OPTICAL OBSERVATIONS AT SVALBARD DURING WINTER 1979-80 CARRIED OUT BY THE MULTI-NATIONAL AURORAL EXPEDITION

DATA REPORT

BY

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OPTICAL OBSERVATIONS AT SVALBARD DURING WINTER 1979-80

This report gives a list of the optical observations at Svalbard during winter 1979-80. The recordings are available for the scientific community to the price of copying. These data were gathered by the Multi-National Auroral Expedition in its second year of operation from November 22, 1979 to February 5, 1970. The members come from the University of Tromsø, Oslo, Alaska, Southampton, University College, London, and the Northern Ireland Polytechnique, Belfast.

Most of the field work was performed at a station consisting of mobile units, called Nordlysstasjonen, and situated 5 km outside Longyearbyen in a valley called Adventdalen. Figure 1 is a drawing of this station. Electric power, food and lodging were obtained from the mining company, Store Norske Spitsbergen Kullkompani A/S. Their support is gratefully acknowledged, decreasing the expedition costs to reasonable levels even in this Arctic desert.

At Ny-Ålesund the Norwegian Research Station, managed by the Norwegian Polar Institute, was used. The facilities for research are more satisfactory at Ny-Ålesund. The drawback with Ny-Ålesund is that the place can only be reached by small aircrafts from Longyearbyen during winter, and the costs for flying are high and regularity and capacity relatively low. However, at Ny-Ålesund the conditions for aeronomic field-work are much better than at Longyearbyen.

The man-made light at Ny-Ålesund can be reduced considerably because the whole community is aimed on doing scientific work. Another advantage is that the air is much more clear than in the vicinity of Longyearbyen. We suggest that the one thousand inhabitants of Longyearbyen are the main source

of Arctic haze and mist which very frequently cover their surroundings.

These facts affect the planning of future campaigns, and more of the field work will be transferred to Ny-Ålesund.

The following instruments were in operation at Longyearbyen during this campaign:

1 multi-channel meridian scanning photometer,
2 Ebert-Fastie spectrometers, and
1 35-mm all-sky camera supplied by Geophysical Institute, University of Alaska;
1 Fabry-Perot interferometer supplied by the Northern Ireland Polytechnique, Belfast;
1 all-sky TV recording system supplied by University of Southampton.

At Ny-Ålesund the following instruments were in operation:

1 multi-channel meridian scanning photometer supplied by The Norwegian Institute of Cosmic Physics, Oslo;
1 Fabry-Perot interferometer supplied by University College, London;
1 16-mm colour all-sky camera, magnetometer and riometer, run on a routine basis by the Research Station.

A separate overview of the Ny-Ålesund all-sky camera operation will be issued.

THE MERIDIAN SCANNING PHOTOMETER OBSERVATIONS

Simultaneous photometer observations at the two stations, 110 km apart along a magnetic meridian, are performed to get data for height determinations of the auroral forms in several wavelengths. The photometers provide data to identify

the dayside cusp, which is normally subvisual. They were calibrated in absolute units, but there seem to be some discrepancies between the calibration scales of the two systems. This could be removed by intercalibration but lack of time has prevented the performance.

At Ny-Ålesund the photometer system had channels recording the auroral emissions at 4278Å, 4861Å, 5577Å, and 6300Å, using fixed interference filters with hald-widths of 20Å. The data was stored on magnetic tape, and for quick-look the data was recorded on a 6-channel strip-charp recorder. A table giving the operation time of the Ny-Ålesund system is given below. Operation finished on Dec. 19, 1979 due to other obligations of this system.

Table 1

Operation time of the Ny-Ålesund MSP-system.

Date	Time in UT			
	On	Off	On	Off
11/22-79	1738	2049		
11/23-79	0447	1114	1328	2015
11/26-79	0459	1403		
11/27-79	0430	1115		
11/28-79	0400	1000	1323	1700
11/29-79	0500	1700		
11/30-70	0400	1657		
12/01-79	0400	1130		
12/03-79	0400	0740	0926	1600
12/04-79	0400	1450		
12/05-79	0400	1800		
12/06-79	0400	1700		
12/07-79	0350	1120		
12/08-79	0505	1745		
12/09-79	0400	1820		
12/10-79	0400	1540		
12/12-79	1420	1700		
12/13-79	0400	1445		
12/16-79	0742	1540		
12/17-79	0545	1806		
12/18-79	0540	1200	1215	1740
12/19-79	0400	1420		

At Longyearbyen the Geophysical Institute meridian scanning photometer system was operated. It had channels recording the auroral emissions at 4278Å, 4861Å, 5577Å, 6300Å, and the N_2 1P (5,2) band at 6705Å, using fixed interference filters with half-widths of 20Å. As in Ny-Ålesund the data was displayed on a multi-channel strip-chart recorder and stored in digital form on magnetic tape. In addition samples of data could be inspected on a computer display screen and copied. Examples will be shown below, Fig. 2. In Table 2 the operation periods of Longyearbyen MSP system are given.

