

619 Original Articles. \$A YEAR'S EXPERIENCE OF THE HABITS  
OF ANOPHELES IN ELLICHPUR.

(Continued from p. 366.)

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THE DESCRIPTION OF THE SPECIES OF  
ANOPHELES FOUND IN ELLICHPUR  
DURING THE YEAR—(continued.)*Anopheles Stephensi.*

The wing costa shows six black-scaled areas; the base of the costa has black scales, while the apex has white scales. The first longitudinal vein shows four black-scaled areas corresponding to the four outer black-scaled areas on the costa, but the third black-scaled area from the apex is divided into two by a narrow white-scaled interruption and is shorter than the corresponding costal mark.

The second longitudinal has a single black-scaled area on the main stem and one on each; of its branches the point of bifurcation is white scaled.

The third longitudinal shows two small black-scaled dots, one near its origin and the other near its termination.

The fourth longitudinal shows two dark-scaled areas on the main trunk, two on the anterior branch and one on the posterior branch.

The fifth longitudinal has a single dark-scaled spot on the trunk, three on the anterior branch, and one on the posterior.

The sixth longitudinal has sometimes three, but sometimes only two dark-scaled spots.

The costal fringe is interrupted by light scales at the outer extremity of all the longitudinal veins.

The proboscis is brown scaled, but has a yellowish colour at its tip.

The palpi.—There is a broad white band at the apex of each palpi which is separated by a small dark-scaled band from a second almost equal-sized white band. There is a third prominent smaller white band at the point between the second and third segments of each palp, and in addition there are two indistinct white-scaled spots on the dorsal aspect of the third segment of each palp.

The antennæ have dark segments surrounded by long silvery hairs.

The head is covered with white scales and has two prominent white frontal tufts.

The nape is covered with brown scales.

The dorsum of the thorax is covered with white scales and shows an indistinct median and two lateral darker longitudinal lines.

The lateral aspects of the thorax are dark.

The halteres have black knobs and white stems.

The abdomen is of a dark colour and covered with numerous yellowish white hairs and scales.

The legs.—The femora and tibiae of all the legs are speckled with white and black scales. The distal extremities of the femora and tibiae are covered with yellowish white scales.

The distal ends of the tarsal segments of the middle and hind legs have yellowish white-scaled bands except those of the terminal segments. In the anterior legs the second and third tarsal segments have distal yellowish white bands, and the first tarsal segment has two additional yellow white bands. The fourth and fifth segments are wholly covered with brown scales.

*Anopheles Jamesii.*

The wing shows five white scaled areas on the costa; one of these is situated at the apex of the wing.

The first longitudinal vein has six white-scaled areas. The outer two correspond to the outer two of the costa. The next two are small and situated behind the third black-scaled area counting from the apex of the wing.

The fifth white scaled portion corresponds to the fourth on the costa. The sixth light-scaled portion is situated behind the fifth on the costa, but is considerably longer than that costal white spot.

The second longitudinal shows a very few white scales at its bifurcation and a few white scales on its posterior branch. It is otherwise entirely black scaled.

The third longitudinal shows two minute white-scaled portions, one near its origin and another at its termination.

Very frequently there is a larger light-scaled portion in the middle of this vein.

The fourth longitudinal is white scaled at its bifurcation, and has in addition a white-scaled portion on each of its branches.

The fifth longitudinal has two white-scaled areas on the main trunk, two white-scaled portions on its anterior branch, and only one on its posterior branch.

The sixth longitudinal has three white-scaled portions.

The terminations of all the longitudinal veins are white scaled, and at these points the costal fringe is interrupted by white scales.

The proboscis is black scaled with a white tip.

The palpi have white tips, and there are white-scaled rings at the joint between the fourth and third, and third and second segments of each palp. The dark scales on the second segment are of large size.

The antennæ have dark segments with silvery hairs.

The head is covered with white scales, and there is a prominent frontal tuft.

The nape is covered with dark scales.

The thorax is covered with white scales. A median and two lateral darker longitudinal lines can be indistinctly made out. The lateral aspects of the thorax are dark.

The abdomen is of a dark colour, and is covered with numerous light yellowish white hairs.

The legs.—The forelegs have apical white spots to the femora, tibiae, and all the tarsal segments except the last two.

