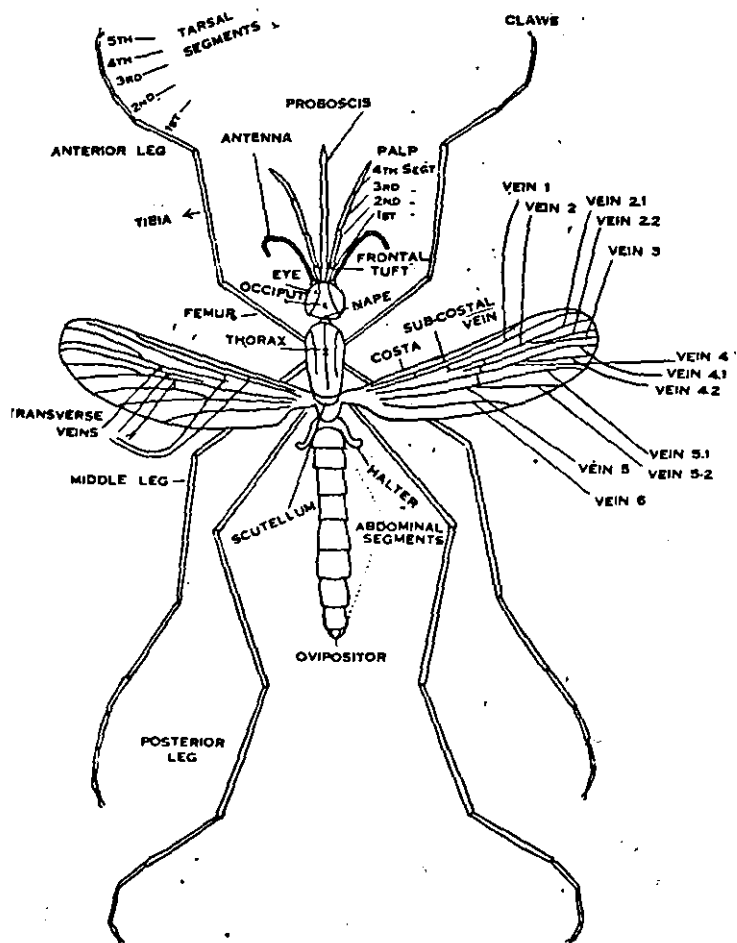


**MOSQUITO
REDUCTION
AND
MALARIAL
PREVENTION**

**BY
CRAWFORD AND CHALAM**

UNIVERSITY PRESS

**MOSQUITO REDUCTION AND
MALARIAL PREVENTION**



DESCRIPTIVE DIAGRAM *ANOPHELES* (FEMALE).

MOSQUITO
Reduction and
MALARIAL
Prevention

A PRÉCIS.

BY

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THIS BOOK IS DEDICATED

TO

LT. COLONEL S. R. CHRISTOPHERS, F.R.S., C.I.E., O.B.E., I.M.S.

FOREWORD

THE Authors of this small book are quite correct when they point out the need of a work such as they now put forward. Many books it is true deal with anti-malarial work and many with various aspects of the study of malaria, entomological, parasitological, clinical, etc. There are also general treatises on malaria and works on the practical prevention of the disease. But the fact remains that it is very difficult to recommend a book to a beginner that will give him the simple facts and interests he requires to help him in commencing actual practical work in the field. The Authors have met the needs of a manager of a tea garden, or a malarial inspector, or the N.C.O. in charge of a regimental sanitary squad from their own experience of what such persons require. They give a brief but sufficient account of the nature of malarial fever, of the chief facts about mosquitoes and of how to find and identify mosquitoes, especially the Indian species of malaria carriers. They end with an account in some detail of practical steps to be taken in prevention, and, in the form of appendices, with some helpful

notes on the technique connected with mounting and preserving specimens. The Authors themselves have had the practical experience that qualifies them to write helpfully for others and I wish their venture every success.

