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978-0-521-89814-0 - Insect Hydrocarbons Biology, Biochemistry, and Chemical Ecology

Gary J. Blomquist and Anne-Genevieve Bagnères

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## INSECT HYDROCARBONS

A unique and critical analysis of the wealth of research conducted on the biology, biochemistry and chemical ecology of the rapidly growing field of insect cuticular hydrocarbons. Authored by leading experts in their respective fields, the twenty chapters show the complexity that has been discovered of the nature and role of hydrocarbons in entomology. Covers, in great depth, aspects of chemistry (structures, qualitative and quantitative analysis), biochemistry (biosynthesis, molecular biology, genetics, evolution), physiology, taxonomy, and ecology. Clearly presents to the reader the array of data, ideas, insights and historical disagreements that have accumulated during the past half century. An emphasis is placed on the role of insect hydrocarbons in chemical communication is shown, especially among the social insects. Includes the first review on the chemical synthesis of insect hydrocarbons. The material presented is a major resource for current researchers and an unending source of ideas for new researchers.

GARY J. BLOMQUIST is chair of the Department of Biochemistry and Molecular Biology at the University of Nevada, Reno. He has published over 200 original research papers, reviews, chapters and books, including co-editing the books *Pheromone Biochemistry and Molecular Biology* (G. J. Blomquist and R. G. Vogt, 2003) and *Pheromone Biochemistry* (G. D. Prestwich and G. J. Blomquist, 1987). His work has been cited over 4500 times (ISI). Much of Blomquist's research career has involved the study of insect hydrocarbons, with an emphasis on their biosynthesis, endocrine regulation and chemical analysis. He published his first paper on insect hydrocarbons 40 years ago (1969) and has remained active in the field, collaborating with many of the early leaders including Larry Jackson, Dennis Nelson, Ralph Howard, Coby Schal and Anne-Geneviève Bagnères.

ANNE-GENEVIÈVE BAGNÈRES is Director of Research at the CNRS and team leader at the Institut de Recherche sur la Biologie de l'Insecte (IRBI) in Tours, France. She completed a PhD on the role of cuticular hydrocarbons in social insects at the University of Paris 6 in 1989, and received the Chancellerie of the Universities of Paris Prize for her Ph.D. work. She spent a year of postdoctoral studies in David Morgan's laboratory in 1990, and a sabbatical in 1996–97 in the laboratories of Gary Blomquist and Coby Schal. AGB is primarily interested in the chemical ecology of social insects, where she continues to be a leading contributor and proponent of the concept of chemical signature. While her primary research focuses on termites, she participates in several collaborative studies involving the chemistry of other insects. She is an active member of the International Society of Chemical Ecology (ISCE) and the bureau of the French section of the International Union for the Study of Social Insects. She has published nearly 100 original research papers, reviews and chapters.

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## Foreword

As every young chemist once realized or was told, hydrocarbons are simple (even “boring”) molecules of limited practical importance, and even less scientific interest. Certainly this was the situation in the early 1960s when the field of chemical ecology was established. Although it was known that insects and other arthropods seemed to have very high molecular weight hydrocarbons on their cuticle, nothing else was known of their chemistry or of their biological importance, other than that they were possibly involved in water retention. As in many cases in science, progress is sometimes stymied by lack of a particular tool or technique. The invention of gas chromatographs and their coupling with mass spectrometers in this same time period formed the critical impetus for the birth of a major field of science, and the realization that those “simple” hydrocarbon molecules are the end product of eons of evolution, that they are far from simple, and that they are critical elements in an amazing variety of biological roles not only in arthropods, but also in microorganisms, plants, and numerous animal phyla.

By 1980, enough progress had been made in the elucidation of the chemistry and ecological roles of arthropod hydrocarbons to warrant a comprehensive review in the *Annual Review of Entomology* (130 papers constituted the entire literature at that time). Progress continued unabated in the ensuing years, and in 2005 a second limited review of the progress since 1980 of our knowledge of the chemistry and biological roles of hydrocarbons was published in the *Annual Review of Entomology*. During this same interval, several other specialist reviews were also published. Despite the enormous amount of insect hydrocarbon research conducted worldwide during these years (literally thousands of publications and numerous symposiums and presentations), no one had stopped long enough to write a monograph on the field. This book, therefore, meets a long-felt need by numerous scientists to stop and see where the field has been and where it is going.

The first generation of insect hydrocarbon scientists are now all either retired or near retirement, and subsequent younger generations have taken their place, using new technologies and building on the solid foundation they inherited to explore ever-expanding facets of these fascinating molecules. Clearly, this discipline has matured to a point where no single scientist is capable of covering all that has been discovered, nor is it possible to cover, even superficially, the entire field in a few book chapters. The authors of this monograph



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are all leading experts in their respective fields, and even a cursory examination of the Table of Contents will reveal the complexity that has been discovered of the nature and role of hydrocarbons in the science of life. The twenty chapters cover in great depth aspects of chemistry (structures, qualitative and quantitative analysis), biochemistry (biosynthesis, molecular biology, genetics, evolution), physiology, taxonomy, and ecology. They clearly present to the reader the enormous wealth of data, ideas, insights and historical disagreements that have accumulated during the past half century. The material so presented is a major resource for current researchers, an unending source of ideas for new researchers, and serves as an exemplar for surveys of similar rapidly developing areas of research in other biological disciplines.

I am privileged to have been one of the early researchers in this marvelous field of scientific endeavor and to have made some small contributions to its development over a period of roughly thirty years. The comradeship I have experienced on a worldwide basis with numerous very gifted scientists (including many of the authors in this book) has brought me many moments of great pleasure and a strong sense of accomplishment that I might never have known otherwise. The editors of this book, Gary Blomquist and Anne-Geneviève Bagnères, have traversed this journey with me almost from the first. I thank them for their many kindnesses over the years, and for bringing this monograph to fruition. Their enthusiasm and scholarship have never failed to be less than outstanding, nor have their gifts as friends and colleagues to not only me, but so many others.

Ralph W. Howard, USDA-ARS, Retired

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GJB acknowledges the financial support from the National Science Foundation, the USDA-NRI and the Nevada Agriculture Experiment Station for the work of his laboratory.