dynamical basis of Cassini motion is demonstrated with due regard for significant but earlier ignored effects of relative motion of lunar centroid.

Main Sequence and Early Evolutionary Models for Moderately Massive Stars. STEPHEN C. MORRIS, PIERRE DEMARQUE, AND JOHN R. PERCY, *Dominion Astrophysical Observatory and David Dunlap Observatory*.—Main sequence models have been constructed for stars of composition $X=0.67$, $Z=0.03$, with masses ranging from 1.4 to 15.9 solar masses. The method used is that described by Larson and Demarque (Larson, R. B., and Demarque, P. R., *Astrophys. J.* **140**, 524, 1964), modified to allow for radiation pressure. The energy source is hydrogen burning, using the formulas given by Reeves (Reeves, H., *Stellar Energy Sources*, Institute for Space Studies Preprint). The opacity law used is a Kramers'-type formula plus electron scattering, the latter being dominant for more massive stars. Radiative zero boundary conditions are assumed.

The resulting models have been compared with the observed mass-luminosity relation and with the zero-age main sequence, after transforming M_{bol} , $\log T_e$ to M_v , $(B-V)$. The agreement is entirely satisfactory, considering the uncertainties in the transformation.

Models of 10.1 and 15.5 solar masses have been evolved to the stage of core exhaustion of hydrogen. Evolution proceeds in the direction of increasing M_v and $(B-V)$ until core exhaustion is approached; then $(B-V)$ decreases again, while M_v decreases slightly. This turning point is reached in 17.6 and 10.2 million years for stars of 10.1 and 15.5 solar masses, respectively.

A comparison has been made with an evolutionary track calculated for a star of 15.6 solar masses, with $X=.90$, $Z=.02$ (Sakashita, S., Ono, Y., and Hayashi, C., *Progr. Theoret. Phys.* **21**, 315, 1959; Hayashi, C., and Cameron, R. C., *Astrophys. J.* **136**, 166, 1962). The shape of this track compares well with that of our star of 15.5 solar masses, but the positions in the color-magnitude diagram and the evolutionary time scales are different, as is expected, owing to the different chemical compositions.

The Stability of Sunspots to the Emission of Alfvén Waves. STEVEN MUSMAN, *High Altitude Observatory*.—Several authors (Schlüter and Temesvary, 1958, *IAU Symp.* No. 6; Chitre, *Monthly Notices Roy. Astron. Soc.* **126**, 431, 1963) found that they could not construct models of sunspots using only radiative transport of energy. One possible mode of nonradiative transport, that of Alfvén waves, is examined here. Danielsen (*Astrophys. J.* **134**, 289, 1961) investigated the stability of a layer of sunspot

material in a vertical magnetic field. He found that for a range of five orders of magnitude in a dimensionless number describing the physical state of the layer small perturbations could grow in the form of increasing oscillations. These oscillations can be interpreted as a standing Alfvén wave in the layer. However, the boundary conditions used did not permit the propagation of the wave outside the layer. When the problem is re-examined by permitting the wave to propagate upward into a stable layer the properties of the unstable layer are drastically altered. In this case there is only a narrow range of 20% in the dimensionless number which allows the growth of the oscillations; hence it is concluded that it is not likely that Alfvén waves contribute substantially to energy transport in sunspots.

Interpretation of 12 Lacertae. G. J. ODGERS AND LEUNG KAM-CHING, *Dominion Astrophysical Observatory and University of Pennsylvania*.—The radial velocity of 12 (DD Lacertae in 3 and 4 September 1956 indicated two distinct discontinuities in the descending branch of the radial velocity curve. H_α radial velocities of 11 and 12 August and 8 November and mean velocity of blue plates (10 stellar lines) of 12 August and 8 November of the year 1957 were measured. The equivalent width (in Å), central depth (in percent), and half-width (in Å) of the H_α lines were measured for all three nights in 1957. Variation in these quantities were found through the period of radial velocity variation. There is a direct relation between the magnitude of variation of equivalent width, central depth, and half-width and the amplitude of the radial velocity variation. The total strength of the H_α absorption is minimum at the phase corresponding to the middle of the descending branch of the radial velocity curve, and becomes larger at phases between the middle of the ascending branch and maximum velocity. Asymmetric line profiles of H_α occur at the phase between the maximum and the minimum of the velocity curve. In this interval the absorption is less in the longward wing than the shortward wing.

A tentative model for 12 Lacertae is proposed to explain the observed phenomena. The model presupposes a hot giant B star, probably with a very thin emission shell around it; hot gaseous material is ejected from the stellar surface as a result of either a shock-wave mechanism or a very strong force pulse of some kind. The ejected matter falls back to the stellar surface due to gravity, suffering cooling in the process. However, the physics of the interaction of the rising and falling masses of gas at different temperatures is rather complicated.

Grateful acknowledgment is made for the opportunity to secure part of these observations at Mount