

Auroral observations in India

M. PANDURANGA RAO

Colaba Observatory, Bombay

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ABSTRACT. The occurrence of Aurora Borealis in low latitudes, such as Bombay and Alibag, is a very rare phenomenon. Aurora Borealis was brilliantly seen in India during the severe magnetic storm of 4 February 1872. Conditions favourable for the observation of Aurora in future are given. Magnetic storms of range exceeding 600 γ in the horizontal intensity at Colaba and Alibag are listed with comments regarding the possibility of observation of Aurora.

1. Introduction

The "Aurora Borealis" or Northern Lights, as is well-known, are luminiscent phenomena observed at great heights in the sky of variegated colours and shapes around the magnetic north pole usually within the Arctic Circle. The Aurorae are most intense over the magnetic north pole but it can be seen as south as England and occasionally Italy. Its counterpart the "Aurora Australis" is seen in the southern skies around the south magnetic pole with its sphere of visibility as far north as Samoa. The agency responsible for the Aurorae is in the Sun. Aurorae are usually associated with magnetic storms. The occurrence of Aurora Borealis in India is an extremely rare event. Chapman has made a strong plea for the observation of Aurora in the mid-auroral belt, *i.e.*, between 45° north magnetic latitude and 45° south magnetic latitude. He has suggested that high altitude stations with low horizons and good seeing conditions should be selected to undertake auroral watch. During the International Geophysical Year (July 1957 to December 1958) and the International Geophysical Co-operation (January to December 1959), the Magnetic Observatory at Alibag kept a special watch for Aurora but none could be located, although two great storms of ranges exceeding 600 γ in the horizontal intensity were recorded at Alibag, which were associated with Aurora in the polar and surrounding regions.

2. Brilliant Aurora Borealis of 4 February 1872

The only instance of Aurora visible in India is that observed on the night of Sunday the 4th February 1872. One of the most intense displays on record, this Aurora has attracted world-wide attention and in our country, newspaper reports regarding it from different parts have appeared in the "Times of India, Bombay" (then known as the "Bombay Times") and other papers in Calcutta and Delhi. This Aurora was visible as far south as Bombay (geographic latitude 19° N, geomagnetic latitude 10° N). Below is reproduced an extract from the Times of India, Bombay, dated 6 February 1872.

"THE AURORA BOREALIS"

Will it surprise our readers to learn that the Aurora Borealis was plainly visible in Bombay on Sunday night last? Such was, indeed, the case and its effect felt too. After sunset on Sunday the Aurora was slightly visible and constantly kept changing colour, becoming deep violet when it was most intense—about three o'clock on Monday morning. It was distinctly visible until sunrise on Monday. The influence of this atmospheric disturbance was unpleasant both for our persons and our correspondence. The cold was unpleasantly keen and all telegraphic communication was stopped for some hours. Both before and after its height, the Aurora affected the working of both sections of the Indian Submarine Cable, one section running

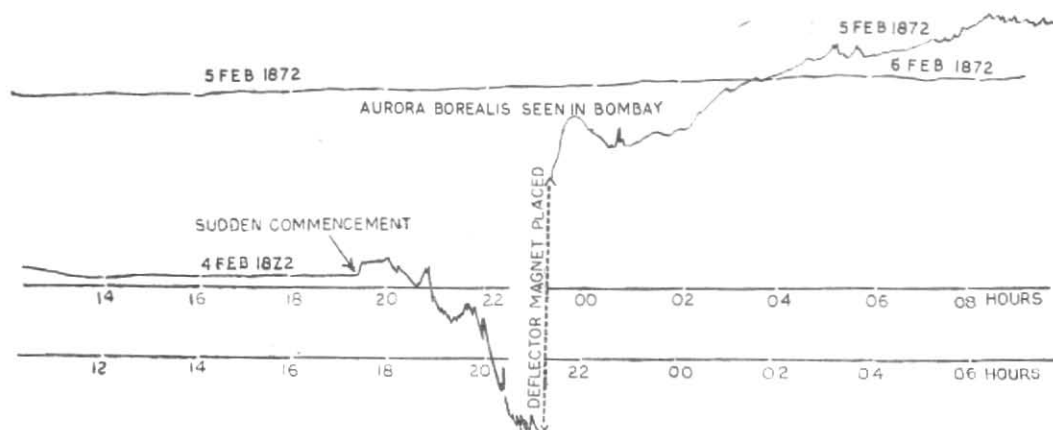


Fig. 1. Record of severe magnetic storm of 4-5 February 1872—Colaba (Bombay) Magnetic Observatory

This storm which had a range of 1023 γ in the horizontal component of the earth's magnetic field is the biggest in the Colaba series. The beginning of the storm and its intense phase occurred during the night which was favourable for the observation of Aurora in several parts of India

east and west and the other north and south. At 8 o'clock yesterday morning, the magnetic disturbance in the telegraphic office was very strong. The extent of the disturbance may be gathered from the fact that all lines to England in connection with the British-Indian Submarine Cable were affected for hours and so were the Government lines. At Aden, the Aurora was brilliant and extreme."

