# SOME FURTHER VARIETIES OF INDIAN SPECIES OF ANOPHELES WITH NOTES ON THE SPECIES *A. PALLIDUS* THEOBALD AND *A. PHILIPPINENSIS* LUDLOW.

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DURING the last fifteen years large numbers of specimens of the various species of Indian Anopheles have been received at the Bureau from different localities in the Indian Empire. This material has recently been examined with the object of seeing to what extent the species occurring in India vary in relation to geographical distribution. Two varieties of geographical significance, *A. gigas* var. *simlensis* James, and *A. lindesaii* var. *nilgiricus* Christophers, have already been discussed by me (1924 a). Three further varieties, which appear to be true geographical forms, are now described. It is of interest that in the majority of cases the closest scrutiny failed to reveal any departures from type that were sufficiently definite or invariable to name as varieties, mere departures from type, without evidence that such denoted a local race, being considered as of no account in the present connection. Only one of these three new varieties now described, var. *moghulensis*, is, however, entirely satisfactorily definable; though as each of them seems to represent a fact in nature it has seemed desirable to record their existence. One other variety recently described by Iyengar (1924) is also discussed, the remaining so-called varieties that have been described among Indian species being more correctly regarded as variants than as varieties.*

* *Note.* All specimens shewing departures from type however extreme these may be, that are not indicative of biological race (variety) distinct from that of the type species may suitably be called 'variants.' Of the Indian varieties so far described (*vide* Christophers (1916) *nivipes, pallidus, vagus* and probably *aconitus* are really distinct species. The varieties *adiei, nagpori, leptomeres, punjabensis, maculosa* and *maculata* (lindesaii), on the other hand are variants, the first three being examples of melanism, the fourth of flavescence and the fifth and sixth being specimens exhibiting characters commonly shewn by a certain number of individuals of the species from any locality. The varieties *barianensis, indiensis, nigerrimus* and perhaps *listonii* representing Indian or Oriental forms of species are true varieties in the above sense but are not discussed here, *vide* Christophers (1924 b).

It is desirable, however, in this connection to mention two forms that have hitherto been regarded only as varieties or doubtful species, but which further study has shewn to be almost certainly valid distinct species viz., *A. pallidus* Theo. and the so-called var. *nivipes*, the correct name for which appears to be *A. philippinensis* Ludlow.

*A. culicifacies* var. *adenensis* nov. var.

*A. culicifacies* has a distribution from the Baluchistan and Afghanistan borders to Burma and throughout the whole Indian peninsula to Ceylon. Throughout this range the species maintains very uniform characters. Specimens taken by Dr. Khazan Chand in the Aden Hinterland that were previously identified by Christophers and Khazan Chand (1915) as *A. culicifacies* differ, however, from the Indian form in that the pale areas on the costa are much broader, those on the outer half of the wing being about as extended as the dark, whereas in the Indian form the pale areas never equal the dark and are usually much less in extent. These broad pale interruptions give to the variety an appearance very like that of *A. sergentii*, but there are no fringe spots and the dark area on the first longitudinal vein opposing the pale mark on the base of the costa, very characteristic of *A. culicifacies* but not seen in *A. sergentii*, is present. Large numbers of specimens all identical in this respect were obtained from a number of localities in the Aden Hinterland (Sheik Othman, Daral Amir, Al Anad, Lahej), breeding in wells and in pools in the bed of streams. A type male and female and paratypes have been sent to the British Museum.

It is now known that the African and Palestine form previously thought to be *A. culicifacies* is not this species but *A. sergentii*. But *A. culicifacies* evidently occurs at Muscat where it is recorded by Gill (1916) and also, represented by a slight departure from type, at Aden (hinterland). The Muscat specimens received from Colonel Gill, though they have fairly wide costal pale interruptions, do not equal the Aden form in this respect.

*A. jeyporiensis* var. *moghulensis* nov. var.

That there were two forms of *A. jeyporiensis* in India was not suspected until specimens of the species were sent by Lieut.-Colonel Browse, I.M.S., from Quetta, a most unexpected locality. It was then found that these specimens differed quite definitely from the type form, but that the Quetta variety was not confined to Quetta, but represented the species over a large part of India.

