AN INTRODUCTION TO BACTERIAL PHYSIOLOGY. By E. L. Oginsky and W. W. Umbreit. San Francisco : W. H. Freeman & Co. 1954. Pp. 416, 94 figures, 18 tables. 21s.

A review for *Heredity* of a book on Bacterial Physiology must necessarily emphasise those parts which are more relevant to the geneticist. In the reviewer's mind there is very little doubt that this is perhaps the only elementary book on bacteriology which a geneticist could and should read from beginning to end. This is something that could not be said of any standard text book on the physiology of higher animals or plants. In the first place bacterial physiology, dealing with unicellular organisms, is necessarily the same as cell physiology. It is therefore nearer the immediate interests of the geneticist than the physiology of higher organisms. In the second place, the authors' way of dealing with bacterial physiology, as part of a general biological approach, cannot fail to capture the imagination of the geneticist.

This is the first book of physiology in which genetics is actually considered to be what Bateson defined it, namely, the physiology of descent. As such, it is given the proper place, both with an appropriate chapter in detail, and with a general outlook throughout. The authors being distinguished bacterial biochemists, this will come as a gratifying surprise to the reader.

A most attractive feature is the imaginative drawings, particularly at the beginning of some of the chapters. To people who think that the bacterial cell is so " simple " that it can be considered as a chemical reactant, the drawing on the frontispiece of Section I will come as a shock. So will fig. 2, an imaginary representation of a small particle approaching a bacterial cell. The sketch on page 72 shows that what is an essential metabolite for one organism may be an essential nutrient for another : it is also exceptionally imaginative. Examples of this kind are all over the text, and they help the student very effectively to build a mental picture, geometrical rather than analytical, of a variety of phenomena. They also help to get the right image of relative dimensions, which is always difficult when dealing with the very large or the very small.

On the whole, this book is a valuable addition to the library of the biologist not primarily interested in bacterial physiology. It is also undoubtedly a very good book for the student of bacteriology at a level just above the very elementary. G. PONTECORVO.

SEX IN MICROORGANISMS. Edited by D. H. Wenrich, *et al.* Washington, D.C. : American Association for the Advancement of Science. (London : Bailey Bros. & Swinfen.) 1954. Pp. 346. 51s. 6d.

Our knowledge of the genetics of microorganisms has advanced very fast in the last dozen years. It has perhaps advanced too fast for our understanding of it as a part of biology. We badly need to examine the evidence as a whole, to reconsider our ideas of genetics in the light of this evidence and to repair if necessary our damaged definitions and generalisations. A book with the title of " Sex in Microorganisms " will clearly offer us something in this direction.

What is it about? It is undoubtedly about sex. But Dr Wenrich, the editorial chairman, puts the term in quotation marks and explicitly

renounces the attempt to define it. His collaborators follow suit. The reviewer must therefore try to make good the authors' reluctance. The book is about all three of the main categories to which the name of sex has been applied. It concerns sexual reproduction and the two barriers to this reproduction, namely sexual differentiation and incompatibility.

These three aspects of " sex " have of course been understood for a long time in the higher organisms and they have been most accurately defined on the basis of this knowledge for over twenty years. Something is lost in this book by ignoring the distinction, and indeed the opposition, between incompatibility and sexual differentiation. Something is also lost by failing to relate chromosome behaviour in protozoa with similar conditions in higher organisms.

This would help in the interpretation of details as well as principles. For example, diplo-chromosomes occur at mitosis and abnormal sequences occur at meiosis in the higher animals and plants. Our knowledge enables us to see these things in an evolutionary perspective and proportion. It also makes us hesitate to accept the one-division meiosis assumed by Cleveland in flagellates without argument. We might prefer to suppose that fertilisation was intercalated between the two meiotic divisions as germination appears to be in the Myxomycetes. Quite a number of higher organisms had to be studied before the genetic interpretation of normal—let alone abnormal—meiosis was resolved.

Much the most serious difficulty in this book is, however, due to the failure of its authors to agree on aims, terms and ideas and to see the thing as a whole. If we now try to do this we see that the immense versatility and elasticity that is displayed by microorganisms in modes of reproduction and in their genetic control does require a re-casting of definitions ; but it is a re-casting which illuminates rather than obscures our established principles.

