

VIII. GEOPHYSICAL RESEARCH

B. Upper Atmospheric Physics*

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1. OPTICAL RADAR AND AIRGLOW OBSERVATIONS IN NORWAY DURING THE PRESENCE OF NOCTILUCENT CLOUDS

Observations of noctilucent clouds were carried out in Oslo, Norway, during the summer of 1966, to obtain information on the temporal variability of the height, structure, and other physical characteristics of noctilucent clouds. The apparatus was basically the same as the optical radar unit used in Sweden in the summer of 1964 (Fiocco and Grams¹), but many improvements were incorporated to improve the reliability and general performance of the system. In the laser unit the ruby, flashlamp, and cavity were cooled by closed-loop circulation of distilled water through a water-cooling unit. This and other improvements in the laser itself provided approximately 2-J pulses of 100- μ sec duration at a maximum p.r.f. of 0.5 sec⁻¹. To record the data at these higher rates, the apparatus utilized an automatically advanced 556-BH1 radarscope camera, modified for use on a Tektronix 555 dual-beam oscilloscope. Two traces displaying the amplified photomultiplier current were recorded simultaneously with different sweep rates: one trace recorded the echoes from 0-200 km altitude for the noctilucent cloud data, the other displayed the echoes from 0-40 km for a simultaneous study of the 20-km aerosol layer to establish latitude and time variations of the dust content of the stratosphere.

In addition to the optical radar instrumentation, a developmental airglow photometer was also mounted in our instrumentation trailer to derive simultaneous measurements of the intensity and rotational temperature of the OH emission from the mesosphere. Observed changes in temperature and water-vapor content near the mesopause inferred from these airglow measurements might provide an insight into the meteorological

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processes associated with the formation of noctilucent clouds.

The equipment was located at Kjeller, near Oslo (60.0°N, 11.0°E). Viewing conditions were excellent throughout the summer: more than half of the nights were sufficiently clear to obtain optical radar data. Noctilucent clouds of varying degrees of intensity were observed visually on approximately one-third of the nights when data could be obtained. Therefore, we have accumulated a considerable amount of data on the dust content of the mesosphere for various noctilucent cloud displays, as well as background information on the scattering properties of the mesosphere in the absence of the clouds.

Our present analysis of these data, at a rather preliminary stage, corroborates the results obtained during the summer of 1964, with definite echoes observed from altitudes between 65 km and 70 km, the strongest echoes being observed when noctilucent cloud displays had been visible overhead during twilight hours. The faster rate at which data could be gathered reduced the observation time for obtaining statistical evidence of the presence of noctilucent clouds; this increases the probability of studying transient features of the clouds that would ordinarily be lost by averaging over long observation periods.

Data obtained from the airglow photometer are available for two nights. From these data we have estimated the OH temperature to be approximately 160°K. In view of appreciable scatter of data points, it was not possible to establish a difference between the temperatures on the two nights, although the intensity in the presence of noctilucent clouds appeared to be lower. This temperature estimate is in agreement with the earlier determinations by Shefov^{2,3} and with rocket measurements of the mesospheric temperature in summer at high latitudes. The decrease in intensity of the OH lines during the noctilucent cloud display is possibly at variance with Shefov's results, and possibly could be interpreted as being due to the removal of H₂O in the vapor phase following the formation of the cloud. In view of the scarcity of data, the evidence is very limited.

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References

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