The above account gives all the salient features about the Aurora observed in Bombay. The disruption of the submarine cable service was obviously due to the earth currents flowing through the surface of the earth as a result of the severe magnetic storm. Mr. Charles Chambers, who was then the Director of the Colaba Observatory, could not possibly guess that it was at all possible to observe the Aurora at such a low latitude as Bombay, even though the incidence of the magnetic storm was noticed at the observatory, where the staff were busy seeing that no photographic trace of the storm was lost during its intense phase when the horizontal component of the earth's magnetic field fell very rapidly. In Fig. 1 is reproduced the record of the severe magnetic storm of 4 February 1872, which shows that a deflector magnet had been placed on the magnetograph to raise the recording speck from its lowest

level to a suitable position. According to Chapman, the altitude of the Aurora at Bombay could have been only about 20° in the northerly direction. The scientific staff of the observatory were obviously keeping watch over the progress of the storm and seeing that no record was lost. The magnetographs were installed in a specially constructed underground room and none would have expected the occurrence of Aurora at Bombay.

The Aurora was also seen at Rawalpindi, Lahore, Multan, Madhopur, Raikot, Sukkur and Jacobabad. All these accounts coupled with the incidence of the magnetic storm, confirm, without any doubt, that the phenomenon was Aurora. The correspondent of the Times of India from Jacobabad (now in West Pakistan) has given a very vivid account of the Aurora observed by him. Following are extracts from his lengthy account—

"As I was returning home about half-past 11 p.m., a sudden change from darkness to light was noticed as bright as the full moon. Its shape was an arch, though not quite so perfect, shooting from the east horizon to the zenith and very nearly at right angles to the magnetic meridian. . . . The upper portion of the arch appeared like a sheet of fire of a

blood red colour and from its centre coruscations or streamers of light would issue of different hues, colours of the rainbow and ran into one another in waves.... After an hour there appeared in the Auroral arch a little below the zenith a bright blue light of a dome shape quite intense; after some 15 minutes it suddenly dissolved to a deep violet...."

Severe Magnetic Storm of 4 February 1872—Following the sunspot maximum at 1870-6 epoch, a magnetic storm of severe intensity was recorded at the Colaba Observatory, Bombay at 19^h 18^m L.M.T. on 4 February 1872. The storm was of the "sudden commencement" type and it became intense from about 20^h when *H* began to fall very rapidly with occasional rise till 23^h, when the recording speck, which was about to go beyond the limits of the photographic paper, was brought back in position by a deflector magnet kept in position, thanks to the awareness and watchfulness of the observatory personnel. After a period of intense magnetic activity lasting till about 9^h L.M.T. on 5 February, the storm subsided at about 16^h on the same day. This short-lived magnetic storm of duration about 22 hours and a range of 1023 γ in the horizontal intensity, is the biggest on record for the Colaba Magnetic Observatory. It was surpassed later only by the severe magnetic storm of 28-29 March 1946, at the Alibag Magnetic Observatory, the successor to the former observatory.

The time of occurrence of the magnetic storm of 1872 was a fortuitous one for the observation of Aurora at Bombay. On 4 February 1872, the sunset time for Bombay was about 18^h L.M.T. and the storm commenced about an hour later. The phase of the moon was midway between the last quarter and the new moon; the crescent moon rose at about 5^h L.M.T. on 5 February, *i.e.*, nearly at the end of the intense phase of the magnetic storm.

The Alibag Magnetic Observatory (geomagnetic latitude 9°·5 N) besides having

other advantages in favour of its location, is an ideal place for the observation of low-latitude Aurora. Electric lighting has been only recently introduced at Alibag on a limited scale and the sky is, therefore, free from atmospheric glow due to electric illumination.

During the severe magnetic storm of 28-29 March 1946, which is the biggest in the Colaba-Alibag series from the range point of view, a special watch was kept by the author at Alibag, under instruction from the then Director of Colaba and Alibag Observatories, Dr. S. K. Chakrabarty, but none could be located. This storm began at 1205 IST (*i.e.*, during the day-time) and its intense phase which lasted about 6 hours, was also over during the day-time. Aurora might have been present in the Indian skies during the storm but due to sunlight it could not have been detected.

In Table 1, are given some particulars of all severe magnetic storms recorded at Colaba and Alibag whose ranges in horizontal intensity exceeded 600 γ for the period 1870 to 1960, with comments as to whether it was possible to observe Aurora on those occasions.

3. Detection of Aurora

For the successful detection of Aurora in India, the observer must have knowledge of the occurrence of a severe magnetic storm; the storm should either begin at night or its intense phase extend into the night; the sky should be cloudless and preferably moonless. Although intense auroral displays have been seen even in bright moonlight (Aurora was reported to have been seen at Watheroo-Australia in bright moonlight on the night of 13-14 May 1921—*see table*), in India, it may be too much to expect to see one on a moonlit night on account of the fact that only the comparatively brighter aurorae only can be seen due to the unfavourable geographical position. Other conditions mentioned above being fulfilled, perhaps Aurora can best be seen in India during the period December to February, when clearer skies are normally expected.