In the type form the scaling of the mesonotum is rather scanty and the scales are rather narrow, and more important, if there are any scales at all at the sides above and in front of the wing root, these are quite narrow and few in number, not being at all conspicuous. In the type form, moreover, the forked cells of the wing have the usual relationship in Anopheles, i.e., the base of the anterior fork is at the same level as, or slightly nearer the base of the wing than, that of the posterior. The apex of the wing in this form almost always has at least one, and often two, dark interruptions on the fringe, and at vein 6 a pale fringe spot is fairly constant.

In the variety on the other hand the scaling of the mesothorax is noticeably heavier and more profuse and the scales are broader, and, a critical point, there is invariably a well-marked and conspicuous elongated patch of broad flat overlapping scales on the sides of the thorax above and in front of the wing root. In some specimens the bases of the forked cells may be about level, but in the majority the base of the posterior cell is distinctly nearer the base of the wing than that of the anterior and in many specimens it is strikingly so, in this respect resembling *A. nili* where a similar condition has been described as a specific characteristic. The apex of the wing in the variety is continuously pale from the junction of vein 1 to vein 3 and there is rarely any dark spot. A fringe spot at vein 6 seems less constant than in the type and is often wanting. One other feature may be mentioned viz., that in the variety the banding of the tarsi is narrow and brilliant, such banding having always been used to distinguish *A. jeyporiensis* from *A. listonii.* In the type form this banding is not so distinct and one might not have thought so much of this if one had not remembered that Major Perry, I.M.S., when carrying out his survey of the Jeypore Hill Tract (the locality from which the type was described), frequently referred to difficulty in deciding on this point; such difficulty can only arise in dealing with the type form.

*Distribution.*—The type form is well represented in the collection by numerous specimens from Nongpoh and Shillong, Assam ; Unqua, Duia and Manharpur, Singhbhum ; the Jeypore Hill Tracts (North-Eastern Madras Presidency) ; Coonoor and other localities in the Nilgiri Hills, South India. There is also a specimen from Castle Rock, on the Western Ghats about 300 miles south of Bombay. The distribution of the type form is therefore from Assam, through Orissa and down the eastern side of India to the southern portion of the Peninsula.

The variety is represented by numerous specimens from Quetta, Kasauli, Bombay, Belgaum, the Satpura Hills, the Pachmarhi Hills in the Central Provinces and Jubbulpore. The distribution of the variety is therefore reminiscent of the ancient Moghul Empire extending as it does over the north-western and central parts of the Peninsula, and on this account I have given to it the name of var. *moghulensis.* A type male and female and paratypes have been sent to the British Museum.

*A. maculatus* var. *dravidicus* nov. var.

Though the Himalayan *A. willmori* with broad and profuse abdominal scaling resembling that of a *Cellia* can scarcely be confused with *A. maculatus* where the scales are narrow and almost confined to the last few segments, this cannot be said for what seems to be the Peninsular form of *willmori*, which is very intermediate in characters between *A. maculatus* and *A. willmori.* This can be distinguished from typical *willmori* from the Himalayas by the condition of the second abdominal segment which in the Himalayan form invariably has a conspicuous patch of broad scales, whereas in the peninsular form, if there are any scales at all in this situation, they are few in number, narrow and inconspicuous.

That the variety is distinct from *A. maculatus* is less certain as scales are often seen extending up the abdomen in this species. In the Indian form, however, the

degree of scaling seems to be much more than is described in *A. maculatus* or than has been seen by me in specimens of this species of a typical form that I have examined. It is characteristic of the variety also that there is great variation in this respect so that out of a single batch of specimens some might easily be identified as *A. willmori* and others as *A. maculatus*. Actually it seems to be a true geographical form as once attention is called to it it is easy to see that all specimens coming from Peninsular India are this form, whilst from the Himalayas specimens are always typical *willmori*. It would also seem that *A. maculatus*, as distinct from the variety, occurs in India, more especially in the Himalayas where the two forms *A. maculatus* and *A. willmori* exist quite distinct from one another and without any intermediate condition, usually occurring in separate localities or situations and distinguished not only by the scaling, but also by the general coloration and banding of the front and mid tarsi. Though I have given the variety a name with some diffidence I believe its recognition is necessary to avoid error and confusion, and if recognised as existing it seems desirable it should have a name. From recent observations of Captain Watts who is now working at the malaria of Singhbhum there seems some reason to believe that var. *dravidicus* may even differ somewhat in its habits as it seems not to be a house or even a cattle-shed species, a character that does not seem to hold good either in the case of *A. maculatus* or *A. willmori*.

