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# PHEROMONES

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## PHEROMONES

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and

E. L. TATUM

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## General preface

The aim of the publication of this series of monographs, known under the collective title of '*Frontiers of Biology*', is to present coherent and up-to-date views of the fundamental concepts which dominate modern biology.

Biology in its widest sense has made very great advances during the past decade, and the rate of progress has been steadily accelerating. Undoubtedly important factors in this acceleration have been the effective use by biologists of new techniques, including electron microscopy, isotopic labels, and a great variety of physical and chemical techniques, especially those with varying degrees of automation. In addition, scientists with partly physical or chemical backgrounds have become interested in the great variety of problems presented by living organisms. Most significant, however, increasing interest in and understanding of the biology of the cell, especially in regard to the molecular events involved in genetic phenomena and in metabolism and its control, have led to the recognition of patterns common to all forms of life from the bacteria to man. These factors and unifying concepts have led to a situation in which the sharp boundaries between the various classical biological disciplines are rapidly disappearing.

Thus, while scientists are becoming increasingly specialized in their techniques, to an increasing extent they need an intellectual and conceptual approach on a wide and non-specialized basis. It is with these considerations and needs in mind that this series of monographs, '*Frontiers of Biology*' has been conceived.

The advances in various areas of biology, including microbiology, biochemistry, genetics, cytology, and cell structure and function in general will be presented by authors who have themselves contributed significantly to these developments. They will have, in this series, the opportunity of bringing together, from diverse sources, theories and experimental data, and of integrating these into a more general conceptual framework. It is unavoidable, and probably even desirable, that the special bias of the individual authors will become evident in their contributions. Scope will also be given for presentation of new and challenging ideas and hypotheses for which complete evidence is at present lacking. However, the main emphasis will be on fairly complete and objective presentation of the more important and more

rapidly advancing aspects of biology. The level will be advanced, directed primarily to the needs of the graduate student and research worker.

Most monographs in this series will be in the range of 200–300 pages, but on occasion a collective work of major importance may be included somewhat exceeding this figure. The intent of the publishers is to bring out these books promptly and in fairly quick succession.

It is on the basis of all these various considerations that we welcome the opportunity of supporting the publication of the series '*Frontiers of Biology*' by North-Holland Publishing Company.

E. L. TATUM

A. NEUBERGER, *Editors*

# Preface

Previous books on pheromones have either emphasized the chemistry of pheromones, practical utilization of chemical determinants of behavior, or a variety of topics in the area of chemoreception. None has primarily emphasized the biology of pheromones throughout the animal kingdom or attempted to cover animal pheromones as a single topic. The study of pheromones demands an involvement with the behavior of animals, but that involvement has usually been kept to a minimum. There has been a strong tendency with the insect work to concentrate on chemical isolation, identification and synthesis, and the technology of field deployment — the behavior of compounds rather than the behavior of insects. Mammalian pheromone research has had a somewhat different approach. Partly due to the greater complexities of the secretions involved, chemistry has lagged behind here: behavior has had more emphasis, although, as with the insect work, it has for the most part been restricted to laboratory animals in situations that cannot easily be translated to natural populations.

The current situation merely reveals how little we know about the way pheromones actually influence the behavior and population dynamics of animals. The biological basis for pheromone research needs a much greater input, especially since pheromones are currently being heralded as one of the most promising new tools for management of pest populations. They are clearly going to be used with, or without, a sound knowledge of the underlying biology.

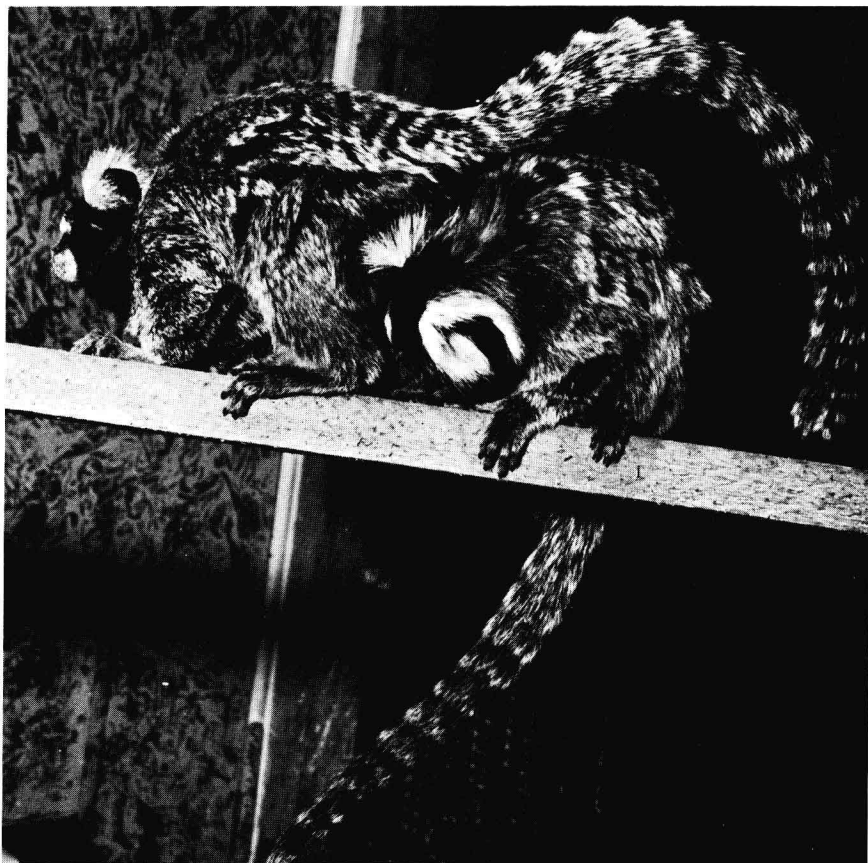
Hence, this book is concerned with the biology of pheromones, avoiding techniques, chemistry and cataloguing of identifications, all of which are indispensable but have tended to crowd out the biology. The book concentrates on the two main groups studied to date — the insects and the mammals (plus fish). Where chemistry and technology intrude, the paucity of the behavioral research is merely emphasized. This book will have served its purpose if it can indicate where research on pheromone mediated behavior is weak and can indicate and stimulate research into new or weak areas.

The editor is very grateful to Barbara Barr, Linda Birch, Stanley Caveney, Charles David, Lewis Edson, Dorothy van Emden, Doug Light, Henry Moeck, David

Moscioni, Curtis Pantle and Susie Wong for their help in various ways with editing many of the chapters, to H. A. Bern, H. van Emden and J. C. Young for valuable help with the introduction, and to R. van den Bosch and J. Diekman for reading the introductory section to Ch. 22. The book could never have been put together without Professor David Wood's support during the time I was with his research group at the University of California, Berkeley; I am very grateful to him. Marian Merrill provided excellent administrative help throughout the organization and editing. The editor is particularly indebted to Barbara Zelwer for typing the entire final draft and to Linda Birch for the arduous task of compiling the index.



Pheromones emanating from the queen honey bee stimulate approaching, feeding and 'grooming' behavior by worker bees. (Photo by N. Gary, see ch. 11.)



An adult female marmoset (*Callithrix j. jacchus*) (left) marks her mate. (Photo by G. Eppe, see ch. 19.)

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