ON THE RANDOM NATURE OF THE ERUPTION OF MAGNETIC FLUX AT THE SOLAR SURFACE

(Research Note)

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It is of interest to inquire about the possibility that the resurgence of activity in an already established active region is somehow associated with that region and is not just a random eruption of solar flux. In other words, does the resurgence of activity in an active region result in some way from the presence of that region, or is it just the chance occurrence of two eruptions of magnetic flux in the same location? It has been noted (Bumba and Howard, 1965a) that active regions tend to form in the weak fields of dying plages, however this is a separate matter because such eruptions would not be considered resurgences of activity. Similarly, the concept of 'active longitudes' does not directly affect these considerations except that a slight crowding of regions at some longitudes may alter somewhat the statistical analysis below.

In order to shed some light on this problem, we have examined two years of recent data to see if the hypothesis of random flux eruption can be supported by the observations. As an estimate of the total area of the Sun occupied by active regions, we measured the area of faculae surrounding spot groups for 26 rotations in the Zürich Heliographic Maps for 1969 and 1970 (Waldmeier, 1969, 1970). We expect that this will give to a good approximation the 'area of active regions'. It is true that some areas are included that are not strictly active regions. On the other hand, the areas of the active regions themselves, measured by their effect on the Hα chromosphere is slightly larger than the facular areas of the regions, so these two effects will to some extent offset each other.

The total number of active regions seen in each rotation was counted from the Heliographic Maps and is listed in Table I along with the facular area for each rotation. We attempted to estimate the number of newly formed regions (not returns) in each rotation. These numbers are listed in Table I. As a check, we counted the number of McMath plages in each rotation and the number of those that were not classified as returns. These data were from the bulletin Solar-Geophysical Data from the Environmental Research Laboratories of NOAA in Boulder, Colo., U.S.A. One would not expect the numbers of regions to match exactly because they refer to different features, but the averages, in particular the ratios of new features to previously existing ones, are in quite satisfactory agreement.

The number of resurgences of activity for this period was estimated from the daily...
magnetograms and Ca ($K_{2,32}$) spectroheliograms from Mount Wilson. In order to do this, each region was examined carefully during its lifetime on the visible disk and, when appropriate, on its return around the east limb. We would have missed those regions that first erupted on the other side of the Sun and then received additional magnetic flux before they became visible around the east limb. In addition small resurgences of activity on the other side of the Sun might have been missed if the magnetic flux had dissipated somewhat before the region next became visible.

The total number of resurgent regions counted during the two-year period was 77. These values are given for each rotation in Table I. If we take 615 as the number of new regions from Table I, then the percentage of resurgent to new plus resurgent regions is 11%. The area occupied by active regions averaged over the period is 2464 deg$^2$ from the data in Table I. It is difficult to estimate precisely the area available for active-region formation. Early in the two-year period there were occasional regions at latitudes greater than 30°. In the last few rotations during this interval there was almost nothing above 25°. If we take 28° as an average maximum latitude for region...