Report on Night Airglow Observation in the 5th Japanese Antarctic Research Expedition, 1960-61, —Latitude Dependency—

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第5次船上大気光（夜光）光電観測報告 —— 緯度効果 ——

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要 旨

第4次船上大気光（夜光）光電観測にひきつづき，第5次船上においても全く同様な装置と方法によって，大気光の4色観測が行なわれた．今次にあって，とくに留意された点は，標準光源の取扱い，とくに赤外波長域光源用白熱電球の電流規正系統である．

結果は，前観測のそれと，多くの部分でかなりよく一致しており，すでにほぼ確立されていた5577 Å の緯度効果に加えて，それ以外の大気光の緯度効果が，かなり確実につかめたと思われる．

i) 5577 Å (OI 禁制線) S 20°付近に極小がみとめられ，更に高緯度にむかって明らかな増加がある．季節変化がみとめられる．

ii) 5893 Å (Na D 線) S 20°付近に極小がみとめられ，かつ季節変化が明らかである．この2点は 5577 Å のそれと相似している．さらに，この線の特徴としては，日変化量が小さく，全体として北半球が南半球の2倍程度の明るさをもつ．

iii) 6300 Å (OI 禁制線) S 30°～40°に極小がみとめられ，より低緯度にむかって増加の傾向がある．季節変化は明らかでなく，むしろ太陽活動度によって支配され，日変化量も大きくなる．

iv) 近赤外 (OH Meinel 帯) 緯度効果は5577 Å と似ており，S 20°付近と N 10°～20°付近に極小がみとめられる．季節変化は小さい．

1. Introduction

In order to find the latitude dependency of the airglow, the photoelectric observations of the four emissions, 5577 Å and 6300 Å lines by oxygen atom, 5893 Å D-line by sodium atom, and the near infrared band by OH molecule, were carried out on board the SOYA, the 5th Japanese Antarctic Research Expedition Ship, during the period from November, 1960 to May, 1961.

The apparatus and the method of observation were the same as in the 4th expedition**. During this voyage particular attentions were paid to the treatment of the standard source of light for calibration, especially to the system including a standard lamp for the infrared radiation.

Observations of the airglow in the 5th expedition are classified into the following three parts:

1) the latitude dependency of the airglow, from Tokyo to the Antarctic

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** T. Nakamura: Antarctic Record (Nankyoku Shiryo), No. 12, 14-30 (1961).

2) the unusual enhancement of the airglow at low latitude (geographic N 37°.2 or geomagnetic N 20°) during a great magnetic storm on November 13, 1960

3) the auroral observations near the Antarctic

2. Results on the latitude dependency

The main results are shown in Appendix and Figs. 1–4, in which the zenith intensities are given in Rayleigh unit.

The obtained data on the latitude dependency shows that the results in the 4th and 5th expeditions are in fair agreement with each other, and so we can get a more definite picture on the latitude dependencies of the three emissions, except 5577 Å which has been almost known by the past four expeditions on the SOYA.

1) 5577 Å line by oxygen atom

It has a minimum around S 20°, and becomes stronger at higher latitude. A seasonal variation is observed.

2) 5893 Å D-line by sodium atom

It has a minimum around S 20° and shows a seasonal variation. These two

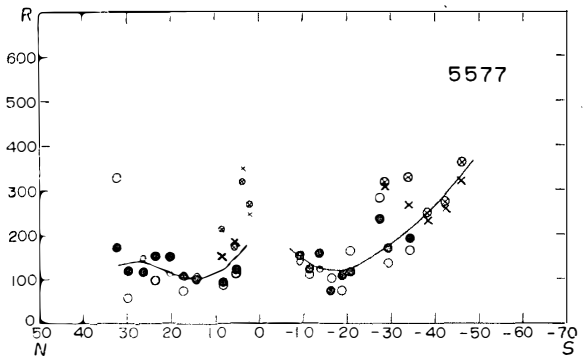

Fig. 1. Observed intensity (in Rayleigh) of the airglow with respect to geographic latitudes.

● daily mean, outward voyage
× daily mean, homeward voyage
○ Oh local time, outward voyage
⊗ Oh local time, homeward voyage
Smaller and same symbol show extraporated value.

