merical coefficients are in seconds of arc and ϕ is the zenith distance. When the image is on the zenith ray, ϕ is zero and the result reduces to 0.15 sec of arc. This indication of the "lens" effect of the atmosphere is measurable on 2-m focal length astrographic plates with micron measuring engines and becomes more readily detectable with larger telescopes.

This author recommends that a function $F(at)_{xy}$ be included in the proposed equation to compensate for changes in focal length of the telescope-atmosphere telecentric system due to both temperature and atmospheric conditions. A method (developed for other work, Roth, E. A., "Photograph and Map Transformations," *Photogrammetric Eng.* **23**, No. 3, 1957) for measuring this effect for calibration purposes is also adaptable to large radio telescopes.

These items must be considered and applied if future star catalogues and radio source listings are to incorporate the most reliable data attainable.

Analytic Solution for Density and Velocity Distributions in Exosphere. C. S. SHEN, *Institute for Space Studies* (sponsored by H. Y. Chiu).—Analytical expressions are derived for the density and velocity distributions in planetary exospheres based on the Öpik-Singer theory. The difference between our density distribution

$$\rho(r) = N_0 \left\{ \exp \left[\left(1 - \frac{R}{r} \right) E \right] - \left(1 - \frac{R^2}{r^2} \right) \exp \left(- \frac{rE}{r+R} \right) \right\},$$

where E is a temperature-dependent parameter and R is the radius of the base of exosphere, and the barometric formula

$$\rho_B(r) = N_0 \exp[(1 - R/r)E]$$

is small near the base of exosphere but becomes significant at large r . At $r = \infty$ the barometric formula gives a finite density where our distribution tends to zero. The particle distribution in the velocity space is not isotropic. The particles are confined in a region bounded by a hyperbola and a half circle; outside this region there is no particle, inside it the particles are distributed like a Maxwellian. The physical significance of this difference and its effect on the escape rate is discussed.

On Jovian $H\alpha$ Auroral Activity. HARLAN J. SMITH, JAMES P. RODMAN, AND WILLIAM A. SLOAN, *Yale University Observatory*.—Recent decametric and decimetric radio observations of Jupiter have established the existence of large radiation belts. Dumping of these belts may produce substantial Jovian auroral activity. Detection of such auroras

should help test the radio theories, ultimately provide a map of Jupiter's magnetic fields, and give data on conditions in Jupiter's ionosphere. However, a number of previous searches in $H\alpha$ light by the authors and by others over the last four years have led to null results, at the several percent enhancement level in $H\alpha$ integrated over the apparent disk.

Using the new Rodman dual-channel pulse-counting photoelectric spectrophotometer on the Yale Bethany Station 20-inch reflector, from August through December 1962 some 3500 individual 2-minute calibrated readings have been made of the ratio of the number of photons in a 15 Å band centered on $H\alpha$ compared to a 15 Å continuum band centered at 6583 Å. Individual readings are made at successive positions around the limb of the planet with an input slit aperture covering 1 to 2% of Jupiter's true surface area; five hours rotation of the planet leads to complete coverage of the surface.

On no occasion did any single observation indicate $H\alpha$ enhancement as large as 0.1 of the integrated solar reflected $H\alpha$ at the limb position being scanned. Also, the averaged results along any 10°-wide latitude belt show no systematic enhancement as great as 0.003 over the average for the entire limb. Translated into more meaningful terms, these observations have detected no individual localized occurrence of $H\alpha$ auroral activity as strong as 100 times that of a bright (1 kR) terrestrial $H\alpha$ aurora, nor any "auroral zone" with an average $H\alpha$ intensity as great as 3 times that of a bright terrestrial $H\alpha$ aurora.

Possible explanations for these continued negative results include (a) the current low solar activity, (b) relatively low densities or relatively weak or infrequent dumping of the Jovian radiation belts, (c) a low abundance of hydrogen in Jupiter's ionosphere or its presence primarily in molecular form.

Molecular Abundances in Stellar Atmospheres.

PHILIP C. STANGER, *Perkins Observatory*.—Tables have been computed for the partial pressures of some twenty diatomic molecules and five polyatomic molecules likely to occur in stellar atmospheres as well as the partial pressures of the neutral and singly ionized forms of fifteen chemical elements. The partial pressures are available for ten different sets of relative abundances of the elements involved, for temperatures ranging from 4000° to 1500°K, and for total gas pressures of 10^5 , 10^4 , 10^3 , 10^2 , and 10^1 dyn/cm². The computations were accomplished by iterative procedures carried out on an IBM 650 digital computer.