

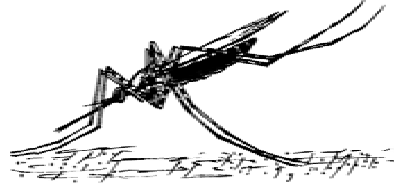
MOSQUITO

Hunters

A history of hostilities against man's
deadliest foe – the mosquito – since 1881



Dr. B.K. Tyagi



MOSQUITO HUNTERS

*An Indian history of hostilities against man's deadliest foe
– the Mosquito – since 1881*

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Dedicated

to

*all those medical arthropodologists and mosquito ambushers
who have given their everything – time, energy and resources,
for a better understanding of the man's deadliest foe – mosquito,
for a happier world to live in.*

डॉ कैलाश चन्द्र
निदेशक
Dr Kailash Chandra
Director



भारत सरकार
भारतीय प्राणि सर्वेक्षण
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय
Government of India
Zoological Survey of India
Ministry of Environment, Forest and Climate Change

FOREWORD

Mosquitoes (Order Insecta, Family Culicidae) are best known for their mediation of several deadly and/or debilitating vector-borne diseases of public health importance. They are indeed no small enemy of human being to whom they carry viruses, bacteria and parasites, infecting some 700 million people and killing more than one million every year. Thus, no creature on Earth has touched directly the lives of more men, women and children than the mosquito which may appear smaller in size but is a giant of a killer. Mosquito is possibly man's deadliest foe on the planet!

Mosquitoes have attracted human attention since the time immemorial and *Susruta Samhita*, India's medicinal classic of yore, has made extensive references to them. It is India where, in 1897, Dr Ronald Ross had made the greatest medical discovery of the inextricable link between mosquito and malaria, for which he won the Nobel Prize (1902). The country has also shown to the world how the deadly malaria could be controlled through a nation-wide vertical programme during the 1960s. Presently, of course, the nation is targeting to eliminate lymphatic filariasis, along with malaria, in next one decade. Truly, hats off to all those mosquito-borne disease specialists, particularly medical entomologists, who have given their entire life to make a better future to live in for all of us.

Mosquito Hunters of India, in my opinion, is a unique book, encompassing in one volume India's great history of hostilities against man's deadliest foe – the Mosquito, during past more than a century! Dr B.K. Tyagi, an eminent arthropodologist of India, has commensurately touched upon all the important characteristics of a mosquito's biology associated with the disease transmission, and, at the same time, taken the reader through a long and meandering journey of rich Indian history of victories and failures, discoveries and inventions, feuds and treacheries, and, above all the importance of comprehensive team work – all against one animal alone, the mosquito, who is still at large!

I wish Dr Tyagi and this book a humongous success among the professional and amateur researchers alike, and hope the book will make an invaluable reading material to the students and general masses for their own wisdom.

23rd April, 2020


(Dr. Kailash Chandra)
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PREFACE

I must have already written over three dozen books on varied medico-arthropodological/entomological subjects especially pertaining to mosquitoes, but one book which I always wanted to pen is this, **“Mosquito Hunters: An Indian history of hostilities against man’s deadliest foe - the Mosquito, since 1881”**, basically to highlight, on the one hand, the grand fables of valour and the ‘Never Say Never’ die-hard spirit of an extraordinary league of mosquito ambushers of India – the country which had once almost defeated malaria during the mid-1960s and is currently marching ahead to pin down another mosquito-borne disease, the lymphatic filariasis, in near future, by 2030, and, on the other hand, the superb evolutionary and adaptive brilliance of this creature, the mosquito, which appears painfully feeble-bodied measuring not more than the size of a barley seed, and yet has posed on the Earth the greatest threat to peoples’ health, economy and intelligence, earning her a commensurate sobriquet “Man’s deadliest foe”. This book in its entirety propels the reader to respect these truly heroic and incredibly intelligent and daring men and women scientists who have given their everything – time, energy and resources, to better our understanding about the deadliest enemy, mosquito, for a happier world to live in! After all, only few creatures on earth can match the uncanny wisdom of a mosquito and are more worthy of scientific inquiry and human wonder.

This book, written from an Indian perspective, is all about a fascinating and terrifying vicious little killer, the mosquito, and the monumental efforts directed against his *bête noire* by the man himself. In this age old war between them, however, the mosquito has so far emerged invincible outwitting man with her (the female mosquito bites, feeds on blood and transmits disease pathogens, hence the focus for attraction and entire discussion) constantly evolving new strategies to stay alive beyond comprehension, though man also has a few splintered fables of success to celebrate. Filled with little-known facts and remarkable anecdotes that bring this tiny being into larger focus, the book offers fascinating, alarming, and convincing evidence that the sooner we get to know this pesky insect – the mosquito, the better off whole mankind will be.

