ON THE RELATION BETWEEN SUNSPOT AREA CHANGES AND FLARE OCCURRENCES

(Research Note)

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HOWARD (1963) has examined the areas of spot groups associated with six major solar flares, one day prior, to one day after the flare, and has attributed the decrease in area of the spot group in each case as caused by the flare.

Unfortunately the areas set out in Table I of Howard's note, said to have been derived from the Greenwich Photoheliographic Results (except for the spot of July 16, 1959 which were obtained from Mount Wilson Plates) contain errors in the area values and also in the identification of spots responsible for the flare. This prompted us to examine the relation closely by extending it to a few other spot groups in which major solar flares have occurred. Howard has apparently been reading as the area of a spot group for a particular day, that area of the group belonging to the next day. This has presumably happened because of the format in which the daily areas of spots are represented in the Greenwich Photoheliographic Results.

We have examined the spot groups associated with 6 cosmic ray flares (of the 10 flares studied by ELLISON *et al.* (1961), 4 are limb flares and have no area measures after the flare) and also for 13 other flares of importance 3 or 3^+ listed by KŘIVSKÝ (1965). The penumbral areas of the spot groups are from those published in the Greenwich Photoheliographic Results for all the cases studied here. These give areas corrected for foreshortening and expressed in millionths of the sun's visible hemisphere. These areas for each spot group for all the days of its appearance on the disc are shown graphically in Figure 1. The flare event associated with each spot group is also indicated in the figure. It is seen, that the flares occurred mostly around the period of maximum area in the evolutionary phase and, in the case of spot groups appearing for more than one rotation, the flare occurred during that rotation in which the area of the spot group was in its maximum phase. This is in agreement with the probability curves of GIOVANELLI (1939). The curves of Figure 1 which include both the cosmic ray flares as well as flares of importance 3^+ and 3 show that the flares, irrespective of their importance, have little effect on the trend of the area change. If the area of a spot group is in the increasing phase, this trend is maintained even after the flare. A similar pattern exists for the decreasing phase. We feel, therefore, that there is sufficient evidence to conclude that any changes in area noticed after a major flare cannot be ascribed to flare stimulation, but are on the other hand only features associated with normal sunspot evolution. Taking only the area one

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day before and one day after the flare for such a study has its limitation. The change of the areas has to be viewed as part of the trend prevailing over the entire period of passage of the spot across the disc during which the flare occurs.

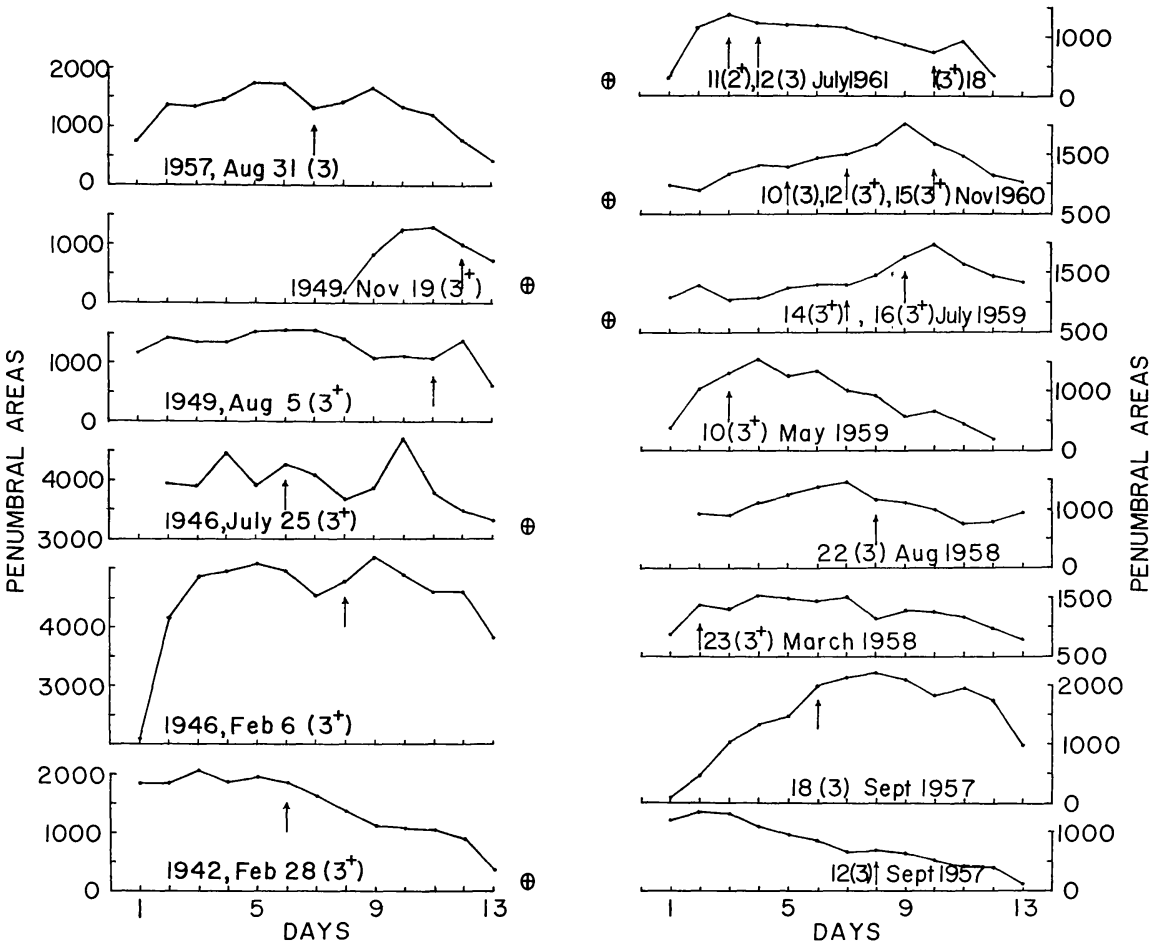

Fig. 1. Areas of spot groups day by day. The abscissa is in days of the passage of the spot group across the solar disk. The ordinates represent the penumbral areas of each group separately in millionths of solar visible hemisphere. The flare event for each is indicated by a vertical arrow with date and the flare importance within brackets. Cosmic flare events are indicated thus ⊕.

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