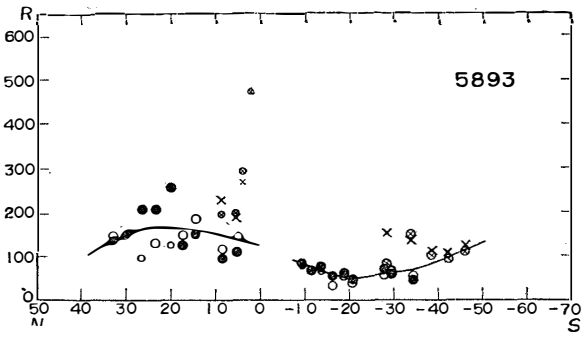

Fig. 2. Observed intensity (in Rayleigh) of the airglow with respect to geographic latitudes.

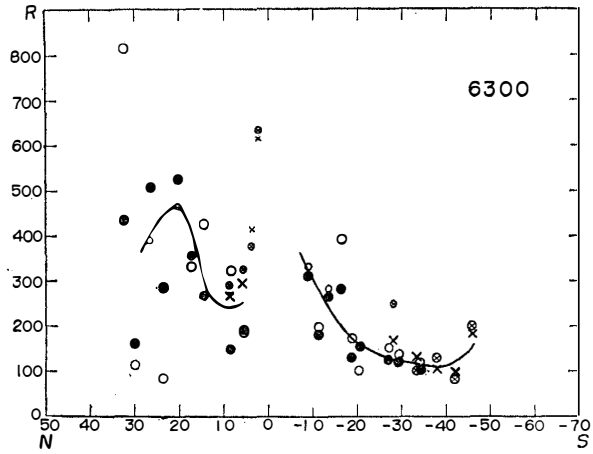

Fig. 3. Observed intensity (in Rayleigh) of the airglow with respect to geographic latitudes.

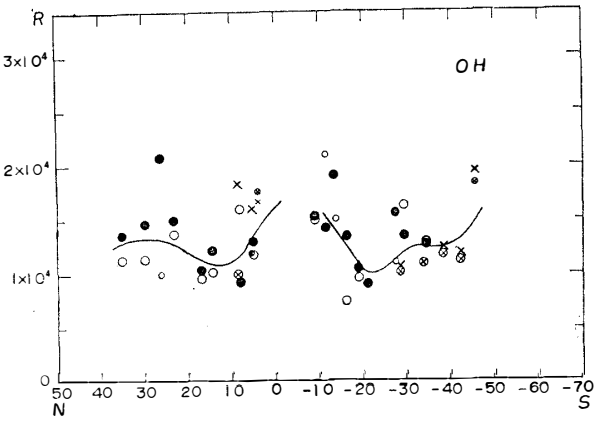

Fig. 4. Observed intensity (in Rayleigh) of the airglow with respect to geographic latitudes.

characters are quite similar to that of the 5577 Å. Its intensity seems to be stronger in the northern hemisphere than in the southern hemisphere, being about twice in strength. Its daily variation is small.

3) 6300 Å line by oxygen atom

It has a minimum at S 30°– 40° and is stronger at lower latitude. It seems that the solar activity predominates over the seasonal variation.

4) near infrared band by OH molecule

The latitude dependency of this emission is similar to that of 5577 Å, and there are two minima around S 20° and N 10°– 20°. Seasonal variation is small.

First the author wishes to express his hearty thanks to Prof. M. HURUHATA and Messrs. T. NAKAMURA and J. NAKAMURA of Tokyo Astronomical Observatory, who planned this observation and rendered constant encouragement and instruction to the author.

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Note added in proof: In Fig. 2, the readings of ordinate should be multiplied by the factor 0.7.

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Appendix

Observed intensity in Rayleigh unit.