Table 2

MSP (LYR)

Date	All time in UT					
	On	Off	On	Off	On	Off
Nov. 23, 1979	0500	0816				
Nov. 24	0500	0925				
Nov. 26	0515	1030				
Nov. 27	0500	0700				
Nov. 28	0500	0910	1259	1500		
Nov. 29	1200	1355	1916	2230		
Nov. 30	0800	1625				
Dec. 1	0950	1620				
Dec. 4	0450	0533				
Dec. 5	0450	0840	1135	1350		
Dec. 6	0450	0930	1115	1350		
Dec. 7	0455	1050	1200	1355		
Dec. 8	0450	1355				
Dec. 9	0655	1440				
Dec. 10	0455	0635	0730	1325		
Dec. 11	0910	1025				
Dec. 13	0505	1235				
Dec. 15	0636	1350				
Dec. 16	0416	1111				
Dec. 17	0445	1340				
Dec. 18	0452	1345				
Dec. 19	0455	2400				
Dec. 20	00	0500				
Dec. 22	1700	2400				
Dec. 23	0000	2400				
Dec. 24	0000	2400				
Dec. 25	0000	2400				
Dec. 26	0000	0800				
Dec. 7	0700	1415	1520	2400		

Table 2 continued

Date	On	Off	All time in UT On	Off	On	Off
Dec. 28, 1979	0000	0455	1240	2400		
Dec. 29	0000	1029	1120	1315	1715	2400
Dec. 30	0000	0350	0645	1245		
Jan. 2, 1980	0950	1345				
Jan. 3	1058	1248				
Jan. 5	0555	0954	1120	2135		
Jan. 6	0115	1102	1130	2310		
Jan. 7	0100	0645	2102	2342		
Jan. 8	0138	0540	1330	0000		
Jan. 9	0000	0503				
Jan. 10	0910	1025				
Jan. 11	0115	0203	0450	1840		
Jan. 12	0100	0925				
Jan. 13	0435	1050	2220	2400		
Jan. 14	0000	2400				
Jan. 15	0000	0915	1315	2030		

SPECTROMETER OBSERVATIONS

The two Ebert-Fastie spectrometers were operated simultaneously. Since the auroral spectrum depends on the composition of the upper atmosphere, movements of the atmospheric constituents, the degree of ionization, electric and magnetic fields, the constituents of the auroral precipitation, the energy and pitch angle distributions of the precipitation, and the recording itself is affected by airglow, sunlight, weather conditions and man-made light and pollution, there are much work left to do before a detailed and satisfactory picture and understanding of the auroral spectrum are obtained.

The two spectrometers were used to study correlations between related auroral emissions as H_α and H_β, orthohelium emissions at 3889Å and 5876Å, NI lines at 3466Å and 5200Å and molecular bands in the near ultraviolet and near infrared spectral regions.

Interested people are encouraged to ask for data, as we are interested in distribution. At present we don't have a complete list of the useful data collected, but several samples will be presented below, Figs. 3, 4 and 5.

As the MSP and spectrometers were operated at the same site, the spectrometers were preferentially used to observe the radiation from the polar cleft. The MSP is found to be a very useful instrument to identify this interesting and low intensity part of the auroral oval.

THE INTERFEROMETER OBSERVATIONS

In addition to the Fabry-Perot interferometer at Longyearbyen another interferometer was installed at Ny-Ålesund, and the main purpose was to measure the Doppler velocities of the oxygen atoms at the same point in the upper atmosphere in two different directions. However, the Ny-Ålesund system did not work properly and gave low quantities of data.

The interferometer at Longyearbyen was operative, using an on-line Apple computer for storing the data on digital magnetic tape and giving quick-look of the measurements on a computer display screen. In addition to examine the temperature and wind of the F-region, long-time observations were performed to study gravity waves. Variations in the Doppler velocity of the 6300Å line were found which indicate existence of gravity waves in the polar upper atmosphere.

