35. COMMISSION DE LA CONSTITUTION DES ÉTOILES

PRÉSIDENT: Sir A. S. EDDINGTON, *Director of the Observatory, Cambridge, England.*

MEMBRES: MM. Chandrasekhar, Emden, R. H. Fowler, Hagihara, Jeans, Milne, Pannekoek, Rosseland, Russell, B. Strömgren, Tiercy, Vogt, von Zeipel, Woltjer.

The Commission has found no opportunity of acting collectively in the last triennial period. Progress in the theoretical study of the constitution of the stars must be mainly a matter of individual effort; and it would be impracticable and undesirable to seek uniformity of views and methods.

A brief reference may here be made to some of the problems now especially engaging attention. In this connection I would call attention to a valuable Report on "Die Theorie des Sterninnern und die Entwicklung der Sterne" (*Ergebnisse der exakten Naturwissenschaften*, Bd. XVI, 1937) by a member of the Commission, B. Strömgren, which deals especially with progress in the last ten years, and shows very clearly the present state of the subject.

Much attention has been paid to the existence of convective regions in a star. The usual belief that the liberation of subatomic energy will increase very rapidly with the temperature and therefore be highly concentrated towards the centre of the star, involves a central core in which radiative equilibrium is replaced by convective equilibrium. If so, the polytropic index will increase outwards from $1\frac{1}{2}$ at the centre to 3 (or $3\frac{1}{2}$) near the outside. Rather curiously this is the same specification as has been assigned (for entirely different reasons) to white dwarf stars. The adoption of this model raises a general mathematical question, not yet fully answered. To what extent are the properties of a star with polytropic index increasing outwards from n_1 to n_2 intermediate between those of the two polytropes with constant indices n_1 and n_2, respectively?

Associated with the same problem of density distribution are investigations of the degree of central condensation by study of the revolution of the nodes and the librations of eclipsing binaries, and less directly by the calculation of the periods of pulsation of Cepheid variables. These also indicate a distribution less concentrated than the standard model $n=3$.

An interesting development of the theory of dense matter is D. S. Kothari's application of it to the densities of planets, taking account of the much lower ionization in small planetary masses than in white dwarf stars. As regards white dwarfs generally, I may repeat the opinion, expressed in the last Report, that the so-called relativistic degeneracy formula is altogether fallacious, and that the "ordinary" formula is correct.

General opinion has now veered strongly in favour of the "intermediate" time-scale, which puts the age of the sun and stars at not more than 10^{10} years. Correspondingly the theory of annihilation of protons and electrons has been laid aside, and it is generally assumed that the star's heat is provided by the transmutation of hydrogen. But the theory of the conversion of hydrogen into higher elements has met with greater difficulty than was at first anticipated when transmutation processes began to be studied experimentally. Although protons, at stellar temperatures, can enter the nuclei of the light elements, this does not take us far enough.

The capture of a proton rarely leads to permanent atom-building. Some catalytic process of converting hydrogen into deuterium, helium or lithium is required, including also a source of free neutrons for building the heavier elements. The theories of evolution that have recently been proposed rest on speculative processes of this kind, for which there is as yet no laboratory evidence.

A. S. EDDINGTON
President of the Commission