Insect Hormones

INSECT HORMONES

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Preface to the First Edition

Research into insect hormones is a biological discipline which has appeared only during the last twenty years and has only become fully developed since the nineteen-fifties. The number of papers on insect hormones has increased geometrically over the last few years. It is therefore a rather difficult task to present a systematic review of the current state of our knowledge in such a rapidly enlarging subject. New information is accumulating at a surprising rate and new theories appear almost daily. An attempt, however incomplete it may be, to summarize and synthesize the present state of our knowledge has nevertheless a use in encouraging the profitable orientation of future research. In the case of insect hormones such a review may be of additional benefit as the data are important in other biological disciplines, especially in general biology, endocrinology and various branches of entomology including the applied field.

It is clear that, with a literature on insect hormones including more than 1500 papers, it is impossible to attempt even an approximately complete survey of the available references. The author's aim has been rather to summarize as many as possible of the most important papers, to review the overall picture from a single viewpoint, and to list all the available references.

An attempt has been made to deal objectively with all the most important aspects of the subjects discussed, including some conflicting views whether or not the author considers them correct. This does not mean, however, that the author has limited himself merely to reproducing the views of others without reference to his own conclusions, which appear to him to be well founded. Where possible the author has evaluated the available information and has developed further the conclusions quoted from other scientists, particularly from the point of view of the prospects for further research. The author is fully aware that many of his conclusions can only be regarded as provisional working hypotheses with the present limited state of our knowledge. He is, however, convinced that even the contradiction or modification of a wrong hypothesis will do more to further progress in a field such as insect

hormones at the present stage of development than a non-critical accumulation of apparently objective facts.

In the field of endocrinology, the facts and conclusions have often been regarded as being inconsistent with the principles of animal evolution. It is, however, the facts about insect hormones which themselves most clearly demonstrate the fallacy of this conclusion. The number of papers dealing with insect hormones from the point of view of phylogeny has increased rapidly, especially in the last few years, and they make an important contribution to a better understanding of animal evolution. One of the chief aims of the present review has been to summarize these papers, enlarging on their approach. This perhaps makes the book at least partly worthy of such an important event in modern biology as the centenary of the first appearance of Charles Darwin's most important work – *On The Origin of Species by Means of Natural Selection* – and the 150th anniversary of his birth.

Last, but not least, the author wishes to express his sincere thanks to all those who took part in making this book possible by their comments, criticism or technical assistance, also to those who made the author's task easier by supplying reprints of their papers. The author is particularly pleased respectfully to acknowledge his debt to his former teacher Dr Karel Wenig, Professor of Animal Physiology at Prague University, for all the care he has taken in his capacity as scientific editor with the compilation and improvement of this book both from the point of view of the subject-matter as well as with the style and language.

The opportunity is equally welcome to record gratitude to the most important and distinguished contributor to the field of insect hormones, Professor V. B. Wigglesworth, F.R.S., under whose guidance the author started his study of the subject as a British Council scholar in 1948–1949 in the department of zoology at Cambridge University.

The author is similarly grateful to Professor Ivan Málek, Fellow of the Czechoslovak Academy of Sciences and Director of the Biological Institute, and to Professor Otto Jírovec, Fellow of the Czechoslovak Academy of Sciences, for their continued interest in his work and numerous encouraging discussions about this book. Thanks are also due to Dr Vladimír Landa for a careful revision of the typescript as well as for many useful comments, and to Dr Viktor Janda, jr., and Dr Jaroslav Veber for reading the typescript and providing helpful criticism and suggestions. The author is indebted to Mr Kinský and Mrs Kohnová for the careful translation of the manuscript into German and to Professor Fiala for the excellent microphotos. Special thanks are due

to my wife for her valuable help with typing the manuscript, for preparing the index and many other time-consuming tasks connected with the preparation of this book. V. J. A. N.

Prague,
20 *March* 1958

Preface to the Second Edition

The fact that the first edition of this book was out of print within a few months of its appearance demonstrates the vivid interest of specialists in the results of research on insect hormones. The number of papers dealing with this subject has increased markedly in the short space of less than two years since the first edition went to press. Many of these papers represent important contributions to our knowledge of insect hormones.

The publishers' aim was to meet the orders of those who missed the first edition as soon as possible. This has made it impossible to incorporate the new information in the original text. The only alternative has been to include all the new data in a special chapter at the end of the book. This will be an advantage to readers of the first edition who will find all the additions in Chapter XI.

The limited time available prevented a more complete survey of the new findings or a balanced assessment of the most important papers. The considerable number of papers, more than 200 in less than two years – including a few earlier references – demonstrates the increasing interest in insect hormones not only of entomologists but also of physiologists and biologists generally.

Thanks are due to the scientific editor, Professor K. Wenig, and the reviser, Dr V. Landa, for many helpful comments; also to Dr G. Petersen (Deutsches Entomologisches Institut, German Academy of Agricultural Sciences) for his careful corrections of the language.

