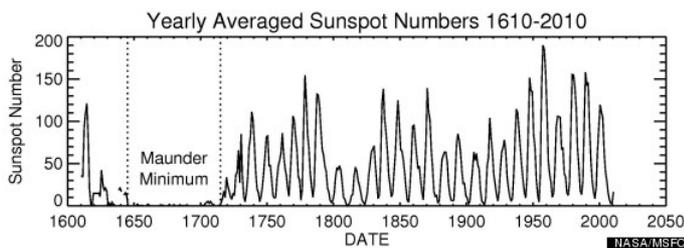


Sun – Part 24 - Maunder Minimum



Maunder Minimum



Frozen River Thames

This well-known event in solar cycle history was the period, from around 1645–1715, when sunspots became very rare, as noted by solar observers at that time, and aurorae were virtually absent. The term was introduced in a paper by John Eddy in 1976.

Edward Maunder (1851–1928) was an English solar astronomer. In 1873, he became a spectroscopic assistant at the Royal Observatory, Greenwich. For 40 years, as part of his job, he photographed, counted and measured solar sunspots on every possible day. This enabled him, and his assistant wife, Annie, to identify several patterns in sunspot activity. However, it was his concurrent study of the history of astronomy which led to discovery of the period of very low sunspot activity which now bears his name.

While studying historical records to seek additional evidence of latitude variation in sunspot positions, the Maunders noted that German astronomer Gustav Sporer (1822–1895) had noticed an almost complete absence of sunspots during those 70 years. For 28 years (1672–1699) Sporer had noted that fewer than 50 sunspots were observed (40,000–50,000 is more typical).

Lack of data on sunspot activity during that period was not the explanation for this finding eg Cassini had led a systematic programme of solar observations in Paris which included that period. Maunder's research, published in 1894 and 1922, revealed the existence of what is now called the Maunder Minimum. Maunder agreed with Sporer's conclusion that there had been a real decline in solar activity then. Later, findings of increased carbon-14 content in tree rings from that period confirmed this (cosmic rays that produce increases in carbon-14 reach Earth in greater numbers when solar activity is low). Historical records of what was called the Little Ice Age which occurred during the same time period also supported the existence of the Maunder Minimum.

However, more detailed investigations have revealed that the reality of the presence of a causal relationship between solar activity and cold temperatures on Earth is not as straightforward as Maunder, Sporer and others accepted. One concern is that fact that the Maunder Minimum and the so-called Little Ice Age are often regarded as referring to the same event. However, the Maunder Minimum coincided only with the middle part of the Little Ice Age, which began about 50 years earlier and continued for several decades afterwards. In a longstanding, ongoing debate, some have argued that the Little Ice Age and Maunder Minimum were the result of a terrestrial cause, a consequence of volcanic activity on Earth.

Furthermore, the terms Little Ice Age and Maunder Minimum have also been argued to be misleading, as they suggest global events. This was not the case. The Little Ice Age refers only to unusual cold experienced in Central Europe and North America. Even then, in the UK, during the periods of very cold temperatures, some years in the Maunder Minimum

were some of the warmest on record until then. Also, summer temperatures during the Minimum years were not very different from the average. Review of historic records has further shown that auroral activity was not reduced during the Minimum.

Modern solar observations have also identified that solar ultraviolet output varies more during the solar cycle than was previously thought. This implies that, although what is known as the Maunder Minimum was a period of reduced solar activity, it was more an example of what happens at the extreme ends of the normal variation range than an exception. In fact, studies suggest that the Sun currently spends up to a quarter of its time in minima. Eighteen periods of sunspot minima during the last 8,000 years have been identified. Some were marked enough to also earn them names eg Sporer Minimum (1450-1550), Dalton Minimum (1790-1820, but they are not the rare events which the historical perception of the Maunder Minimum has suggested.

Despite these confounding factors, sunspot observation records and carbon-14 and beryllium-10 tree ring and ice sheet analysis do confirm notably lower solar activity during the Maunder Minimum. This period is an important time in the study of sunspot activity, but explanations are not as simple as historically suggested. Although a 1% decrease in solar output could cause such effects on Earth as occurred during the Maunder Minimum eg freezing of the River Thames, a direct association between reduced sunspot numbers and lower temperatures on Earth has not been proven.

The explanation may even be Earth-based. For example, in addition to the possible volcanic activity, changes in jet stream behaviour have also been proposed as an explanation. This has been found to affect winter temperatures in different areas of the Northern hemisphere ie colder winters in North America and central and northern Europe and milder winters in southern Europe, Canada and Greenland.(as occurred during the Little Ice Age and Maunder Minimum).

Sources: Ridpath, I (Ed) (2012) Oxford dictionary of astronomy 2nd ed rev, www.en.wikipedia.org