heavy obscuration, profiles are roughly symmetric and vary little with position. Between $b^1 = -18^\circ$ and -23° , they show 2 or 3 peaks or strong asymmetry, and vary markedly with position; this region contains faint, irregular emission and reflection nebulosities. Our measurements agree fairly well with those by Menon (*Astrophys. J.* **127**, 28, 1958). His expansion model, however, is not confirmed.

Analysis of these profiles into Gaussian components was made via an iterative least-squares procedure. Usually, two to six components satisfactorily represent a profile. Many components have dispersions between 1 and 2 km/sec; some of these have been confirmed by measurements with 5 kc/sec bandwidth. Component structure is sufficiently continuous with position to permit delineation of neutral hydrogen clouds on the sky. Cloud sizes range from $10'' = 80$ pc to below $1''$.

A survey of interstellar calcium lines in high-dispersion (1.1 and 1.9 Å/mm) spectra of the brighter Orion stars is proceeding at Mount Wilson. Preliminary comparison indicates considerable differences between the *Ca II* and *H I* spectra.

Sky scans with 20 kc/sec bandwidth, obtained at 40 frequencies along 32 tracks of constant longitude or latitude and some 60° length, display the relation of the Orion complex to its surroundings. These scans furnish profiles at 1800 positions spaced by $1''$. Considerable quantities of hydrogen are found between 180° and 185° longitude, where bright stars and emission nebulae are lacking.

A similar study of the II Sco association is underway.

This work will be published in detail in *Bull. Astron. Inst. Neth.* It has been supported by the Netherlands Organization for Pure Research (ZWO).

March of Molecular Abundances in Late-Type Stars. M. S. VARDYA, *University of California, Berkeley*.—A program for the IBM 7090 electronic computer has been prepared for the computation of outer envelopes to provide better boundary conditions for the construction of late-type stellar models. These envelopes consist of a radiative atmosphere and a transition zone, the treatment of which is along the lines of Mrs. Böhm-Vitense's work (*Z. Astrophys.* **46**, 108, 1958). The effect of molecular hydrogen, which becomes important in late-type stars, has also been incorporated. This is a modified version of an earlier program written for the IBM 704. In this version, the effect of sphericity of the atmosphere is taken into account in deeper layers as well as in the very outer layers, where the temperature stratification is given by a $T-\tau$ relation. The role of sphericity in the atmosphere of

giants and supergiants is well known but the effect becomes important also for late-type dwarfs because the convective zone is fairly deep in these stars.

To run in conjunction with this program, a program for computing the Rosseland mean opacity has also been written. At present, the opacity sources being considered are: H^- , H , H_2^+ , He , He^+ in the form of absorption and H , H_2 , e^- in the form of scattering.

Models for late-type stars have been computed with the help of the above two programs. These models have been then used for computing the march of abundances of several molecules in these stars. It is interesting to note that in the very outer layers, the abundance of certain molecules may be negligible. There is a gradual buildup as we go deeper, before it starts to dissociate. This was noticed in the case of molecular hydrogen for which better data are available. This also showed that starting at *KO*, molecular hydrogen starts playing its role.

Using the tables of de Jager and Neven (*Mém. Soc. Roy. Sci. Liège Ser. 4*, **18**, p. 357), we have estimated the march of abundance of several molecules in normal chemical composition late-type stars. It was surprising to find that even in a K5V star, $p_{H_2O}/(p_H + p_{H_2}) \simeq 10^{-3}$ in the very outer layers. This implies that the role of H_2O —as a source of blanketing—may be significant as early as K5V.

This study was supported by the Air Force Office of Scientific Research Grant No. AF-AFOSR-171-63.

A Modification of the Photospheric Temperature Distribution: LTE to Pure Scattering. J. WADDELL AND T. ARNY, *Kitt Peak National Observatory*.—Limb darkening measurements yield, through the inversion of the integral equation of transfer, the source function as it varies with optical depth. Additionally, the variation of mean intensity with optical depth may be obtained from the same limb darkening measurements. (Pierce and Waddell, *Memoirs Roy. Astron. Soc.* **68**, 89, 1961). These relations are independent of any assumptions regarding local thermodynamic equilibrium (LTE) or radiative equilibrium.

With such observationally derived quantities, we may, in principle, calculate the relative population of the number of neutral hydrogen atoms to the number of negative hydrogen ions. In practice, the task is considerably more difficult. The first problem arises by our lack of knowledge of the collisional ionization cross sections of the negative hydrogen ion. In such a case, we are forced to assume pure scattering. The results of the calculations, therefore, represent an upper limit to the departures