Take, first, sexual reproduction. An alternation of doubling and halving of nuclei in the life cycle has long been taken (has it not ?) as defining sexual reproduction. But it has been maintained that a fusion of these two processes in the suppressed meiosis of many plants might qualify as " subsexual reproduction ". Similar suppression occurs in micro-organisms and might deserve the same name. In this situation we retain the possibility, and in some cases we even have the evidence, of sexual recombination. Now recombination appears (as Weismann thought) to be the very essence of sexual reproduction, the property from which its adaptive advantage and evolutionary development arise. The inclusion of an opening article on recombination in phages by Visconti suggests that this view is assumed, although it is not discussed anywhere else in the present book.

Secondly, take the barriers to sexual reproduction or rather to mating. Sexual differentiation consists (does it not ?) in a differentiation of gametes as into eggs and sperm. This differentiation is genetically determined and its determination has been shifted back to cellular antecedents of the gametes themselves, even to the preceding diploid generation. The same is true of incompatibility or heterothallism which consists (does it not ?) in the restriction of the possibility of mating within a breeding group to gametes that are in themselves or in their antecedents genetically dissimilar. Further, differentiation and incompatibility can occur together in the same species when they are both shifted back in their determination.

These principles apply both to the higher and the lower organisms.

The agreement is important because there are such good reasons for it : genetic reasons, evolutionary reasons. To understand the reasons it is necessary to consider the three aspects of " sex " in conjunction with the mechanism of vegetative or mitotic heredity and to see them together as processes in the evolution of genetic systems.

The present book lacks any such guiding principles and in doing so it loses clarity and sometimes loses meaning. " A number of complicating phenomena tend to mitigate the simplicity of the picture " writes one editor. We may mitigate our complaint by admitting that the editors have attempted what no-one else has dared to do. But we must assert that they should have tried to find a common denominator of agreement before they set to work. In doing so (who knows ?) they might have discovered the meaning of their title. C. D. DARLINGTON.

BIOMATHEMATICS. THE PRINCIPLES OF MATHEMATICS FOR STUDENTS OF BIOLOGICAL SCIENCE. By C. A. B. Smith. London : Griffin. 1954. Pp. xv+712. 80s.

Feldman's *Biomathematics* first appeared in 1923 as a book for students of biology who wanted to acquire in a short time enough mathematical knowledge to follow mathematical researches in their subject. In twenty chapters averaging sixteen pages each, the author dipped into arithmetic, algebra, geometry, and the calculus. In the twenty-first and final chapter headed " Biometrics " and comprising fifty-five pages, Feldman attempted to dispose of the statistical treatment of experimental results. If this was a subject for which he had no great liking, it was one that he could not ignore. When a second edition appeared in 1935 the chapter on biometry had perforce grown to eighty pages, a sixth of the whole book. It was still the weakest part of the text.

Now Dr Smith has courageously attempted to rebuild on this old framework. The text has been completely revised and rewritten so that it is almost a new book, but it still bears the stamp of Feldman's mind.

The book begins with elementary arithmetic, algebra and geometry and then deals in some detail with logarithms and graphs. There follows a large section devoted to the differential and integral calculus and then chapters on series, vectors, matrices and the solution of equations. This is the best part of the book. Many examples, some of them worked, are provided from a number of biological fields. These should be particularly useful to teachers who, unfortunately, have tended to neglect mathematical applications in biology.

The last four chapters of the book deal with probability, statistical theory and arithmetical notation. These are rather patchy. The first of these chapters, " Chance and Probability " begins with a good introduction to probability theory and contains many useful genetical illustrations. Later in this same chapter there are sections on the binomial distribution and the normal approximation, the derivation of Stirling's approximation for factorials and the gamma and beta functions. But it is not only that whole sections seem to have been misplaced ; some have surely been lost. In chapter 20, headed " Distributions ", the Poisson series is dismissed in two lines. This seems to be the only mention of the Poisson distribution in the 712 pages of *Biomathematics*. In chapter 21, " Simple