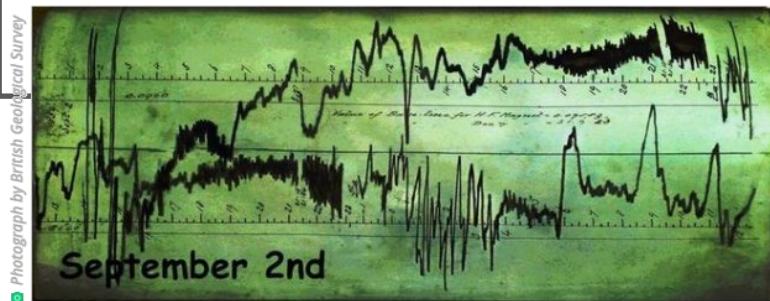
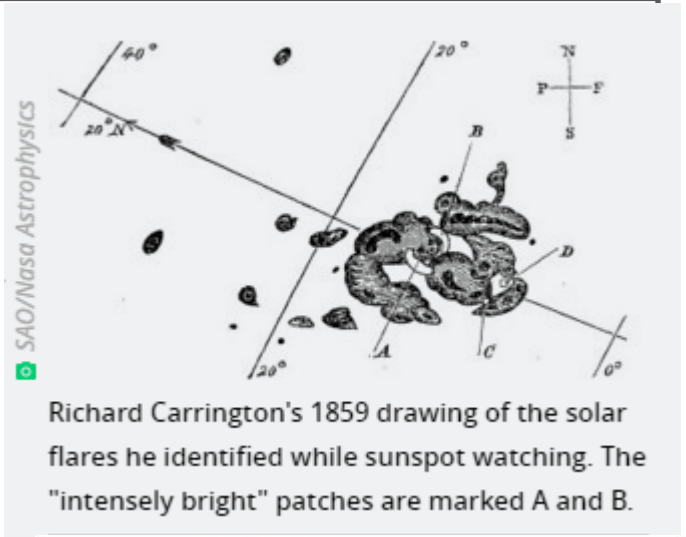


September 1, 1859 - The Largest Electromagnetic Storm on Record

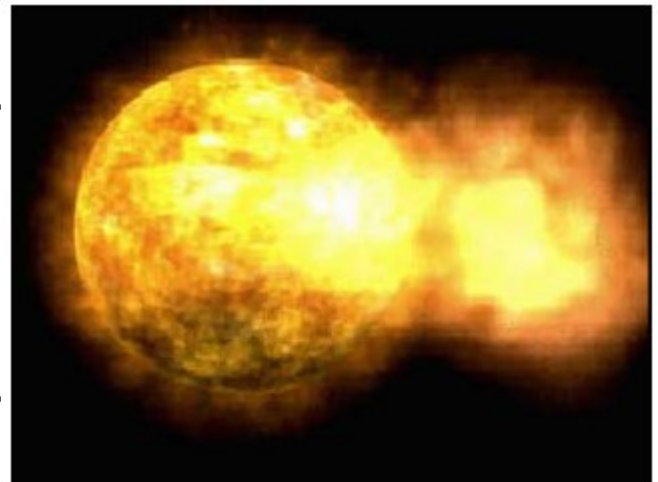
British astronomer, Richard Carrington, noticed two unusually bright patches as he was tracking sunspots.

Auroras were seen around the world. In the northern hemisphere as far south as the Caribbean. *The Rocky Mountain News* reported aurora so bright over the Rocky Mountains in the U.S. that the glow woke gold miners, who began preparing breakfast because they thought it was morning.

Telegraph operators reported disruptions, fires, and electrical power with their batteries disconnected.



A magnetogram recorded at the Greenwich Observatory in London during the Carrington Event of 1859.

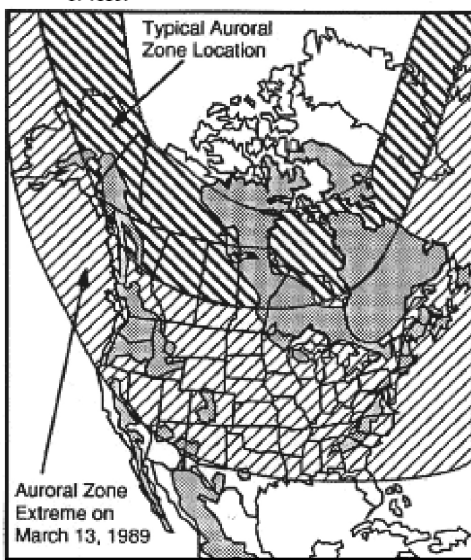


Solar flares and coronal mass ejections (CMEs), associated giant clouds of plasma in space, are the largest explosions in the solar system. They are caused by the buildup and sudden release of magnetic stress in the solar atmosphere above the giant magnetic poles we see as sunspots. CMEs can cause magnetic storms affecting communication systems, power grids and astronauts in space.

Credits: NASA/ Walt Feimer

March 13, 1989 - Quebec Geomagnetic Storm

In March 1989 a massive geomagnetic storm on the sun caused a blackout throughout the province of Quebec, and affected the power grid throughout much of the U.S. and Europe. Auroras could be seen in the Southern U.S. and Cuba. The intense magnetic disturbance created electrical currents in the ground beneath much of North America. In space, some satellites actually tumbled out of control for several hours. NASA's TDRS-1 communication satellite recorded over 250 anomalies as high-energy particles invaded the satellite's sensitive electronics.



Power systems in areas of igneous rock (gray) are the most vulnerable to the effects of intense geomagnetic activity because the high resistance of the igneous rock encourages geomagnetically induced currents (GICs) to flow in the power transmission lines situated above the rock. Shown in cross-hatching are the auroral zone and the extremes that the aurora can reach during severe disturbances such as March 13, 1989.

Credit: American Geophysical Union