ANOPHELES DONALDI: SOME RECOLLECTIONS AND SPECULATIONS

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INTRODUCTION

In May 1941 there was a widespread strike of labour on the rubber plantations of Malaya. This strike posed a considerable threat to the war effort for which rubber was essential. The Government therefore acted quickly with various measures, one of which was to mobilise the F.M.S.V.F. (The Federated Malay States Volunteer Force) to patrol the estates. Most of the estate workers were Tamils and in the State of Selangor, where I was a humble private in the F.M.S.V.F., the affair was referred to jokingly as "The Tamil War".

We spent several rather uncomfortable and boring days in patrol and guard duties on estates around Kuala Lumpur before the strike ended. But during that time I was bitten at night by what, with high sight, was probably *Anopheles donaldi* Reid, an important member of the *Anopheles (An.) barbirostris* species group (Reid, 1968, 1980). It is the circumstances and possible significance of this encounter with *A. donaldi* that are related here.

FACTS AND SPECULATIONS

Puchong

My unit of the Volunteers was based on Puchong estate, some 10 miles south of Kuala Lumpur near the Klang river swamps. We slept in an estate hospital that was not much more than half a mile from the edge of the swamps, merely taking off our boots and lying down in our clothes. I spent one particularly uncomfortable night because of attack by mosquitoes and remember a bite on the big toe through my sock that was most painful. At that time I was a Research Student in the Division of Entomology of the Institute for Medical Research, and in the morning I looked round the ward which had walls of wire-gauze mosquito screening in which there were a few small holes. Resting on the inside of the gauze I found several large blood-fed black anophelines. I had no means or opportunity of catching them, but from their very thick shaggy black palps it was easy to recognise them with the naked eye as *'barbirostris'**. Many years earlier Leicester (1908) had noted this naked-eye character of *'barbirostris'*.

It was not till some sixteen years later, when I distinguished the species subsequently called *donaldi* from *barbirostris* Van der Wulp which it so closely resembles, that the probable significance of that bite on the big toe in 1941 became apparent.

As related in the account of the *Anopheles barbirostris* group (Reid, 1962), I had begun to suspect the existence of yet another species in the group, the adults of which differed from those of *barbirostris* by usually having an additional pale fringe spot at the tip of the wing, opposite the end of vein 2.1. But it was not until 1957 that I was able to confirm that this form was a new species. On the morning of 20th November of that year my staff and I entered some low jungle by the roadside at the 14 mile on the Puchong – Klang road, near the edge of the Klang river swamps. I think I chose to search in this area from my memory of being bitten indoors by *'barbirostris'* on Puchong estate nearby, and having a hunch that the mosquitoes responsible might not have been ordinary *barbirostris,* which seldom bites man indoors. In the jungle we were at once attacked by large numbers of *'barbirostris'*. We allowed some of them to feed on us before catching them in glass tubes. Then with a hand lens, they were separated on the spot into those with and those without the extra pale fringe spot at the tip of the wing. Some days later, when these mosquitoes laid eggs in the laboratory, it was clear that the eggs laid by the females with the extra fringe spot were distinctly different from those laid by the females without the extra spot, the eggs of which were already familiar to me.

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The new species was name for Dr. Donald H. Colless who did so much valuable work on the anophelines of Borneo, where *donaldi* proved to be the commonest member of the *barbitrostris* species group. Field work in Borneo and Malaya showed that *donaldi* will enter houses at night to bite man and is a vector of human filariasis and possibly malaria (for summary, see Reid, 1968, p. 468). By contrast *barbirostris* rarely attacks man indoors at night, though like several other species in the series *Myzorhynchus* of subgenus *Anopheles,* both vectors and non-vectors, it will attack in the shade by day if disturbed in its resting places. *A. barbirostris* is a zoophilous species (Reid, 1968, p. 449) that is not a vector of human disease, except at the eastern end of its range in Sulawesi, Timor and Flores where it readily bites man indoors (Reid, Harrison and Atmosoedjono, 1979). The zoophily of *barbirostris* in peninsular Malaysia has been shown on the Selangor coast by the results of DDT house-spraying (Moorhouse, 1965). This spraying exterminated the man-biting, house-resting *Anopheles campestris* Reid (dark-winged *barbirostris* of Reid, 1942) which so closely resembles *barbirostris* in appearance but not in biology, while the numbers of *barbirostris* were unaffected.

In the light of this knowledge and the occurrence of *donaldi* in large numbers not far from Puchong estate, it seems very probable that the mosquitoes which entered the estate hospital through the holes in the gauze and bit us in 1941 will have been *A. donaldi.* Whether the species was responsible for any malaria on the estate, as it appears to have been in the brickfields road area of Kuala Lumpur earlier in the century (Reid, 1980), is not known.

