551·521·4 : 551·576

RADIATION FROM OVERCAST SKIES DURING NIGHT

Measurements of the heat radiation from the night sky with the help of Angstrom's Pyrgeometer were commenced at Poona (India) early in 1930 (Ramanathan and Desai 1932). Discussions of the data with particular reference to clear or cloudless nights have been made in a series of papers (Raman 1935, 1936; Ramanathan and Ramdas 1935; Ramdas, Sreenivasaiah and Raman 1937). The influence of clouds on the nocturnal cooling of the ground surface as well as of the air layers near the ground is a problem which deserves special examination. We may consider the net radiation loss R experienced by unit area of the black element of the pyrgeometer exchanging radiation with the atmosphere. This quantity is directly given by $R=ki^2$ where k is the instrumental constant and i is the compensating electric current passed through the black strip of the pyrgeometer.

Observations of R with respect to restricted portions of the clear night sky, at different altitudes show that R is minimum (approaching zero) for a horizontal direction and increases with altitude, attaining a maximum value for the zenith sky. If we imagine a cloud patch to appear in the horizon and to move towards the zenith, we should find that its effect on R will be to decrease it to a greater and greater extent as the cloud approaches the zenith. In the present discussion we shall confine our attention to the simpler case when skies are overcast with different types of clouds and see the effect of the cloud height on the net radiation.

The mean values of R on nights overcast with different cloud forms are given for Poona at the bottom of Table 1, along with n, the number of observations on which the mean values of R are based. The net radiation on clear nights is of the order of 0·174 gr. cal cm^2 min^{-1}. With skies overcast with high, medium and low clouds respectively, the mean value of R decreases progressively from 0·130 to 0·026. This variation of R with cloud height has also been observed in other parts of the world and the available information is summarised in the same table. The variation of R at Poona is more or less similar to that at other places for which sufficient data are available.

It can be shown that in an isothermal atmosphere with overcast skies the net radiation should be zero whatever be the

cloud height and the water vapour content of the atmosphere below the cloud. In the actual atmosphere, however, temperature decreases with height above ground and the mean temperature of the cloud layer may be expected to be lower than that of the atmosphere below; the actual sky radiation would, therefore, be greater than black body radiation at the cloud temperature. On some nights during the monsoon, when skies were overcast with very low clouds it has been found that the net loss of radiation R was actually zero or negative, indicating that the downward radiation from the overcast sky was equal to or slightly greater than the outgoing radiation from the instrument. A detailed discussion of these problems will be possible only for occasions when full information covering the actual cloud and air temperature are available from sounding balloon data.

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