The book also tells the story of some of the mosquito species that contribute to human diseases such as malaria, filariasis, dengue, Zika, chikungunya, and Japanese encephalitis. These diseases have played an important role in slowing down the national progress through depleted economy, health and intelligentsia. The country spends almost 50% of its health budget in fighting against these ailments. Therefore, it emerges that, besides the brutal facts of how the mosquito has insinuated itself into human

history, from the earliest times of malaria that devastated invaders of ancient Rome (Alexander 'The Great' had reportedly died due to *Plasmodium falciparum* malaria while returning home after the battle in 326 BC against the Indian king Porus in the malaria infested Punjab region), and the story of man's struggle to live with the mosquito, from the early 19th century malaria-defeat in Mian Mir under direct charge of one of the greatest medical entomologists ever, Dr Samuel Rickard Christophers, who advocated to Dr Ronald Ross's theory of 'environment sanitation', to the malaria-deaths of hundreds of rural inhabitants living in The Thar Desert's irrigated Command Area under the world famous Indira Gandhi Nahar Pariyojana (IGNP), in the early 1990s, and the recent panic over the chikungunya virus' in Kerala and many other States and Union Territories, crippling thousands of people, in 2006, and deaths from dengue all over the country during 2012-14, the stories of their numerous encounters need to be told to the modern generation of medical entomologists and vector-borne disease specialists to relive the moments of victories and defeats in this vicious age-old battle between man and mosquito. At the end we find that we have only ourselves to be blamed to a great extent for accelerating the spread of mosquitoes and the diseases they transmit; with climate change and increased international travel, mosquito-borne illnesses are flaring up all over the globe. Catastrophic failures of mosquito control have ensured that worldwide even now one person dies of malaria every twelve seconds.

India is blessed to boast of a large number of ingenious entomologists, both those who specialized in the discipline as a college or university subject in their Master's Degree or did doctoral research in the subject, and those who by vocation or profession were though basically a medico, engineer, geographer, statistician or historian etc. but acquired deeply the knowledge of insects of medical significance as a part of expansion and improvement in resources under establishment of the Britishers' colonial rule in India. The latter, in particular, varied from having been born and brought up in India to those who either served in India in some kind of vocation or even connected with Indian mosquitoes or the mosquito-borne diseases through research projects, travelogues and global writings, such as books and reviews, etc. etc. All these are bracketed as "Indian mosquito hunters" for convenience of completing the illustrated history of Indian mosquito scientists' combat against the humankind's deadliest foe as well as bringing into light the glory of medical entomology in India. I do not, however, claim in anyway that I would have covered 'all' medical entomologists, although I made fairly a well-judged decision to portray only those who in my opinion have made an impact, however trifle, in our understanding of the biology of mosquito, with focused attention on control.

Mosquito's biology seems quite simple and yet it is so extraordinary in its comprehensive portrayal of the villainous role in history and its threat to

mankind. The famous culicidologist, Dr A.N. Clements (2011) has signified mosquito's life in human learning as: "The great importance of mosquitoes lies in their role as transmitters of pathogens and parasites, and in their use as experimental animals well suited to laboratory investigations into aspects of biochemistry, physiology and behaviour." This book describes, in a mosquito's-eye view, how mosquito breeds, rests, feeds, flies, mates, and dies, besides makes interaction with her natural enemies. The book also deals with the current constraints and future control prospects of mosquito control. In view of the increasing resistance to insecticides and chemotherapy, the book throws light on the subject of greatest promise to ending mosquitoes' deadly assault on man by rendering them impotent by genetic manipulation or replacing them through paratransgenesis involving micro-organisms such as bacteria and fungi.

In essaying this book I have felt both the thrill of recounting my own endless confrontations with mosquitoes of varied nature in far flung nooks and corners of the country, describing in course as new species *Anopheles pseudosundaicus*, after a gap of more than six decades for an Indian anopheline mosquito, and *Toxorhynchites darjeelingensis*, the first ever under the genus since early 20th Century, besides being honoured in having been given to a mosquito my name, *Tx. tyagii* (for authorities describing these species see Chapter 5), discovering a new malaria paradigm, 'Desert Malaria' in the Thar's xeric ecosystem, expounding *de novo* about *Aedes albopictus* transmitting dengue in Kerala as a 'primary' and 'major' vector without the presence of *Ae. aegypti*, inventing a 'mosquito sampler', and executing transfer of two technologies (ToT) to the Public Health Department of Tamil Nadu etc. etc. But after close to forty years now, my work on mosquito continues with double the energy and enthusiasm. Still I do not know the kind of challenges and surprises this little critter has in store to offer! My quest for mosquito-related knowledge will continue forever!

Prof. Dr B.K. Tyagi

August 20th, 2020

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It is unimaginable to encompass in a small composition like this a vast and diverse life attribution of one of the world's diverse group of animals which is also the man's deadliest foe, mosquito, without the immense help of the generous Librarians of various national institutional libraries, particularly personal courtesies of xerox copies and other material of the various different scientific materials by a large number of friends and colleagues all over country and beyond!

As always I sincerely thank my consort, Ajita, who was all supportive and motivating to me throughout the period of completing this rare composition.

Last, but not least, I owe much to Mr Pawan Kumar Sharma, CEO of the Scientific Publishers (India), Jodhpur, for his trust in me and for the patience and help extended throughout the process of writing this monograph.

Prologue

“No creature has touched directly the lives of more human beings than the mosquito.

She has been a nuisance, a pollinator of plants and an angel of death all over the globe.

And throughout history, much of our trouble with the mosquito has been caused by man himself.”

- Andrew Spielman & Michael D’Antonio (2001)

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