

EXTRACT FROM A REPORT ON THE NORTHERN LIGHTS EXPEDITION TO BOSSEKOP—STORE KORSNES IN THE SPRING OF 1913.

BY

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§ 1. *Previous expeditions, having for their object the taking of photographs of the Northern Lights for the determination of their height and situation.*

The expedition of 1913 was a direct continuation of that which I undertook to Finmarken in 1910, and it is therefore necessary to say some few words regarding its results. A detailed account was printed in the publications of the Videnskabselskabet for 1911.¹⁾ As is known, we were successful during this expedition in taking for the first time a number of photographs of the Aurora, the time of exposure being reduced to a few seconds. This result was partly due to the employment of an extremely luminous cinematograph lens *Ernemann Kinostigmat*, with a diaphragm of 25 mm and a focal length of 50 mm, and also partly to the use of extremely sensitive plates, *Lumière étiquette violette*. Several hundred successful photographs of the Aurora were taken. These single photographs gave a good impression of the many characteristic forms of the Northern Lights and were thus of considerable scientific interest. Of far greater importance, however, was the method of photographing and determining the height and situation of the Northern Lights which I employed for the first time during the expedition of 1910.

The method of procedure was to take simultaneous photographs of the Aurora with known stars as a background, from two stations connected with each other by telephone. From the time, and the parallax measured out on the plates, the height and situation of a number of points on the Northern Lights could be determined. We will call such »pairs« of pictures *photograms*. With a distance between the stations of 4½ kms., there were taken about 40 simultaneous photographs of the Northern Lights, and these gave about 140 determinations of height. Of these many were not certain, partly on account of the great height of the Aurora in relation to the selected base, and partly on account of its unfavourable situation in the heavens with relation to the position of the base line. In 1911, with a base of 27 kilometers (from Christiania to Aas) I succeeded in taking a number of photograms. My method was employed in the winter of 1912—

¹⁾ Bericht über eine Expedition nach Bossekop zwecks photographischer Aufnahmen und Höhenmessungen von Nordlichtern, loc. cit. Math. Naturv. Klasse 1911. No. 17, with 57 figures and 88 plates.

See also: *Sur les trajectoires des corpuscules électriques dans l'espace sous l'action du magnétisme terrestre avec application aux aurores boreales. Second mémoire, Troisième partie, Archives des sciences physiques et naturelles, Genève 1912.*

1913 by Dr. Kurt Wegener¹) on Spitsbergen (base 7 kilometers) and by Dr. Vegard and Krogness in Finmarken (base Haldde—Bossekop 12,6 km). An account of Dr. Wegener's expedition will be found printed in »Schriften der Wissenschaftlichen Gesellschaft in Strassburg, 21 Heft, 1914«. An account of Vegard and Krogness' Aurora measurements was published in the Videnskabselskabets Skrifter for 1914²).

§ 2. *The Expedition: Preparation and Equipment.*

In the account of the expedition of 1910 I concluded by suggesting a number of improvements for future expeditions. Such improvements were carried out as regards the expedition of 1913 on the basis of the experiences gained in 1910. A detailed account of these will be given in the following:

Photographic apparatus.

In order to make sure that the time was observed for each Aurora photograph, an improvement was introduced by photographing on the plate a picture of the illuminated watch, simultaneously with that of the Aurora. We could then subsequently at our leisure read the time, and obtain the time of exposure from the sector described by the second hand, or in the case of longer exposures by the minute hand. I employed this improvement as early as during the winter of 1910—1911 whilst photographing the Aurora at Christiania. The electric lamps for illuminating the watch, however, were in the case of the expedition of 1913 replaced by oil lamps protected against the wind by a tin case, for electric batteries proved to be unreliable in the cold. As our objective in the cameras we used that employed in 1910, the extremely luminous cinematograph lens Ernemann Kinostigmat, with an aperture of 25 mm. and focal length of 50 mm.

Cinematograph and prism objective arrangement.

The attempts that were made in 1910 to photograph the Aurora on a cinema film failed because the film employed was not sufficiently sensitive. In the meantime, Lumière et Fils succeeded in producing a new film of extreme sensitiveness. Experiments which I made with the latter showed that it was just as sensitive as the plates we had taken with us. I therefore decided to repeat the trials, and in that connection procured from Ernemann of Dresden a complete cinematograph equipment for taking the pictures. As will be mentioned later on, we succeeded in obtaining a number of cinematograph pictures of the Aurora. In order if possible to get some prism-objective pictures of isolated Aurora rays, I also took with me a prism with an angle of refraction of 60° to place in front of the kinostigmat lens. The selection of the kind of glass to be employed was made after conferring with Dr. Sliper at the Lowell Observatory, Flagstaff, Arizona, during my visit to that place in the summer of 1912. The height of the prism was 40 mm, length of side 80 mm. It was made by Zeiss of Jena, marked 0.3863 $v = 35.9$ and $n = 1.6223$. This prism almost doubled the time of exposure.