*Distribution.*—*A. willmori* is represented in the collection by numerous examples from : Kalaw, Shan States, Upper Burma ; Shillong, Khasi Hills, Assam ; Dehra Dun, Kalka, Kasauli, Dharmsala, Madhopur, Kangra, all North-West Himalayas ; Tarumerg and other localities, Kashmir ; Abbotabad, Kohat, Kotkai and other localities North-West Frontier Province.

Var. *dravidicus* is represented by numerous examples from : Shillong, Khasi Hills and Haflong, Cachar Hills, Assam ; Manharpur and other localities in Singhbhum ; Pachmarhi Hills, Central Provinces ; Salem Hills, South India ; Coonoor and other localities in the Nilgiri Hills, South India ; Bombay ; Belgaum, Bombay Deccan.

*A. maculatus*, type form, (taking this to be the somewhat lighter (brownish) species, with broad apical and basal banding of the front tarsi, narrower but distinct banding of the mid-tarsi, and the abdomen hairy except that there are scales towards the end), is represented by numerous specimens from Madhopur (where it is the common species), Kasauli (where it is rare, the common form being *A. willmori*), Abbotabad, and Dehra Dun.

### *A. minimus* var. *varuna* Iyengar.

This form, described by Iyengar (1924) as *A. varuna*, appears to be a definite local variety distinct from *A. minimus* type form as seen in Assam. The type form, which is very common in Assam, seems invariably to have an interruption, either complete or partial, on the basal portion of the costa, whereas *varuna* has no trace of an interruption. The rather frequent presence of some paling of the proboscis in the apical half, taken with the character of the palpal banding, would

suggest that *varuna* is a form of *A. minimus* rather than of *A. listonii* and it is probable that it represents *A. minimus* in the Peninsular area. It would seem to be restricted, however, to the eastern and southern portions of Peninsular India. There are specimens in the collection from: Calcutta; Cuttack, Orissa; Manharpur, Singhbhum; Ennur near Madras; and Bombay.

*A. pallidus* Theobald.

This was first described by Theobald as *A. fuliginosus* var. *pallida*. It was described by me later as a new species under the name *Neocellia fowleri*. The points of distinction then emphasized were (*a*) the lighter colour of the insect which enables it to be picked out at a glance from among the much blacker *A. fuliginosus*, (*b*) the different details of the wing markings, (*c*) the more extensive scaling of the dorsum of the abdomen, (*d*) the absence of any white interruption on the hind tarsus above the extended pale apical area. Further examination of the species has shewn that whilst these points of distinction hold good there are a number of others which enable this species to be differentiated. The resemblance between *fuliginosus* and *pallidus* is in fact difficult to see when one has studied both in detail.

In *A. fuliginosus* the costa has very narrow pale interruptions and the subcostal pale spot is almost invariably bridged by dark on the first longitudinal vein; in *A. pallidus* the pale costal interruptions are broad and complete. The basal portion of the costa in *A. fuliginosus* is mainly dark; in *A. pallidus* it is extensively pale. Still more important, the fifth vein in *A. fuliginosus* is largely dark and any pale areas form spots only on the main vein or its posterior branch; in *A. pallidus* this vein is continuously pale from near its origin almost to its termination on the wing margin, a condition that will be referred to later as the fifth vein extensively pale. In *A. fuliginosus* the abdomen usually has fairly distinct or even prominent tufts of dark scales on the last few segments laterally, but this species never has heavy pale scaling over these segments or any marked extension of pale scales forward. In *A. pallidus* the terminal segments are thickly clothed with broadish pale scales and the scaling may often extend forward five or more segments, this character, however, being somewhat variable. A more marked and apparently an invariable distinction is that in *A. pallidus* there are broad scattered white scales over almost the whole of the ventral aspect of the abdomen, whereas in *A. fuliginosus* there is no such condition. *A. pallidus* has numerous pale scales on the prothoracic lobes, and a considerable scaling of the mesosternum forming patches of conspicuous scaling on the pleuræ; *A. fuliginosus* has no scales in either situation, or somewhat rarely a few scales in the latter situation. When caught along with *A. fuliginosus* shewing the dark band on the tarsus on which the variety *adiei* has been based, *A. pallidus* never shews this variation, this apparently not being a variation to which this species is subject. *A. fuliginosus* has a wide distribution in India and is very common in the North-West and in Bengal, whereas *A. pallidus* is pre-eminently a Central Indian species associated with rice cultivation and often found in great profusion where there are but few *A. fuliginosus* present.

