INTRODUCTION

It is known that the historical Carrington Event occurred from August 26 to September 7, 1859, during which the strongest geomagnetic disturbance, low-latitude auroras, and ignitions along long telegraph lines in Eurasia, America and Australia were observed (Stewart 1861, p. 424). Extreme geomagnetic storms were recorded twice: on August 28 and September 2, 1859.

To date, researchers believe that the Carrington Event was caused by solar flares and two interplanetary coronal mass ejections (ICMEs) that impacted Earth. The flare on September 1, 1859, observed visually by R. Carrington and marked by a magnetic crochet trace (a characteristic 'hook' on the magnetogram), was identified as a solar white-light flare, i.e., with radiation in the continuum spectrum.

However, at the same time in 1859, astronomers expected observations of the Andromedids meteor shower and two secondary comets, which appeared together after the breakup of the 3D/Biela Comet in the 1840s. As is now believed, they were not observed due to poor weather. Nevertheless, published evidence indicated that the 1859 Carrington Event, with a high probability, was linked to the Andromedids and/or secondary comets of Comet Biela.

The 3D/Biela Comet, which has an orbital period of about 6.7 years around the Sun, belonged to the Jupiter family of comets and was independently discovered by astronomers J. Montaigne and C. Monsieur on March 8, 1772. Then Comet Biela was observed by J. Pons on November 10, 1805, and rediscovered again on February 27, 1826, by W. Biela. A meteor shower was also discovered along the orbit of the 3D/Biela Comet. Astronomer E. Herrick concluded that the 1838 radiant these meteors should be located near the Cassiopeia constellation or, more likely, the vicinity of the Perseus' sword cluster (Newton 1886, p. 423).

A close approach near Jupiter caused a gradual decrease in the longitude of the ascending node of the 3D/Biela orbit. As a result, the radiant of the meteor stream shifted to the γ-star (Alamak) in the Andromeda constellation, where it remains to this day as the source of the Andromedids meteor stream.

On December 19, 1845, the nucleus of Comet 3D/Biela was observed to be splitting, and on December 31, 1845, this process was complete. In mid-January 1846, astronomer M. Mori reported that the nucleus had disintegrated into two parts, so-called 'A' and 'B'. Each of them was a separate comet with a nucleus, coma, and tail (Fig. 1). Still, the 3D/Biela Comet was probably divided into a larger number of fragments[1], as the connecting arch was clearly traced be-

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1 In this book, I use the term 'fragments' to refer to both the large secondary comets 'A' and 'B' and the Andromedids

tween the two main parts. The 'A' secondary comet in 1846 appeared *diffuse and had as many as five multiple nuclei*.

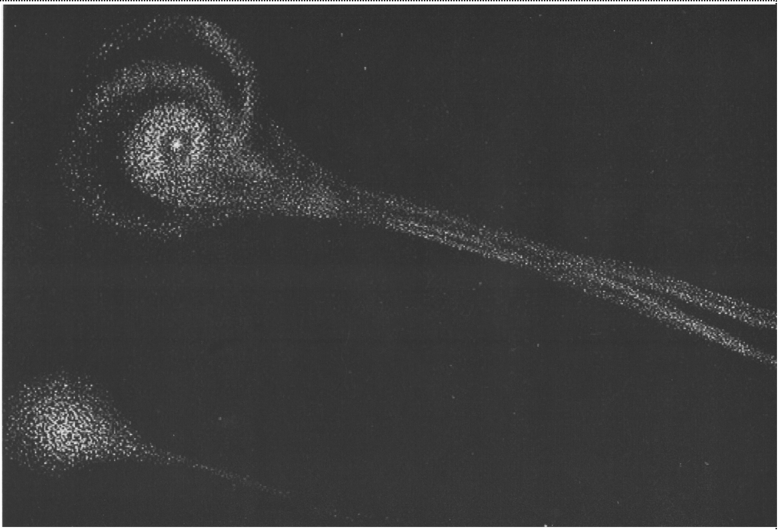

Fig. 1: Two secondary comets, 'A' and 'B', immediately after the disintegration of the parent Comet 3D/Biela in February 1846.

Source: adapted from Weiß, E. (1888): Beitrage zur Kenntniss der Sternschnuppen. In: Bilderatlas der Sternenwelt I: 11. (in Deutsch). A translation: Contributions to the knowledge of shooting stars. In: Picture Atlas of the Starry World I: 11.

Moreover, Hawkins et al. (1959, p. 183) assumed two different Andromedids streams: from 1741–1847 and from 1850–1899. When and where did they move? The appearance after the disintegration of the 3D/Biela Comet, its sec-

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meteor shower, since they appeared together after the disintegration of 3D/Biela in the 1840s.

ondary 'A/B' comets on August 26 and September 15, 1852, practically coincided with similar dates of geomagnetic storms from August 26 to September 7, 1859. Therefore, these secondary comets could have acted in August–September 1859, resulting in the intense geomagnetic storms and low-latitude auroras during the Carrington Event (German 2025g, #0008).

Since the Mazapil iron meteorite fell and was immediately discovered in Mexico on the day of the maximum of the Andromedids shower in 1885 (Hidden 1887, p. 221), the Comet Biela could have contained magnetic metallic fragments. Therefore, the movement of magnetised particles of meteors along the force lines of the geomagnetic field could cause effects indistinguishable from those created by particles of the solar wind. These include penetration into the magnetosphere/atmosphere from the north and south magnetic poles, as well as the initiation of auroras and induced telluric currents (GIC).

The absence of Andromedids activity in 1878 was estimated as the spread of the trail of comet 3D/Biela by no more than 40% of the length of its orbit. Later there was a gap of 7 years between the Andromedids of 1892 and 1899, and about 5 years between the Andromedids of 1899 and 1904 (Denning 1905, p. 853). This indicated a more significant differentiation over time of the remnants of the broken 3D/Biela Comet along its orbit.

Nowadays, the Andromedids are observed from September to December. The main source of meteors is numerous filaments formed due to significant changes in the comet's orbit. If, on November 27, in both 1872 and 1885, there were several thousand meteors per hour (Fig. 2), then now, in the region of November 14, the Andromedids are only a weak stream with a maximum activity of fewer than 3 meteors per hour.

Fig. 2: The falling meteors on 18 November 1872 in Paris.

Source: adapted from Flammarion, C. (1894): Popular Astronomy: A general description of the Heavens, p. 534, Fig. 231.

A correct interpretation of the Carrington Event is important in light of the debate about the threats to terrestrial civilisation. However, the current hypothesis that the 1859 Carrington Event had an entirely solar origin faces significant difficulties. This will be discussed further.