Medical Entomology

A Handbook of Medically Important Insects and other Arthropods

B.K. Tyagi

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A HANDBOOK OF MEDICALLY IMPORTANT INSECTS AND OTHER ARTHROPODS

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SCIENTIFIC PUBLISHERS (INDIA)

P.O. Box 91 JODHPUR

Published by:
Pawan Kumar
Scientific Publishers (India)
5-A, New Pali Road, P.O. Box 91
JODHPUR – 342 001
Tel.: +91-291-2433323 Fax: +91-291-2512580
E-mail: scienti@sancharnet.in

ISBN: 81-7233-351-X
eISBN: 978-93-87741-32-4

Lasertype set : Rajesh Ojha
Printed in India

Dedicated to

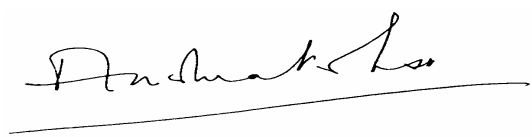
Parents and Teachers

FOREWORD

Medical Entomology is an integral part of applied ecology involving the study of diverse ecto- and endoparasites and comprise a fundamental complement of numerous diseases which have a significant impact on human health. Insect vector-host interactions have become a basic component of many important diseases like malaria, filaria, leishmaniasis, dengue to mention only a few. In recent years increasing insights into the eco-physiology and behaviour of insect transmitted diseases have established a major challenging assumption regarding the interactions between insect vectors and the concerned parasites. The development of agriculture, of industrial establishments leading to urban migration and consequent increase in populations have led to communicable diseases establishing in a very significant way. Further increased denudation of forests has resulted in increased human-vector contact which has become almost irreversible. It is therefore of particular relevance that the author has chosen to discuss diverse aspects of vector-human relationship in relation to the changing environment of climatic variability.

One of the earliest publications on Medical Entomology in India is that of Patton and Cragg (1913), besides brief references to insect vectors of medical importance in text books of Entomology. Sen and Fletcher's (1969) book on Veterinary Entomology also deals in a small way the vector importance of insects. The present volume by an experienced Medical Entomologist has therefore become very relevant in terms of current information on all aspects of medical entomology. This thoughtful volume comprises 17 Chapters which deal with the ecology, physiology and behaviour, public health importance, distribution and control of several vector insects prevalent in India and abroad.

Dr. B.K. Tyagi has to be congratulated on producing a very informative and authoritative publication on Medical Entomology, which will fulfill a long felt need by both applied and general Entomologists in the country.



Chennai
1.7.2003

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PREFACE

It is amazing to acknowledge the bare fact that insects and other arthropods together constitute over 75% of the world animal species! Insects, who along with spiders, scorpions, mites, ticks, centipedes, millipedes and numerous other 'jointed legs' are grouped under phylum Arthropoda, have more species, and individuals on earth, than any other metazoan phylum. There are over 2 million described species of insects alone, with possibly several millions still remaining to be described. Amongst arthropods of all kinds, insects are undisputedly the most significant creatures due sheer to their remarkable structural and behavioural diversity. According to an estimate there are about 200 million insects for each human alive. They are of various different forms and sizes, and are present in all environments including water, land and air, leaving virtually nothing imaginable on the Earth that is not inhabited by these tiny yet evolutionarily highly successful animals! Born some 400 million years ago, in the Devonian-Silurian periods, insects have in course achieved, to the utter envy of all other organisms struggling to speciate during the late Paleozoic era, a formidable diversity on Earth so much so that on dry land they have virtually reigned supreme. In general, the eminence of the phylum Arthropoda among animals is very much a reflection of the supremacy of insects alone.