Table 3 lists the recording periods.

Table 3

Ulster Fabry-Perot Interferometer.

Recording periods			
16-1-80	1750 onwards	Full sky survey making 24 hour plots	6/24 hour periods
17-1-80	complete		
18-1-80	complete		
19-1-80	until 1600		
22-1-80	1813 onwards		
23-1-80	until 2225		
27-1-80	1552 onwards		
28-1-80	until 1830		
29-1-80	0810 onwards		
30-1-80	until 1800		
30-1-80	1800 onwards	Search for waves with high time resolution	
31-1-80	until 0955		
1-2-80	1411 until 1750, 2123 onwards		
2-2-80	until 0805, 1456 onwards		
3-2-80	until 0905, 1332 onwards		
4-2-80	until 0828, 1435 onwards		
5-2-80	until 1830, 1500 onwards		

ALL-SKY TV OBSERVATIONS

During this campaign Dr. P. Rothwell, University of Southampton installed an all-sky TV at Longyearbyen with the main purpose of observing optical auroral pulsations. The occurrence and power of the auroral pulsations at the latitude of the polar cleft are expected to be marginally small, and the first glance on these TV data seems to give a similar conclusion. The TV observations were indeed valuable for operation of the complete optical station at Longyearbyen since the auroral and the weather conditions could be inspected indoors. Table 4 lists the recording periods of the TV system.

Table 4

Southampton all-sky TV data, Svalbard Jan/Feb 1980

	Time in UT					
	On	Off	On	Off	On	Off
Jan. 13	0500	0000				
Jan. 14	0000	1535	1540	0000		
Jan. 15	0000	0800	0817	1415	1500	1715
					1715	0000
Jan. 16	0000	0450				
Jan. 17	0904	0000				
Jan. 18	0000	0725	0940	0000		
Jan. 19	0000	0810	1015	1100	1500	0000
Jan. 20	0000	1000				
Jan. 21	2030	2110				
Jan. 22	1715	0000				
Jan. 23	0000	0950	1400	2300		
Jan. 26	1842	0000				
Jan. 27	0000	0800	1410	1800	2200	0000
Jan. 28	0000	0800	1410	1800		
Jan. 29	0145	0545	2140	0000		
Jan. 30	0000	0445				
Feb. 2	0100	0700	1500	0000		
Feb. 3	0000	0510	1800	0000		
Feb. 4	0000	0420	2200	0000		
Feb. 5	0000	0700	1520	1940		

The Auroral Observatory
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As participating scientists in MNAE at Svalbard the following persons can be contacted for more detailed informations:

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FIGURE CAPTIONS

Fig. 1 The main station at Longyearbyen, drawn by Karen Lundberg.

