meet the second of the above situations, for it presupposes a fairly sound working knowledge of at least simple mechanistic organic chemistry; it could be used with advantage by second or third year undergraduates in Britain, and it would also be of considerable value as a starting point for graduate students as well.

The arrangement of the material is relatively orthodox, though logical—three-membered rings with one, and then two, hetero atoms; four-membered rings; furan, pyrrole and thiophene; condensed five-membered rings; azoles; pyridines; quinoline and isoquinoline; diazines and s-triazine; and some heterocycles of biological interest. Within these subject divisions the emphasis is not then on systems with differing hetero atoms *seriatim*. Instead, an attempt is made to establish general features and behaviour first, and only then to consider differences that change of hetero atom may produce. Within each section there is first a discussion of synthetic methods—this discussion is not exhaustive, but it sensibly discriminates in terms of those that are preparatively successful and of general utility. Then ring-opening, substitution and, where relevant, addition and side chain reactions are discussed in terms of their mechanistic type. A relatively novel feature is to return, late in the book after the student has become familiar with a very wide range of material, to a consideration of further principles of heterocyclic synthesis in terms of cycloaddition reactions, valence-bond isomerizations and enamine condensations.

There is an enormous amount of material here, sensibly selected and very well set out, and the coverage of, and reference to, the literature is quite unusually useful and comprehensive. Indeed, one's only reservation is that perhaps so many reactions have been included that not quite enough space has always been left for explanation and rationalization. Problem exercises have been provided at the end of each chapter, but one wonders a little whether at this level of sophistication they really warrant the space that they take up. But it would be a pity to end on a slightly carping note about what is an extremely well done and most useful text: it can be warmly recommended as a first rate work.

PETER SYKES

EMISSIONS OF LIGHT

Luminescence in Chemistry

Edited by E. J. Bowen. (The Van Nostrand Series in Physical Chemistry.) Pp. xiv + 254. (Van Nostrand: London and Princeton, October 1968.) 75s.

THE fields of research in which a knowledge of luminescence phenomena is required are continually increasing in number. The principles involved are identical in all of the diverse areas to which they may be applied, so that a unified treatment is both timely and desirable. Unfortunately, this relatively short work has contributions from ten authors with a resulting unevenness of treatment. A useful, if elementary, introduction defines the chief mechanisms of emission of light and touches on the concepts of quantum yield, quenching and light absorption. A more detailed treatment of the last subject would have been a better preparation for some of the material too briefly discussed in later chapters. Instrumentation is given a well and concisely written following chapter with an effective bibliography. The description of discharge lamps in a short and interesting section provides a useful summary somewhat reduced in utility by a lack of reference to particular commercial examples. Brief reports on luminescence in the gas phase and in inorganic substances provide useful introductions to two fruitful fields. Larger sections dealing with phosphorescence and delayed fluorescence and intramolecular energy transfer are excellent. Some readers may be confused, however,

by the abrupt introduction of conceptually difficult mathematical treatments insufficiently developed for obvious reasons of space. Examples are the considerations of spin-orbit coupling and resonance transfer. Also, the diagram on page 146 will not be particularly informative to those new to the field.

On the whole, the physical aspects of the subject are satisfactory, but, with one exception, the applications of luminescence are doubtful. The information to be obtained from the study of fluorescence in biological systems is very well brought out in the chapter on luminescence in biochemistry. Bioluminescence is not well served, particularly because the information has not been brought up to date. In the chapter on the fluorescence of organic compounds less precision than in earlier sections is to be expected because the complexity of most organic molecules does not allow, for example, the specific prediction of the occurrence of fluorescence. The requirements for fluorescence are adequately covered, but lapses elsewhere may prevent confident use of the material presented. Thus there are a large number of typographical errors, and also several structures the inaccuracy of which is more fundamental; for example, those on pages 82 (formula VI), 105 (both formulae) and 108 (formulae XXXIX and XLII). Structure XXXV is wrongly called a resonance structure and the greater acidity of aniline in the excited state is not clearly appreciated. Some of the analogies and concepts used are so imprecise as to be misleading. For example, the comparison of anthracene with phenanthrene (page 81), the idea of the "mobility of electrons" as used on several occasions, and the suggestions for enhanced fluorescence found in rigid molecules and for the reduced fluorescence of nitrogen heterocycles, all have more informative explanations than those given.

Chemiluminescence of solutions is given a brief and superficial discussion which by being out of date does not convey a proper impression of the field. It should be possible to produce a more balanced account of this subject with a better indication of the direction of advance. A more detailed treatment of mechanism both physical and chemical is necessary and feasible. A final chapter introduces what will be to many users of the book a novel field. "Fluorescence Microscopy and Histochemistry" concerns mainly the latter, the other applications not being considered. As the author points out, advances in this area depend greatly on the accuracy with which the observations under the microscope are correlated with known and reliable chemistry. Again, formulae errors result in some almost meaningless reaction sequences (for example, page 243), and interpretation is seriously wrong in the formulae on page 244. One's guesses about the reactions involved reinforce the author's plea for contributions from chemists to this difficult but potentially rewarding field.

The format of the book is pleasing and it is well produced, with the exception of the errors noted. Approaches to what is the best size of bibliography for each chapter differ markedly, reflecting to some extent a certain confusion as to the intended readership. The index is quite inadequate. In summary, the book presents a useful breadth of subject, marred by some carelessly written chapters and redeemed by some very useful contributions.

FRANK MCCAPRA

GAME IDEAS

Game Theory

By Guillermo Owen. Pp. xii + 228. (Saunders: Philadelphia and London, 1968.) 76s 6d.