S. R. CHRISTOPHERS.

PREFACE

THE Authors, in placing before the public this volume, do so with the hope of filling a need long felt by the worker and inspector in anti-malarial measures. There are at present many tomes and excellent treatises dealing exhaustively with the life, habits and elimination of mosquitoes, and many are written with a view to controlling yellow fever and malaria—but the man who is too busy in other walks of life, or who has not the necessary technical education, cannot readily acquire the knowledge contained in these. We have only introduced such technical names and phrasing in this book as are absolutely necessary for the proper understanding of the subject, and where these are introduced they are explained as simply as possible. It has been our experience that the manager of a tea garden, or a malarial inspector, or the N.C.O. in charge of a sanitary squad dealing with anti-malarial measures begins to take a much keener interest in his work when he has acquired some knowledge of the habits and life-history of the mosquito, and it is primarily in the hope of quickening their interest that this work has been undertaken.

Our thanks are due to Lt. Colonel S. R. Christophers F.R.S., C.I.E., O.B.E., I.M.S., for his kindness in reading through our work and for his many valuable criticisms, and also for allowing us to include a Synoptic Table of Indian *Anophelini* issued by the Central Malarial Bureau, Kasauli, 1926. We also desire to thank all who by their kind criticism have encouraged us in our work.

BOMBAY,

June, 1926.

J. A. C.

B. S. C.

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APPENDIXES

APPENDIX I

HOW TO SEND LARVÆ AND LARVAL SKINS
FOR PURPOSE OF IDENTIFICATION
AND DESCRIPTION

FULL-GROWN larvæ are isolated by placing them in tubes. Only one larva should be placed in each tube. When pupation takes place the larval skin is cast in the water complete with all the hairs and chitinous parts; the skin is carefully poured off with a little water into a clean petri dish, the pupa being left in the original tube with some water. The skin is carefully lifted from the water by means of a small slip of filter paper and transferred to a small tube containing a mixture of formalin and water (about 10 per cent. formalin). This small tube containing the skin is numbered by placing a number on a small slip of paper in the top of the tube; a similar number on another slip is put in the top of the tube containing the pupa, being held in place by a plug of cotton wool, this plug also serves to prevent the escape of the mosquito when it emerges. When emergence has taken place the mosquito is transferred to a clean tube by holding the latter with its mouth to that of the former tube, after removing the plug. The plug is then pushed into the mouth of the tube containing the mosquito and a few drops of chloroform poured upon it; the mosquito is then mounted in the usual way and a small label attached to the pin corresponding to the number of the larval skin from which this mosquito resulted. The mosquitoes and the skins can be sent in their respective tubes by post. The small tubes containing liquid should be filled up to the cork, and if possible sealed with wax by dipping the top of each tube into melted wax.

APPENDIX II

HOW TO MOUNT AND PRESERVE MOSQUITOES

APPARATUS REQUIRED :

1. Specimen tubes with corks.
2. Fine double-pointed nickel pins, No. 3.
3. Cork sheets.
4. Cardboard.
5. Forceps with grooved teeth at the tip.

First prepare your specimen tubes as follows :

Paste white paper on to a cork sheet and cut it into small strips just broad enough to go inside the specimen tubes. Attach a strip to the cork of the specimen tube by passing an ordinary pin on either side from the strip to the cork. The cork strip when thus fixed to the cork of the tube should not touch the bottom of the tube but just clear it. Make a small triangular slit on one side of the cork of the specimen tube so that a small groove exists between the cork and the glass, and into this groove fix a pledget of cotton wool. The tube is now ready for receiving the specimen. Place the mosquito upon its back on the cardboard. Hold the pin about the middle with the forceps and push one end steadily through the thorax so that it just emerges from the centre of the dorsum of the thorax. The mosquito is now transfixed to one end of the pin ; lift the pin and transfix the other end to the cork strip of the prepared specimen tube. In this way about ten mosquitoes can be mounted and preserved in each tube. Put a few drops of pure carbolic acid on the cotton wool plug. Put carbolic acid on the plug once a month and this will prevent the specimens getting mouldy.

