confirms this remark also in the cases of Jacobshavn and Upernivik.

[The movement of the auroral zone in relation to the direction of the northern light on the sky] (pp. XXXI–XL)

Tromholt continues with a discussion of Weyprecht's theory that the northern light zone moves north and south, so that it is more to the south at equinox and more to the north at winter solstice. Tromholt begins by dividing the northern lights into two groups, those that are seen on the northern sky or at zenith and those that are seen on the southern sky, **Tab. 30, 31 and 32**. These tables show that the relative frequency of northern lights seen directly above the observation spot or to the north follows a yearly period with two minima at equinox and a maximum at winter solstice. This is confirmed by data from Sukkertoppen, **Tab. 33**, from other places in Greenland as well as Stykkisholm in Iceland, **Tab. 34–35**. This confirms Weyprecht's theory. Moreover, Tromholt finds that at times when the evening northern lights are few, there are more northern lights on the southern sky, **Tab. 36**. He concludes that the northern light oval moves north during the night to reach its maximum some hours after midnight, and this is why one can see more northern lights late during the night the longer north one is at the time of observation. Tromholt thereafter looks at the relation between the morning and the evening northern lights during the years, **Tab. 37–39**. The result is that at sunspot minimum there are more northern lights in zenith or to the north on the sky; this brings Tromholt to the conclusion that the northern light oval moves to the north during sunspot minimum. The overall result is thus that the movement of the northern light oval can explain the contrast between the observations of many northern lights in Godthaab and other polar areas and the sunspots in the same periods, and at the same time help explain the daily and yearly periods.

[Periods according to type of northern light] (pp. XL–L)

Tromholt continues by looking at the single types of northern light and how they have been observed in relation to the periodicity of the northern light in general. First he looks at the frequency in the evening compared to that in the morning, **Tab. 40**, after this in connection with the 11-years period, and later according to the variation during the seasons. Tromholt concludes that also the types of northern light follow the periodicity, meaning that the

northern lights in the maximum have more vivid and spectacular forms than the northern light in the minimum, both in the 11-years period, and the yearly variation. A daily variation is hard to find from the data from Godthaab, even though Tromholt presents tables of this, **Tab. 41, 42 and 43**; upon consideration of these, he concludes that the auroral zone has a lateral movement also during the day.

[Connection with other meteorological phenomena] (pp. L–LV)

Tromholt looks at the connection between the northern light and various meteorological phenomena. With regard to the total quantity of clouds he has, as mentioned before, not found any relation. He does, however, perceive a relation to the quantity of Cirrus clouds, **Tab. 44**. Tromholt remarks that one is almost certain about the connection between Cirrus clouds and sunspots. The result is that the quantity of Cirrus clouds has a maximum and a minimum at the same time as the northern light in Godthaab, which is the opposite result in connection with sunspots compared to the one that has been found for lower latitudes. After this, Tromholt goes through various theoretical attempts to explain the contrast between high and low latitudes in connection with sunspots. He concludes, as elsewhere, that there is an auroral belt that moves with a certain periodicity; this, he remarks, is very likely to be valid for other meteorological phenomena as well.

[Final remarks] (pp. LV–LX)

The paper ends with a discussion of the theory of the movement of sunspots on the sun. Might possible currents on Jupiter be the result of sunspots? Tromholt accentuates that since the periods of the northern light are not similar all over the Earth, one must concede that the search for cosmic theories of the northern light are probably futile. Instead, he suggests that the northern light is a telluric phenomenon. He is convinced, however, that the time for a correct theory of the northern light has not yet come, as most of the laws that rule the phenomenon are still unveiled. The most important thing for the foreseeable future will therefore be to assemble ever more observations. Observation of the northern light is not easy; Tromholt knows examples of people that have seen no northern lights in periods and places where others have seen many. Nevertheless, he concludes from his own collected data that the northern light is such a frequent phenomenon that there will be a northern light almost every night. It is thus no longer remarkable that there is always a northern light when there are major magnetic perturbations, as said by François Arago, nor is it strange that there is polar light at the same time at the South and North Pole. The question about a connection between the telluric phenomena and the periodicity of the sunspots, still awaits its solution.

[Figures] (no pages)

Appended to the end of the article, there are eight figures (figure legends in translation).

Fig. 1
‘Sunspots and days with northern light (Tab. 10)’.

Fig. 2
‘Sunspots and northern lights (Tab. 15)’.

Fig. 3
‘Sunspots, morning and evening northern lights (Tab. 19–20)’.

Fig. 4
‘Yearly period of the aurora (Tab. 23–25)’.

Fig. 5
‘The yearly period of the northern light (Tab. 28)’.

Fig. 6
‘The yearly movement of the auroral zone (Tab. 30–32)’.

Fig. 7
‘The 11-year movement of the auroral zone (Tab. 37–39)’.

Fig. 8
‘Cirrus clouds (Tab. 44)’.