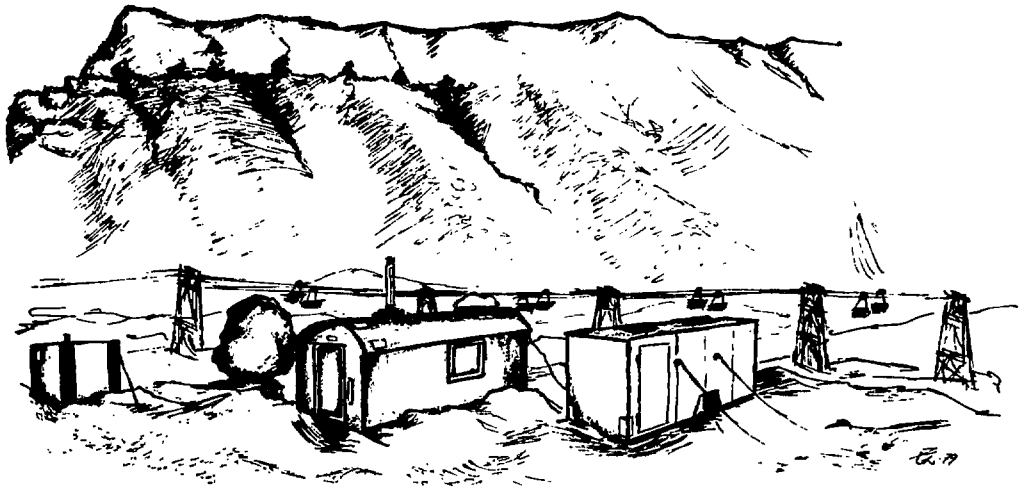


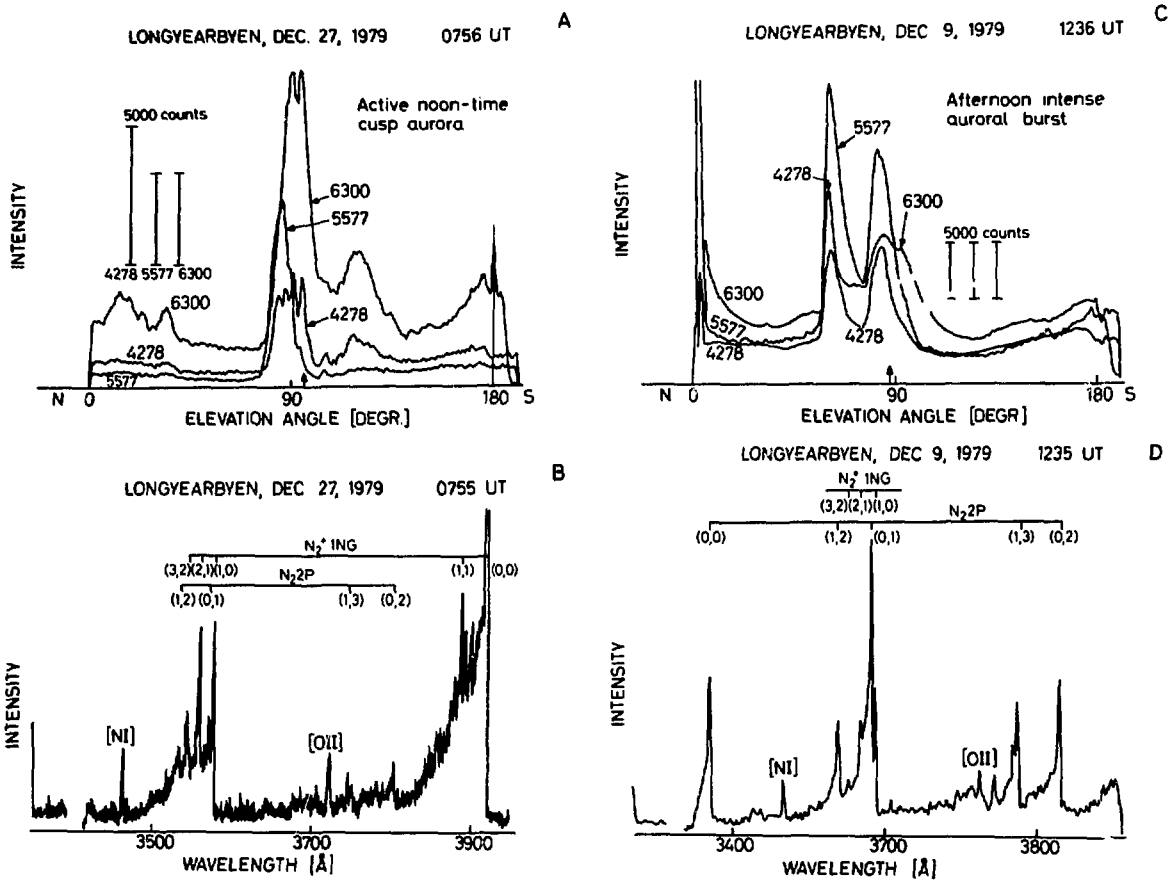
Fig. 2 Correlation between MSP-records of polar cleft aurora and magnetic disturbance. The auroral emissions at 4861Å and 6705Å are generally weak in dayside aurora and therefore not displayed. Relative intensity in counts per second for each channel is given, and the inherent calibration factors in Rayleigh/counts, R/c, are: 4861 1.6 R/c, 4278 0.3 R/c, 5577 0.9 R/c, and 6300 0.93 R/c.

Panel A: Polar cleft, defined by the 4278Å, 5577Å, and 6300Å emissions seen 20° above southern horizon from Longyearbyen.

Panel B: A magnetic bay gets its maximum value at Ny-Ålesund (panel F) and in the Alaskan sector (panel G). Simultaneous with this bay at 0925 UT an intensification of the cleft aurora occurs, and both the 4278Å and 5577Å emissions exceed the 6300Å intensity.

Fig. 3 MSP observations and near ultraviolet spectrograms of polar cleft aurora.

Panel A: MSP record of active cleft aurora one hour before local magnetic noon.



Panel B: In this daytime active aurora the N_2^+ first negative bands and atomic (NI and OII) lines at 3466Å and 3726Å are enhanced.

