

The penultimate chapter gives an excellent background to the problems of pulsating flow and there are separate name and subject indexes at the end of the book.

Dr. Pankhurst's valuable contribution has helped to make this attractive book a worthy successor to the earlier editions and it should continue to be the basic reference on air flow measurement for many years.

J. C. McVEIGH

EMPTY SPACE

Introduction to the Theory and Practice of High Vacuum Technology

By L. Ward and J. P. Bunn. Pp. vii + 216. (London: Butterworth and Co. (Publishers), Ltd., 1967.) 48s.

AFTER introducing basic vacuum concepts, this book deals with gaseous flow, pumps, gauges, the construction of vacuum systems, their design and operation, leak detection, and finally gives a brief account of some important processes requiring high vacuum.

Within this conventional framework, the scope for distinctive treatment lies in selection and emphasis, and here the authors appear to be influenced by what is convenient for a lecture course. As a result, the book is less likely to be of assistance to laboratory workers actually faced with vacuum problems. The impression that the needs of the classroom are paramount is reinforced by the authors' habit of listing advantages and disadvantages of particular pieces of equipment; while no doubt useful for examination purposes, this approaches the ludicrous when it is said to be a disadvantage of the Pirani gauge that it requires calibration against an absolute instrument.

The aim of the authors was to emphasize physical principles, and they are on the whole successful, although their touch is sometimes unsure. In particular, their discussion of viscous flow of gases in terms of sliding layers of molecules is a piece of physical nonsense which should certainly be removed if the book reaches a second edition.

W. L. WILCOCK

DIGGING FOR COAL

The Strength, Fracture and Workability of Coal

By Ivor Evans and C. D. Pomeroy. (A Monograph on Basic Work on Coalwinning carried out by the Mining Research Establishment, National Coal Board.) Pp. x + 277. (Oxford, London and New York: Pergamon Press, Ltd., 1966.) 63s. net.

SINCE the Second World War, in most coal producing countries, mines have become increasingly mechanized. The development of coal winning machines, in Britain as probably elsewhere, has been largely empirical without thorough understanding of the mechanical behaviour of coal. This is possibly because coal is a particularly difficult material to study: from the point of view of rock mechanics, coal is heterogeneous in petrographic structure, anisotropic in elastic properties, reticulated with fine cracks, and tends to behave as an incipiently fractured, semi-coherent granular mass. Coal thus deviates so far from the concept of an ideal solid that one might have once doubted whether it could ever yield meaningful and useful data concerning its mechanical properties. The present monograph describes some basic investigations carried out by a team of workers at the Mining Research Establishment (M.R.E.) of the U.K. National Coal Board into this much neglected field of coal mechanics. It convincingly demonstrates that, despite the difficulties of studying coal, problems associated with coal winning can be analysed, and the design of mining machines placed on a scientific basis.

The book deals with some of M.R.E.'s basic work on coal winning, conducted mainly on the laboratory scale, concerned in one way or another with the effects of instrumental forces on the deformation or rupturing of coal specimens. The design of experiments is complicated by the several independent variables, such as coal rank, the size, shape and mechanical history of the coal specimen, hydrostatic pressure and the variety of ways of applying forces, and also by sample variation. The first half of the book is on the measurement of mechanical properties of coal, namely elastic moduli, compression and tensile strength, and on devices for empirical tests of the strength of coal as it occurs at the seam face. The basic data thus gained provide comparative information on the strength of different coal seams and an assessment of their relative workability. The two middle chapters give an analysis of coal breakage, this being important in predicting the extent of size degradation that could be expected to occur as the result of mining operations. The third line of approach is on the measurement of friction between coal and various metal surfaces in order to gain some understanding of the problem of relatively high friction losses which inevitably occur between the machine and coal strata. The last five chapters are devoted to the various aspects of coal cutting, namely to the examination of how such factors as coal strength, friction, tool geometry, depth of cut and overburden pressure determine the force and energy requirements for cutting, and the size of the product. Considerable emphasis has been given to the technique of coal ploughing, because this evidently had a certain potential in the mining of thin seams in the U.K. without producing too much undersize. A theory of coal ploughing had been developed by one of the authors from observations of the mode of breakage of coal, somewhat on the lines of Merchant's theory of metal cutting, and from this theory attempts were made to deduce relations between cutting force and wedge angle of the tool and other relevant factors. This latter aspect of the work has helped to formulate some basic principles of coal cutting, to make recommendations on tool and pick design, and, in general, to suggest practical ways of improving the design and performance of certain types of coal cutting machines.

The chapters are readable and well illustrated, and only a few minor printing errors have intruded. The mathematical treatment is kept at a relatively simple level, and no extensive knowledge by the readers of the theory of elasticity or other concepts is assumed. Theoretical concepts, such as the "weakest link" theory of breakage, are introduced and explained as and where required.

While the work described in the chapters has undoubtedly made outstanding contributions to the science of coal winning, there seems to be little justification for the book itself: it is essentially a collection of papers which have been extensively published in scientific and technical journals and at symposia during the period 1954 to 1962. Indeed, most chapters are virtually verbatim reproductions of previously published articles, while the remaining chapters, excepting the introductory one, are partially recast versions, and the book does not offer anything new in this specialized area of mining research. Because the book is essentially a set of reprints, it lacks unity and continuity, despite the few introductory remarks in the first and at the beginning of each following chapter which are no doubt intended to draw the threads together.

It seems unfortunate that the authors did not use their knowledge and experience to write a review type of textbook on coal mechanics, as the title of the book might lead us to believe, drawing on similar work carried out elsewhere; such a book would be of lasting value to mining students and engineers both for educational purposes and as a source of references.

P. L. WATERS