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VECTOR PROBLEMS IN MALAYA

by

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Exophily in Anopheles balabacensis and resistance in A. sundaicus are obvious vector problems facing malaria eradication programmes in South-East Asia but, as suggested by Reid (1960) the mild malaria produced by secondary vectors often proves the most difficult to eliminate. Where the level of malaria transmission is very low it is also extremely difficult to obtain proof of the identity of the vector mosquito. However, in most parts of South-East Asia the number of Anopheles mosquitos that have been incriminated as vectors of malaria is extremely limited. Thus A. minimus is the dominant vector throughout the countries to the north of Malaya, and apart from A. sundaicus in certain coastal regions and A. balabacensis in the mountains, it is regarded as the only vector of significance. The situation is rather different in Malaya where no less than six species have been identified as vectors both on epidemiological and on parasitological evidence, and several other species have been found with sporozoites but are not regarded as vectors of human malaria (Hodgkin, 1956). Most of these anophelines occur also in neighbouring countries and might therefore be of some importance, particularly in areas where small foci of malaria persist despite the apparent success of residual insecticides against the major vector. For example it would be unwise to disregard A. maculatus, the main Malayan vector, in such circumstances. Unfortunately many of our vectors belong to so-called species groups and are difficult to identify both as larvae and as adults while in some instances the taxonomic picture is still not clear and the identity of the vector is not yet known. It has therefore been considered worth while to give a brief summary of our knowledge of these species groups and their relation to the transmission of malaria.

There is one other vector problem which may develop in importance in some areas. It is related to the question of whether monkey strains of Plasmodium cynomolgi are transmissible to man. One such strain<sup>1</sup> has been experimentally transmitted from monkey to man, then from man to man via mosquito in the United States of America (Eyles et al., 1960). The malaria strain came from a Malayan monkey and though there are as yet no grounds for believing that this occurs in nature it is important to know whether the known malaria vectors bite both man and monkey. If they do, and it is found that further monkey strains are readily transmissible to man, then a monkey reservoir of malaria would be an important obstacle to malaria eradication in certain areas.

#### Anopheles leucosphyrus group

The importance of the A. leucosphyrus group as a malaria vector was clearly demonstrated for the first time by McArthur (1947), and a preliminary account on the various forms included under the name A. leucosphyrus was given by Reid (1949) followed later by the authoritative accounts of Colless (1956, 1957). The group is distributed over the tropical rain-forested and monsoon forest regions of the Orient, from India in the west, to the Celebes and Philippines in the east and Taiwan and south China in the north. At present some 13 forms are recognized, seven full species, three geographical sub-species and the remainder forms of doubtful status.

A. balabacensis balabacensis, A. leucosphyrus and the Celebes form are vectors of malaria, A. balabacensis balabacensis over a wide area in the monsoon forests north of Malaya and in Northern Borneo, while A. leucosphyrus has been identified as a vector only in Sarawak and Sumatra. In Malaya the position is rather complex. A. leucosphyrus and a sub-species of A. balabacensis occur together in central Malaya but there are no records of either species in the large stretch of country north to the Thai border where the type sub-species of A. balabacensis has been found. It is not known whether either species transmit human malaria in Malaya but there are indications that the leucosphyrus group are important vectors of monkey malaria. A. leucosphyrus and A. balabacensis introlatus have been caught attacking man, but larger numbers were taken in the canopy than at ground level (Macdonald & Traub, 1960). Another member of the

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<sup>1</sup> P. cynomolgi bastianelli (Editor)

group, A. hackeri, does not attack man but has been caught biting monkeys and very recently has been identified as a vector of Plasmodium knowlesi, a parasite of the long-tailed macaque monkey, Macaca irus<sup>1</sup>. The A. leucosphyrus group thus poses many problems both in the distribution and identity of the various forms encountered, and in their relationship to both human and monkey malaria transmission.

#### Anopheles barbirostris group

There has been little published about the A. barbirostris group though Reid (1941) showed that light and dark winged forms occurred in Malaya and suggested that the dark winged form was an important vector of malaria. This has since been confirmed and dark winged A. barbirostris is now known to transmit malaria in several quite large coastal areas of Malaya. It rarely occurs outside the coastal regions and is distinct from the form of A. barbirostris which de Zulueta (1956) records as a vector in inland Sarawak. There is no information on whether malaria transmitted by dark winged A. barbirostris is interrupted by residual spraying but observations in window-trap huts indicate that A. barbirostris is moderately susceptible to DDT and dieldrin (Reid & Wharton, 1956). Studies by Dr J. A. Reid indicate that in certain parts of Thailand there is a form of A. barbirostris indistinguishable from the dark winged Malayan form, but its vector status is not known. However, there are also indications that the Borneo form may occur and transmit both malaria and filariasis in Malaya. A. barbirostris should therefore be regarded with suspicion wherever unexplained transmission is found.

#### Anopheles hyrcanus group

The complexities of the A. hyrcanus group in South-East Asia were exposed by Reid (1953). Previously only two sub-species were recognized, A. hyrcanus sinensis and A. hyrcanus nigerrimus. The former has long been regarded as the principal or only vector in some parts of China, but is not important elsewhere. A. hyrcanus nigerrimus on the other hand, was identified as a malaria vector in Malaya by Hodgkin (1933) and the Celebes by Venhuis (1939). Reid's studies confirm the identity of A. nigerrimus as a possible malaria vector in South-East Asia but there are now seven, probably eight species in Malaya alone and only once has a member of the group been incriminated. The A. hyrcanus group thus seems unlikely to prove a serious obstacle to malaria eradication in Malaya, but should not be overlooked as a possible vector elsewhere.

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<sup>1</sup> Wharton & Eyles (1961) (Editor)

Anopheles umbrosus group

This group of Anopheles has also proved to be a complex of some nine species, of which A. umbrosus, A. letifer, A. roperi and A. baezai have been found with sporozoite gland infections (Reid & Hodgkin, 1950). On epidemiological grounds only A. letifer appears to be unquestionably an important vector of human malaria though this species also appears to contain more than one form (Wharton, 1960). A. umbrosus and A. baezai have quite high sporozoite rates but there is some doubt as to the origin of the sporozoites and it has been suggested that they are probably from animals. Thus A. baezai is strictly a coastal mosquito not strongly attracted to man, yet was found with a sporozoite rate of nearly four per cent. by Hodgkin (1956) in an area where malarial endemicity was only moderate. Similarly A. umbrosus has been found heavily infected in swamp forest which was completely uninhabited by man (Wharton, unpublished). Monkeys would seem the obvious source of at least a portion of the infections but A. umbrosus is not a canopy feeder.

Summary

1. In most of South-East Asia the main vectors of malaria are limited to A. minimus, A. sundaicus and A. balabacensis, but in Malaya there are at least six known vectors. They also occur in neighbouring countries and might be of possible significance where malaria transmission is continuing at a low level.
2. Most of the Malayan vectors belong to species groups and the present knowledge regarding the A. leucosphyrus, A. barbirostris and A. umbrosus groups is briefly reviewed

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