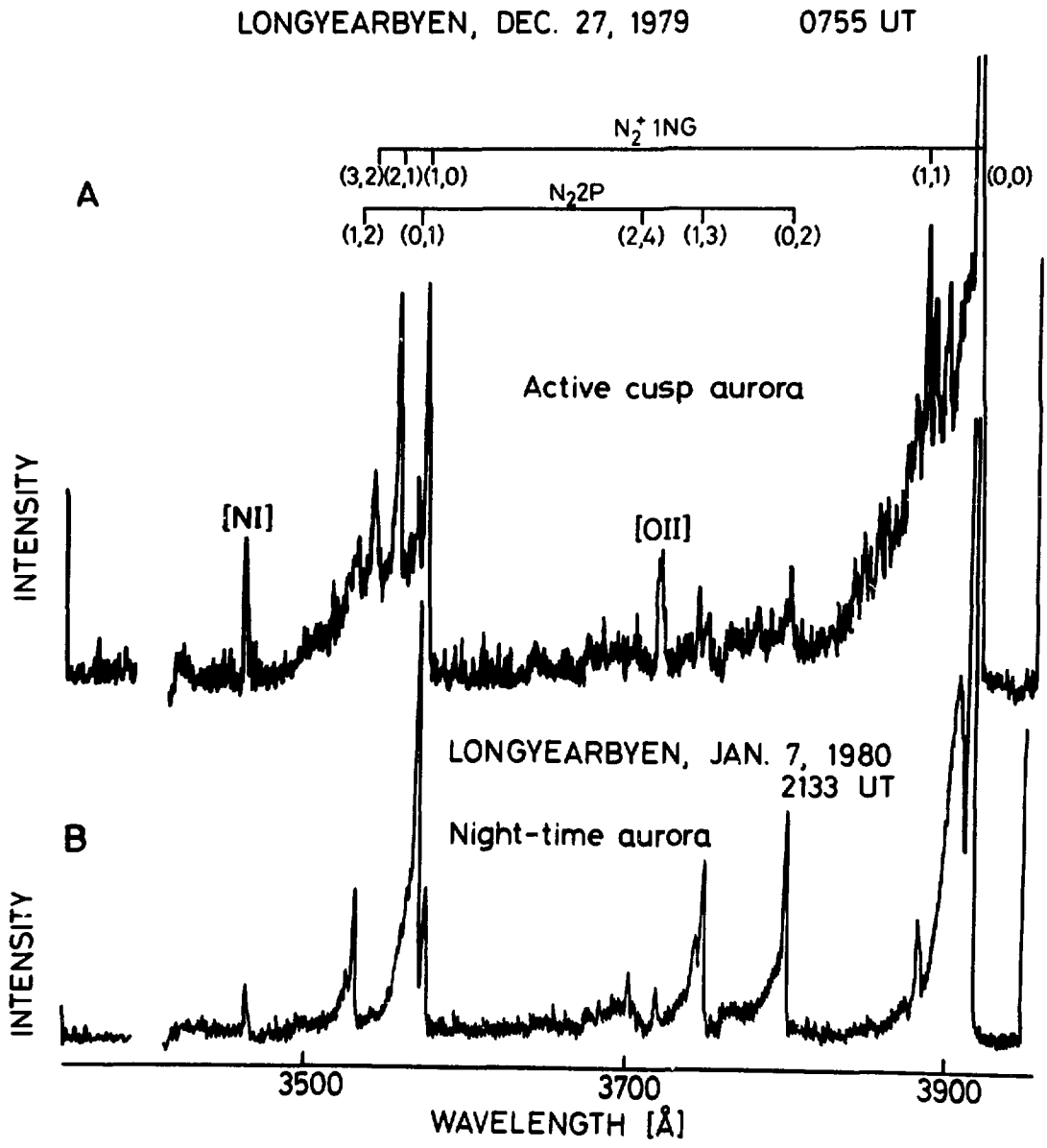
Panel C: An intensification of the polar cleft aurora is recorded 3 hours and 36 minutes after local magnetic noon. The 5577Å line becomes the strongest emission.

Panel D: In this intensification the N_2 second positive bands are enhanced. Note the (0,0), (1,2), (0,1), (1,3), and (0,2) bands.

Fig. 4 Daytime and nighttime spectrograms.

Panel A: Spectrogram of active dayside aurora with enhanced N_2^+ second negative bands and atomic emissions.

Panel B: Spectrogram of nighttime aurora with enhanced N_2 second positive bands.



