

ideas of chemical engineering science are indicating some of the important fundamentals in these processes as, for example, in the mixing of solids and the settling of particles, it is not yet possible to make an entirely satisfactory design simply by using these physical concepts, and sound practical experience is essential in specifying equipment.

Dr. Heywood has given a short and clear account of the principles of crushing and size analysis, but the recent work of Bond and Rose might well have received greater emphasis. Messrs. Farrant and North have given a splendid account of crushing and grinding equipment, including practical data on the performance of machines.

All the chapters are written by men with wide experience of the industry, and they have given us valuable results arising from their work. Each chapter contains an account of the theoretical principles as at present understood, but the main emphasis is on the performance and use of existing equipment. Mr. Forbes Stewart has introduced two simple calculations on the design of sedimentation equipment and more illustrations of this kind would be welcome. Examples of methods used by practical men in design are always to be encouraged.

We are given results of the experience of those who have worked for many years in the various fields, and we must be indebted to them and to Mr. Cremer and Mr. Davies for providing this information. It is clear that in this area of chemical engineering there is a considerable amount of research and development to be done before the physical concepts are fully established and can be applied in a quantitative manner.

This book is well presented and will be welcomed by a large number of practising engineers.

J. M. COULSON

## VECTOR ANALYSIS

### Vector Analysis

By Prof. Louis Brand. Pp. xiv + 282. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1957.) 48s. net.

**I**N this book the subject is carried as far as is required by a course of first-degree level, the treatment being rather more elementary than in the author's "Vector and Tensor Analysis".

Starting with a vector as a directed line segment, the rules of vector algebra are developed in Chapter 1, including the various products and the use of reciprocal bases. The examples include vector proofs of geometrical theorems such as Desargues's theorem as well as the more usual applications to planes and straight lines.

After a short chapter on line vectors (that is, vectors localized in a line), and statics, we have three chapters in which variable vectors, differentiation and integration are developed. Chapter 3 on functions of one variable includes the curvature and torsion formulæ, velocities, accelerations and kinematics of a rigid body.

Chapter 4, differential invariants, includes a brief discussion of dyads and dyadics, and the divergence and rotation of a vector point function are obtained as the invariants of its gradient dyadic. This enables some results in this and the following chapter on integral theorems to be obtained more neatly. These two chapters cover the standard theorems in vector calculus of Gauss, Green and Stokes, with some discussion of solenoidal and irrotational vector fields.

Formulæ are derived in general orthogonal co-ordinates, but the examples are limited to polar and cylindrical co-ordinates.

A rather elementary chapter on dynamics is then followed by one on fluid mechanics and one on electro-dynamics in which the application of the theory is illustrated. The electrical theory is developed from Maxwell's equations, rationalized M.K.S. units being assumed. A short paragraph on units and dimensions is included, and an appendix lists the names and dimensions of the various units.

In the last chapter the reader is brought back to abstract theory with an introduction to vector spaces.

The book is well produced. The writing is clear and simple, and the theory is illustrated by many examples. In fact, it can be recommended without reservation.

A. W. GILLIES

## INTERNATIONAL ASTRONOMY

### Transactions of the International Astronomical Union

Edited by P. Th. Oosterhoff. Vol. 9 : Ninth General Assembly held at Dublin, 29 August to 5 September 1955. Pp. ix + 802. (Cambridge : At the University Press, 1957.) 80s. net.

**T**HIS volume is devoted for the most part to the proceedings of the meetings of the International Astronomical Union at Dublin in 1955. There are reports and discussions of some forty commissions and of about half that number of sub-commissions. A very wide range of work is covered and the reports themselves also vary a great deal, from brief summaries and recommendations to long critical surveys of recent research, complete with bibliographies. In addition there are accounts of four joint discussions, in each of which several commissions took part, dealing respectively with solar flares, photoelectric image tubes, fundamental stars (for positional measures), and turbulence in stellar atmospheres. The proceedings of three more elaborate symposia, on non-stable stars, radio astronomy, and a comparison of the large-scale structure of the galactic system with that of other stellar systems, are to be published separately. The first of these, in fact, has already appeared.

The International Astronomical Union is one of the oldest and most successful of the international unions. This is not to say, however, that its members are completely satisfied. Rather drastic steps are now being taken to change the commissions, some of which have in recent years become altogether too big and unwieldy, into much smaller and more compact groups. Further, the general growth in membership has led to some loss of the close personal contact and interchange of ideas which were such a happy feature of early meetings of the Astronomical Union and of the Solar Union before it. To meet this difficulty, quite small discussion meetings on special topics are now being organized outside the General Assembly, and these so far have proved very successful.

One part or another of these Transactions will be essential reading for every active astronomer, even if relatively few go through the whole volume. Any other scientist who wishes to get a fairly accurate idea of what modern astronomy is—neither old-fashioned routine on the observational side, nor irresponsible speculation on the theoretical—would do well to take a serious look at this book.

R. O. REDMAN