tion (Davis and Greenstein, *Astrophys. J.* **114**, 206, 1951) depends strongly on the grain temperature. For this reason it seems worthwhile to attempt to obtain reasonably narrow bounds on the range of grain temperatures under a variety of plausible assumptions. The basic method of calculation is that used by van de Hulst (*Rech. Astron. Obs. Utrecht* **11**, Part I, 1946). However, the effect of the wavelength dependence of the index of refraction (particularly the imaginary part) and of the absorption cross section for spherical particles has been considered in a more precise way. For simplicity it is assumed that the radiation field corresponds to a blackbody at $10\,000^\circ$ diluted by a factor of 10^{-14} . As a point of departure we first consider pure ice grains. Subsequently we introduce the effect of impurities which raise the calculated grain temperature because of the greater absorption in the visible and near infrared. We conclude that for any material which is optically similar to pure or impure ice the temperatures of grains (ranging in size from 0.1 to $10\,\mu$) are from 2° to 12° K, respectively. This result is appreciably less than the range of 10° – 20° which is customarily stated. Furthermore the results are quite insensitive to variations in the radiation field. An increase in grain temperature from 5° to 10° requires roughly a factor of 30 increase in the visible and infrared region of the radiation field relative to the one assumed. Finally, it has been shown that the classical calculation of the temperature of dielectric grains as determined by equilibrium with the radiation field is meaningful in the sense that fluctuations of the heat content of the grain are generally small compared to the average heat content.

Angular Expansions of Planetary Nebulae. W. LILLER, B. L. WELTHER, AND M. H. LILLER, *Harvard College Observatory*.—Direct photographs of 30 planetary nebulae taken in 1961 with the Lick Observatory's Crossley reflector have been compared with plates taken between 1898 and 1917 with the same telescope. Some nebulae, such as NGC 2392 (the Eskimo Nebula) show no apparent angular expansion (± 0.1 sec of arc) in 62 years even though radial velocity observations predict increases in diameter of several seconds of arc. Other planetaries (such as NGC 6853, the Dumbbell Nebula) show conspicuous increases in size (over a second of arc). The observations are described further and possible reasons for the results are discussed.

Characteristics of Type III Bursts. J. M. MALVILLE, *Radio Astronomy Observatory, The University of Michigan*.—Observations of the drift rate, duration, and frequency range of type III bursts between 580–8 Mc/sec are discussed. The drift rate

below 40 Mc/sec is systematically lower than expected from the interferometric measurements in the 60–45 Mc/sec range. A lower density gradient than that of Newkirk's streamer model is indicated. The upper frequencies of simultaneous noise storms and type III bursts generally coincide. The two phenomena may be similar, differing primarily in the growth rate of the instabilities. The duration of type III bursts can be related to the electron–proton collision time in the corona. An observed mean duration of 5 sec at 25 Mc/sec indicates a temperature of 2.7×10^6 °K. It should be possible to test models of the temperature and density structure of the outer corona by observations of type III bursts at very low frequencies. On the basis of Chamberlain's hydrodynamic model of the corona (*Astrophys. J.* **133**, 675, 1961), the duration and bandwidth of type III bursts are predicted down to a plasma frequency of 700 kc/sec. Landau damping appears to be of little significance for type III bursts. The natural bandwidth of the oscillations may be so small that the Landau damping rate is negligible compared to the collision frequency. Electron scattering may be more important than Landau damping for establishing a minimum drift rate for the bursts.

Photometry of Certain Gaseous Nebulae. JOHN S. MATHIS, *Washbury Observatory*.—Photoelectric measures of the Balmer lines H_α , H_β , H_γ , and the helium line $\lambda 5876$ for the diffuse nebulae NGC 604 (in M33), M8, M20, and NGC 1976 (the Orion Nebula) are presented. The observational evidence for the self-absorption of H_α in these nebulae is discussed. It is concluded that the optical depth in H_α of all objects is below three and is probably nearly zero. The helium/hydrogen abundance ratio for the objects is found to be 0.106 by number. The average deviation from the mean is only 6%. The difference in intensity ratios at various positions in the Orion Nebula is compared, and the difference in composition of diffuse and planetary nebulae is discussed briefly.

X-Ray, Radio, and Particle Emissions from the Solar Atmosphere. A. MAXWELL, *Radio Astronomy Station of Harvard College Observatory, Fort Davis, Texas*.—At the time of larger solar flares, electrons and protons are accelerated to quasi-relativistic energies, possibly by the Fermi mechanism. Protons accelerated to energies of approximately 100 Mev escape from the solar atmosphere, and reach the earth approximately 45 min after the commencement of the flare. Electrons, accelerated to relativistic velocities, would have energies of approximately 10^6 ev. These electrons are apparently trapped by magnetic fields in the upper atmosphere and corona, to give