The middle legs have corresponding white points to the forelegs, but in addition there is a very characteristic white spot on the posterior aspect of each femur near its apex. There is no apical white spout to the three last segments of the tarsus. This fact is not correctly represented in the plate. The hind legs have white apical bands on the femora, tibiae, first and second tarsal segments. The last three tarsal segments are entirely white. The posterior tarsal segments are longer than the tibia in the hind legs. This is not shown in the figure.

*Anopheles Turkhudi.*

The wing has six white-scaled portions on the costa, one of these is situated at the apex of the wing.

The first longitudinal has white areas corresponding with the outer five white areas on the costa. There is, however, in addition a small white scaled interruption at the position of the transverse vein.

The second longitudinal has five white-scaled areas; the two at the position of the transverse veins, one at the bifurcation of the vein and two on its anterior branch.

The third longitudinal has two white-scaled portions, one at the position of the transverse vein, and the other immediately below the white area on the bifurcation of the second longitudinal vein.

The fourth longitudinal is white scaled at its base and has in addition a white scaled portion at its bifurcation and at the position of the transverse veins.

The trunk of the fifth longitudinal is white scaled except for a single small dark scaled portion. At its bifurcation, it is dark scaled, and each of its branches are dark scaled except for one white-scaled portion in each branch.

The sixth longitudinal has a single white-scaled area.

The wing fringe is interrupted by white scales at the distal extremity of all the veins except the sixth.

The proboscis is covered with dark scales, but is yellow at its tip.

*The palpi.*—The tips of the palpi are black scaled. There are, however, three white scaled circles on each palp. One circle is situated in the middle of the terminal segment, while the other two are situated at the apex of the second and third segments of each palp.

The antennæ have dark segments which are surrounded by light and dark hairs.

The head has a not very prominent white frontal tuft. The occiput is covered with dark scales.

The thorax is covered with white scales on a dark background, and the scales are so arranged as to show a median and two rather less distinct lateral darker longitudinal markings. The lateral aspects of the thorax are covered with brown scales often tipped with white.

The abdomen has a dark olive green colour and is covered with many light yellow hairs.

The legs are dark scaled throughout except for a few yellowish white scales at the distal extremities of all the femora and tibiae.

The descriptive diagram shown in the plate will enable all to follow the description of the mosquito. I have endeavoured to use as simple and untechnical language as possible. I have avoided any description of the exact position of the transverse veins as well as the size and shape of certain wing cells which are considered by some to be of importance. The study of these details is difficult, and from an examination of a large number of specimens of all species of anopheles I am inclined to believe that the importance of these points has been much exaggerated. For the same reasons little notice has been taken of the sub-costal or auxilliary vein. The dimensions of the various parts have not been given, in that the size of different specimens of the same species of anopheles differs to a considerable extent.

With regard to the differential diagnosis of these anopheles mosquitos, it may be said that anopheles Rossii and anopheles Stephensi might be mistaken for one another, but a glance at the palpi will show that the two terminal white bands in the former are quite unequal, while these bands in the latter are almost equal. Further, an examination of the femora and tibiae will show that in Rossii they are of a brown colour throughout, while they are speckled in Stephensi. Anopheles Listoni somewhat distantly resembles Rossii and Stephensi, but it is altogether a darker mosquito and can be readily differentiated by its entirely black legs.

Colonel Giles says it resembles anopheles Funestus of Africa, but differs from that mosquito in the wing pattern.

A. Theoboldi and A. Jamesii might be mistaken for one another in that in both the terminations of the hind legs are white, but their wings are very different.

Theoboldi has a much lighter wing than Jamesii and further in the former the femora and tibiae are much speckled, but are almost entirely black in the latter except for apical white bands. A. Culicifacies is at once recognised by its culx-like attitude.

It is of the seven anopheles found in Ellichpur the smallest. A. Turkludii is at once distinguished from all the others by having the tips of the palpi black. It is, too, the largest of all these anopheles.