APPENDIX III

HOW TO HATCH OUT MOSQUITOES
FROM LARVÆ

PLACE the larvæ in a white enamelled basin containing some of the water in which they were found. Keep them there till they become pupæ, when they should be removed from the basin to wide-mouthed glass bottles filled three-fourths with water and over the neck of which a piece of mosquito-netting is tied.

The mosquito-netting retains the emerging adults.

APPENDIX IV

HOW TO MAKE A CLEAR AND PERMANENT
PREPARATION OF LARVÆ

METHOD I:

Put the larva in a test-tube and pour a few drops of caustic potash or soda (2 to 5 per cent.) solution in water.

Boil for a few minutes; when clear, transfer the whole into a watch glass, pour off potash solution, wash in distilled water two or three times. Then transfer the larva to 50 per cent. alcohol, keep for five minutes, then transfer it to 70 per cent. alcohol. Keep there for 5 or 10 minutes, then transfer to absolute alcohol, and keep for 15 to 30 minutes. During all these processes never allow specimen to get dry. It is better to change the absolute alcohol two or three times.

From absolute alcohol place it in a drop or two of clove oil till it is sufficiently clear (about 5 to 10 minutes); when clear, remove with a pin or brush to a slide and put a drop of Canada balsam over it and with needles manipulate the position in which you want the larva; then cover with a cover slip.

METHOD II:

Put the larva in a watch glass containing 10 per cent. formalin. When dead, transfer it to another watch glass containing absolute alcohol so as to dehydrate it; then transfer it to clove oil or oil of wintergreen and when clear mount in balsam. Two strips of cardboard placed under the cover glass will support it.

DAILY ROUTINE OF ANTI-MALARIAL WORK FOR THE MONTH OF

.....192 .

Area 'A'	Sunday
Area 'A'	Monday
Area 'A'	Tuesday
Area 'A'	Wednesday
Area 'A'	Thursday
Area 'A'	Friday
Area 'A'	Saturday
Area 'A'	Sunday
Area 'A'	Monday
Area 'A'	Tuesday
Area 'A'	Wednesday
Area 'A'	Thursday
Area 'A'	Friday
Area 'A'	Saturday
Area 'A'	Sunday
Area 'A'	Monday
Area 'A'	Tuesday
Area 'A'	Wednesday
Area 'A'	Thursday
Area 'A'	Friday
Area 'A'	Saturday
Area 'A'	Sunday
Area 'A'	Monday
Area 'A'	Tuesday
Area 'A'	Wednesday
Area 'A'	Thursday
Area 'A'	Friday
Area 'A'	Saturday

APPENDIX VI

QUESTIONNAIRE CARD

Bungalow No.			
Occupant's } Name }			
<p><u>'Are You Troubled by Mosquitoes?'</u></p> <p>On presentation of this card please state 'Yes' or 'No' and sign your name</p>			
Date	Yes	No	Signature

APPENDIX VII

TABLE FOR IDENTIFYING THE FEMALES OF
THE *ANOPHELINES* OF INDIA

N.B.—Always make certain that the specimen examined *is* a female *Anopheline*. Special attention is drawn to the Notes at the end of the table.

I. WINGS UNSPOTTED

A. DISTINCT WHITE KNEE SPOTS AT DISTAL ENDS OF
HIND FEMORA (NOTE 7).A. *plumbeus* var. *barianensis*

B. NO DEFINITE KNEE SPOTS.

1. Head scales very narrow, linear. Palps very thin. Anterior forked cell nearly double posterior (Note 7).

A. *aitkenii*

2. Head scales expanded as in ordinary *Anopheles*. Palps not very thin. Anterior forked cell relatively shorter (Note 7).

A. *culiciformis*

II. WINGS SPOTTED

A. TIPS OF HIND LEGS WHITE.

(If not white, see p. 96.)

