the fourteenth-century report of increased ice on the east coast of Greenland. It would probably have more than a little influence on the distribution of the fauna and flora, and in turn would affect the distribution of Indian and Eskimo communities.

T. C. LETHBRIDGE

## POWER-STATION CHEMISTRY

Boiler House and Power Station Chemistry By Dr. Wilfred Francis. Second edition. Pp. xiv + 274 + 9 plates. (London : Edward Arnold and Co., 1947.) 21s. net.

URING recent years, with the latest designs of power-station boilers raising steam at high pressures and temperatures, and with the difficulties in obtaining regular supplies of fuels of the desired qualities, the problems confronting those responsible for the generation of steam and electricity have increased in intensity and become more varied in character. The book by Dr. Wilfred Francis, the first edition of which was published in 1940, is intended for "chemists, students of fuel technology, and operators of boiler plant and power stations". It provides a useful background of information on the properties and combustion of coals, and on such subjects as the treatment of boiler feed water, types of oil required for turbines, switches and transformers, and the treatment of flue gases to remove grit and sulphur compounds. Part 1 of the book is written in a style to suit those with "no profound knowledge of chemistry", while Part 2 gives a detailed description of standard methods of chemical analyses used regularly by power-station chemists, with some modifications based on the author's experience.

In the second edition, the author endeavours to anticipate the changes in boiler-house and powerstation practice which in his view are likely to be made in the future in consequence of recent advances in coal research. He urges the efficient use of coal as a source of chemicals, while serving as the raw material for prepared fuels; but the argument is somewhat marred by the fact that his example is the combined coal carbonization and boiler plant erected and operated some years ago at the Dunston power station. As the author mentions, this plant was not commercially successful, and was shut down in 1931.

Few will share his view that many processes are available for washing flue gases economically and efficiently so that the sulphur may be recovered in useful form without increasing the cost of generation of electricity. No process has been tried on a large scale for recovering sulphur in a really useful form from the flue gases of power stations; and no process so far suggested shows any definite promise of operation without increasing the cost of electricity. Cost figures given for those processes of flue-gas washing, without sulphur recovery, which have been operated on a full scale, seem to be based largely on 1938 prices. At present-day prices, the cost of these processes is equivalent to an addition of seven or eight shillings on every ton of coal burnt in the boilers.

Great advances have recently been made, as a result of chemical investigation and supervision, in mitigating the serious difficulties caused by deposits of solid matter on the external heating surfaces of power-station boilers. This important problem, which is related to the composition of the coal and conditions of combustion, is not mentioned. Admittedly the investigations are very recent, and no doubt the author will include a chapter on this subject in a future edition, even if limitations of space necessitate curtailing the chapter on the constitution of coal.

This useful book occupies a place not filled by any other book in this field of technology.

A. PARKER

## AN INTRODUCTION TO STELLAR DYNAMICS

Einführung in die Dynamik von Sternsystemen Von Prof. Dr. E. von der Pahlen. (Lehrbücher der Monographien aus dem Gebiete der exakten Wissenschaften, 10; Astronomisch-geophysikalische Reihe, Band 1.) Pp. 240. (Bern : Verlag Birkhäuser, 1947.) 36 Swiss francs.

HE subject of stellar dynamics is concerned with the general properties of the motions of assemblages of stars. Just as in gas theory it is not possible to follow the motions of individual molecules, but the properties of the motions of all the molecules are discussed by statistical methods, so in stellar dynamics it is not the motions of individual stars that are of interest but the general statistical properties. An assemblage of stars moving under their mutual gravitation is not, however, analogous to an ordinary gas, for collisions are practically non-existent; the effect of close encounters is to cause a slow approach toward equipartition of energy; but it can be shown that the time required for equipartition to be attained is of the order of a hundred times larger than the ages of the stars on current views. The motions of stars are therefore analogous to those of molecules in a gas theory where there is a gravitational potential but no collisions.

This volume provides an excellent introduction to the subject. A limited number of problems are discussed and considered in relation to the data provided by observation. The book is divided into three parts. The first part outlines the general theory; the effect of close encounters is considered and the time of relaxation derived. The basic equations of stellar dynamics are then formulated and the general method of solution for stationary states discussed. The special cases of axial and spherically symmetrical systems are discussed and the transformation of equations into general orthogonal co-ordinates obtained.

The second part considers the application of the equations to the galactic system. The observational evidence concerning the solar motion, star streaming, the asymmetry of motions of the high-velocity stars, and galactic rotation is summarized. The general theory of galactic rotation is then discussed and related to the observational data. It is concluded that they cannot be fully explained on the assumption of the stationary state, and possible modifications of the simple theory are outlined.

The third part deals with the extra galactic star systems. Hubble's classification, according to the shape of the system, which suggests a definite evolutionary sequence, is described. The general theory for stationary and non-stationary systems with internal motions is then outlined. Special discussions are given of the possible mode of transition from an