Slides and shifting boxes.

In order to utilize fully the short time during which the Aurora was revealed in its full glory, we provided ourselves with a large number of slides, of the type employed

- ¹) Dr. Kurt Wegener: *Das Polarlicht in Spitsbergen nach photogrammetrischen Messungen*, 35 pages with plates.
- ²) *Höhenmessungen des Nordlichts an dem Halddeobservatorium von Oktober 1912 bis Anfang Januar 1913*, loc. cit. Math. Naturv. klasse 1914, no. 11. See also L. Vegard et Krogness: *Résultats d'observations d'aurores boréales exécutées à l'observatoire de Haldde*, Comptes Rendus Paris, 23 octobre 1916 and Geofysiske Publicationer Bd. 1 No. 1.

in 1910. We took 48 with us, and at Bossekop by the courtesy of the director of the Halde Observatory, Mr. O. Krogness, we were lent 24 more, so that each station had 36 slides. In addition, I made for each station a shifting box. This was an ordinary wooden case with two round holes in one side. When the lid was shut, plates could be changed in the slides inside the box by inserting one's arms into the holes. This could be done in the open air, so that at the same time we could watch the development of the Aurora and stop the work if it were desirable to take new photographs. The openings for the arms were of black cloth furnished with elastic, so that the cloth fitted tight around the arms and no light entered the box.

Chronometer and watches.

In order to check the time, we had with us a chronometer marked Hohwü No. 639, belonging to the Astronomical Observatory, Christiania. As regards watches for placing in the cameras, we employed at Bossekop a watch belonging to Mr. Birkeland, meteorologist, marked N. W. Noodt, Trondhjem, and at Store Korsnes we used my watch. The latter for the sake of photography was furnished with a black surface which covered half the dial concentrically. The figures over the black surface were painted white, whilst those over the white surface were painted black, and we thereby secured greater chances of successfully photographing the figures.

Telephone arrangement.

In order to have our arms free when we took photographs of the Aurora, I procured bands for the telephone apparatus, so that the receiver could be fastened to the head, and also a breast plate so that the microphone was fastened to the chest by a ribbon around the neck in a similar manner to that employed by telephone operators. Connection with the field telephone apparatus was obtained by means of a wire four metres long.

Plates and development.

As regards plates, after the experiments in Christiania of 1910, we employed partly *Lumière étiquette violette* used on the expedition of 1910, and partly the *ultra rapid* from *Hauff Feuerbach*. They were developed on the spot by myself with the aid of Agfa hydrochinon-methol.

For the sake of completeness and to assist future expeditions I give below a list of articles taken to Bossekop and of those subsequently sent to us.

1. Camera with time registration in case, with strap to carry over shoulder. In the case there were also

Shutters	Oil lantern in tin case
Strips of paper	Tissue paper
Wash leather	Screw driver
Handle to camera	Note book and pencil
Wicks for lantern	Lid to opening in front of objective.
2. Stand for camera (1).
3. Camera with time registration in case, with strap to carry over shoulder. In the case there were also:

2 shutting strings	Strips of paper
Oil lantern in tin case	Wash leather
Screw driver	Handle to camera
Wicks for lantern	Watch
4. Stand for camera (3).

5. Light-proof case with 24 slides. In addition the case contained a number of empty boxes, and also chalk and a sponge. For use at Bossekop.
6. Ditto for use at Store Korsnes.
7. Field telephone with microphone and receiver as described above, for use at Bossekop.
8. Ditto for use at Store Korsnes.
9. Chronometer in case lent by the Observatory at Christiania.
10. Pocket spectroscope from John Browning, London, also lent by above.
11. Oil lantern in case for use at Bossekop.
12. Ditto for use at Korsnes.
13. Small magnifying glass for looking at Aurora negatives.
14. Two small collapsible tables.
15. 2 shifting boxes of kind described above.

We had with us the following plates, films, chemicals, etc.

1. Lumière étiquette violette 9×12 cms. in soldered tin boxes.
2. Ultra rapid, Hauff, 9×11 cms. in soldered tin boxes.
3. Developer in tubes (Agfa) (for all plates).
4. Fixing soda for all plates.
5. Measuring glass.
6. 16 empty bottles.
7. 2 knives for opening the soldered tin boxes.