Considering all these points it is impossible to consider *A. pallidus* as other than quite a distinct species from *A. fuliginosus.*

### *A. philippinensis* Ludlow.

*A. philippinensis* as shewn by specimens very kindly sent to me from the Philippines by Dr. Tiedemann (*vide* Christophers (1924 b)) is the species formerly known as *A. fuliginosus* var. *nivipes.* This differs from *A. fuliginosus* in the same general characters as does *A. pallidus*, i.e., the fifth vein is extensively pale and the costal pale interruptions are broad and complete. *A. philippinensis* is, however, again quite distinct from *A. pallidus*, differing in the following respects: (*a*) the venter of the abdomen is devoid of scales (except of course apically), (*b*) the prothoracic lobes and the pleural surface of the mesosternum are entirely devoid of scaling. The tarsal ornamentation is interesting. In *A. pallidus* the unbroken dark of the hind leg down to the pale area on the tarsus was thought to be an invariable distinguishing character until the rule seemed to be broken by specimens from Chittagong shewing a slight, but often quite definite, interruption. Further examination, however, shewed these specimens to be *philippinensis* (*nivipes*). In *philippinensis* this character is variable, the dark length of the leg being sometimes uninterrupted, at other times with the joint picked out with white, though as a rule much less markedly so than in *A. fuliginosus.* The differing extent of the pale area on the second tarsal segment described by authors holds good generally but is not invariable.

Briefly the three species *A. fuliginosus*, *A. pallidus* and *A. philippinensis* may be readily distinguished as follows :—

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| 5th vein not extensively pale, costal interruptions narrow and subcostal pale area almost invariably bridged by dark on the first longitudinal vein. No pale scales scattered over the venter of the abdomen ; prothoracic lobes without scales. Joint above the pale area on the hind legs invariably picked out with white .. .. .. .. | *A. fuliginosus.* |
| 5th vein extensively pale, costal interruptions broad, the subcostal pale area not bridged with dark on first longitudinal. | |
| Broad pale scales scattered over the venter of the abdomen. Prothoracic lobes with pale scales. Pleuræ with conspicuous patches of scales. Joint above pale area on hind tarsus never picked out with white .. .. .. .. | *A. pallidus.* |
| No scattered pale scales over venter. Prothoracic lobes without scales. Pleuræ devoid of scale patches. Joint above pale area on hind tarsus with a variable amount of white .. .. .. | *A. philippinensis.* |

*A. pallidus* has a wide distribution through Peninsular India being represented in the collection by numerous specimens from : Cuttack ; Singhbhum ; Jeypore Hill Tracts ; Bihar ; the Central Provinces ; the Deccan and Madras Presidency. Specimens have also been received from Mandalay, Burmah and Nongpoh, Assam,

to the east, and from Delhi, Amritsar and Sheikpura, Punjab, to the west. *A. philippinensis* is represented by specimens from India only from Chittagong and the Andamans.

The opportunity may be taken here to mention that recently numerous typical examples of *A. multicolor* Camboulin, have been received from East Persia, British Baluchistan (Duzdap) and the North-West Frontier (Jandola, Piazha). This species has, therefore, to be added to the Indian list. The phallosome is without leaflets. Specimens of *A. turkhudi* are also received from this area.

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