GEMAS

Another place where *A. donaldi* may once have been an important pest mosquito and possibly a malaria vector, is Gemas, the railway junction town on the borders of Negeri Sembilan and Johore. Malaria among the railway staff and others at Gemas was a serious problem and in 1918 H.P. Hacker was asked to investigate. He made a thorough larval survey of the area in August and September 1918, but did not catch or dissect adult mosquitoes. In February 1919 he made a shorter survey to assess the effect of control measures undertaken following his first survey (Hacker, 1919). In 1918 he found 65/106 men and women (61 per cent) with parasites in the blood, enlarged spleens, or both, and 80/132 children (61 per cent). The incidence of malaria in relation to length of residence increased from 50 per cent, in 24 persons who had not been in Gemas longer than three months to a maximum of 70 per cent, in 20 persons resident between one and two years, thereafter decreasing to 58 per cent, in 19 persons resident between 4 to 13 years. Gemas was clearly a very malarious place by any standards. When one examines Hacker's map of the area, the species of anophelines he found in the main types of breeding places, and their numbers (his Table H), the intensity of malaria is not surprising, for certainly one and probably two or more malaria vectors were common. Most importantly, *A. maculatus* was present in seepages, etc., in all open and sloping or hillfoot areas. Then *'umbrosus'**, in the extensive areas of low-lying swampy jungle, was the commonest of his species with 542 out of the total of 2,347 larvae collected (22 per cent.); *'barbirostris'* was the second commonest with 536 larvae.

The problem is that the identity of Hacker's *'umbrosus'* and *'barbirostris'* cannot now be known for certain, though there are some clues. His *umbrosus* was not the true *umbrosus* Theobald (which was then called *novumbrosus* Strickland), for Hacker was familiar with the larval differences between the two; *novumbrosus* having some developed palmate hairs on the abdomen not present in his *'umbrosus'* (see Reid and Hodgkin, 1950). He found larvae of both species in jungle-covered ravines at Sungei Besi 7 miles south of Kuala Lumpur (his Table A, p. 12). His *umbrosus* must have been one or more members of the *letifer* sub-group of the *umbrosus* species group *(letifer* Sandosham, roperi Reid, *whartoni* Reid and *collessi* Reid). We know that *roperi* was present from 4 specimens collected at the time by Hacker and preserved in the collections of the Institute for Medical Research in Kuala Lumpur (Reid and Hodgkin, 1950). Also, in 1946 and 1947 a further 18 *roperi* were collected at Gemas.

Though *A. roperi* is rather local and not usually abundant, the low hills and swampy valleys around Gemas appear to be the type of territory most favoured by this species. It was found in numbers in comparable territory in Selangor, where the hills merge into the coastal plain, by Moorhouse and Whar-

* The specific name in the single inverted commas indicates that this 'species' is now known to be a group of very similar looking species, and that the exact one(s) collected by Hacker cannot now be determined.

ton (1965). But though they caught 275 *roperi* attacking man in the forest, nearly all by day, none were caught at night with human bait outside or inside a dwelling in the open only 65 metres from the forest edge. *A. letifer and donaldi* were also numerous at this place and were also caught in the forest throughout the 24 hours. But in addition, they were caught attacking men inside and outside the dwelling at night. In four comparable areas in Sarawak, all low-lying inland rural, or forested areas, Macdonald, Smith and Webb (1965) and Macdonald, Smith, Dawson *et al.,* (1967) caught the same three species, *roperi, letifer* and *donaldi,* occurring together.

There is no positive evidence so far that *roperi* is ever a vector of human malaria; sporozoite infections found appear similar to those in *umbrosus* that are believed to be *Plasmodium traguli* Garnham and Edeson, the malaria of mouse deer (Wharton, Eyles, Warren *et al.,* 1963).

In addition to the vector *A. letifer,* it is possible that its close relative *A. whartoni,* also a vector (Wharton, 1960; Reid, 1968), could have been present. Until recently *whartoni* was known only from the eastern side of peninsular Malaysia and it still appears to be absent from the west side of the main mountain range. But in January 1978, near Bemban in south Malacca, 92 adult *whartoni* were collected (Cheong, Mahadevan and Loong, 1978), This area, like Gemas, lies just south of the sourthern end of the main range. The species has also been recorded from low-lying areas in Thailand and Cambodia (Harrison and Scanlon, 1975).

From Hacker's description of the breeding places and his photograph 12, and by analogy with the findings of Moorhouse and Wharton, Macdonald et al., and Cheong et al., quoted above, it seems likely that *A. letifer* and/or *whartoni* will have been present, as well as *roperi.* Also that Hacker's *'barbirostris'* will have included *donaldi* as is suggested by further evidence below.

The probability that *donaldi* was present at Gemas is supported by the nature of the breeding places (swamps on the edge of forest), as Reid (1980) shows for the Brickfields Road area of Kuala Lumpur (shaded swamps) where Hacker (1921) also found *'barbirostris'* larvae very common. But more to the point is the fact that in October 1935 B.A.R. Gater collected a long series of *donaldi* from swamps 3 miles from Gemas beside the Tampin road, and his illustration of the wing of *'barbirostris'* (Gater, 1935) is that of *donaldi,* having the extra pale fringe spot at the end of vein 2.1.

SUMMARY

Facts are presented which suggest that mosquitoes of the *Anopheles barbirostris* species group that gave me a very uncomfortable night in 1941, whilst serving with the Volunteer forces, were probably *A. donaldi.* This species is now known to be a vector of human filariasis and probably malaria. Some of the steps are described by which I was led, sixteen years later, to recognise and later name *donaldi* as a new species.

Reasons are given for thinking that around 1918 *A. donaldi* was present in some numbers at the railway town of Gemas where malaria was a serious problem. H.P. Hacker made a survey at Gemas in 1918 and though the principal vector was probably *A. maculatus, 'umbrosus'* and *'barbirostris'* were the commonest larvae he found.

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