the 85-ft antenna. Numerical models have been computed giving the relative antenna temperature as a function of lunar dielectric constant, pole darkening law, feed horn orientation, and beam ellipticity. The observed polarization is the same as that computed for a smooth sphere with dielectric constant less than 1.5.

The observations along the southern part of the lunar axis indicate a considerably higher apparent dielectric constant than elsewhere. The minimum value there is 2.0, and it could be much higher if only a small region has an increased value.

On 2 November 1963 observations were made of the lunar region where Greenacre and Barr observed a red spot 30 October. No increase of temperature was detected.

New Infrared Observations with Stratoscope II.

R. E. DANIELSON, W. K. ROSE, M. SCHWARZCHILD, N. J. WOOLF, *Princeton University*.—The second flight of Stratoscope II was carried out during the night of 26 November 1963. The telescope was again equipped with an infrared spectrometer, this time employing indium arsenide detectors with a useful sensitivity range from 1 to 3 μ . The balloon operations were carried out without difficulties from the launch at Palestine, Texas, to the landing at Kosciusko, Mississippi. The telescope was operated from the ground station near Ruston, Louisiana, from 6 p.m. until 6 a.m. Spectral tracings were obtained for ten objects: Jupiter, the moon, Aldebaran, Mu Cephei, Betelgeuse, Mira, Sirius, R Leonis, Rho Persei, and Mu Geminorum.

The spectra of the moon, Aldebaran, and Sirius showed that the terrestrial atmosphere above the balloon (80 000 ft) had no disturbing effects on the measurements; the only terrestrial band weakly indicated in the spectra is that of carbon dioxide at 2.7 μ . The spectrum of the moon shows an increasing albedo from 1 to 2 μ . Above 2 μ the intensity increases rapidly in accordance with the expected thermal emission of the moon. The spectrum of Jupiter shows deep methane bands at 0.85, 0.99, 1.16, 1.37, and 1.7 μ and the ammonia fundamental band at 3.0 μ . A very broad feature in Jupiter's spectrum from 2.0 to 2.5 μ is probably caused by combination bands of methane with the possibility of a contribution from the hydrogen molecule. The spectrum of Aldebaran (K5) shows practically no bands but has a clear intensity peak around 1.6 μ where the bound-free and the free-free absorption of H^- and H_2^- leave a relatively transparent region in the continuous absorption coefficient; the same phenomenon is also shown by the spectra of the cooler giants through complicated by band structure. Betelgeuse (M2) clearly shows the water vapor bands at 1.4 and 1.9 μ as well as

indications of a band at 2.7 μ ; also the carbon monoxide band at 2.3 μ is fairly strong. The spectra of R Leonis (M8) and particularly of Mira at minimum (M9) show the water vapor bands at 1.4 and 1.9 μ with extreme strength. Finally, the spectrum of Mu Cephei permits the determination of an upper limit for the absorption of interstellar ice grains in the band at 3.1 μ ; this upper limit turns out rather smaller than the expected value.

Analysis of Planetary Surface Parameters through Observation of Polarized Thermal Radio Emission.

F. D. DRAKE AND C. E. HEILES, *Jet Propulsion Laboratory AND Princeton University Observatory*.—At some radio frequency, probably in the microwave region for the terrestrial planets, the surfaces of planets become electrically smooth. Since most plausible surface materials will be good dielectrics, the thermal emission will be governed by the optics of dielectric interfaces and Kirchhoff's law. This results in a rather unexpected pattern of radio emission. Along a diameter of the disk perpendicular to the polarization of a radio telescope there is limb darkening. In the orthogonal polarization there is enhanced emission as the limb is approached, with a maximum at the Brewster angle, and then limb darkening. Hence the thermal radiation from most points on a planetary disk will have a net polarization governed by the surface dielectric constant, roughness, inclination to the line of sight, and wavelength of observation.

If this polarization is measured in detail, it is possible to determine several significant surface parameters, including: (1) Dielectric constant, hence some indication of surface constitution; (2) whether limb darkening is due to atmospheric absorption or surface effects; (3) true surface temperature, rather than equivalent blackbody disk temperature, and including diurnal, seasonal, and latitudinal temperature variations; (4) the orientation of the rotation axis, as noted by Pollack and Sagan; (5) Regions of increased roughness, especially those covered by extensive vegetation. (6) The scale of roughness. This may be determined from measurements at various wavelengths, since the surface becomes sensibly smooth when the wavelength exceeds about four times the scale of roughness.

Extensive observations of the moon and limited observations of Venus indicate that this approach works well with those objects. With the moon a mean dielectric constant of 2.0 is observed if the moon is assumed absolutely smooth; if the scale of roughness determined by radar measurements is assumed, the observed dielectric constant is 2.8, in agreement with the value inferred from the radar reflection coefficient.