

Stellar Dynamics*

THE recent publication of the book with this title by Prof. Smart can well be considered as a landmark in the development of this very important branch of Astronomy. Books written on a rapidly growing subject can be placed generally in two classes, those of a pioneering character, and those of a consolidating nature. Two remarkable books of former type on the two important subjects of Astrophysics and Stellar Dynamics have been written by Eddington, and are well known to workers in Astronomy. These books written early in the history of the development of the subject were in no small measure responsible for its further rapid progress, and for this very reason have become rather out of date as text-books. This is specially true of Stellar Dynamics since Eddington's book *Stellar Movements* was written just a decade after the birth of the subject itself, and the last quarter of a century has brought great and important additions to our knowledge of the subject. In so far as Astrophysics is considered, the want of text-books of a consolidating type has been met by the books of Rosseland and Unsöld. For Stellar Dynamics, the gap is now admirably filled by the book under review.

One finds some nearly three hundred references, in the footnotes, to papers published in several journals by the foremost workers in the field. This vast amount of material is suitably condensed and in many cases improved upon so as to suit the logical presentation of the subject. The author has achieved striking success in presenting, for the first time, a systematic account of Stellar Dynamics, and there is no doubt that this book will be extremely helpful in encouraging further research in many directions.

The book could be roughly sub-divided into three parts, viz., Stellar Kinematics, Stellar Statistics and Stellar Dynamics, with an introduction devoted to the essential preliminary notions of Astronomy. The book is complete by itself, and does not presuppose any preliminary knowledge on the part of

the reader except, perhaps, an acquaintance with a text-book on Astronomy like the excellent one by the author himself.

The Introduction, though short, is quite comprehensive, and contains all the necessary preliminaries. A general description of the galactic-system is followed by the explanations of the fundamental notions of modern Astronomy like spectral type, stellar magnitudes apparent and absolute, parallaxes, proper motions, radial velocities, masses, solar motion and galactic latitude, stellar evolution and the time-scale. It is quite appropriate, as an emphasis on the importance of the subject, that the author should include in the introduction itself a treatment of statistical notions like the correction of observed frequency curves, and mean values.

The next four chapters deal with the kinematical part, and exhaustive investigations are given of the theory of two star-streams, Schwarzschild's Ellipsoidal theory and the solar motion. The mathematical treatment is greatly simplified by prefacing the discussion with a chapter on a single star drift, and the work in this chapter on the mean stellar speeds, T , R , W , and the formula for the drift curve by a Fourier series greatly facilitate the presentation of the two-star stream theory. In discussing this last theory special attention is given to technical details relating to the analysis of observational material. Probably the chapter on the Ellipsoidal Theory is the most beautiful in the book, while that on the solar motion is the most complete. Particular mention might be made of the general treatment of proper motions on the Ellipsoidal Theory, and the illustration of the analysis from a particular region of the sky, as also the determination by Smart and Green of the solar apex, and solar motion.

The statistical part consists of two special investigations followed by a chapter on general theorems of stellar statistics. The particular characteristics of stars, viz., statistical parallaxes, and the space distributions of stars are first discussed by making suitable assumptions regarding the law governing the distributions of these characteristics. The important work of the author on the treatment of the density law of space

* *Stellar Dynamics*, by W. M. Smart, M.A., D.Sc., Regius Professor of Astronomy in the University of Glasgow. (Cambridge University Press), 1938. Pp. 1-429. Price 30s.

distribution on the ellipsoidal hypothesis is presented here in full detail. General theorems on stellar statistics are brought together in the eighth chapter, which explains the important work in this field done by Schwarzschild, Kapetyn, Eddington, Van Rhign and others.

The fundamental work of Jeans and Eddington on Stellar Dynamics is dealt with in the tenth chapter. The fundamental principles of the subject, the fundamental equations in several systems of co-ordinates, the theorems of Jeans and Eddington, the cases of spherical and cylindrical symmetry, the hydro-dynamical equations, the recent work of Shiveshwarkar, and the deduction of the possibility of star-streaming are some of the topics in a chapter which is rich in theoretical investigations and suggestions for further work.

The culminating portion of the book is, of course, the topic of galactic rotation. This is treated from the observational standpoint in the eleventh chapter whereas the last chapter deals with the theoretical aspects of galactic dynamics. This last chapter is undoubtedly the most important, and contains all the recent work on the galactic system. The relation between galactic rotation and star-streaming, and the derivation of the ellipsoidal distribution of stellar

velocities are beautiful examples of the application of the general theorems of Stellar Dynamics to galactic rotation. The proof of the asymmetry of stellar motions by pure dynamical theory can well be considered as one of the triumphs of Stellar Dynamics. The limitations of the theory are also brought out in the investigation of the differential effects for radial velocities and proper motions, and the direction of star-streaming as consequences of the rotation of the galaxy about the galactic centre. The book concludes with an account of Oort's work on the density of dark matter in the neighbourhood of the Sun—a typical example of what modern Stellar Dynamics has been able to achieve.

A very useful appendix of astronomical constants is to be found at the end of the book, where it is very gratifying to find the Oort's constants A and B in company with aristocratic constants like the constant of gravitation, and the velocity of light!

Dr. Smart has written an extremely well-balanced book without omitting any relevant important work or without going off at peculiar radial speeds in particular directions. We might say with a zero "factor of exaggeration" that this book will at once become the standard work on the subject and remain so for a long time to come.

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Theosophy and Science Shake Hands*

IN the *Current Science* for August 1938, I had noticed the first volume of the series entitled "Where Theosophy and Science Meet" issued under the general editorship of D. D. Kanga, in which the ground, scientific and theosophical from "Macrocosm to Microcosm" had been surveyed, and the second volume under notice sketches, as it were, the progress from "Atom to Man". The volume opens with a contribution on "Matter and the Atom" by G. Monod-Herzen who points out that neither theosophy nor science "is yet complete", but both reveal the factor of progress, "an infinite succession of ignorances". The claim is advanced that "Theosophical observers revealed the existence of isotopes before the physicists

did so" (p. 26). The second article is contributed by D. D. Kanga in which an attempt is made to show "where and how far Theosophy and Chemistry meet" (p. 29). After explaining the "septenary system" on which the Universe, according to Theosophy, is based, the author examines what Chemistry has to say, summing up the epoch-making discoveries of modern science. 49 sub-planes constitute the physical universe and man. Of these, scientific activity and research are restricted to just three. "It is only there that Theosophy and Science can meet" (p. 56). Then follows an article on "Physics" (Light, Sound, etc.), by R. D. Kanga. The author points out or claims that the modern "physicists have unconsciously entered into the region of metaphysics" (p. 86). The next contribution on "Relativity" is by Shyama Charan, as also the succeeding one on "Modern Mathematical Thought" in which the strange

* *Where Theosophy and Science Meet*.—Part II. Edited by D. D. Kanga. (Published by the Adyar Theosophical Library), 1938. Pp. 169. Price Re. 1-14-0.