551·577·52 : 523·546 (542)

ANOMALIES — SUNSPOT-CYCLE AND REGIONAL RAINFALL

Adityat jāyate vrishtih—rains are caused by the Sun—is an old adage and is the motto of the India Meteorological Department. Any irregularities in the solar radiation, such as due to sunspot activity, will affect the rainfall pattern in various regions of the earth. By working out the variations of excess or subnormal daily rainfall, Sen Gupta (1957) found significant correlations between sunspot activity and rainfall patterns in Tamilnad (southeast Madras) for the season October to December.

The writer (Deshpande 1968) analysed the January rainfall data for sixtytwo years in respect of seven representative stations in the plains of west Uttar Pradesh (north India) adopting Sen Gupta's method. Fig. 1(a) shows the number of days of excess rainfall over west Uttar Pradesh (U.P.) during the period 1900—1961. Fig. 1(b) shows the sunspot numbers (ordinates reversed) in corresponding years.

Figs. 1(a) and (b) show that there is recurrence of more frequent excess rainfall days over west U.P. in January during sunspot minimum phase. However, there are some anomalies in the rainfall pattern, particularly in the years 1903, 1913–14, 1920–22 and 1930–34. In these years there is a sudden drop in the number of excess rainfall days, out of phase with the sunspot curve.

The intensity of solar radiation over the earth may be affected by terrestrial factors, such as volcanic dust. It is an observed fact that violent volcanic eruptions throw up fine dust to great heights. The dust in some cases remains suspended in the atmosphere for an appreciable time. In the case of Kakatoa eruption (1883), fine volcanic dust probably reached an altitude between 40 to 60 km and took as long as 2½ to 3 years to reach the earth.

Volcanic dust is quite effective in shutting out solar radiation. This is also confirmed by, marked decreases in pyrheliometric readings subsequent to exceptional volcanic activity. Recently Arakawa (1955) has also confirmed that there was a fall in the hemispherical temperature in the year following the volcanic eruptions. He concluded that cool summers followed by bad harvests in Japan are significantly related to volcanic eruptions.

It is an observed fact that during sunspot maximum phase, there is a lowering of temperatures over the earth particularly, the tropics

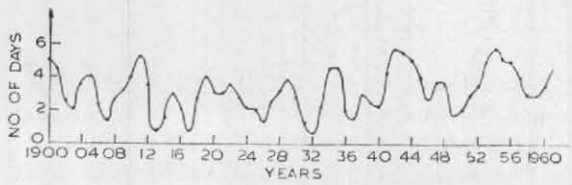

Fig. 1(a). Excess rainfall days

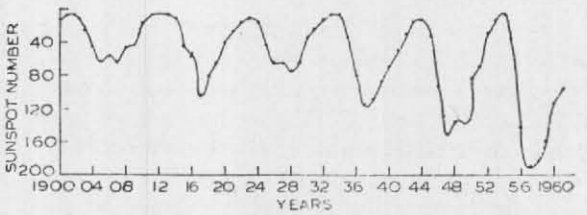

Fig. 1(b). Sunspot-cycle (ordinate reversed)

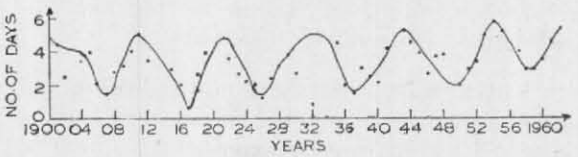

Fig. 1(c). Excess rainfall days

(Humphreys 1940). According to one theory, this results in the weakening of temperature gradients between the equator and pole with consequential decrease in the zonal circulation, cyclogenesis and the rainfall in low latitudes. The lowering of temperatures in the lower troposphere over the earth due to volcanic dust therefore corresponds to the effect of sunspot–maximum phase.

The chief volcanic eruptions in the last sixty years are the eruptions of Pele's (1902), Santa Maria (1902), Colima (1903) and Katmai (1912). It would, therefore, be logical to expect a decrease in the rainfall over west U.P. in the years following this eruption, *viz.*, in 1903 and 1913-14. This is confirmed by the sudden dips in the curve in Fig. 1(a) for these years.

No major volcanic eruptions were recorded either in 1919 or 1930-32. It is, therefore, difficult to explain the rainfall-anomalies for these years. However the pyrheliometric values for 1920-21 indicate an unexplained drop. Also Arakawa (1955) mentions that in 1931 and 1934 Japan had abnormally cool summers and bad harvests. These indicate that the anomalies in the curve in Fig. 1 (a) for the years 1920–22 and 1930–34 are probably due to a general lowering of temperatures over the earth. The causes for the lowering of temperatures are not yet known, if we disregard the possibility of volcanic eruptions in remote and inaccessible regions.

Fig. 1(c) represents the same curve as in Fig. 1(a) but omitting the data for the years following volcanic eruptions etc. The parallelism in the curves of Fig. 1(c) and the sunspot-cycle (ordinate reversed) in Fig. 1(b) is very striking.

It would, therefore, appear that following violent volcanic eruptions and lowering of temperatures over the earth, there is a marked decrease in the rainfall in west U.P. in January. This may partly explain the U.P. rainfall-anomalies observed in relation to the sunspot-cycle.

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D. V. DESHPANDE

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