Panel C: During the recovery phase of the bay the normal spectral distribution of the cleft aurora is back again.

Panel D and panel E:

Later in the magnetic recovery phase the polar cleft has shifted to the north of Longyearbyen, the initial position before the magnetic activity started.

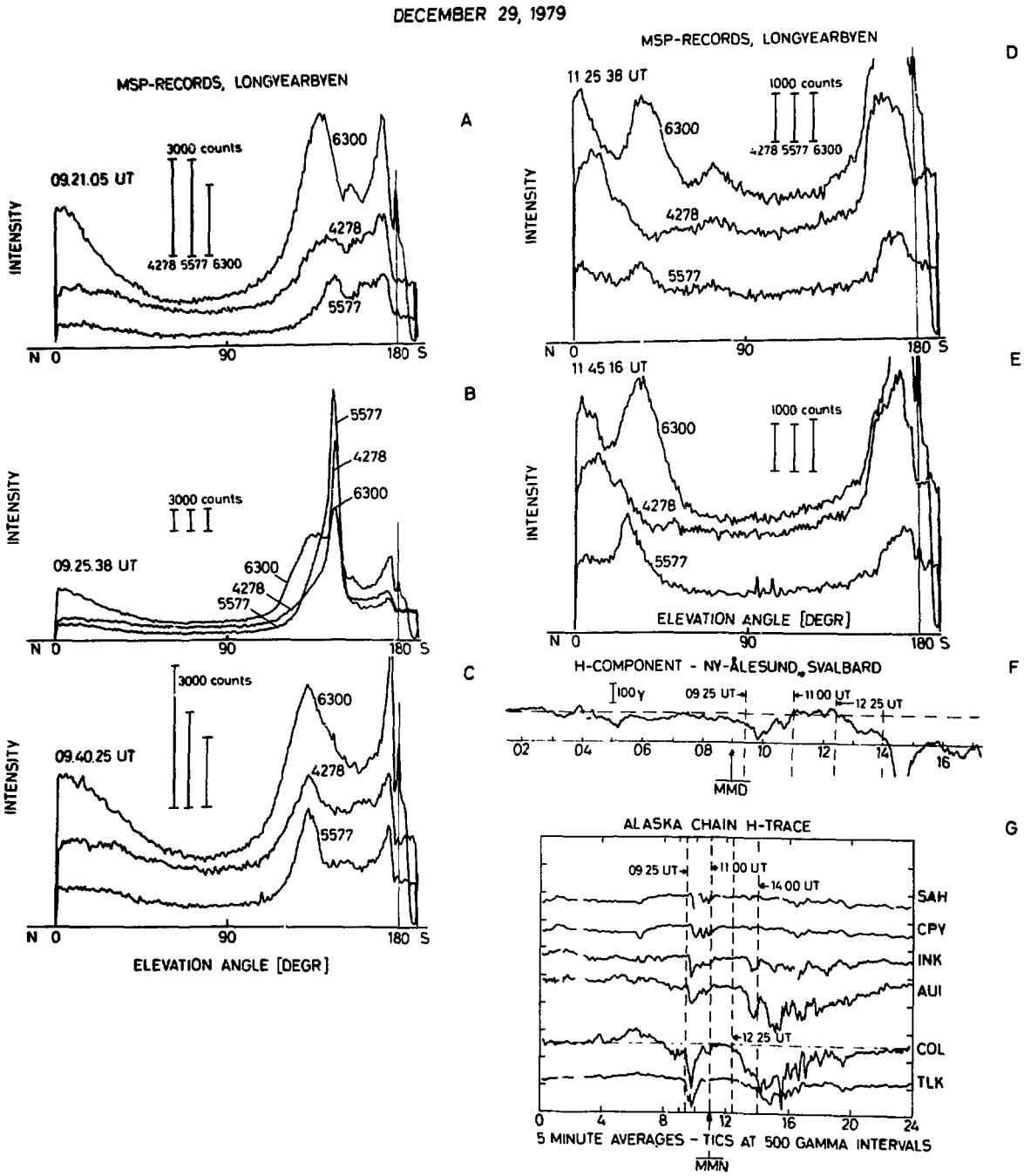


Fig. 5 Spectrogram of the wavelength region from 6250Å to 6450Å in dayside aurora.

Panel A: The auroral lines at 6300Å and 6364Å are the dominating emissions.

Panel B: The intensity scale has been increased forty times, and now OH rotational bands and N_2 1P bands can be identified.