1. Femora and Tibiae not Speckled (Note 1).

(If speckled, see p. 95.)

a. At least the two terminal tarsal segments of the hind legs *completely* white (Notes 2 and 7).

(i) Dorsum of abdomen heavily clothed with pale scales, projecting at the sides to form tufts on all segments. **A. pulcherrimus**

(ii) Dorsum of abdomen not so clothed. No lateral scale tufts.

Fifth vein of wing pale in the greater part of its extent (Note 7).

Ventral aspect of most of the abdominal segments with scattered pale scales. Distal end of first hind tarsal segment never picked out with white (Note 7). **A. pallidus**

Ventral aspect of abdominal segments not so. Distal end of first hind tarsal segment variable, usually picked out with white (Note 7). **A. philippinensis**

Fifth vein of wing mostly dark. Distal end of first hind tarsal segment conspicuously picked out with white (Note 7).

A. fuliginosusb. Only the terminal hind tarsal segment *completely* white (Notes 2 and 3). Four white bands on each palp, including apical band (Note 7).**A. karwari**

2. Femora and Tibiae Speckled (Note 1).

(If not speckled, see p. 94.)

a. Two or three terminal tarsal segments of hind legs *completely* white (Notes 2 and 7).

- (i) Each palp with two broad pale distal bands, and one narrow proximal one (Note 7).

*Three terminal hind tarsal segments completely white (Notes 2 and 7). Palps prominently speckled (Note 4).***A. maculipalpis** var. **indiensis***Two terminal hind tarsal segments only completely white (Notes 2 and 7). Broad white band above this. Palps not speckled (Note 4).***A. theobaldi**

- (ii) Each palp with one broad pale apical band, and two narrow more proximal ones (Note 7).

A. jamesiib. Less than two terminal tarsal segments of hind legs *completely* white (Notes 2 and 7).

- (i) Each palp with four well-marked pale bands, including apical band (Notes 5 and 7).

*Three dark spots only on sixth longitudinal vein of wing. Conspicuous black scale tufts on ventral surface of all abdominal segments. Half of terminal hind tarsal segment only white (Note 7).***A. kochi***Five or six dark spots on sixth longitudinal vein of wing. Only extreme tip of terminal hind tarsal segment white (Note 7).*

Tibio-tarsal joint of hind leg broadly and conspicuously banded with white.

A. leucosphyrus

Tibio-tarsal joint of hind leg without such broad band.

A. tessellatus

- (ii) Each palp with three pale bands, including apical band (Notes 5 and 7).

*Dorsum of most of the abdominal segments thickly clothed with scales.***A. willmori***Scales, if present, restricted to the last few abdominal segments only.***A. maculatus**

B. TIPS OF HIND LEGS NOT WHITE.

1. Femora and Tibiae not Speckled (Note 1).
(If speckled, see p. 98.)

a. *Less than four dark areas on costa involving both the costa and the first longitudinal vein of wing (Note 7).*

- (i) Inner half of costa without any distinct pale interruption (Note 7).

Broad white band on femur of hind leg.

With prominent scale tuft associated with the band. **A. annandalei**

Without such a tuft. **A. lindesaii**

No broad white band on femur of hind leg.

Palps with some pale bands.

A. hyrcanus var. nigerrimus

Palps with no pale band.

With prominent scale tuft on ventral surface of seventh abdominal segment.

A. barbirostris

With no such scale tuft.

A. umbrosus

- (ii) Inner half of costa with pale interruption (Note 7).
A. gigas

b. *At least four dark areas on costa involving both the costa and the first longitudinal vein of wing (Note 7).*

- (i) Front tarsal joints with broad pale bands (Note 7).
(If without, see p. 97.)

Palps with dark pre-apical area equal to, or nearly equal to pale apical band (Note 7).

A. subpictus (rossii)

Palps with dark pre-apical area half, or less than half the length of the pale apical band (Note 7).