#### *The Habits of Adult Anopheles.*

It is of some importance to know something of the habits of adult anopheles. All are aware that they are nocturnal in their habits. They fly about at night and rest during the day. They dread the light ever more than Culex mosquitos do. They are seldom seen unless sought for in some dark corner. They even fear artificial light, and seldom even come near a lighted lamp. On only one occasion have I ever seen an anopheles light upon any article near a lamp. This particular anopheles was an anopheles Theoboldi. To catch them it is necessary to know their haunts by day. They love all dark corners and prefer certain materials to rest upon, viz., dark-coloured flannel, cotton, or cloth, woodwork, furs, skins, &c. They are easily found, for example, in ward-ropes which have been partly left open during the night and which are filled with clothes. They are often found beneath a table or desk in a corner of a room or behind a dark curtain. A cloth screen placed in a dark part of a room is an excellent trap for anopheles. Anopheles seem to enter and leave a house daily. Every day for sometimes I caught all the anopheles I could find in my house, but despite the fact that from 20 to 40 were taken daily from all the likely places where they might be found, yet each day more could be caught in the very places that were apparently cleared the day before.

There was a very evident seasonal prevalence in the number of mosquitos found in my house. Anopheles were most abundant shortly after the rains in the months of September, October and November. After these months they became gradually scarcer, but were still numerous even in the hot weather months of April and May.

The number of females taken during the months from September to February was in excess of the number of males taken, but later, especially in April and May, many more males were captured than females.

The different species of anopheles found varied somewhat with the season. Rossii were more abundant during the rains, while Culicifacies were most common during the hot weather.

Already mention has been made of the fact that anopheles females never laid eggs in captivity during the months of April and May although other circumstances than season were favourable to their doing so.

Wet weather seemed to prevent mosquitos from moving about. It was very hard to find any anopheles in the house during wet weather. When the wind blew from breeding places to a house where anopheles were found, the numbers of anopheles frequenting the house were greater during the prevalence of that wind.

All the species above described except A. Turkludii, A. Jamesii and A. Stephensi were reared from larvae obtained from a river which flowed near the house in which they were captured.

All the varieties were taken in one house during the months of March and April.

I regret that pressure of my ordinary duties during the famine season prevented me from making dissections of the mosquitos captured with a view to ascertaining how far each species was capable of communicating under natural circumstances the malarial parasite.