For dark room work we had the following:

1. 2 dark room lanterns with yellow and red glass.
2. Extra cylindrical dark room lanterns.
3. 24 sheets of black paper.
4. 4 tubes of secotine.
5. 2 packets of stearine candles.
6. 3 large enamelled dishes for developing.
7. 4 small porcelain dishes for plates 9×12 cms.
8. Large lacquered wooden dish.
9. 2 glass funnels.
10. 1 enamelled iron funnel.
11. 5 stands for drying plates 9×12 cms.
12. 6 zink vessels for washing plates.
13. 2 porcelain vessels for stand development.
14. 5 glass boxes for fixing plates.
15. 12 sheets filter paper.
16. 2000 envelopes for negatives 9×12 cms.
17. 1 packet of purified cotton.
18. 1 box drawing pins.
19. Oil and petroleum for lanterns.
20. A measuring tape 23 meters long.

General survey of the work of the expedition at Bossekop and Store Korsnes.

As mentioned above, I was also as in 1910 accompanied on this occasion by my assistant, the meteorologist *Bernt Johannes Birkeland*.

Every evening when the weather was fine we went out, and as a rule continued our work of photographing the Aurora until early next morning. For the use of future expeditions I will give here a short account of the equipment and method of work at each station.

At the Bossekop station we had the following for field work:

Camera	Prism objective	Cinematograph
Slide case containing	36 slides filled with plates	
Field téléphone	Pocket spectroscope	
Oil lantern in box	2 electric pocket lamps	
Shifting box	Suitable stock of photographic plates	

In addition an officer's tent, 2 fairly large tables and a number of stools to sit upon.

At the Store Korsnes station we had:

Camera	Slide case containing 36 slides filled with plates.	
Field telephone	Oil lantern in box	
2 electric pocket lamps	Shifting box	
Suitable stock of photographic plates		

In addition an officer's tent, 2 fairly large tables, and a number of stools to sit upon.

As soon as we had got into the field we established telephone connection between the stations, set up cameras, and placed the receivers on our ears and the microphones on our chests. When the Aurora began to appear we put a slide in the camera, drew out the lid, focussed upon a suitable constellation which we had selected, and were ready to take pictures. In order to judge the time of exposure correctly, I fastened a watch under my cap by means of a safety pin, so that it rested upon my ear, and I could count the seconds during exposure. In general we exposed as long as the Aurora remained quiet. When taking the photographs the conversation between the stations was somewhat as follows:

Bossekop. Focus upon Vega and report when everything is in order.

Korsnes. Everything is in order.

B. Very well, look out.

B. One.

B. Two.

B. Did it go well. That was plate number 17.

K. Everything in order. Plate number 17.

The number was then written with chalk on the back of the slide. When the pictures were taken in rapid succession the slides were laid in order on the table and the conference regarding their numbers was postponed until later. Moreover, the numbers merely serve as a check, for of course the pictures of the watches appeared on the plates. When about twelve plates had been taken at each station we took care to replace them by new ones in order to be well prepared. These changes were quickly effected in the shifting boxes. Whilst changing, we wrote the numbers in pencil on the gelatine side of the plates, an operation that is not difficult after a little practice. The twelve plates were packed in black paper and placed in an empty plate box. On the outside of the latter were written the name of the station, the date and numbers of the plates. The box was then packed in black paper in order that no light should act through any possible hole or cracks.

The following table shows the results of our work. The time is reckoned from 0^h to 24^h, 0^h corresponding to 12 noon:

Date	Time of work	No. of pairs of Aurora photographs
February 28	6 ^h —14 ^h	14
March 3	6 ^h —15 ^h	38
4	9 ^h —14 ^h	23
6	6 ^h —13 ^h	7
11	5 ^h 30 ^m —14 ^h	86
14	5 ^h 30 ^m —15 ^h 30 ^m	81
15	6 ^h —13 ^h 30 ^m	81
16	7 ^h —13 ^h	8
17	8 ^h —13 ^h 30 ^m	14
18	6 ^h —14 ^h	5
21	7 ^h —12 ^h 30 ^m	23
22	7 ^h —14 ^h	20
23	8 ^h —12 ^h	1
24	9 ^h —14 ^h	6
28	7 ^h —15 ^h 30 ^m	5
29	9 ^h 30 ^m —15 ^h	83
30	6 ^h 30 ^m —13 ^h 30 ^m	71
April 1	7 ^h 30 ^m —14 ^h	70

The plates taken were developed at Bossekop as quickly as possible after exposure, and the pairs of photograms were always developed in the same bath.