A READER prepared for a really "mathematical" presentation of the subject will find this book pleasant reading. The theorems are proved with a fair degree of rigour (not as in Bourbaki, but certainly not as in an engineering

text). I found the balance of heuristic suggestions, motivating remarks and actual proofs satisfactory. Nevertheless, the book gives very little information about the background of the subject in economics, statistical decision theory and elsewhere. The book is therefore suitable for mathematical specialists reading the subject for its own sake and for others, well prepared mathematically, who already know why they want to read about game theory. Advantages of this approach are clarity and conciseness. Furthermore, the book fills a gap. Not many recent books on game theory as such are available, although there are good ones where the theory appears embedded in its applications. Some older books are good, but the author of this one includes newer results.

There are ten chapters and two appendices—on convexity and on fixed point theorems, which are subjects that are basic to game theory and which it is convenient to include for reference. The problems provided are tough, being mainly outlines of theorems which the author has not included in the text. Problem one of chapter one calls for the reader to carry out a construction using the axiom of choice. I would have liked this austerity to be tempered by the presentation of more illustrative exercises, but this is a matter of taste.

I recommend the book for mathematicians who want to read and to have on their shelves a concise introduction to the ideas of game theory. Its usefulness to other readers will depend on their mathematical background and their interests. Game theory has been proposed as a way for people to make decisions, as has the related statistical decision theory, although business men (for example) may not really be using such processes. Perhaps technological development suggests a growing new class of readers. Pilots in a dogfight are playing a differential game (chapter five, section five) in which each one chooses a curve in space. It is doubtful whether they consciously use this fact, but it is used by the designers of the missiles that are replacing them. As this and (one hopes) more peaceful uses develop, mathematically oriented engineers and scientists will require a knowledge of game theory, and this plain mathematical treatment may be what they want.

W. A. O'N. WAUGH

Obituaries

Dr B. M. Schofield

DR BRENDA M. SCHOFIELD, lecturer in physiology at the Royal Veterinary College since 1954, died in London on December 2. She was educated at the University of St Andrews, where she graduated BSc in 1948 and received her PhD in 1951. She was then departmental demonstrator in pharmacology at Oxford for a year and, although concerned with the study of sundry aspects of the pharmacology of the iris and the coronary circulation, her research interests remained centred on the uterus. To this end she went to the Carnegie Institute of Embryology in Baltimore where, under the stimulus of George W. Corner, S. R. M. Reynolds and the late Professor A. St G. Huggett, the physiology of this organ was a fast developing subject. In these surroundings she found scope for her wider interests and it was here that she came into contact with Dr A. I. Csapo, who stimulated her enduring interest in the biology of the uterus.

Brenda Schofield was a diligent and careful worker who got the most out of any problem. Her published work, for which she was awarded the DSc of the University of London a few months before she died, covers a consid-

erable range of topics. First came researches into the innervation of the cervix and cornu uteri, and the influence of ovarian hormones on the isometric activity of uterine muscle. Then followed the application of this knowledge to investigations on the blocking action that progesterone exerts on the myometrium, a finding that well explained the relative inactivity of the pregnant uterus. This led her to study the "local" effect of placental progesterone on the placental bed and problems associated with the functionally asymmetrical myometrium of late pregnancy. She showed that the systemic and local progesterone effects may combine in various species, resulting in species differences in uterine activity during pregnancy. Recently she had been investigating the experimental production of "ring-womb" in the pregnant ewe. There can be few who have united more completely a broad acceptance of the need to study problems of great practical interest and urgency, and a research flair for getting at the fundamental mechanisms of the problems involved.

She was a member of several scientific societies, but her favourites were the Physiological Society, the Society for the Study of Fertility, the Society for Endocrinology and the Blair Bell Society, of which she was a founder member. She was a great supporter of the International Physiological Congresses, and attended all the meetings between 1950 and 1968. She had many interests outside physiology—music, modern art, travel and an abiding concern for the welfare of the young, which found expression in her ardent support for the Pestalozzi Children's Homes. She loved the countryside and the flowers, and it was this passion which took her on her travels to wild and lonely places.

She had a passionate hatred of hypocrisy and pretension and was always ruthlessly outspoken in her condemnation of any such suspected defect. As time went by, it was also apparent to those who knew her well that she was becoming dissatisfied with the crudities of modern life and, in particular, felt unhappy about the decline of manners and morals in our time. The student body was ever her particular concern: their deportment, manners, dress—little escaped her vigilance—and on their application and training she often expressed herself strongly.

Hers was a generous, courteous and upright nature, with a great sense of responsibility in everything she undertook. Her chief personal attribute was one of kindness and sympathy, yet there was always about her a certain brusqueness. But within was a different and much shyer person, deeply appreciative of human comradeship. Her values were courage, loyalty and integrity and she assumed them in others. But this personality, so likeable and so sincere, had, in addition to immense courage, another characteristic—an iron will which did not permit the indulgence of self-pity—and up to the very end, even when she knew the meaning of her illness, she continued to work on her manuscript. Her church was very real to her and was a support and an abiding interest, and she lived always a happy and fruitful life in the midst of a devoted family.

Dr G. G. F. Newton

DR G. G. F. NEWTON, who died suddenly on January 1, aged 49, made some valuable contributions to the study of antibiotics.

Guy Newton went from Oundle to Trinity Hall, Cambridge, in 1938, but his career was interrupted by the Second World War. He volunteered for a special service unit, operated behind the enemy lines and won the Military Cross. He returned to Trinity Hall in 1946. Although an outstanding oar who might have obtained a blue, he gave up rowing to concentrate on work and took part II of the tripos in 1947. In response to an advertisement by Sir Howard Florey in *Nature*, he then went to