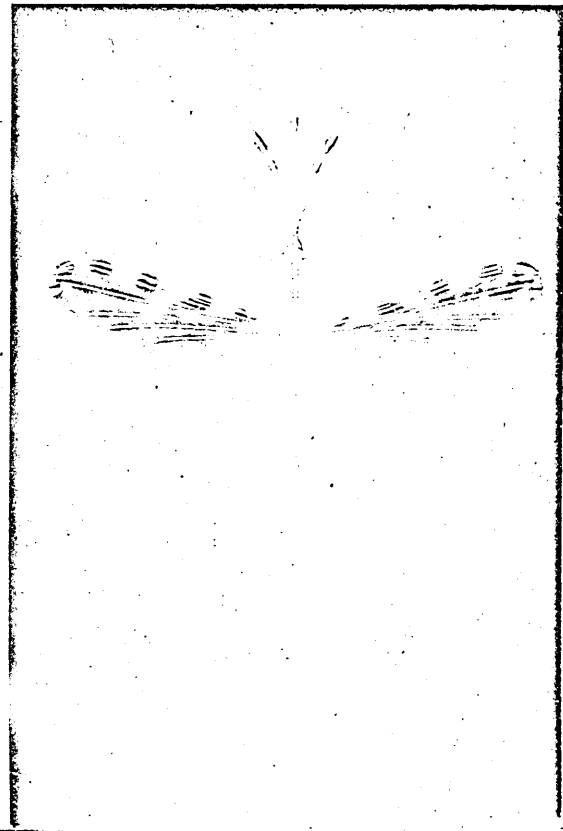
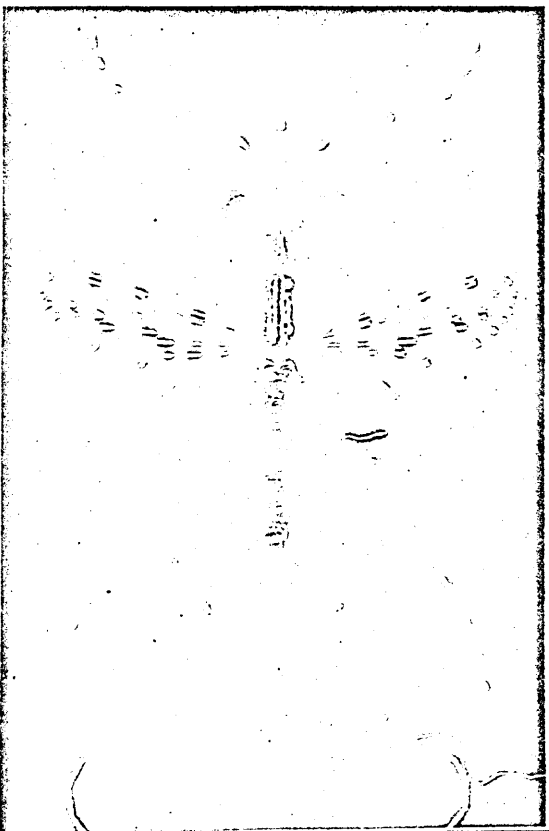
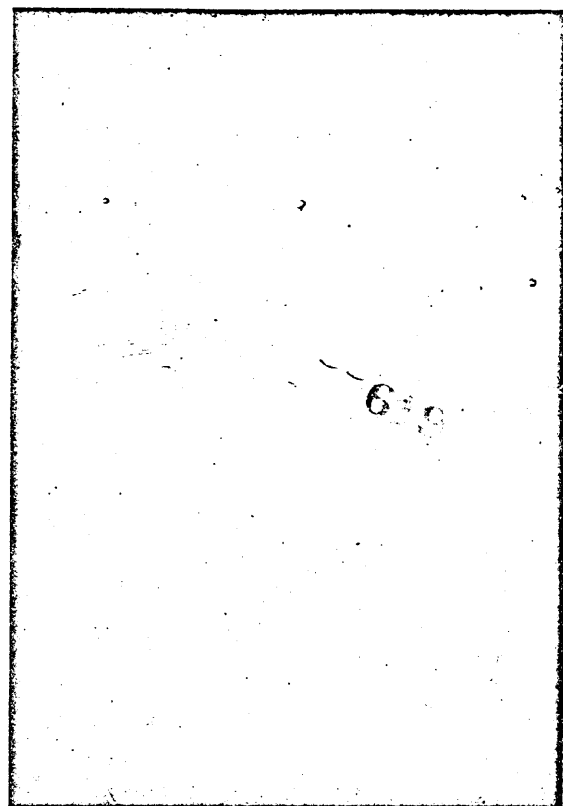
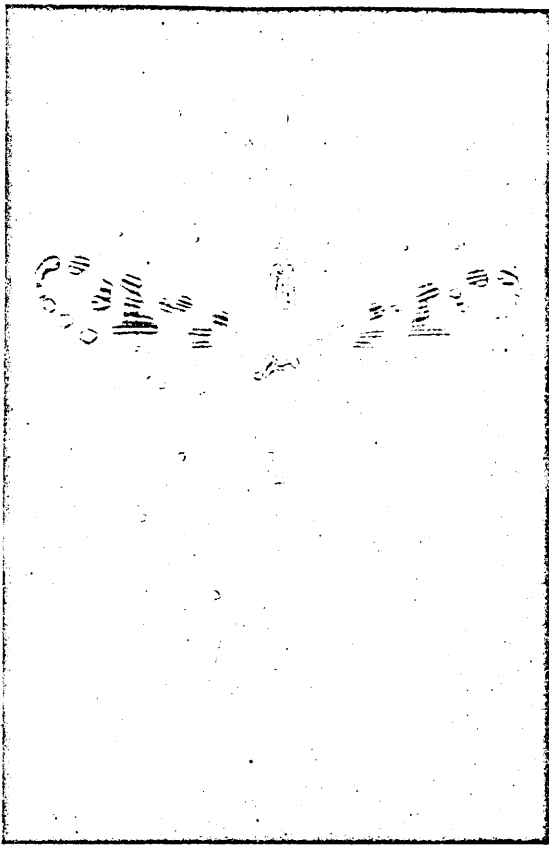
#### CONCLUSIONS TO BE DRAWN.

What conclusions then can be derived from this study of the habits of anopheles in Ellichpur?

