

The Size of the Carrington Event Sunspot Group

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Abstract: The size of the sunspot group that produced the white light solar flare observed by Carrington and Hodgson in 1859 is measured and compared with the size of sunspot groups since 1874.

Introduction

On 1859 September 1, Richard Carrington and Richard Hodgson independently observed one of the first white light solar flares^{1,2}. The recording of this flare and the subsequent magnetic disturbances and aurora are well known and documented^{3,4}. But how large was the sunspot group that produced this flare and how does its size compare with other recorded sunspot groups?

Area Measurement

Figure 1 shows Carrington's drawing for the day of the white light flare⁴ after being modified (background removal and conversion to a mask, coloured red) and input into the author's HelioViewer software⁵. Various heliographic

parameters are shown in the left panel for the time of Carrington's drawing. Superimposed are Carrington's latitude and longitude of various individual sunspots for his group number 520 (blue crosses)⁶. Note that Carrington's longitude values have been corrected by -7.99° ^{7,8}. HelioViewer calculates the area of each red mask pixel, corrected for foreshortening, within a user specified rectangle⁹.

The area within the blue box is calculated to be 3100 millionths of the Sun's visible hemisphere (MSH). Although the small sunspot above the box was included as part of the main group by Carrington, it would now be marked as a separate group, being more than 5° in latitude from the sunspots within the box (the mean heliographic position of the main group is at $18^\circ\text{N}/96^\circ$ while the sunspot above the box is at $28^\circ\text{N}/107^\circ$).

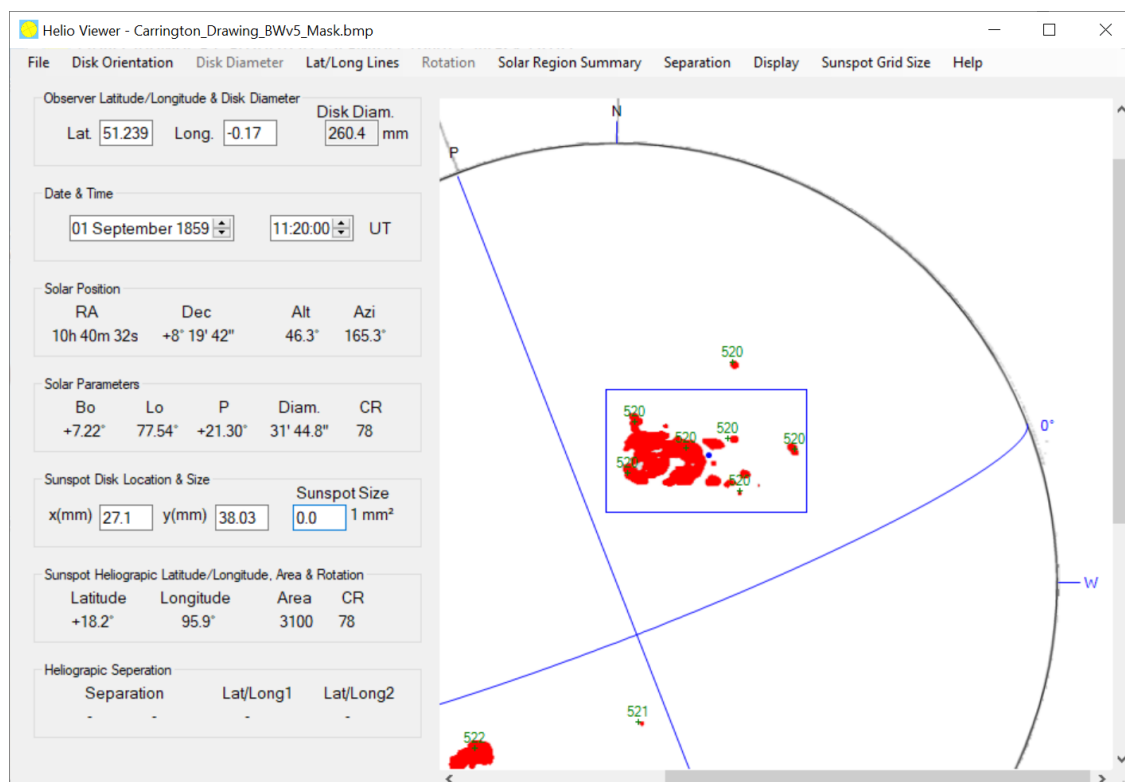


Figure 1. Area measurement of the Carrington Event Sunspot Group

Comparison with Other Groups

A group area of 3100 MSH is just over half the area of the largest recorded sunspot group on 1947 April 08 of 6132 MSH. It would also be the 24th largest recorded group if it were included in a list of the largest groups since 1874 as given in Table 1 (the group numbers are Greenwich Group numbers prior to 1977, NOAA group numbers since the start of 1977 and Carrington's group number)¹⁰.

Table 1. Largest Recorded Sunspot Groups

	Group	Date	Area (MSH)
1	14886	1947 Apr 08	6132
2	14417	1946 Feb 07	5202
3	16763	1951 May 19	4865
4	14585	1946 Jul 29	4720
5	14851	1947 Mar 12	4554
6	12192	2014 Oct 24	4419
7	5395	1989 Mar 14	4201
8	6368	1990 Nov 16	3872
9	9861	1926 Jan 19	3716
10	12673	1938 Jan 21	3627
11	7977	1917 Feb 14	3590
12	10486	2003 Nov 01	3388
13	9393	2001 Mar 29	3387
14	12902	1938 Jul 20	3379
15	12553	1937 Oct 05	3340
16	5441	1905 Feb 02	3339
17	12455	1937 Jul 28	3303
18	4474	1984 Apr 26	3274
19	6555	1991 Mar 23	3257
20	5528	1989 Jun 16	3249
21	6850	1991 Oct 27	3234
22	21482	1968 Feb 01	3202
23	8181	1917 Aug 09	3178
24	520	1859 Sep 01	3100

Summary

Thus, the Carrington and Hodgson white light flare did not occur in the very largest of the recorded sunspot groups but, for example, in a group that was smaller than the largest group from the last solar cycle: AR 12192 on 2014 October 24 at 4419 MSH. If sunspot group area were the only factor in the generation of white light flares, there would have been many more instances of Carrington and Hodgson's disruptive solar flare since 1859.

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