4.17 OLD SUNSPOT RECORDS

V.R. Venugopal
Radio Astronomy Centre (TIFR)
P.O.Box 8, Udhagamandalam-643 001
India

Abstract: The works of Eddy (1976) and Clark and Stephenson (1978) on the ancient sunspot records are reviewed and a plea is made for the search for ancient records of astronomical events and phenomena in India.

1 THE ELEVEN YEAR SUNSPOT CYCLE:

Among the large number of solar phenomena that can be observed, the oldest and the best known is the spot activity on the sun. The true discovery of the sunspots as they are described in modern solar physics can be traced to about 1610 when the telescope was used for observing celestial bodies by Galileo. Observations of sunspots in the early seventeenth century have been made by Galileo Galelei, Johannes Fabricius, Father Christoph Scheiner and Johannes Kepler. Galileo and father Scheiner could recognise the movement of the sunspot on the surface from higher to lower latitudes on the sun and correctly conjectured that they were fixed to the sun. Father Scheiner could not only determine the period of the sun's rotation but also noticed that the sunspots changed their latitude in the course of the years. Later in the nineteenth century, following the report of Heinrich Schwabe in 1843 suggesting the existence of an apparent period of approximately ten years between the maxima in the number of sunspots on the visible surface of the sun, Rudolf Wolf made an organised systematic study of the annual means of the relative number of sunspots and found the period to be 11.1 years in 1852. Using scattered data from a host of sources Wolf succeeded in deriving spot numbers back to 1749 and the epochs of maxima and minima back to 1610 when sunspots were observed with the telescope.

The variability of the spottedness is well established and the plot of the annual mean relative sunspot numbers from 1750 to the present seems to indicate a quasi periodicity of roughly 11 years taking on the average about 4 years to rise to a maximum and about 7 years to decrease to a minimum. Carrington, in 1859, discovered the law of latitude drift of sunspots.

https://doi.org/10.1017/S0252921100106141 Published online by Cambridge University Press

2 ANOMALOUS ABSENCE OF SUNSPOTS-DOUBTS ON LAW OF SUNSPOT PERIODICITY:

On the basis of the post 1750 observations of the sunspots one would take for granted that the sunspot cycle of period of approximately 11 years is a fundamental and nonvarying property of the sun. But this does not seem to be true. There have been clear indications from the works of Gustav Sporer and E.W. Maunder in late nineteenth century, who carefully examined the historical records, that during the 70 years between 1645 to 1715 there was a "prolonged sunspot minimum" when the sunspots had almost entirely disappeared. While Maunder's conclusion was considered questionable by many solar astronomers the recent thorough work of Eddy (1976) convincingly establishes that there was a significant decrease in the amplitude of the solar activity cycles from about 1645-1715, an interval coinciding with the reign of Louis XIV in France, when sunspots all but disappeared. This 70 year minimum is called 'Maunder Minimum' by Eddy (1976). Parker (1978) writes: 'The "absurdity" of Maunder's claim that the historical records proved sunspots absent in the late seventeenth century has survived almost to the present day. Only Eddy's recent work has set the topic to rights'. Eddy's plot of the relative deviation in the ^{14}C concentration based on measurements of tree rings and sunspot activity is reproduced in Figure 1. This clearly reveals that ^{14}C record is an indicator of long term variation of solar behaviour. Pretelescopic data on sunspots have been collected by Eddy from published literature on naked eye sunspots. It may be noted that under favourable conditions larger sunspots are easily visible to the naked eye. Actually naked eye sunspots are best seen near sunset when absorption in the atmosphere cuts the normal glare of the sun down far enough that one can look directly at the solar disk.

From this plot Eddy (1976) not only indentified the Maunder minimum 1645-1915 AD but also two other anomalies, namely i) the grand maximum 1100-1250 AD and ii) the Spörer minimum 1460-1550 AD. Clark and Stephenson (1978) on the basis of a catalogue of pretelescopic sunspot records from the orient confirm the existence of 'Maunder minimum' and the 'Sporer Minimum' and suggest the existence of a 'Medieval Minor minimum' in the period 1280-1350 AD. They also point out that these anomalies in sunspot data are supported by the ^{14}C data.