It is very possible that the cantonment of Ellichpur could be almost completely rid of Malarial Fevers in a year or so if precautions were taken to rid the place of anopheles mosquitos. In a previous paper in this Journal (*Indian Medical Gazette*, Vol. XXXVI, No. 4,

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1893 LISTON, W. G. A YEAR'S EXPERIENCE OF THE HABITS OF ANOPHELES IN ELLICHPUR. BY W. G. LISTON, CAPTAIN, I.M.S.

April 1901) a detailed account was given of the places in which anopheles larvæ were to be found from the month of June to December in the Ellichpur Cantonment.

In the present paper it has been shewn that the breeding places of anopheles during the hot weather become non-existent. That the adults, however, remain alive in considerable numbers throughout the hot weather. That at the close of the rains, anopheles spread over the country much as a cholera epidemic does, one piece of water becoming infected after another till many breeding places can be found all over the land. Later, these infected waters gradually disappear as the dry season progresses, and the breeding places of anopheles become more and more confined to the river pools.

It would be possible, as pointed out in the paper before referred to, to completely remove many of the breeding places by simple drainage measures. The few breeding places which could not be so drained could well be treated with paraffine. A small permanent staff could easily be trained and employed to sweep out such ponds as were small enough to be so treated, while the larger ponds which contained larvæ could be painted with crude paraffine or tar oil once a week. Altogether Ellichpur seems a most favourable cantonment for the prevention of malaria by a raid on mosquitos, but it would folly to rely wholly on this one method of combating the disease.

As we have shown, no less than fifty per cent. of the total admissions to the Jail Hospital and forty-one per cent. to the Military Hospitals during one year were for malaria. These collections of malarial patients form a suitable infecting ground for the many anopheles mosquitos that can be found in these buildings. Having become once infected, they are free and can fly about infecting other patients and convicts. It would therefore be a wise precaution to make the Jail Hospital and Wards as well as the Military Hospitals mosquito-proof. Such an arrangement applied to the jail would be particularly useful, for the convicts are locked up in barracks before sunset, are not let out again till sunrise. If malaria could be prevented in this way, the sickness of the jail would be reduced by 50 per cent, i.e., if all the malarial cases in the jail hospital were infected in the jail, and were not simply *relapses* from previous infection obtained outside the jail.

In concluding this paper, I have to thank Colonel Giles, I.M.S., for identifying and naming some of the mosquitos I have described, and Dr. Turkhud for his great pains in producing the beautiful and exact drawings of the mosquitos. The plates are reproduced from photographs of his paintings.

Since completing the manuscript of this article a paper has appeared in the *British Medical Journal* for September 14th, page 668,

the influence of colour upon anopheles by George Nuttall. It will be of interest, I think, to record my experience in this connection in Ellichpur. Already a reference has been made to the fact that dark objects and dark corners attract anopheles. Except for white and very light colours all others seem to be suitable for anopheles.

Nuttall says "in any case the number of insects congregating in dwellings might very well be lessened by the choice of colours of a suitable character applied to the walls." Judging from the results of his experiments, yellow should be the chosen colour. Now my house in Ellichpur was a notably yellow house; it had been nicknamed the "Pila Ghur," yet anopheles were more numerous in it than in any other house in the station. Yet further my best traps were yellow articles, viz., a large yellow cloth screen and a pair of yellow Indian curtains. The walls of the rooms were covered with yellow wash. It would therefore appear that for Indian anopheles at least yellow has *not* a repellent power. I have already pointed out that rather than a choice for certain colours, anopheles choose certain materials in preference to others to rest upon. Thus, anopheles are rarely taken on linen or silk articles, while they like to rest on woollen materials and upon furs or skins. Possibly the character of the cloth which was used in Nuttall's experiments varied.

I will be obliged to any who may be interested in this subject if they would send to me specimens of Anopheles Mosquitos for identification.

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#### ON THE ACTION OF SNAKE VENOM ON THE COAGULABILITY OF THE BLOOD.\*

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THE physiological action of the venom of the various species of poisonous snakes is a subject which has received considerable attention from different observers. Experiments on the problems which this subject presents have, however, been for the most part conducted by men outside of India, for with the exception of the researches of Fayer, Wall, and Cunningham, India has added nothing to our knowledge of the action of the poisons of the various snakes and of the differences which exist between them.

\* A paper read at the Bombay Medical and Physical Society.