

104  
CONTROL AND ERADICATION OF  
PLASMODIUM SPP. IN MAN

by

Fredrick E. Lindbeck

B.S., Kansas State Univ., 1973

---

A MASTER'S REPORT

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Parasitology

Division of Biology

KANSAS STATE UNIVERSITY  
Manhattan, Kansas

1978

Approved by:

*M. F. Hansen*

Major Professor

Document  
LD  
266T  
.R4  
1978  
L55  
C,2

TABLE OF CONTENTS

I. ACKNOWLEDGEMENTS . . . . .

II. INTRODUCTION . . . . . 1.

III. THE DISEASE . . . . . 2.

IV. ERADICATION . . . . . 4.

V. PROBLEMS OF RESISTANCE . . . . . 9.

VI. HUMAN FACTORS AND MALARIA . . . . . 12.

VII. IMMUNOLOGICAL ASPECTS OF MALARIA . . . . . 17.

VIII. SUMMARY . . . . . 21.

## ACKNOWLEDGEMENTS

The author wishes to express his sincere thanks to all faculty and students for their support. My special thanks to Dr. M. F. Hansen for his continued help and understanding.

## I. Introduction

With the development of D.D.T. as an insecticidal tool during W.W. II, it was hoped that world-wide control of malaria could be achieved. Now some 30 odd years later, malaria still kills an estimated one million people a year, with an additional 50 million suffering from some aspect of its attack. Although great advances have been made, (in Africa) north of the Sahara, 67 million people are under malaria risk, but 95.5% are protected by some type of anti malaria measure); in other areas, however, such as the Indian sub-continent, the number of people under malaria-risk has increased against a previously decreasing trend, by 300 million people (W.H.O. bulletin, 1977). This increase is possibly one due to a let down of effort, but can also be traced to the development of resistant strains of mosquitoes and Plasmodia. Undoubtedly, social and economic development of afflicted areas will be determined by the continuing success of malaria eradication.

If the appearance of malaria can be approximated by the origin of its vector, then it is an ancient disease indeed, as mosquito like fossils that are 100 million years old have been found. In addition, the development of resistance mechanisms in man, such as the sickling trait (which gives increased protection to heterozygotes until they can achieve immuno-competency) or the Duffy-blood groups, imply an extremely long association. Probably the first to record the associated symptomologies of the disease was Hippocrates (460-377 B.C.), who noted both the intermittent fever and the palpability of the enlarged spleen, which is still a diagnostic characteristic. However, our name for the disease is derived from the Italians, who described the disease as being due to mal (bad) - aria (air). Even then, an association between the disease and swampy areas was noted. It was not until after Alphonse Laveran, in 1880, demonstrated the intraerythrocytic parasites, that Patrick

Manson persuaded Ronald Ross, in 1894, to test the hypothesis of mosquito transmission.

Malaria is still generally associated with rural settings, and one could thus assume that with increasing urbanization, the problem would disappear. However, it should be remembered that mosquitoes can breed and reproduce in tremendous numbers in very limited environments. In fact, the tendency towards urbanization can actually precipitate an increase in malaria incidence, as the mosquitoes that would normally feed on the now displaced large vertebrates, turn to man as a food source, thus increasing their role as possible vectors. In addition, the construction of various projects (roads, railroads, dams, irrigation systems) that accompany the process of urbanization, tends to increase the available habitats of many vector species. It has also been found that the haphazard growth of shanty towns around growing urban centers without the benefit of proper sanitation and waste water disposal also increases available breeding grounds.

## II. The Disease

Malaria, in man, can be caused by any one of four protozoan species; Plasmodium falciparum, which has a 6 day incubation period from inoculation to appearance in the blood, is asynchronous in its development of the erythrocyte invading cells (merozoites); P. vivax - an 8 day incubation and a synchronized merozoite release (48 hr. cycle); P. malariae - a 27-37 day incubation and a 72 hr cycle P. ovale - a nine day incubation and a 48 hr. cycle. Of these four, the first two account for approximately 95% of all cases worldwide. The species P. malariae is unevenly distributed throughout the world, and P. ovale is restricted to Africa south of the Sahara. The life cycle of Plasmodium spp. is split into an asexual phase (in man) and a sexual phase (in the obligate vector - some Anopheline mosquito). Beginning with the injection of the