Fig. 1. Trajectory of photon.

where $\dot{x}_n = (y_r v_r^x - y_e v_e^x) / \Delta y$. According to equation (5), if a radar signal emitted from the Earth is reflected by Mercury (or Venus), $|S_2| \leq 1.4 \cdot 10^{-9}$ ($4.4 \cdot 10^{-10}$). If a signal emitted from a satellite in orbit around the Sun (eccentricity 0.8, and semi-major axis 0.5 A.U.) is observed from the Earth, $|S_2| \leq 1.8 \cdot 10^{-9}$. If a source outside the solar system (20 cm line in the radio emission for example) is observed from the Earth, $|S_2| \leq 8 \cdot 10^{-10}$. (We thank Prof. J. Weber for pointing out this case to us.)

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PLANETARY SCIENCE

Lunar Geomagnetic Variations

THERE have been several attempts to detect lunar tidal variations in the ionosphere from the geomagnetic records¹. These earlier attempts used the method of classical harmonic analysis, and sought to determine the amplitude of the important semidiurnal component. The availability during the International Geophysical Year of continuous geomagnetic data from many stations has made it possible to use power spectrum analysis, and resolve the individual frequency components of the lunar effect on the magnetic record². The results of such a spectrum analysis for Godhavn are displayed in Fig. 1. The components with periodicities centred around the diurnal, semidiurnal and terdiurnal periods are shown separately. The various components are identified by the symbolism adopted by Schureman³ and Bartels⁴ for tidal components.

Most of the periodicities to be expected on the basis of the gravitational forcing are, in fact, detected in the mag-

netic spectrum, even at a station like Godhavn, which is at a high geographic latitude. The relative amplitudes of the peaks in the spectrum, however, are different from those based on gravitational forcing. The predominance of the diurnal over the semidiurnal peak is by itself not surprising because of the high latitude of the selected station^{5,6}. However, the amplitudes of the M_2^* and M_3^* components of the terdiurnal period are enormously high. (These two components have little significance in Earth tides.) It is believed that the solar action in the ionosphere is an important influence on the peak amplitudes observed in the magnetic spectrum.

More quantitative details of the investigation and of the study of the lunar tides in the ionosphere will be published elsewhere shortly. I thank Prof. Gordon J. F. MacDonald and Dr. S. V. Venkateswaran for their help.

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Frost Protection by Fog Droplets coated with Monomolecular Films

THE prevention of frost during calm nights has often been attempted with an artificial fog of water droplets, but because droplets evaporate rapidly in unsaturated air, the method is seldom successful. I have overcome this difficulty by coating the droplet with a monomolecular film of a compound which inhibits evaporation, and has an appropriate hydrophilic and lipophilic balance. For example, the commercial compound OED, a mixture of oxyethylene docosyl ether ($C_{22}H_{45}OC_2H_4OH$) and oxyethylene octadecyl ether ($C_{18}H_{37}OC_2H_4OH$), was synthesized by me and my collaborators in 1957 and has been used in agriculture for raising the temperature of water in paddy fields by decreasing evaporation, and for preventing wilting of plants and fruits by decreasing the rate of transpiration.

If droplets are sprayed from a colloidal solution of OED, a solute concentration of 0.1 per cent is in theory sufficient to provide a monolayer of OED on the surface of droplets which are more than 15μ in diameter. The low surface tension of the solution, about half that of pure water, promotes the formation of fine droplets.

For laboratory measurement of droplet life, an emulsion of OED in water at a concentration of 0.2 per cent was prepared by vigorous shaking. Droplets sprayed from the emulsion and similar droplets from pure water were caught on a spider's web stretched on a slide holder. Threads less than 0.5μ in diameter were preferred to avoid deformation of droplet shape at the point where the thread penetrated the droplet. The slide holder with some droplets caught on the thread was inserted into a small chamber in which temperature was controlled thermo-electrically and humidity was controlled by equilibrium with a salt solution. Through a window of the chamber, one droplet was photographed intermittently through a long-focus microscope.

Table 1 shows the average time for a decrease in drop diameter from 30 to 5μ , comparing pure water drops with drops coated with an OED monolayer. A lower limit of 5μ was adopted because the coated drops do not vanish because of the residue of emulsion.

Fig. 1. Parts of the geomagnetic spectrum (H -component) showing the diurnal, semidiurnal and terdiurnal components and their tidal equivalents. The frequency, in cycles/day, is obtained by multiplying m (the estimate number in the spectrum) by the frequency interval $f = 0.00416666$. The components M_2^* and M_3^* belong to the tidal terms A_{22} and A_{32} , respectively³.