

# A watercolor painting of northern lights seen above Japan on 11 February 1958

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**Abstract**—A 61 years old watercolor painting of red aurora was recently provided from a Japanese citizen, and it contributed to understand the detailed time evolution around the peak time of the large magnetic storm on 11 February 1958. The painting gives information of the elevation angle of the red aurora seen from low latitude ( $27.4^\circ$  magnetic latitude) at 1205–1225 UT during the beginning of the recovery phase of the magnetic storm. Combined with the hand-made sketch of the same red aurora seen from the Abashiri Local Meteorological Office (located at  $34^\circ$  magnetic latitude) at 1215 UT, the position of the red aurora is determined via triangulation. It is found that the red aurora reached up to 400 km at  $41^\circ$  magnetic latitude, which is  $1.0^\circ$  higher in magnetic latitude than the red aurora which appeared just before the peak time of the magnetic storm.

**Keywords:** aurora / storm / space weather / ionosphere (auroral) / magnetosphere

## 1 Introduction

It was about 61 years ago that the last watercolor painting of aurora was recorded in Japan. It is very rare to see aurorae from Japan because of its low magnetic latitude, and the main reason why no auroral paintings were reported since then would be due to the fact that Japanese citizens rapidly adopted to take photographs rather than making paintings to record such rare phenomena. In 1989, there was another chance to see aurora from Hokkaido, Japan (Table 1), but at that time photography was already a popular tool. Many Japanese citizens were aware of aurorae since 1957, when the first Japanese Antarctic Research Expedition (JARE) was successful to build the Antarctic research station Syowa and start overwintering. Syowa Station is located at high magnetic latitude of  $69.6^\circ$  (geographic coordinates  $S69.00, E39.59$ ). In 1958, the expedition ship was at several 100 km away from Syowa Station and could not reach the station due to bad weather and thick ice. The second overwintering campaign was abandoned. On 11 February 1958, communications were disrupted between Japan and the expedition ship because of the occurrence of a record-large magnetic storm which attracted great public attention.

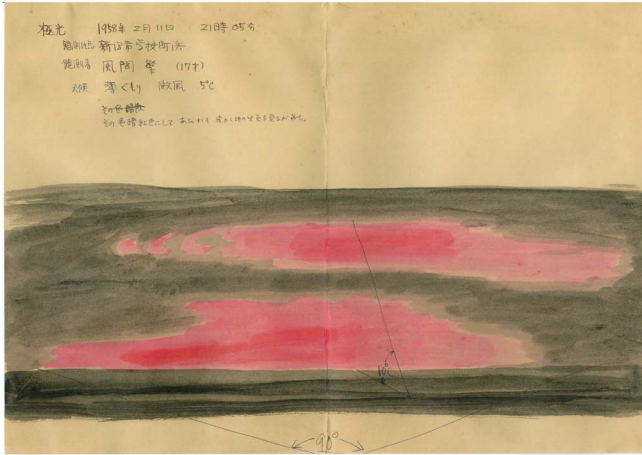
For a few hours from 1000 UT on 11 February 1958 onward, northern lights were observed over northern Japan.

The aurorae were photographed for the first time, and several hand-made sketches were also recorded at the same time. This event serves as a valuable point of contact between the modern recording of data and pictorial records taken over a long period of time. The new findings reported by Kataoka et al. (2019) owe to the digitization of such precious data, especially the microfilm archived at the Japanese Meteorological Agency. The purpose of this article is to report a new contribution of the last auroral color painting which was provided from a citizen.

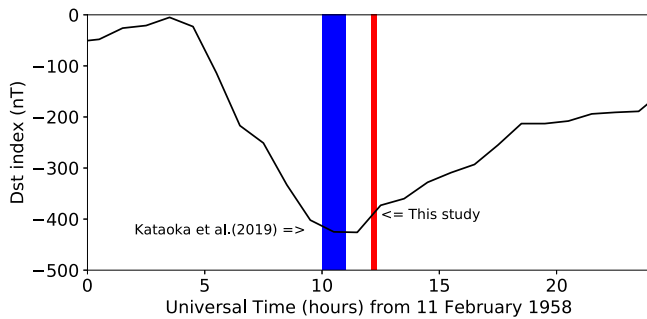
## 2 Watercolor painting

Shigeru Kazama, a 17-year-old high school student with an interest in astronomy, was listening to the radio broadcast at night, which said “an extraordinary light is now being observed in the sky over a wide area of northern Japan”. This broadcast prompted him to go to the shore at the Niigata coast ( $37.9^\circ$  N,  $139.2^\circ$  E,  $27.5^\circ$  magnetic latitude) and watch out toward the north. It was between cloudless and scattered clouds over the coast at that night. He observed the red aurora over the sea from 1205 UT to 1225 UT (2105–2125 JST) on 11 February 1958, and carefully painted it with the watercolors which he was using in his high school life (Fig. 1). He noted little change in the

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**Fig. 1.** The auroral painting on 11 February 1958. The information written in Japanese can be translated in English as follows: Northern light; 2105 JST on February 11, 1958. Observation site; Gakko-cho Hama, Niigata City. Observer; Shigeru Kazama (17 years old). Weather; slightly cloudy, weak wind, 5 °C. Others; the color was dark-red, looked like a fire of cities far away.