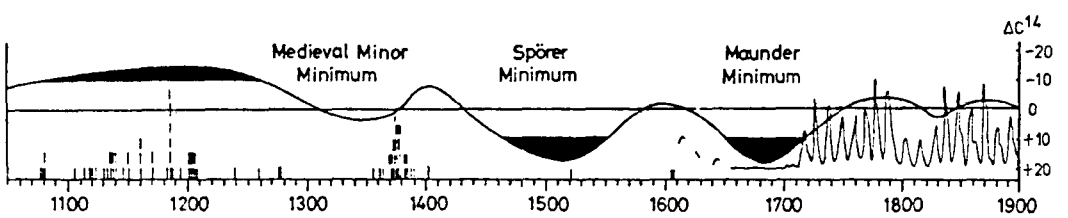

Fig.1. Reproduction of Fig.8 from Clark and Stephenson (1978)

https://doi.org/10.1017/S0252921100106141 Published online by Cambridge University Press

3 ABSENCE OF ANCIENT SUNSPOT RECORDS FROM THE INDIAN SUBCONTINENT-NEED TO CARRY ON SYSTEMATIC SEARCH.

It is an acknowledged fact that the astronomical tradition in India dates back to the Vedic period, the second millenium BC. There are reasonable evidences to believe that naked eye observations of the Sun, the Moon and the planets and study of their movements and charting of eclipses were carried on by ancient Indian astronomers. There seems to have been an astronomiCcal observatory in Banares called the 'Man Mandir' even as early as the early sixteenth century or even before (Mathur, 1974). In spite of all this it is regrettable as well as ununderstandable that no ancient records describing astronomical events and phenomena such as sunspots, comets, supernovae etc have been found in the Indian sub continent. The reason attributed is that ancient records were lost during the invasions of Muhammad Ghouri and Aurangazeb (Mathur 1974). Even if this were true such destruction was mostly confined to north India and the southern part of India was relatively free from such invasions and destruction. Hence search for historical records of astronomical events such as occurrence of large naked eye sunspots, supernovae like the Crab Nebula of 1054 AD, bright comets etc must be undertaken among the archaelogical inscriptions in ancient temples and old palm leaf manuscripts. Perhaps one can look for any pictographs of such events on ancient rocks and in caves.

Also, H.N. Bhalme and S.K. Jadhav (1984) have studied the patterns of good and bad rainfall over the years in relation to changes in solar activity and have suggested that since 1891 there seems to be a significant tendency for droughts and floods to occur in alternate 11-year sunspot cycles. Since the work of Clark and Stephenson (1978) extends the pretelescopic sunspot records to about 1 AD the study of the link between solar activity and occurrence of floods and droughts in India can be carried out over a longer time scale in order to verify the results of Bhalme and Jadhav. If their results are confirmed over the longer base line of time then this link with solar activity will provide a means of predicting periods of flood or drought risk even though there is, as yet, no clear explanation as to why sunspot changes affect the rainfall.

REFERENCES

Bhalme,H.N. & Jadhav,S.K. (1984). The double (Hale) Sunspot cycle and floods and droughts in India. Weather, **39**, 112.

Clark,David H. & Stephenson,Richard F.(1978). An interpretation of the Pre-Telescopic Sunspot records from the Orient. Q.Jl.R.astr.Soc. **19**, 387.

Eddy,J. A. (1976), The Maunder minimum. Science, **192**, 1189.

Mathur,Krishna D. (1974). Indian astronomy in the era of Copernicus. Nature, **251**, 283.

Parker,E.N. (1978). The New Solar Physics. ed.J.A. Eddy, page 7.

EDITORS' NOTE

Recently Bracewell (1986) and Bracewell & Williams (1986) Have reported interesting result of the existence of two periodicities

~ 314 and 350 Varve years in the sequence of Varves (thickness variations of annual sedimentary layers) from the late-Precambrian formations similar to such periodicities in Sunspot counts and have suggested that from such studies the next solar magnetic cycle could be predicted (References: (1) Bracewell,R.N. (1986). Simulating the Sunspot Cycle. Nature, **323**, 516; (2) Bracewell,R.N. & Williams,G.E. (1986). Hilbert transform analysis of the Elatina Varve record of Solar Activity. Mon. Not. R. astr. Soc., **223**, 457).

https://doi.org/10.1017/S0252921100106141 Published online by Cambridge University Press