

COMMISSION 35: STELLAR CONSTITUTION (CONSTITUTION DES ÉTOILES)

Report of Meetings, 19 and 22 August 1970

PRESIDENT: A. Masevich.

SECRETARIES: G. Ruben, R. C. Smith.

Paczynski discussed the final evolution of Population I low- and moderate-mass stars, using a numerical technique designed to deal with the dynamical instabilities found; a semi-convective region appears in the model, similar to the results of Uus. He also described the evolution of helium stars which reached the R CrB part of the HR diagram only if neutrino emission was included. *J. P. Cox* described a survey (with King) of the Cepheid instability strip, using linear and non-linear calculations, aimed at determining Cepheid masses. The left-hand edge of the observed strip is well-described if the masses are those given by evolution without mass-loss. *Von Sengbush* showed that the evolution to the giant branch of a $4 M_{\odot}$ star with $X=0.36$ was very similar to that of a $7 M_{\odot}$ star with $X=0.6$. *Christy* surveyed the non-linear aspects of pulsation over a range of models, including Cepheids and extending to RV Tau stars. Masses of about 0.6 times the evolutionary mass seemed indicated for Cepheids. The disagreement with Cox could be due to uncertainties in colour/temperature conversions or in the opacities. *Giannone* (with *Giannuzzi*) reported Case B evolution of close binaries with mass exchange. For the cases studied, the mass of the final white dwarf is in the range $0.2 M_{\odot}$ to $0.4 M_{\odot}$, depending on the initial separation and mass ratio. Work on post-helium-flash models (in collaboration with *Castellani* and *Renzini*) shows the presence of a semi-convective region which increases the time-scale of evolution. *Demarque* showed that the assumptions of relativistic and non-relativistic degeneracy have quite different effects on post-helium flash evolution. It also appears to be necessary for horizontal branch stars to have a range of masses. *Refsdal* showed that moderate mass loss suppressed the loops in the HR diagram in the central-helium-burning stage of evolution. *Schwarzschild* remarked that his models also possessed semi-convection zones. He suggested that details of horizontal branch models might be very sensitive to opacity. *Masevich* reported on late evolution with stellar wind mass loss, which may be important for certain T_{eff} and g , and on binary evolution with mass exchange. Mass loss from the whole system speeds up the evolution.

Second Scientific Session – Joint Meeting with Working Group on Be Stars of Commission 29

CHAIR: R. Herman, E. Schatzman.

Herman described measurements of radial velocity variations in certain Be stars, with timescales of 20 to 30 yr. The timescale for α Dra is about an hour. *Coyne* showed that the polarisation in Be stars is intrinsic and irregularly variable. A list was given of stars whose spectra and polarisation should be simultaneously measured to clarify the nature of the variation. *H. C. Thomas* described computations of the evolution of $5 M_{\odot}$ and $9 M_{\odot}$ models with rotational mass loss. Unlike some other workers, they found no mass loss in the contraction phase. *Bernacca* discussed the statistics of rotation velocities of Be stars, and showed that not all Be stars need be rotating at break-up.

In discussion, *Schwarzschild* stressed that in rotational mass loss there is no mechanism for removing the mass from near the star, a point that was also stressed by *Cowling*. *Underhill* pointed out that the lines discussed by the observers were formed in regions which are completely outside the star from the point of view of stellar interior calculations.

Third Scientific Session – Solar Neutrinos and Rotation

CHAIR: L. Mestel.

Shaviv discussed the discrepancy between solar models and the observed neutrino flux, from the point of view of mixing in the Sun. He pointed out that the Sun could not be mixed through more than about a third of its mass if evolutionary calculations were to give ages for globular clusters consistent with cosmological ideas. In that case, the theoretical flux could be reduced by no more than 40%.

R. C. Smith compared the effects of rotation in the colour-magnitude diagrams of Praesepe and the Hyades with theoretical predictions and concluded that uniform rotation was excluded for both clusters, but that the data are too uncertain to support any particular law of non-uniform rotation. *H. C. Thomas* described the use of spherically averaged models for evolution with rotation. Rotation lengthens the timescales for H- and He-burning and lengthens the loops in the HR diagram. The carbon and oxygen cores become rotationally unstable before C-burning starts. *Roxburgh* described calculations on convection in rotating shells, assuming a latitude dependence for the efficiency of convection. It was possible to reproduce the solar equatorial acceleration with equatorial heating and an oblateness less than that observed by Dicke.

Fourth Scientific Session – Instabilities

CHAIR: P. J. Ledoux.

Schatzman proposed the mechanism of turbulent diffusion as a means of mixing Li, Be and B in the Sun down to a depth where they could be burned. The depletion of these elements at the surface can be explained with plausible values of the diffusion coefficient, but the generating mechanism of the turbulence was uncertain, possibly being shear instabilities. *James* discussed the role of circulation when the Goldreich-Schubert-Fricke instability is damped by a dynamical instability. The resulting timescale for redistribution of angular momentum is certainly less than the Eddington-Sweet circulation time. *Ruben* described calculations, by the PIC method, of shock wave propagation in stars. Mass loss occurred, the amount depending on the energy in the initial disturbance. Agreement was found with the results of Sparks for lower energies. *Aizenman* reported that a study of the complex roots of the secular stability eigenvalue problem showed the possible existence of slow decaying pulsations, with a period of about 10 million years, in stars just leaving the main sequence. In discussion, *J. P. Cox* and *Schwarzschild* reported the presence of complex roots in later stages of evolution. *Paczynski* remarked that in difference equation schemes the determinant of the equations of stellar structure sometimes changes sign. *Christy* discussed the disagreement in pulsation calculations – different authors make contact with observations at different points, and not all computed quantities agree with observation for any model. He also speculated on shear instabilities in semi-convection zones as a source of the tidal bulge wave proposed to explain β CMa stars.

Business Meetings

CHAIR: A. G. Masevich.

The President's report was presented at the beginning of the first scientific session. On the proposal of Professor Schwarzschild, the report was passed without discussion.

The nominations for the new President and Vice-President were accepted. The list of new members of the Commission was presented. It was agreed to add three names which had been inadvertently omitted. It was decided not to fix by-laws at the moment, but to experiment for the next three years. The President and Vice-President were asked to propose at least three names for the next Vice-President and to communicate them to the Commission members at least 6 weeks before the Assembly.

Additional names shall be added if they are proposed by not less than three Commission members. A secret ballot shall be taken. The President shall report to the General Secretary the three top names from the ballot (in order of preference). It was agreed to form a small organising committee to help the President. Members should serve not more than two terms in the Organising Committee. The list of members for the first Organising Committee was approved.

It was pointed out that work on neutron stars, supernova explosions and similar topics was poorly represented on the Commission. It was decided to discuss these questions with members of Commissions 47 and 48. The question of inviting theoretical physicists working in these fields to be members of the Commission was discussed, and it was suggested that they might be made consultants. Professor Cowling congratulated Professor Masevich on her able organization of the Commission and in particular on her excellent circulars.