A. vagus

- (ii) Front tarsal joints without broad pale bands.
(If with, see p. 96.)

Tips of palps black.

Dorsum of thorax with hairs or narrow false scales.
Sixth wing vein with very indefinite markings
(Note 7). **A. turkhudi**

Dorsum of thorax with obvious true scales. Sixth
wing vein with very definite marking (three dark
spots) (Note 7). **A. multicolor**

Tips of palps not black.

Third longitudinal wing vein dark (Note 7).

*No pale spots on wing veins other than those on
costa (Note 7).* **A. rhodesiensis**

Pale spots present on other veins.
A. culicifacies

Third longitudinal wing vein light (Note 7).

*Each palp with two almost equal broad pale distal
bands and a narrow proximal one (Note 7).*

Proboscis pale in apical half. Sixth wing vein
with three dark spots (Note 7). **A. aconitus**

Proboscis not so. Sixth wing vein with two
dark spots (Note 7). **A. minimus**

Palps not so.

Inner quarter of costa without pale interruption
(Note 7). Scales present only on the extreme
front of dorsum of thorax. **A. listonii**

Inner quarter of costa with pale interruption
(Note 7). Scales present over most of
dorsum of thorax.

*Longest pale area on costa less than half
the length of longest dark area (Note 7).
Tarsi of hind legs usually narrowly but
distinctly banded with white.*

A. jeyporiensis

*Longest pale area on costa very little shorter
than longest dark area (Note 7).
Tarsi of hind legs not banded thus.*

A. superpictus

2. Femora and Tibiae Speckled (Note 1).

(If not speckled, see p. 96.)

a. Each palp with four well-marked pale bands, including apical band (Notes 5 and 7).

(i) Tibio-tarsal joint of hind leg broadly and conspicuously banded with white. **A. leucosphyrus**

(ii) Tibio-tarsal joint of hind leg without such broad band. **A. tessellatus**

b. Each palp with three well-marked pale bands, including apical band (Notes 5 and 7).

(i) Each palp with two broad distal and one narrow proximal band (Note 7). Palps speckled (Note 4).

A. stephensi

(ii) Each palp with one broad apical and two narrow more proximal bands (Note 7). Palps not speckled (Note 4).

A. ludlowii

NOTES TO PRECEDING TABLE

- Note 1.* A faint mottling is not considered as *speckling*. Seen under the microscope the spots constituting speckling are always clearly defined areas of pale scaling.
- Note 2.* Tarsal segments *completely* white are counted from the tip of the leg, *stopping at the first dark band*.
- Note 3.* In this case there are usually white areas forming bands higher up the tarsus.
- Note 4.* *Speckling on the palps* refers to white spots on their dorsal surface, usually between the middle and proximal pale bands.
- Note 5.* *Beware of speckling imitating a fourth band.*
- Note 6.* Species entered in more than one place in the table may show sometimes one appearance and sometimes another, or an appearance which may be overlooked. In either case the table will work out correctly.
- Note 7.* The *first tarsal segment* is that nearest to the tibia. *Terminal segments* are those at the tip of the leg. *Hind tarsal segments* etc., are those of hind legs. *Front tarsal segments*, etc., are those of front legs. By *apical band* is meant one involving the extreme tip. *Distal* means situated furthest from the body. *Proximal* means situated nearer to the body. The *costa* is the anterior border of the wing. The *first longitudinal vein* runs parallel with the costa. The *second longitudinal vein* lies behind the first, and divides into two branches. The *third longitudinal vein* lies behind the second, and is unbranched. The *fourth longitudinal vein* lies behind the third, and divides into two branches. The *fifth longitudinal vein* lies behind the fourth, and divides into two branches. The *sixth longitudinal vein* lies behind the fifth, and is unbranched. The *anterior forked cell* is the part of the wing lying between the branches of the second longitudinal vein. The *posterior forked cell* is the part of the wing lying between the branches of the fourth longitudinal vein.

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