Most of the insects, or for that matter arthropods, are not harmful to humans and, in fact, many are highly beneficial organisms. Yet, many isolated groups of insects, in particular, concern humans because of their harmful nature of causing injuries through their poisonous bites and/or stings, disturbing tranquility of humans' living environment and, above all, playing a key role in the transmission of a large number of diseases which have for long been responsible for the massive human sufferings, both in the form of morbidity and mortality. These infections affect all strata of social groups and both sexes, yet perhaps it is health of children and women which is most severely affected, both physically and mentally. These diseases are particularly rampant in tropical and subtropical countries. Although the list of vector-borne diseases existing the world over is considerably long, but generally malaria, dengue, filariasis, leishmaniasis and Ja panese encephalitis are the major public health hazards in India, where very recently a non-insect arthropod (copepod)-borne infection dracunculiasis or guineaworm disease, has

been declared eradicated and another insect (mosquito)-borne lymphatic filariasis disease is targeted for complete elimination in about 20 years from now, or sooner, although the flea-borne plague disease has deceived by having re-emerged after more than three decades in epidemic forms in a couple of States. As to the injurious and poisonous arthropods very little is indeed known on the medical importance of these creatures, particularly the insects, and more especially in the Indian context. After all, how many of us will appreciate knowing that while tabanid flies can potentially transmit anthrax, some species of edible crabs are vectors of trematode lung flukes, *Paragoinimus*, to humans!

Venoms of various different kinds of arthropods offer an array of highly useful antidotes and novel pharmaceutical molecules. The notion that those insects or arthropods which inflict injuries and/or play an intermediate host's role by vectoring disease pathogens (viruses, bacteria, protozoans, helminthes etc.) of deadly or debilitating infectious and/or communicable diseases only are medically important is highly biased and unfounded. On the contrary, insects present a totally new world of information on astonishingly large variety of molecules that hold good promise in providing life saving drugs in near future. Insects' significance in medicocriminal investigations has now been far more greatly recognized than ever before as it often provides a foolproof evidence on various aspects of the nature of the crime committed. Unfortunately, the science of forensic entomology is very poorly developed in India when compared to some of the developed nations where a forensic entomologist plays an integral role all along the proceedings of the criminal investigation. Such insects deserve a special attention by biomedists, particularly medical entomologists and parasitologists due to inherent necessities of correct taxonomic identification, and bio-ecological, evolutionary and physiological characterizations of the necrophagous insects.

The insect life and the pathways involved in their transmitting various human diseases are amply dependent on the climatic and environmental support in their propagation. In fact, the whole interaction between man and insects/arthropods pivot around the climatic and environmental variabilities both locally and globally. As a model for interpretation of this well founded theory, the Great Indian Thar Desert in northwestern Rajasthan State, with all its uniqueness of "a fast changing ecosystem under the impact of extensively canalized irrigation" vis-à-vis its insect-faunal wealth and their intensified roles in exacerbating many a vector-borne infection in the changed physiography, lends a good model in redefining dynamics of connectivity of the vector-pathogen-human host 'triad' with the environment. It is noteworthy to remember here that malaria, particularly *Plasmodium falciparum*-dominated one, has only recently emerged in the Thar Desert, and cutaneous leishmaniasis, earlier limited to certain northern parts of the desert, has in course of time spread over other areas under canalized irrigation. Dengue has now certainly established in the Thar. Japanese

encephalitis disease has so far not been reported from the Thar *per se*, although presence of specific neutralizing antibodies has been detected from the region. A pandemic disease like plague, which has already created havocs during 1994 and more recently during early 2002 in the country, bears no documented epidemic history in the Thar Desert in past, but the recent high alert enforced by the State health department leaves but little space for any complacence especially in the light of presence of a far more conducive environment harbouring rodent and flea species known to be susceptible to *Yersinia pestis,* in some parts of the Thar Desert. Dracunculiasis is no more in India today; the last case having been detected in 1996 from the Thar Desert only!

The present book, written in a lucid and easy style, is a unique attempt directed for the use of both the professionals and amateurs alike particularly the University students of Medicine and Zoology. It is hoped that this book, rife with latest information on Indian faunal examples, will serve a good purpose to induce intensive and extensive research in the hitherto unexplored biomedical aspects of insect/ arthropod life – for an everlasting benefit to the science of medical entomology.