TABLE 1
Severe Magnetic Storms and Aurorae
Colaba and Alibag (1870 to 1960)

Year	Month	Date	Magnetic storms					Phase of the moon	Remarks on associated aurorae
			Time	Type	Initial impulse	Duration of storm	Range in		
					ΔH	(hrs)	H, F.		
(IST)	γ	γ							
1872	Feb	4	19.9	s.c.	69	22	1023	Between second quarter and full moon	Brilliant Aurora Borealis and Aurora Australis seen in several parts of the globe. Seen clearly in Bombay, Rawalpindi, Lahore, Multan, Raikot, Sukkur and Jacobabad. Brilliant at Aden
1892	Feb	13	10.5	s.c.	161 (in three stages)	48	612	Full moon	Due to comparatively low range in <i>H</i> and Full Moon, Aurora could not have been seen in India
1894	Aug	20	8.4	s.c.	71	26	607	Between full moon and second quarter	Storm and its intense phase occurred during day-time, so no Aurora could have been seen in India
1903	Oct	31	11.5	s.c.	50	41	819	Between first quarter and full moon	Biggest storm since 1872. Auroral display in England, Hungary and New York. Storm occurred during day-time, including its intense phase. No Aurora could have been seen in India
1909	Sep	25	17.2	s.c.	105	24	>600	Do	Aurora Australis from Australia and Cape (South Africa)
1921	May	13 14 15	18.7 0.7 3.7	s.c. s.c. s.c.	130 45 230	90	>700	First quarter	Really a multiple storm with three sudden commencements. Aurora seen at Watheroo in bright moonlight. Seen also in California. Feeble Aurora might have been visible in some parts of India

NOTE—Data for the years 1872, 1892, 1894 and 1903 refer to Colaba Magnetic Observatory and the rest refer to Alibag Magnetic Observatory

TABLE 1 (contd)

Year	Month	Date	Magnetic storms					Phase of the moon	Remarks on associated aurorae
			Time (IST)	Type	Initial impulse	Duration of storm	Range in H. F.		
					ΔH γ		(hrs)		
1928	Jul	8	5.1	s.c.	280	24	>780	Second quarter	Storm and its intense phase occurred during daytime, hence no Aurora could have been visible in India
1938	Jan	22	8.2	s.c.	74	20	613	Do	Storm and its intense phase occurred during daytime. No aurora
1938	Jan	25	17.3	s.c.	76	57	>469	Do	Great auroral display in south England. Seen as far south as Italy, Madeira and Bermuda. Aurora not seen in India
1940	Jan	18	15.3	s.c.	13	22	817	First quarter	No account of Aurora from anywhere in the world
1940	Mar	24	19.3	s.c.	62	28	>757	Full moon	No account of Aurora from anywhere in the world. Bright moonlight
1941	Mar	1	9.5	s.c.	42	19	>785	Between new moon and first quarter	Unusual display of dark red Aurora in Scotland. Storm and its intense phase occurred during daylight hours, hence no Aurora could have been seen in India
1941	Jul	5	10.5	s.c.	29	19	>729	Between first quarter and new moon	No account of Aurora from anywhere in the world
1946	Mar	28	12.1	s.c.	84	47	1038	Between second quarter and new moon	Greatest storm in the Colaba-Alibag series to date. Aurora Australis seen at Watheroo. Storm and its intense phase occurred during daylight hours. It can be reasonably expected that Aurora might have been present but not visible due to sunlight

TABLE 1 (contd)

Year	Month	Date	Magnetic storms					Phase of the moon	Remarks on associated aurorae
			Time	Type	Initial impulse ΔH	Duration of storm	Range in H.F.		
			(IST)		γ	(hrs)	γ		
1949	May	12	12.2	s.c.	46	33	607	Full moon	No account of Aurora from any where in the world
1958	Feb	11	6.9	s.c.	80	45	68	Second quarter	Aurora observed in several parts of the world. Storm and its intense phase occurred during daylight hours, hence no aurora visible in India
1958	Jul	8	13.3	s.c.	95	40	610	Do.	Aurora observed in different parts of the world
1959	Jul	15	13.5	s.c.	79	24	750	First quarter	Storm occurred during daylight hours. Intense aurora seen in different parts of the world

If Aurora is visible, the observer should try to estimate its height and also photograph it. A time exposure with a fast photographic film using a camera of short focal length lens will be useful. The recently developed Orthicon Camera used in stellar photography will be ideal. All the salient features of the Aurora should be noted down and all the observations should be timed. Chapman says "If at all possible, observations should be continued throughout the night. The great rarity and interest of the low latitude aurorae, if understood and appreciated by those fortunate enough to witness them, may provide an incentive to thorough observation even at the cost of inconvenience and loss of

sleep; in a place where more than one observer is available, a plan of watches covering the whole night might be arranged on occasions when the chances of occurrence of Aurora seem particularly favourable. Groups of amateur observers may combine for the purpose."

4. Acknowledgements

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