as in a sense completed. What now happens to queuing theory, and to operations research (in which it has played an important role)? One of the most interesting aspects of the book under review is the light it casts on this question.

In his introductory lecture, Philip Morse (U.S.) suggests a promising line of growth by effectively invoking the Jacobi injunction: always invert. In present uses of the theory, the input and structure of the system are usually taken as given, in some convenient probability form, whether or not measurements or observations are available to establish their relevance. In the inverse uses, the characters of the input and structure would be inferred from the output. Of course, an extensive mathematical development, probably more difficult to carry out than the existing theory, is necessary.

In the third session of the conference, J. F. C. Kingman (U.K.) in an invited paper examines the heavy-traffic condition (that is, a condition close to the limit of stability of the system) with a view to finding an approximation of the performance of the system (the distribution of delays) which holds under more relaxed assumptions than the usual independence ones. For a single server and order-of-arrival service, he finds a remarkably simple approximation. For many servers and for other orders of service, there is an open field for hardy investigators. Finally, in the closing session, T. L. Saaty (U.S.) offers many nonmathematical remarks under the title "Ordering disorderly queues." The matters he mentions range from improving the condition of waiting rooms (more comfort) to improving the behavior of waiting people (more courtesy). In supermarkets, the multiple checkout lines seem to him less efficient and less equitable than a single line with first-come, first-served service to the idle checkers. Curiously, he does not consider the question of whether there may not be a critical queue size beyond which order is impossible, that is, beyond which the waiting line becomes a mob. It has been known for some time that telephone operators handling long-distance calls by ticket inevitably pass from order-of-arrival service to random service as the number waiting increases, and such transition in any service control may be expected to alter waiting behavior.

Aside from these glimpses into the future, the technical reader will be pleased to find a résumé, though a somewhat disjointed one, by R. Syski (U.S.) of the work of a pioneer in the theory, Felix Pollaczek, who at last receives the appreciation he deserves. The individual papers, which cannot be given detailed notice here, illustrate the variety of interesting uses of the theory.

JOHN RIORDAN
Bell Telephone Laboratories, Murray Hill, New Jersey

Antimicrobial Agents

Biosynthesis of Antibiotics. Vol. 1. J. F. SNELL, Ed. Academic Press, New York, 1966. 246 pp., illus. $10.

It is historically fitting in a volume devoted to the review of our knowledge of the biosynthesis of antibiotics that the first group of antibiotics to be discussed in depth is the penicillins and cephalosporins. In an excellent contribution, A. L. Demain reminds us that penicillin "still remains the most active and one of the least toxic" antibiotics. Advances in the biochemistry of fermentation and production methods are especially impressive when one reads that in the early stages of the development of penicillin it took over a year to accumulate enough for clinical trials. Today's cultures produce 5 milligrams per milliliter. Evidence for the biosynthetic origins of the β-lactam-thiazolidine ring nucleus common to all penicillins is reviewed. It is particularly useful to have the associated pathways of sulfur and carbon synthesis in cysteine and other pathways related to penicillin biosynthesis presented in parallel. A review of the "new penicillins," penicillinases, and the biosynthesis of cephalosporin C and its derivatives and mention of the use of particulate fractions bypassing permeability difficulties all make this chapter well worthwhile.

A concise and lucid chapter on the status of the biosynthesis of the tetracycline antibiotics is presented by R. H. Turley and J. F. Snell. The use of mutants in working out the probable steps of formation of 7-chlortetracycline from 6-methylpretetramide is of interest; it is evident that other mutant-selection techniques will be needed before the steps from acetate or malonate to naphthacenic intermediates can be worked out.

It is surprising that although the chemistry and the major sources of carbon atoms in the streptomycin molecule have been known for years, there is still no knowledge of the manner in which the individual units are linked together by *Streptomyces*. However, a clearer idea of the immediate precursors of the streptidine moiety and streptose has emerged from recent studies. J. D. Bu'lock reviews the biochemistry of the polyacetylenes, an interesting group of fungal compounds which have not reached the chemotherapeutic eminence of other antibiotics. The macrolides represent the final group of fascinating antibiotics covered in this book, and although they are relative "newcomers," considerable progress in the understanding of their chemistry and biogenesis is evident from the data given in the chapter by J. W. Corcoran and M. Chick.

The chapter on the "Preparation of radioactive antibiotics" is a useful source of material, although it would have been better placed at the end of the volume so that the reader would have first been informed about the biosynthetic pathways. The volume is well supplied with references and will provide many with a very useful condensation of current knowledge in this field.

MILTON R. J. SALTON
Department of Microbiology, New York University School of Medicine, New York 10016

Organic Compounds

Carbohydrate Chemistry. EUGENE A. DAVIDSON. Holt, Rinehart, and Winston, New York, 1967. 447 pp., illus. $11.95.

The author indicates that a major stimulus for this work has been the need for a book on carbohydrate chemistry in which the principles of modern physical organic chemistry are applied to the properties and chemical reactions of the carbohydrates.

The principles of optical activity and of the spectroscopic methods of nuclear magnetic resonance, infrared, and optical rotatory dispersion, with some applications to carbohydrates, are well presented. The discussions of NMR and infrared are not illustrated with reproductions of spectra and their interpretation; the *tau* values and the infrared absorption bands for some important substituents are listed in tables, however. Aspects of the biochemistry of carbohydrates, including pho-