way or the other cannot be excluded, the amount of curvature recently estimated by Humason, Mayall, and Sandage would definitely be at variance with the present results. In this connection, the following points should be mentioned: In the first place, the present photometric data are all photoelectric, whereas the critical parts of the earlier work were photographic. In the second place, the present material extends to roughly twice as large a redshift. In the third place, all of the earlier material can be recalibrated by means of the photoelectric data and added to the diagram; when this is done, the picture is not significantly altered.

Robertson's formula for the redshift-magnitude relation has the form: $m_{bol} = 5 \log cz + 1.086(1 - q - 2\mu)z + \text{constant}$, where q is a parameter identifying the cosmological model and where μ is an omni-purpose term to accommodate evolutionary changes in the absolute magnitudes, evolutionary changes in the K correction (that is, a Stebbins-Whitford effect), and intergalactic obscuration. The values of these factors comprising μ are presently not well known, but the available evidence suggests that μ is likely to be considerably less than unity. If $\mu \sim 0$, the observed redshift-magnitude relation yields $q \sim +1$. Values from, say, $+0.5$ to $+1.5$ fall within the presently acceptable range. These results indicate that the universe either is Euclidean or is mildly curved inward, that is, closed and finite. The Euclidean case $q = +0.5$ is represented by the Einstein-de Sitter model in which the expansion continues indefinitely. The closed models, $q > +0.5$, represent the oscillating solution in which the expansion eventually halts at a finite radius and the universe then starts contracting. Strongly curved models, either inward or outward, would not be compatible with the present results, nor would the steady-state model of Hoyle, Bondi, and Gold.

From the value of q and the associated value of k , we can compute the radius of the universe, the age of the universe, and the mean density of matter in it, on the assumption that the cosmological constant is zero. The formulae for these quantities are reviewed in a paper by Hoyle and Sandage in the August issue of *Pub. A. S. P.* If we adopt as expansion constant 150 km/sec per megaparsec, the Euclidean case yields the age 4.3 billion years and mean density 4.2×10^{-29} g/cm³, while the closed models yield smaller ages and larger densities. Although the present material would not be incompatible with a closed

model as young as 2.6 billion years (radius = 1400 mpc, density = 12.7×10^{-29} g/cm³), other evidence tends to favor something closer to the Euclidean case.

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Bell, Graydon D. Absolute f -values for lines of CuI, MnI, and FeI.

Absolute f -value measurements have been made on some elements of the iron group by means of atomic beam experiments. Extensive work was carried out on CuI in order to check the theory and technique of the atomic beam method. By means of variations in evaporation temperatures and multiple traversals of the light beam, a curve of growth for CuI has been developed and compared with the theoretical curve. Experiments were designed to determine the possible presence of Cu₂ molecules in the beam, impulse measurements for the depositing atoms, and checks were made on the density distribution across the beam. Results of f -value measurements for the resonance lines of CuI, MnI, and FeI are obtained.

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Bidelman, William P. and McKellar, Andrew. Double lines in the spectrum of ρ Cassiopeiae.

Many strong lines in the spectrum of the unusual variable supergiant star ρ Cassiopeiae were found to be double with a separation of 35 to 40 km/sec in 1951 (Strömberg 1952). We now present measurements of these double lines made on spectrograms taken at the McDonald and Dominion Astrophysical Observatories. The radial velocities of the components of these lines have been sensibly constant from 1951 through 1955. In recent years emission has been present at H α and at the intercombination line $\lambda 6573$ of CaI; it is suspected also at the sodium D lines and at the lines of BaII. It is probable that this star presents a similar problem to that of RW Cephei, the somewhat cooler supergiant star that has recently been found to possess complex lines by Merrill and Wilson (1956).

Merrill, Paul W. and Wilson, Olin C. 1956, *Ap. J.* **123**, 393.
Strömberg, Bengt. 1952, *A. J.* **57**, 203.

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