However, as is well understood through the time-tested adage, all authors depend on those who came before. I am extremely grateful to my teacher and guide, Professor Dr. T.N. Ananthakrishnan, D.Sc., FNA, the doyen of Indian entomological sciences and, as more respectfully referred to amongst his innumerable scholars and disciples all over the country, ``The Father of Modern Entomology'', who was magnanimous enough to write the *Foreword* for this book. Professor Ananthakrishnan has known me and my work since my research scholar days at the Zoological Survey of India, Kolkata where he was the Director.

Dr. B.K. Tyagi

ACKNOWLEDGEMENT

In writing this book many of my colleagues both in India and abroad have rendered a great help through long discussions and/or correspondence, by providing scientific material, photographs and permission to use published or unpublished material. I am, therefore, grateful to all of them particularly to Dr. R. Bos (WHO, Geneva), Dr. Eline Boelee (SIMA, Sri Lanka), Dr. P. Amerasinghe (IWMI, Sri Lanka), Dr. Wim van der Hoek (IWMI, Sri Lanka), Dr. Vijay Veer (DRDE, Gwalior, India), Prof. Devendra Mohan (Zoology Dept. Jodhpur), Dr. Q.H. Baqri (ZSI, Jodhpur) and Dr. R.C. Sharma (ZSI, Jodhpur).

As ever in past, I am also thankful to my wife, Ajita, and two daughters, Anupama and Akansha, for their constant support and healthy criticism, without which it would not be possible to accomplish this task in time.

Last, but not the least, my grateful thanks are due to Shri Pawan Kumar Sharma, Scientific Publishers (India), Jodhpur for his excellent support and encouragement throughout this exercise of book writing and for timely bringing out this book.

Dr. B.K. Tyagi

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Plate - I


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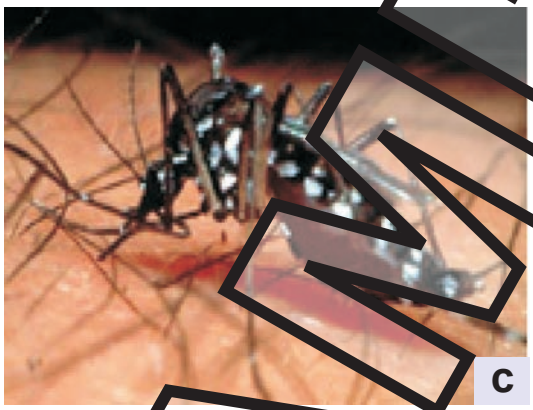
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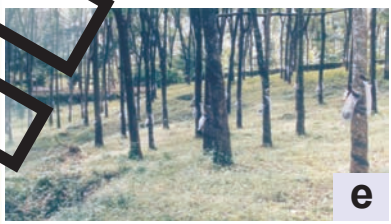
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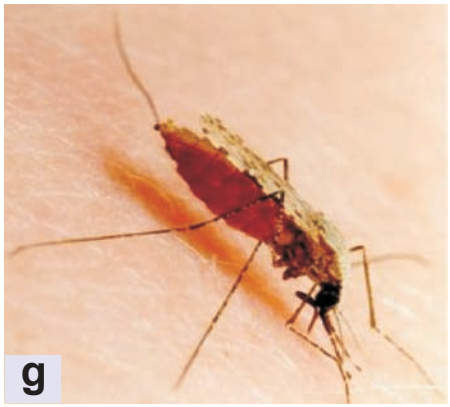
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Plate - II

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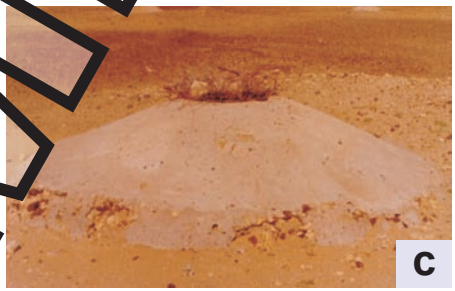

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Plate - III

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b

Plate - IV

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