have under their direction skilled men capable of erecting and running the new processes and of conferring with the technologist on problems which are bound to arise in the step from experimental to large-scale production. Skilled and well-trained men are less likely to resist changes essential to progress; rather they are frequently enthusiastic in bringing their work to a successful conclusion. Full industrial efficiency, in fact, requires personnel at all levels to show an intelligent appreciation of and response to the complex and rapidly changing techniques of modern production.

In these observations the Parliamentary and Scientific Committee shows awareness of a factor which was virtually ignored in the discussion which followed Sir Ewart Smith's paper at Birmingham. However much a more widespread and efficient system of technical education can do to dispel it, the recent dispute at the Wernett Mill, Oldham, is a reminder of a temper and outlook among trade unions which can offset any advantages in productivity to be gained by new machinery. The adjustment of working methods demands not only a higher standard of technical education, but even more a new outlook and attitude on the part of the workers. While the importance of the human factor in productivity was fully recognized in the discussion at Birmingham, not enough stress was laid on what is, in part at least, a psychological problem and one to which trade unions as well as educationists must turn if industrial productivity and efficiency are to be advanced, and with them standards of living raised, or even maintained.

WHY RUBBER IS 'RUBBER'

The Physics of Rubber Elasticity

By L. R. G. Treloar. (Monographs on the Physics and Chemistry of Materials.) Pp. vii + 256. (Oxford: Clarendon Press; London: Oxford University Press, 1949.) 21*s*. net.

IN these days one's first reaction to any new book is: Does it fill a real need? Of Dr. L. R. G. Treloar's book one can say at once that it does. Rubber is not only an important class of industrial material, but it also represents virtually a fourth state of matter—not solid, not liquid, not gas. Rubber, therefore, has a physics of its own, without an understanding of which its remarkable elastic properties can never be fully utilized. Fortunately, the subject has during the past fifteen years attracted many able physicists, who have built up an impressive structure of knowledge in this new field. Dr. Treloar's book, as the first comprehensive account of these developments, is thus of great importance, both to the rubber technologist and to the physicist desiring to investigate this intriguing subject further.

The fundamental concept of the new rubber physics is the statistical (or statistical-kinetic) origin of the force in stretched rubber. Whereas in an ordinary solid this force is due to deformation of inter-atomic bonds, in rubber it is due to rearrangement of the randomly kinked long-chain molecules into straighter forms with lower entropy. The first seven chapters of the book describe the gradual development and refinement of this theory and the comparison of its predictions with experimental data. The story is a fascinating one. It is perhaps not generally realized that the basic idea was put forward as early as 1855 by Kelvin, although further progress was not made until 1932–33. The story is not yet complete, and important further advances may be expected from the line of approach used by Mooney (1940) and developed by Rivlin, based on the stored-energy function rather than the force as the basic parameter, characterizing a deformation.

The second half of the book shows how various aspects of rubber deformation fit into the statistical theory or require its predictions to be modified. These are: photo-elastic properties (Chapter 8), neatly explained by the theory and yielding valuable data for its further development; crystallization in rubbers and its effects on mechanical properties (Chapters 9 and 10), the main effect being a departure from 'statistical' elasticity; stress relaxation and flow (Chapter 11), dynamic properties (Chapter 12), solution of problems involving large elastic strains (Chapter 13—which might better have followed Chapter 7). Chapters 10-12 show that these aspects of rubber deformation are far less understood than simple elastic deformation. Thus, no one yet seems to have explained why crystallization increases tensile strength (Chapter 10), and Chapters 11 and 12 clearly show the need to study flow and other technically important time-dependent deformations on lines analogous to those which have so successfully explained elastic deformation. Here, then, is a new challenge to the physicist.

Dr. Treloar's lucid style makes his book easy reading, and the fact that his own and his colleagues' researches form not a little of the subject-matter explains his mastery of it. The author's attempt to deal with the subject "in not too mathematical language" has succeeded admirably, and the readers for whom the book is intended—"physicists in universities and in government and industrial laboratories"—should have no difficulty whatever. The rubber technologist may regard the statement (p. 184) that "the carbon particles are evidently capable of taking over the function performed by the crystallites" as an over-simplification, or does it suggest a novel approach to explaining reinforcement? Errors seem remarkably few: neoprene is a *crystallizing* rubber (p. 191); "$1{\cdot}05 \times 10^{6}$" should be "$1{\cdot}1 \times 10^{12}$" on p. 195, line 8 from bottom.

The paper, printing and binding are fully worthy of the contents of a book on which both author and publisher are to be congratulated. J. R. Scott

A NEW MARINE NATURAL HISTORY

Natural History of Marine Animals

By G. E. MacGinitie and Nettie MacGinitie. Pp. xii + 473. (New York and London: McGraw-Hill Book Co., Inc., 1949.) 36*s*.

THIS volume is an important and refreshing addition to the literature on the interrelationships of marine animals in general, and it is all the more valuable in that most of the animals mentioned are from the relatively unknown littoral and offshore waters of the Pacific coast of North America. There are many points which will be of interest to marine biologists in Europe as, for example, the