bands, many allowed CO₂ bands contribute strongly to the infrared opacity.

The opacity in the wings of the above bands depends on the profiles of the lines making up the bands. Conservative estimates of these line profiles yield sufficiently wide bands that they overlap to produce a harmonic mean opacity (based on the Planck distribution at 600°K) greater than 50. On the other hand, the opacity due to Rayleigh scattering is sufficiently small to allow a significant fraction of the solar radiation to penetrate to the surface.

Thus it appears possible to produce a greenhouse effect on Venus which is sufficient to maintain a 600°K surface temperature by a deep CO₂, N₂ atmosphere. The required surface pressure is reduced if the relative abundance of CO₂ is larger than 10%. Furthermore, it does not seem that H₂O is necessary to produce a greenhouse model on Venus, although a small amount of water vapor would substantially add to the infrared opacity without producing a cloud layer thick enough to prevent penetration of incident solar radiation to the surface.

A New Determination of the ¹²C/¹³C Abundance Ratio in the Solar Photosphere. L. DELBOUILLE, *University of Liège, Belgium*, LUISE HERZBERG, *Defence Research Telecommunications Establishment, Ottawa, Canada*, AND G. ROLAND, *University of Liège, Belgium*.—There are at present in the literature two different values for the photospheric abundance ratio ¹²C/¹³C, derived from different interpretations of the 3874 Å region of the solar spectrum. This region, as Greenstein, Richardson, and Schwarzschild (*Publ. Astron. Soc. Pacific* 62, 15, 1950) have suggested, is the only region where there are suitable windows for the observation of lines of C¹³N [*P*(58), λ3874.345 Å and *P*(57), λ3874.922 Å of the 0,0 ultraviolet band].

Greenstein *et al.* could not detect lines of ¹³CN, and from their absence and the fact that in the windows the solar continuum is approached within 3% derived a lower limit $R=36$ for the ¹²C/¹³C ratio. In contrast, Righini (*Liège Colloq.* 1956, p. 265; *Ric. Sci. Rev.* 3, 145, 1963) obtained $R=10^4$ on the assumption that the known weak 3874.358 Å Zr⁺ line is blended with the ¹³CN, *P*(58) line. Correction of a trivial error in the equivalent width reduces his value to 10³, leaving a discrepancy by more than a factor 10 between the results.

We have re-examined the question with solar spectra of higher resolution than obtained before, and with new laboratory spectra kindly provided by A. E. Douglas. We confirm the coincidence of the *P*(58) ¹³CN line with the Zr⁺ line at λ3874.358 Å. However, near the predicted position of the *P*(57) line

λ3874.923 Å we find only one new line at λ3874.99 Å. The wavelength difference of 0.07 Å is too large for identification of this line as ¹³CN. We therefore conclude that the coincidence between the solar line at 3874.358 Å and the ¹³CN, *P*(58) line is spurious, and that even the new high-resolution spectra do not show lines of ¹³CN. From this we arrive at a lower limit $R \approx 40$, essentially confirming the value of Greenstein *et al.*

Blue Stragglers in Old Open Clusters: Implications of Their Spectra. ARMIN J. DEUTSCH, *Mount Wilson and Palomar Observatories, Carnegie Institution of Washington*.—Coudé spectrograms of the blue straggler in NGC 752 and seven in M67 confirm the results of Wallerstein and Herbig that the lines are appreciably broadened as though by rotation. Typical equatorial velocities of rotation must be of the order of 100 km/sec. If these objects have returned to the main sequence near A0 after evolving through a red-giant phase, as the color-magnitude diagrams suggest, they are metamorphs of late F dwarfs. This implies that at least some solar-type stars have rapidly rotating interiors, as Dicke and Roxburgh have independently proposed for the sun itself. In such an object, the convection zone drives a stellar wind that nearly halts the rotation of this part of the star, on a time scale short compared with its first sojourn on the main sequence. After becoming a red giant, the star sheds some fraction of its mass, including its slowly rotating outer part. Then it mixes and returns to the main sequence as a chemically homogeneous star with early type, low mass, high helium content, and rotationally widened lines.

Polarimetric Measurements of Simulated Lunar Surfaces. WALTER G. EGAN AND LEWIS L. SMITH, *Grumman Aircraft Engineering Corporation*.—Polarimetric studies of rough surfaces serve to delimit the range of their appropriate physical properties and geometries. In an effort to lay the basis for an analytical approach, the polarization properties of volcanic ash and furnace slag were investigated as a function of particle size, albedo and porosity, since current theories of polarization indicate that these properties are significant. These investigations were made on a large-scale polarimeter (4-in.-diameter viewing area) in order that coarse specimens could be analyzed.

For both samples, it was found that the maximum percent polarization (positive) and the corresponding phase angle at zero and 60 deg viewing angles, the inversion angle and the minimum percent polari-