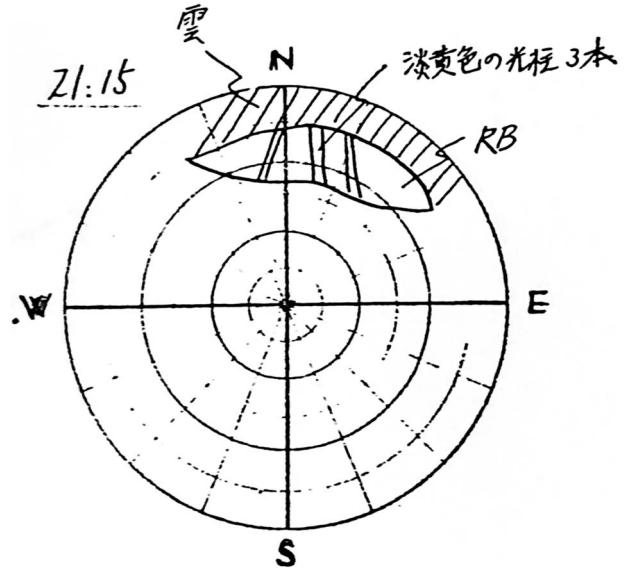
**Fig. 2.** The Dst index of the magnetic storm on 11 February 1958, as obtained from Kyoto University. This study is about the early recovery phase (red), while the time interval of Kataoka et al. (2019) is just before the peak time of the magnetic storm (blue).

appearance during the 20 min. There was a horizontal dark band that virtually separated the aurora into the upper and lower parts. He believes that the dark band were clouds. Artificial light pollution, which is minimum in those days, would have been nearly absent in the northern part of Japan Sea.

Mr. Kazama once sent a copy of the painting to the National Astronomical Observatory of Japan where it was archived. This painting is credited to being the only Japanese color representation of the aurora during that magnetic storm. Sixty-one years later a newspaper report on the fan-shaped aurora (Kataoka & Iwahashi, 2017) caught Mr. Kazama’s attention. He visited the National Institute of Polar Research (NIPR) on 7 March 2019, and presented his original watercolor painting for detailed analysis.

### 3 Data analysis

It is noteworthy that this painting gives the most equatorward graphical information of the elevation angle, which was



**Fig. 3.** Hand-made sketch of the red aurora at Abashiri Local Meteorological Office at 1215 UT on 11 February 1958 (after Japan Meteorological Agency, 1958). Information written in Japanese can be translated as follows: “cloud” (diagonal lines near the northern horizon); “RB” (ray-band) type bright dark-red aurora; with “three light-yellow pillows”.

**Table 1.** Top five magnetic storms with the most negative Dst index since 1957.

| Date       | Minimum Dst |
|------------|-------------|
| 1989/03/14 | −589 nT     |
| 1959/07/15 | −429 nT     |
| 1957/09/13 | −427 nT     |
| 1958/02/11 | −426 nT     |
| 2003/11/20 | −422 nT     |

10° at the top edge of the red aurora, seen from low latitude (27.4° magnetic latitude) for the time interval 1205–1225 UT during the beginning of the recovery phase of the magnetic storm on 11 February 1958 (Fig. 2). It is also noted that this magnetic storm on 11 February 1958 was one of top five magnetic storms since 1957 according to the Dst index (Table 1).

To make a triangulation in spherical coordinates, we combined the painting and another data source, a sketch drawn at 1215 UT (Fig. 3). It shows an elevation angle of 32.7° at the top edge of the red aurora seen from the Abashiri Local Meteorological Office located at 34° magnetic latitude. Note also that fan-shaped aurora with three pillars transiently appeared at Abashiri, although there were no pillars observed at Niigata city at that time. These pillars should therefore be light emissions at lower altitude than the red aurora and were probably below the northern horizon at Niigata city. From the triangulation it is found that the red aurora reached up to 400 km at 41° magnetic latitude, which is 1.0° more poleward than the red aurora (Kataoka et al., 2019) which appeared just before the peak time of the magnetic storm. This result contributes observational

facts for future simulations of ring current development during the largest magnetic storms, especially on the rapid decay of the ring current (e.g., [Keika et al., 2015](#)).

## 4 Conclusions

The viewing of the aurora at multiple locations provides an opportunity to understand its extent to low latitudes. In this paper, we showed that a watercolor painting provided by a Japanese citizen made it possible to determine the position of the red aurora associated with the rapid recovery of the ring current just after the peak time of the record large magnetic storm on 11 February 1958.

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