Date		L.T.	Intensity (Rayleigh)			
			5577	5893	6300	Infrared (OH)
1960	Nov. 13/14 (N 32°.7 ; E 133°.6)	19:00	120	130	305	235×10^2
		20:00	190	80	585	160
		21:00	185	70	440	120
		22:00	130	60	120	90
		23:00	255	90	805	90
		00:00	325	100	815	115
		01:00	120	115	135	120
		02:00	75	115	155	160
		03:00	150*	90*	550*	—
		m.v.	172	94	435	136
	Nov. 14/15 (N 29°.9 ; E 131°.0)	19:00	145	150	380	280
		20:00	100	130	255	195
		21:00	75	100	205	145
		22:00	80	110	175	125
		23:00	70	115	120	120
		00:00	60	105	115	115
		01:00	75	90	100	105
		02:00	155	80	50	90
		03:00	300*	75*	65*	—
		m.v.	117	106	163	147
	Nov. 15/16 (N 26°.3 ; E 128°.3)	19:00	105	180	645	—
		20:00	110	155	485	245
		21:00	135	100	385	170
		m.v.	117	145	505	208

Date		L.T.	Intensity (Rayleigh)			
			5577	5893	6300	Infrared (OH)
1960	Nov. 16/17 (N 23°.2 ; E 125°.1)	21:00	315	290	785	—
		22:00	150	180	450	215×10^2
		23:00	135	120	240	165
		00:00	100	90	85	140
		01:00	95	105	80	125
		02:00	140	145	180	145
		03:00	150	125	200	130
		04:00	150	85	265	130
		m.v.	154	143	285	150
	Nov. 17/18 (N 20°.0 ; E 121°.8)	19:00	160	200	570	—
		20:00	145	155*	480*	—
		m.v.	152	179	525	—
	Nov. 18/19 (N 17°.2 ; E 118°.6)	19:00	105	90	145	—
		20:00	155	100	360	150
		21:00	205	90	520	120
		22:00	210	90	620	105
		23:00	150	120	830	115
		00:00	70	105	330	95
		01:00	35	90	250	90
		02:00	25	70	215	85
		03:00	30	55	165	65
		04:00	55*	50*	110*	—
		m.v.	104	87	355	104
	Nov. 19/20 (N 14°.4 ; E 115°.5)	19:00	75	85	165	115
		20:00	100	100	245	135
		21:00	140	120	350	155
		22:00	110	130	400	130
		23:00	110	110	500	165
		00:00	105	130	425	100
		01:00	65	105	295	120
		02:00	55	150	230	145
		03:00	90	100	160	105
		04:00	135	65	100	85
		05:00	225	45	55*	85
		m.v.	101	104	266	122
	Nov. 21/22 (N 08°.3 ; E 107°.3)	22:00	135*	170*	—	—
		23:00	95	115	305	155
		00:00	90	80	320	160
		01:00	70	60	190	110
		02:00	45	50	105	80
		03:00	50	30	30	55
		04:00	70	20	15	50
		05:00	185	15	90	40
		m.v.	93	67	150	93
	Nov. 22/23 (N 05°.2 ; E 106°.8)	19:00	120	60	70	165
		20:00	125	65	60	170
		21:00	175	70	270	135
		22:00	255	120	500	165
		23:00	175	135	305	165
		00:00	115	100	190	120
		01:00	95	90	150	120
		02:00	45	75	105	110
		03:00	30	65	100	125
		04:00	60	50	145	100
		05:00	125	30	180	65
		m.v.	120	78	188	130

