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ANOPHELES AS VECTORS OF ANIMAL MALARIA PARASITES
(Summary of present records)

by

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In the incrimination of the main vectors of human malaria, the dissection of wild-caught *Anopheles* for the presence of sporogenic forms of plasmodia has traditionally played an important role. The regular recurrence of sporozoite infections in species of *Anopheles* known to be closely associated with man has usually been regarded as convincing proof of the implication of the species concerned in the transmission of human malaria. It has also been recognized for many years that in a comparatively small number of anopheline species sporozoite infections occur which must be of non-human origin on the grounds that the anopheline species concerned are sylvan or non-domestic, and have little or no contact with man.

In recent years the progress of the malaria eradication programmes has made it necessary to reappraise long-established criteria, and to review with a more critical eye the significance and interpretation of infection rates in vectors and suspect vectors. In addition, the extension of the programme to many new and unsurveyed countries or areas has revealed situations which cannot readily be explained simply by reference to the one or two species which have long been regarded as the main vectors in a particular area. Furthermore, there are many suspect vectors which feed readily on both man and animals and it is difficult to know if the infections are of human or animal origin.

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There are an increasing number of cases where field investigators, faced with the problem of persistent transmission in problem areas, are finding it difficult to evaluate the situation because of the ever-present doubt about the human or non-human origin of infections found by routine dissection of all suspect species. In those cases where the investigator has strong grounds for believing that infections found in the local anophelines may be non-human, attempts to find confirmatory evidence from the literature have proved extremely difficult because of the scattered nature of the available records, and because not all relevant information has yet appeared in print.

The present note represents an attempt to bring together all this scattered information - published and unpublished - in such a way as to be of some value in the interpretation of field problems in malaria eradication. In this connexion it is of considerable significance that, since the first draft of this report was prepared last year, the new information which has come in from South-East Asia alone has necessitated extensive additions and revisions.

There is some recent evidence that mosquitos other than Anopheles may be experimentally infected with simian plasmodia[40] and therefore that some natural infections of Mansonia and Aedes may possibly be due to Plasmodium spp. of mammals. Work on this aspect of the parasitology of malaria is now proceeding in India and Malaya and started in Congo (Leopoldville).

It is hoped that the present summary will stimulate further critical research and lead eventually to a more exact technique for distinguishing the sporozoites and oocysts of human malarias from those of animal origin, such as that which is being developed by Corradetti et al. (1964, WHO/Mal/432) using the fluorescent antibody technique.

1. Proven Anopheles vectors of animal malaria parasites in nature

Anopheles	Parasite	Host	Locality
A. balabacensis introlatus	P. cynomolgi[41]	Macaca irus ? (monkey)	Malaya
	P. fieldi[41]	Macaca irus ?	Malaya
A. dureni	P. berghei[39]	Thamnomys surdaster) (rat))	Katanga Province, Congo
	P. vinckei[34]	Thamnomys surdaster)	
A. hackeri	P. cynomolgi[41])		
	P. inui[41])	Macaca irus and/or	Malaya
	P. knowlesi[42])	Presbytis cristatus (monkeys)	
	P. coatneyi[12])		
	P. fieldi[41])		
A. leucosphyrus	P. inui[41]	Macaca irus	Malaya
A. smithi rageaui	P. atheruri[29]	Atherurus africanus (porcupine)	Cameroon
A. umbrosus	P. traguli[43,44]	Tragulus javanicus (mouse-deer)	Malaya
A. vanthieli (= A. faini vanthieli)	P. atheruri[1]	Atherurus africanus	Kivu Province, Congo

2. Suspected *Anopheles* vectors of animal malaria parasites in nature

Anopheles	Suspected parasite	Suspected host	Locality
A. baezai	*P. traguli*[43,44]	*Tragulus javanicus*	Malaya
A. barberellus	*P. cephalophi*[3]	Antelope	Liberia
A. concolor	*P. cephalophi*	Antelope	Congo
A. crucians	*P. praecox* ?[13,23]	Passer ? (sparrow)	U.S.A.
A. donaldi	?	?	Malaya
A. letifer	(?	?	Sarawak
	(*P. traguli*[43,44]	*Tragulus javanicus*	Malaya
A. machardyi	*P. anomaluri* ?[32]	*Anomalurus* ? (flying squirrel)	Tanganyika
A. maculipalpis	?	?	Cameroon
A. marshalli	?	?	Congo
A. nili	?	?	Liberia
A. pretoriensis	?	?	S. Rhodesia
A. pujutensis	*Plasmodium* spp.[41] of Malayan monkeys	*Macaca* and *Presbytis*	Malaya
A. riparis	?	?	Malaya
A. roperi	*P. traguli*[43]	*Tragulus javanicus*	Malaya
A. rufipes	*P. cephalophi* ?[27]	*Cephalophus grimmi* ? (duiker antelope)	Upper Volta S. Rhodesia
A. smithi rageaui	*Plasmodium* sp.[26] (to be named)	*Roussettus* (fruit bat)	Ghana

3. Anopheles shown to be able to transmit efficiently animal malaria parasites in the laboratory

A. albimanus	P. brasilianum[**4] P. bastianellii[9] P. praecox[22] P. gallinaceum[**9]
A. annularis	P. cynomolgi[24] P. knowlesi [?25]
A. atroparvus	P. gonderi[**35] P. cynomolgi[38] P. bastianellii[15] P. inui[**14] P. gallinaceum
A. aztecus	P. shortti[37] P. berghei[*31] P. cynomolgi P. bastianellii[15] P. gonderi[**18] P. knowlesi[**17] P. inui[36] P. brasilianum[**16]
A. bezai	P. traguli[44]
A. balabacensis introlatus	P. bastianellii[**11]
A. barbirostris	P. cynomolgi[24]

3. Anopheles shown to be able to transmit efficiently animal malaria parasites in the laboratory (continued)

A. crucians	P. praecox**[23]
A. culicifacies	P. cynomolgi[24]
A. fluviatilis	P. cynomolgi ?[33]
A. freeborni	P. bastianellii[8,10] P. cynomolgi[8,10] P. inui[10] P. praecox[22] P. gallinaceum[7]
A. gambiae	P. cynomolgi
A. hyrcanus	P. cynomolgi[24]
A. kochi	P. cynomolgi[19]
A. letifer	P. traguli[44]
A. lesteri	P. bastianellii[11]
A. maculatus	P. cynomolgi[19] P. bastianellii[40]
A. philippinensis	P. bastianellii[11]

3. Anopheles shown to be able to transmit efficiently animal malaria parasites in the laboratory (continued)

A. quadrimaculatus	P. cynomolgi[5]
	P. bastianellii[2]
	P. inui**[10]
	P. gallinaceum[20]
	P. lophurae[5]
	P. praecox[23]
	P. fallax**[21]
A. splendidus	P. cynomolgi[30]
A. stephensi	P. knowlesi**[25]
	P. cynomolgi[33]
	P. bastianellii[15]
	P. inui**[36]
	P. shortti[37]
A. subpictus	P. cynomolgi[24]
	P. praecox[28]
A. sundaicus	P. bastianellii[11]
A. tarsimaculatus	P. brasilianum[4]
A. vagus	P. cynomolgi[19]

* On one occasion only

** Dubious efficiency as a vector

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