LETTERS TO THE EDITOR

THE HOTTER THE SUN, THE COOLER THE EARTH

It has been known for a long time that the average temperature of the earth as a whole varies inversely as the frequency of sunspots. Humphreys[1] has expressed this fact by the paradox: "The hotter the sun, the cooler the earth". Although he[2] has indicated an explanation, he[1] concludes that the cause cannot be determined without further observation.

The author[3] has studied the relationship between the average annual sunspot numbers and the pressure distribution in the neighbourhood of South America during April and May. He assumes a sine-curve to represent the normal latitudinal distribution of pressure and finds significant correlation (5 per cent. level) between sunspots and the amplitude of the curve. He finds that *the amplitude of the normal pressure profile in the South Atlantic decreases with increasing sunspots.* Since a strengthening of the meridional circulation should increase the convection and subsidence near the equator and in the horse-latitudes respectively, and hence increase the pressure gradient from the equator to Lat. 30°, a decrease in the amplitude implies a weakening of the meridional circulation. Again, since a decrease in the amplitude of the pressure profile means a decrease in the pressure gradient between the high pressure area at Lat. 30° and the low pressure areas at the equator at Lat. 60°, that also implies a weakening of the westerlies of the higher latitudes and the easterlies of the equatorial zone. But a weakening of the easterlies near equator means an increase in the absolute wind strength in that region. Therefore during sunspot maxima (i) the meridional circulation weakens and (ii) the energy of the atmosphere is increased in the equatorial zone and decreased in the higher latitudes. It could be easily seen that (i) and (ii) are mutually balancing factors in the general atmospheric circulation.

Now, during sunspot maxima the meridional circulation weakens and, therefore, the transport of heat to higher latitudes becomes less. Hence there should be excess of heat in the equatorial zone and less of it in the higher latitudes. This effect is already noticed to co-exist even from a consideration of variation of the amplitude. The excess of heat that should thus be available in the equatorial zone will strengthen the zonal circulation (absolute wind velocity increases) as well as increase convection in the region. The latter will increase the cloud amount and ward off insolation. Thus due to a weakening of the meridional circulation during sunspot maxima, the temperature in the higher latitudes will be reduced and that near the equator cannot increase appreciably. Therefore the average temperature of the earth is reduced.

However, further work has to be done before establishing the relationship between the meridional circulation and the sunspots.

Poona, K. S. Ramamurti.
December 30, 1947.

1. Humphreys, W. J., *Physics of the Air*, McGraw Hill Book Co., Inc., New York and London, pp. 619-21, 1940. 2. —, *Astrophys. J.*, 1911, **32**, 97. 3. Ramamurti, K. S., *Indian Sci. Congress*, 1948.