V. J. A. N.

Prague,
30 *January* 1960

Preface to the Third [First English] Edition

The number of papers dealing with insect hormones has increased out of all proportion in the last three years and many important new findings have appeared since the second edition was published. The aim of the author has been to include as many of them as possible into the new edition. However, the more rapidly a branch of science develops the more difficult it becomes to make a complete survey up to a particular date. The material in Chapter XI of the second edition has been incorporated in the appropriate sections of the book. The material in the new edition has been rearranged in several places, particularly in Chapter III. Care has been taken to make a clear distinction between views which are generally accepted and the views and conclusions personal to individual authors, including the author of this book. Thanks are due to all who have helped the author to improve the language and to make this new edition as good and complete as possible.

The preparation of the typescript for print took more time than was originally expected. During this period a large number of new papers on the subject appeared, many of them of primary importance. Since, as in the second edition, even a brief treatment of them could not be incorporated in the text, a new chapter has been added containing the additions for the years 1963 to 1965 referring to the papers available to the author until about 1 June 1965.

V. J. A, N.

Prague,
18 *August* 1965

Preface to the Fourth [Second English] Edition

Since the last, i.e. the third, edition of this book was published in 1966, very many more studies dealing with various aspects of insect hormones have appeared. Apart from earlier reasons, interest in this subject has received a new, strong stimulus with the discovery of the juvenoids (juvenile hormone analogues). Hundreds of papers have since been published by both chemists and biologists on the production, testing and investigation of over 1000 new substances with juvenile hormone activity. More recently, a number of studies related to field trials of these substances has also appeared. Since the first edition of this book was published in 1958, the number of references has more than quadrupled (from 1500 to over 6000).

Concomitantly, there has been a similar increase in the number of papers dealing with various theoretical aspects of the subject. New substances alleged to possess endocrine activity, as well as new effects of previously described hormones, have been reported. Important advances have been made in the elucidation of the chemical structure of these substances and in our knowledge of their mechanism of action. Similarly, we now know more about the specific features of the endocrines in different groups of insects. This has further augmented interest in insect hormones, as can be see not only from the number of new studies, but also from the increase in the number of reviews on various aspects of this subject.

Interest in insect hormones and their various effects is not limited to students of entomology (either theoretical or applied), but is spreading more and more among workers engaged in research in different fields of general and evolutionary biology. Findings on insect hormones have contributed both to our understanding of the problem of morphogenesis in general and of some of its particular aspects, such as regeneration, blastomogenesis, ultrastructure, etc. The structure of the endocrine system in various groups of insects has proved to be an important criterion in the determination of phylogenetic relationships. Many important conclusions have been reached on the mechanism of action

of hormones in general, and on other important questions of general endocrinology.

The rapid accumulation of papers and data on insect hormones makes it increasingly difficult to keep surveys of this type within reasonable bounds without omitting anything of importance, yet providing as complete and up-to-date a list of references as possible. Obviously, it is quite impossible to give the whole of the bibliography from the very beginning. Since the preceding edition is presumably available in most of the relevant libraries, it was decided that it would probably be the lesser evil to drop all references up to the end of 1964, except for reviews, and instead, to compile as complete a list as possible of references not included in the previous edition (apart from a few at the beginning of 1965). Thus almost all references since 1965 are given, although, of course, only the most important of them are actually discussed. Where their significance merits it, special attention has been paid to papers by authors from Czechoslovakia and other countries less well known to readers in the West.

It was the author's aim to adhere as closely as possible to the previous division of the subject-matter, with only a few supplements and emendations. For example, a new chapter on substances with moulting hormone and juvenile hormone activity (4 – The Entocones) and various aspects of their research had to be included. It also seemed more rational to divide the original Chapter 3 (The Metamorphosis Hormones) into two separate chapters, one for the three main hormones and related substances (3), the other for the principles of metamorphosis and morphogenesis in general (5). On the other hand, it was found reasonable to amalgamate the addenda for the years 1963 to 1965 with the corresponding sections, so that Chapter 11 could be abolished, thereby bringing the total number of chapters to twelve.

As in the previous editions, care has been taken all through the book to make the survey as comprehensive, handy and useful for the reader as possible. Consequently, the author does not simply record the conclusions and opinions of the authors of the papers cited, ignoring reciprocal contradictions, but attempts to maintain a consistent synthetic approach. He has been very careful to keep his own conclusions strictly separate from those of other authors, however, so that the reader has an opportunity of forming his own conclusions on each question.

The author would like to take this opportunity to express his indebtedness to all his colleagues and others who helped to make this review as complete and as well supplied with illustrations and references as was

possible within the short space of time available. He specially wishes to thank Mrs Schierlová, B.A., London, for her careful revision of the English, Mr J. Holubec, member of the Czechoslovak Academy of Arts, for redrawing the illustrations, and last, but not least, his wife, who had the onerous task of drawing up the bibliography and indexes and of the technical editing and retyping of the manuscript.

The author hopes that readers will find this book useful and that it will stimulate their interest in this field of modern biology which has such a promising future. If so, he will be more than satisfied.

V. J. A. N.

Prague,
June 1974

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