Date		L.T.	Intensity (Rayleigh)			
			5577	5893	6300	Infrared (OH)
1960	Dec. 8/9 (S 09°.2 ; E 73°.6)	21:00	165*	50*	—	—
		22:00	150	65	310	155×10^2
		23:00	145*	55*	—	—
		m.v.	152	57	310	155
	Dec. 9/10 (S 11°.4 ; E 70°.2)	21:00	120	50	150	85
		22:00	120	40	170	120
		23:00	130	45	225	150
		00:00	110*	45*	—	210*
		m.v.	121	46	181	142
	Dec. 10/11 (S 13°.8 ; E 66°.4)	20:00	190	40	230*	—
		21:00	170	55	285	200
		22:00	150	65	260	200
		23:00	125	45	275	170
		m.v.	158	51	263	190
	Dec. 11/12 (S 16°.3 ; E 62°.7)	20:00	60	65	300	245
		21:00	70	60	250	205
		22:00	60	30	220	95
		23:00	70	25	220	90
		00:00	100	20	395	75
		01:00	70	10	295	95
		m.v.	72	36	280	134
	Dec. 12/13 (S 18°.8 ; E 59°.0)	20:00	160	40	190	110
		21:00	140	45	115	105
		22:00	110	40	110	100
		23:00	105	45	95	100
		00:00	75	40	170	95
		01:00	65	35	190	115
		02:00	—	—	45	—
		m.v.	109	41	131	105
	Dec. 13/14 (S 20°.9 ; E 54°.9)	20:00	125	20	275	115
		21:00	130	15	210	65
		22:00	150	15	140	60
		23:00	145	60	155	75
		00:00	165	25	100	90
		01:00	150	25	110	95
		02:00	90	35	120	135
		03:00	80	35	120	135
		04:00	30	55	170	—
		m.v.	118	31	156	91
	Dec. 16/17 (S 27°.5 ; E 42°.6)	21:00	210	55	210	140
		22:00	—	—	120*	—
		23:00	245	50	155	95
		00:00	280	—	150	—
		01:00	185	30	130	160
		02:00	240	50	100	205
		03:00	245	50	65	175
		04:00	235	55	65	155
		m.v.	234	49	124	156
	Dec. 17/18 (S 29°.5 ; E 37°.7)	21:00	120	50	220	130
		22:00	105	55	165	145
		23:00	115	65	165	180
		00:00	135	45	135	165
		01:00	145	30	120	100
		02:00	220	20	55	120
		03:00	260	35	65	125
		04:00	255*	25	55	130
		m.v.	169	41	123	135

Date		L.T.	Intensity (Rayleigh)			
			5577	5893	6300	Infrared (OH)
1960	Dec. 20/21 (S 34°.5 ; E 23°.9)	21:00	180*	45*	170	120*×10²
		22:00	205	40	100	125
		23:00	170	30	120	140
		00:00	165	40	120	130
		01:00	190	25	90	110
		02:00	200	20	65	110
		03:00	235	25	100	135
		04:00	190*	30	85*	145
		m.v.	192	32	106	127
1961	Mar. 10/11 (S 45°.9 ; E 21°.4)	22:00	285	95	180	215
		23:00	300	85	165	190
		00:00	365*	80*	200*	180*
		m.v.	316	85	181	194
	Mar. 11/12 (S 42°.3 ; E 20°.1)	22:00	180*	35*	110	—
		23:00	250	60	100	95
		00:00	275	65	80	110
		01:00	285	80	75	110
		02:00	290	120	100	150
		m.v.	256	72	93	117
	Mar. 12/13 (S 38°.2 ; E 18°.9)	22:00	230*	50	175*	—
		23:00	260	65	140	150
		00:00	250	70	130	115
		01:00	210	70	80	115
		02:00	240	75	65	115
		03:00	260	85	75	110
		04:00	230	90	55	130
		05:00	185	90	75	110
		m.v.	235	75	99	121
	Mar. 13/14 (S 33°.9 ; E 18°.4)	21:00	155	70	210	—
		22:00	185	60	150	125
		23:00	225	50	120	95
		00:00	330	105	100	110
		01:00	440*	185*	85*	100*
		m.v.	267	96	133	109
	Mar. 24/25 (S 28°.3 ; E 40°.2)	00:00	315	55	245	—
		01:00	310	65	125	90
		02:00	360	95	110	90
		03:00	260	135	165	115
		04:00	—	170*	185*	135*
		m.v.	312	105	165	105
	Apr. 14/15 (N 03°.9 ; E 99°.6)	22:00	380*	170*	450*	160*
		23:00	—	—	—	—
		00:00	320*	200*	380*	175*
		m.v.	348*	186*	414*	167*
	Apr. 21/22 (N 02°.2 ; E 104°.9)	00:00	265*	330*	630*	—
		01:00	220*	340*	595*	235*
		m.v.	243*	333*	612*	235*
	Apr. 22/23 (N 05°.5 ; E 107°.4)	01:00	165*	145*	—	—
		02:00	230	130	340	135
		03:00	155	120	255	—
		04:00	180	135	295	185*
		m.v.	182	133	296	160

Date		L.T.	Intensity (Rayleigh)			
			5577	5893	6300	Infrared (OH)
1961	Apr. 23/24 (N 08°.7 ; E 110°.0)	02:00	170	150	290	150*
		03:00	135	165	240	215*
		m.v.	151	158	263	183*

*: extraporated value

m.v.: value of daily mean

( ): geographical position of the SOYA at Oh local time