Studies in Stellar Rotation. III. A Redetermination of Rotational Velocities in the Pleiades.

CHRISTOPHER M. ANDERSON, ROBERT STOECKLY, AND ROBERT P. KRAFT, *Mount Wilson and Palomar Observatories, Carnegie Institution of Washington*.—A redetermination of the rotational velocities of 57 Pleiades members down to spectral type $\sim$ F5V has been made. The function $\langle V \sin i \rangle$ for the Pleiades is shown to be always larger than that for the field stars regardless of absolute magnitude. This conclusion appears to support the Abt-Hunter hypothesis that high rotation is accomplished by a low frequency of spectroscopic binaries with $P < 100$ days.

Calculated Light Curves for Models of the Venus Atmosphere.

ALBERT ARKING AND JOHN POTTER, *Institute for Space Studies*.—The microwave observations of Venus have led to widely differing interpretations of the Venus atmosphere—from a dry $N_2 + CO_2$ mixture at several hundred atmospheres surface pressure [Barrett, A. H., and Staelin, D. H., *Space Sci. Rev.* **3**, 109, 1964; Thaddeus, P. (private communication)] to a very wet, precipitating cloud model at a few atmospheres (Deirmendjian, D., *Icarus* **3**, 109, 1964; Barrett and Staelin, previous citation). The implications of these models with respect to scattering of solar radiation in the visible spectrum have been examined by obtaining numerical solutions to the anisotropic multiple scattering problem for thick but finite atmospheres. Results of these calculations for various models are presented and compared with photometric observations of Venus.

Opacity of Hot Water Vapor. JASON R. AUMAN, *Princeton University*.—As a step in the analysis of the infrared observations of red giant stars by Stratoscope II (*Astrophys. J.*, **140**, 833, 1964) the opacity of water vapor has been calculated in the spectral region between 0.8 and 3.1μ for $\theta = 1.5$, 2.0, 2.5, and 3.0 and for turbulent velocities of 2.0, 4.0, and 8.0 km/sec. The positions and the strengths

of the individual spectral lines have been calculated, and the water vapor spectrum has been reconstructed by summing the contributions of these lines. The harmonic mean of the opacity has been calculated over intervals of 100 cm^{-1} .

For solar abundances water vapor is an important source of opacity for $\theta = 1.5$ ($T = 3360^\circ \text{K}$) and is the dominate source of opacity for $\theta \geq 2.0$ ($T \leq 2520^\circ \text{K}$). Table I gives the ratios of the opacity at various wavelengths when water vapor is included with the previously known sources of opacity to the opacity when water vapor is not included.

Two Observational Tests: Are Quasars Superluminous Objects or Optical Effects?

J. M. BARNOTHY, *Biomagnetic Research Foundation*.—In a paper presented at the last meeting of the Society (*Astron. J.* **70**, 666, 1965) the author has shown that quasi-stellar sources may be images produced by gravitational lenses acting upon suitable astronomical objects. If these objects are nuclei of Seyfert galaxies, the images would be in all respects (large redshift, extreme absolute luminosity, starlike appearance, high intensity in the ultraviolet, strong and broad emission lines, secular and irregular brightness variations in optical and radio emission) similar to those of quasars and the number of images to be expected would be compatible with present observations. The number of images depends not only on the number of suitable objects, but also from the number and proper position of deflecting galaxies. In a nonexpanding Euclidian space the number of images brighter than a given absolute magnitude would increase with the fifth power of the distance and not with the third power as the case would be for superluminous objects. In model universes with curved and/or expanding space this difference decreases for very distant objects but remains significant. Another test which could be performed with medium-size telescopes is based on the circumstance that light flashes of a few days or few weeks duration could arise through the scanning motion of the optical axis as a consequence of the proper motion of the involved galaxies whenever the optical axis crosses a bright star. Consequently, the light curves of such flashes (as observed in 3C273) should be symmetrical, while if they are due to energy outbursts within a superluminous object the light curves would not be symmetrical. The number of "image quasars" versus apparent magnitude relation is a much more powerful test of the cosmological model of the universe than the galaxy count versus apparent magnitude relation, or number versus flux density relation of extragalactic radio sources. Should quasars be images produced by gravitational lenses, already the observation of a few dozen quasars in the range from $z = 0.8$ to $z = 1.3$ would suffice to

TABLE I.

λ	θ			
	1.5	2.0	2.5	3.0
0.94	1.0	2.0	2.7×10^1	6.5×10^1
1.06	1.0	1.5	1.2×10^1	2.3×10^1
1.16	1.1	5.5	1.2×10^2	3.7×10^2
1.27	1.1	4.0	6.2×10^1	1.7×10^2
1.42	3.4	9.0×10^1	2.9×10^2	1.1×10^3
1.66	4.9	2.1×10^2	8.8×10^2	1.0×10^3
1.87	1.6×10^1	1.4×10^3	1.1×10^4	2.8×10^4
2.30	2.4	7.5×10^1	4.4×10^2	2.0×10^3
2.60	2.5×10^1	2.4×10^3	2.1×10^4	1.7×10^5