Letters to the Editor

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Atmospheric Absorption of Solar Infrared Radiation

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(Received December 17, 1951)

As a result of some measurements of solar radiation taken with a KBr double monochromator in the infrared region 1.5 to 20 microns, the data collected were assessed and values of absorption coefficients for the continuous absorption spectrum in the region 8–20 microns were evaluated. The coefficients were obtained from the slopes of the lines shown in Fig. 1, which indicate adherence to the well-known Lambert's law. The resulting coefficients were compared with those of Adel[1] and Elsasser[2] in Fig. 2. The computed values indicated by Elsasser's curve were based on line width of 0.25 cm^{-1} and should be reduced in accordance with the more recent value of the line width in the water vapor rotation spectrum measured by Adel[3] to be 0.11 cm^{-1}. In the 8–13 microns region of the solar spectrum the absorption coefficient can be taken to be proportional to line width. When thus reduced, these values come to closer agreement with the smaller values of the coefficients.

In a recent paper presented at an American Physical Society meeting[4] it was pointed out that there appears approximately a factor of 2 difference in the experimental determination of the absorption coefficients by Adel and the author. Actually, in terms of percent transmission, there is agreement within 8 percent in the values obtained for this region of low absorption for, say, 1 cm of precipitable water in the optical path. Furthermore, we have found that the window in the region 17–20 microns recorded by Adel[5] has shown up quite well with a slit width four times that used in the region 8–14 microns. This region is highly sensitive to water vapor content.[6]

The observations were made from the top of Table Mountain, California, with the cooperation of the Smithsonian Institution group stationed there.

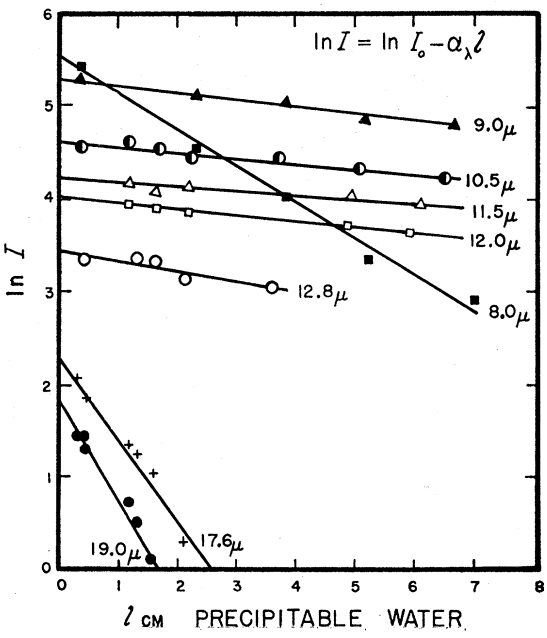

FIG. 1. Experimental curves for the logarithm of the solar intensity *versus* precipitable water with wavelength as parameter. Water vapor content determined spectroscopically using Fowles method (reference 6).

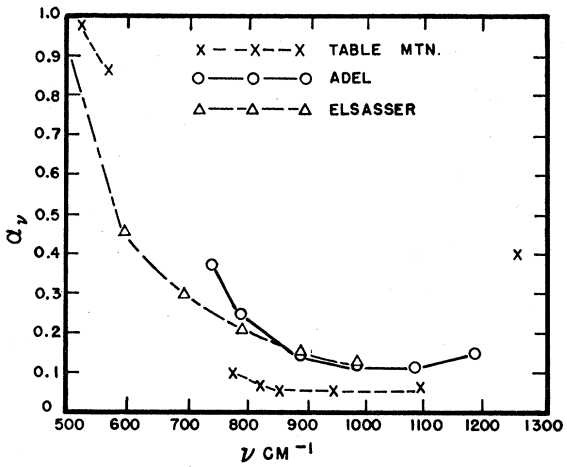

FIG. 2. Comparison of computed values with experimental values of absorption coefficient α_ν, as a function of ν cm^{-1}.

[1] Arthur Adel, Astrophys. J. **89**, 1 (1939).
[2] W. M. Elsasser, Phys. Rev. **53**, 768 (1938).
[3] Arthur Adel, Phys. Rev. **71**, 806 (1947).
[4] Romuald Anthony, American Physical Society Meeting, June 25, 1951, Vancouver, B. C. [Phys. Rev. **83**, 888 (1951)].
[5] Arthur Adel, Astrophys. J. **96**, 239 (1942).
[6] F. E. Fowle, Astrophys. J. **42**, 394 (1915).

Diurnal Variations in High Energy Cosmic-Ray Intensities*

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(Received December 26, 1951)

EXPERIMENTS were performed in a salt mine near Ithaca, New York, at a depth of 1600-meters water equivalent to investigate the properties of high energy cosmic rays. The apparatus consisted of five counter telescopes, each containing two trays of Geiger counters (30 in.×36 in.) separated by 4 in. of Pb and ½ in. Fe, and shielded above and below by 2 in. of Pb. From July 15, 1951 to October 9, 1951, 90,702 coincidences were recorded with an average rate per telescope of 10.46 hr^{-1}. The accidental coincidence rate was about 5 percent. The number of coincidences in each telescope was recorded every hour.

Other experiments, to be reported later, indicate that the particles observed are mu-mesons. In order to penetrate to this depth the meson must have an energy of at least 5×10^{11} ev. On the average, the mesons are created with 10^{12} electron volts by pi-mesons of 1.3×10^{12} ev energy, and these pi-mesons are created by nuclear interactions of primary nucleons having an average energy on the order of 5×10^{13} ev. Because of the zenith angle distribution of the mesons the angular resolution of the telescope is about 60 degrees, and therefore, only variations in the coincidence rate lasting for four hours or more should be considered significant.

The variation of intensity with solar time is shown in Fig. 1. The errors are standard errors. The mean square deviation of the observed coincidence rates from the average agrees with that expected from a normal distribution. These data indicate that